VETERINARY OBSTETRICS

INCLUDING THE

DISEASES OF BREEDING ANIMALS

AND OF

THE NEW-BORN

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PREFACE.

Whatever apology may be due the American veterinary profession for the imperfections of this volume, the author does not deem it necessary to apologize for considering desirable a treatise upon Veterinary Obstetrics, and the diseases and accidents intimately associated therewith.

In American veterinary colleges, and largely in the veterinary colleges of the world, obstetrics is the most poorly and inefficiently taught of all the major subjects in the veterinary curriculum. The available obstetric literature in the English language is very unsatisfactory. The author believes that the chief question affecting this treatise is not the need for a comprehensive volume upon veterinary obstetrics and the closely related subjects, but the efficiency of the volume to partly supply that need.

We have felt warranted in introducing features which are not usually included in treatises upon obstetrics. We have devoted a chapter to the "Accidents and Injuries of Coïtion." A yet greater space has been devoted to the "Infections of Coïtion", especially to the specific venereal infections. Still more emphasis has been placed upon the subject of sterility.

The writer desires to heartily express his sense of profound obligation to the various authors and publishers upon whose publications, with their kind permission, free draft has been made for illustrations and material for the text. It has been aimed, at the proper places, to give due credit for the source of the material used.

Special mention is due to the authors and publishers of the treatises on Embryology by Bonnet, Heisler and Marshall; the Obstetrics of St. Cyr and Violet, Harms, Franck, DeBruin, and Fleming; the Teratology of Gurlt; and the Handbook of Surgery and Obstetrics by Bayer and Frohner.

The author is under specially deep obligations to Professor Doctor E. Hess, of the Berne Veterinary School, for his courtesy

in permitting the insertion in our text of his extensive and admirable contribution relating to sterility in cows.

With a keen sense of the many and serious imperfections, this volume is submitted to the veterinary profession of America, hoping that it may awaken new interest in the practice of obstetrics, and extend some aid to those veterinarians engaged in obstetric work.

W. L. Williams.

Cornell University,
June 1, 1909.

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VETERINARY OBSTETRICS

INTRODUCTORY

Veterinary obstetrics, in its most restricted sense, is a consideration of the necessary or advisable oversight or aid during the act of parturition in domestic animals. Birth constitutes one of the most prominent epochs in mammalian existence, marking the boundary between intra-uterine or fetal development, in which the young animal is nourished and protected within the maternal body by the mother, and the extra-uterine life, when the young animal must assume more or less independence and responsibility, partly or wholly secure its own food and provide for its safety.

The giving of birth to young is the culminating act of a series of complex and interesting phenomena, the perversion or interruption of any one of which may lead to the defeat of reproduction, and when the act has been completed and living offspring produced, there are still incidents immediately following, which are essentially dependent upon parturition and which may jeopardize the life or usefulness of either the mother or her young.

The subject is one of intense scientific and economic importance as it lies at the very foundation of livestock husbandry and largely determines the ultimate success or failure of this great industry.

It is necessary to have a full comprehension of each corollary process in order that we may effectively grasp the significance of the phenomenon itself. Successful parturition occurs only when the prospective mother is normal in the structure and physiologic development of all her organs of reproduction and of others which may have an essential relation thereto ; and the fetus must undergo a normal development ere it can be born in a viable state.

We consequently habitually include under veterinary obstetrics all factors which necessarily precede and lead directly to parturition and all immediate consequences of birth which affect the health of either the mother or the young. In this wider significance veterinary obstetrics may be defined as the study of the

dangers and diseases occurring in the process of reproduction in domestic animals and our means for avoiding or overcoming them.

Under this conception we necessarily include :

1. A study of the anatomy of all those organs having a vital relation to the act of reproduction either directly or indirectly : *Obstetric Anatomy*.

2. A study of the physiologic functions of the reproductive organs, including such phenomena as sexual desire or estrum, ovulation, menstruation, copulation, fecundation, the origin and development of the fetus and the birth of the young : *Obstetric Physiology*.

3. The pathology of breeding, including the accidents and diseases dependent upon coition or interfering with fecundation.

4. Aberrations in the development of the embryo : *Teratology*.

5. Accidents and diseases of the mother and fetus during pregnancy ; *Pathology of Pregnancy*.

6. Difficult birth : *Dystocia*.

7. Accidents and diseases of the mother occurring as a sequence to parturition : *Pathology of the Puerperal State*.

8. Diseases and accidents of the new-born acquired during intra-uterine life or referable to the exigencies of birth.

OBSTETRIC ANATOMY

Each organ or part of the body contributes directly or indirectly toward the function of reproduction, but, in many of them, the influence is so remote that their relationship to breeding does not require special consideration, while some organs or parts, designed primarily to serve other ends, incidentally perform important accessory offices in the act of birth, as in the case of the pelvis, while other organs, like the ovaries, uterus, vagina, vulva and mammæ are devoted exclusively to the procreation of the species and are designated reproductory or generative organs.

A. The Accessory Organs of Reproduction.

The Pelvis.

The pelvis constitutes an accessory organ of generation of fundamental importance because the fetus must traverse its canal in the process of birth, and success or failure may be decided by the amplitude of the pelvic channel in relation to the size of the fetal body.

It consists of a bony girdle forming the posterior body wall, into which extends the posterior prolongation of the peritoneal cavity, and the terminal portions of the digestive, urinary and generative systems. Our chief obstetric interest in the pelvis is in its internal face, constituting the walls of its cavity.

The pelvis is composed of the sacrum and coxae or ossa innominata, with their ligaments, and the first two or three coccygeal vertebræ may be regarded as participating somewhat in its formation as they constitute a part of the pelvic roof.

The sacrum consists of a series of anchylosed sacral vertebræ, varying in number in the different species of domestic animals ; in the horse and ruminants five, in the pig four, and in carnivora three.

In sagitttal section it presents the form of a truncated cone with its base articulating anteriorly with the last lumbar vertebra and its apex posteriorly with the first coccygeal bone,

In cross section it is triangular, with its base inferior. The lateral surfaces offer roughened facets for articulation with the

coxae. The inferior surface contributes to the formation of the pelvic roof, is concave from before to behind, essentially plane from side to side and shows transverse lines of demarcation between the individual vertebræ in the form of ridges varying in prominence with species, age, breed and individual. It is alleged that the sacrum varies according to sex, the articular elevations being, it is claimed, less prominent in the female. We have not been able to verify this claim by the study of specimens.

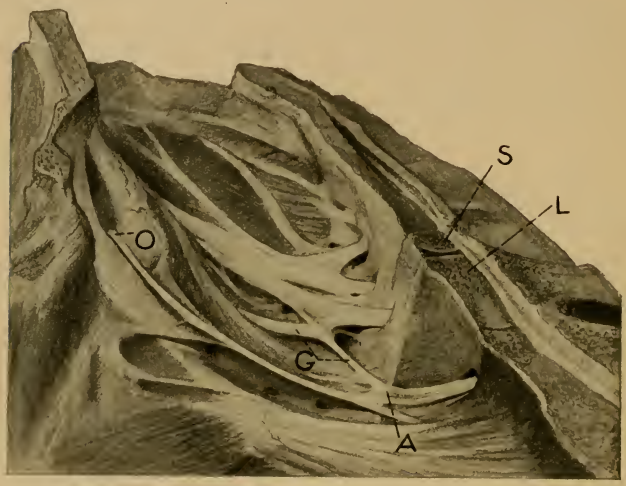

FIG. 1. SAGITTAL SECTION OF THE PELVIS OF THE MARE, SHOWING LUMBO-SACRAL NERVES.

S, First sacral vertebra. L, Last lumbar vertebra. A, Last lumbar nerve, passing passing over lumbo-sacral eminence. E, Gluteal nerves. O, Obturator nerve entering foramen.

The spinal canal extends through the sacrum and is occupied by the terminal nerves of the spinal cord. The inferior surface of the bone shows a series of paired openings, through which the sacral nerves emerge to take a prominent part in the formation of the lumbo-sacral plexus. Most of these emerge in such a

manner as to render mechanical injury to them during parturition very improbable, while others, especially the anterior gluteal and obturator nerves from the last lumbar pair, Fig. 1, have to pass over a promontory marking the lumbo-sacral articulation at A, in such a manner that they may be, and not rarely are, crushed between the bony ridge and some unyielding part of the fetus during its passage through the pelvic canal. The obturator nerve may also be injured in a somewhat similar manner as it enters the obturator foramen, as shown in Fig. 140. (See Contusions of Lumbo-sacral Nerves.)

The two coxae or ossa innominata are elongated, flattened bones, widely expanded at each extremity, where they are composed chiefly of cancellated tissue, and constricted in the center, where they partake more of the structure of long bones. Above and anteriorly they are briefly separated from each other by the intervening sacrum, with which they articulate by means of an almost immovable joint; behind or below they converge to form the pelvic floor, in which, on either side of the median line and about midway from behind to before, occur two large oval openings, the foramina ovale. They unite on the median line to constitute the ischio-pubic symphysis and, becoming anchylosed early, serve, with the aid of the well-nigh immovable sacro-iliac articulation, to complete the pelvic girdle. Near the middle of each coxa, on the infero-external face, occurs the acetabulum or cotyloid cavity for articulation with the femur.

Each coxa is composed of an ilium, ischium and pubis, which constitute separate bones during early fetal life, but become fused together prior to birth to constitute a single bone.

The general direction of the ossa innominata is obliquely backwards and downwards from the sacrum, the two coxae curving at first outwards and later inwards to unite on the median line and, with the sacrum, to complete the oval pelvic inlet.

The ilium, the largest of the three, is flat and triangular in outline, its supero-external face being concave and occupied by the gluteal muscles, the infero-internal face being occupied largely by the articulation with the sacrum inwardly and by muscular insertions laterally. The postero-inferior angle of the bone is contracted and rounded to form the iliac shaft and ends by concurring with the ischium and pubis in the formation of the acetabulum. The two ilia extend obliquely downwards and back-

wards from their sacral articulation, their inner borders being concave. They attain their greatest distance from each other soon after leaving the sacrum, near the great sciatic notch, at the point where the flattened anterior portion merges into the shaft, from whence they converge slightly as they approach the cotyloid cavities. The ilia form the major portion of the lateral walls of the pelvic inlet.

The ischium is an irregular triangular, flattened bone, constituting the most posterior portion of the pelvis and concurring with the pubis in the formation of the pelvic floor. It occupies an almost horizontal position in the horse and most domestic animals, but, in the cow, its posterior portion is directed upwards and backwards and compels the fetus, during its expulsion, to pass obliquely upwards and backwards, instead of horizontally backwards. Anteriorly, it constitutes internally the posterior boundary of the foramen ovale and, externally, concurs in the formation of the acetabulum, where it articulates with the ilium and pubis; on the median line it unites throughout its anterior part with the corresponding bone of the opposite side, constituting the posterior portion of the pelvic symphysis.

The postero-external angles of the ischia are tuberous, constituting the ischial tuberosities and between these is the receding angle known as the ischiatic notch, which depends largely upon the extent of the tuberosities for its depth while its width is fixed by the degree of divergence of the two bones.

This triangular notch varies greatly with species and individuals and some authors contend that it is wider and more ample in the mare than in the horse. The latter contention is not well established and, if it exists, is not sufficiently marked to constitute a means for differentiation between the sexes.

The ischium is of little obstetric significance in domestic animals, except possibly in the cow, where the notch may be very deep and narrow and the tuberosities, being very prominent and directed sharply upward toward the coccyx, tend to limit the dimensions of the pelvic outlet and constitute a barrier to the passage of the fetus.

The pubis is a flattened bone placed transversely at the anterior border of the pelvis, articulating on the median line with the corresponding bone of the opposite side to constitute the floor of the pelvic inlet. It articulates posteriorly with the ischium and

concurs with the ilium and ischium in the formation of the acetabulum.

In the mare there frequently appears a sharp elevation on the median line at the anterior end of the symphisis pubis, surmounting the pubic brim and projecting upwards into the pelvic cavity in a manner to endanger the integrity of the vaginal or uterine walls when impinged between this sharp elevation while the body of the fetus is passing over it under great pressure. See Fig. 113*a*.

The relations between the pelvis and the spinal column are maintained by a series of ligaments and muscles. The sacro-iliac articulation is very rigid, the two bones being closely applied to each other by means of roughened surfaces and maintained by short and very strong inter-osseous ligaments.

The integrity of the sacro-iliac articulation is further preserved behind by the sacro-sciatic ligament and in front by the prepubian tendon and the muscles contributing thereto.

The great sacro-sciatic ligament arises from the transverse spinous ridge of the sacrum and, commencing immediately behind the sacro-iliac articulation, extends to the posterior extremity of that bone; passing downwards, it is attached along the supero-external border of the ilium and ischium from the sacro-iliac articulation, backwards to the ischial tuberosity. The two ligaments thus form wide aponeurotic sheets, which constitute the greater portions of the lateral pelvic walls and occupy all that area comprised between those portions of the sacrum and ilium posterior to the sacro-iliac articulation and the external border of the ischium to the summit of the ischial tuberosity. This broad and powerful ligament serves to prevent the posterior portion of the pelvis or ischia from receding downwards from the sacrum and affords a strong and somewhat flexible and yielding wall to the pelvic cavity. It is sufficiently extensible that, under the pressure of parturition, it yields enough to permit the constricted outlet to equal in dimensions the larger bony inlet to the pelvis.

The powerful prepubian tendon arises from the pubic brim and, through the linea alba and the contributory muscles, finds attachment in front to the ensiform cartilage of the sternum and prevents the pubis and ischium from passing upwards and backwards toward the sacral termination when the body weight is thrown upon the coxo-femoral articulation, which lies behind the

ilio-sacral joint. It plays a very important part in the large herbivora, especially in the mare, where it sometimes ruptures during advanced pregnancy, resulting in a hernia of the gravid uterus and destroying the normal relation of the pelvis to the spinal column. (See Rupture of Prepubian Tendon, and Figs. 82, 83, 84 and 85.) In addition to these ligaments, the great dorsal and psoas muscles serve an important function in maintaining the relations between the pelvis and spine.

The pelvic cavity is somewhat conical in form in its antero-posterior diameter, with the base of the cone presenting forwards so that the pelvic inlet is somewhat larger than its outlet, a difference which is counter-balanced fully by the fact that the inlet is really the only non-extensible portion of the pelvis so that, in practice, other things being normal, if a fetus can enter this portion it can pass through the outlet by causing its dilation. This distensibility is dependent upon the yielding character of the sacro-sciatic ligament, as mentioned above. In woman, the relations between the sacro-pubic and bisiliac diameters of the pelvis are inconstant, resulting in a tortuous passage, which leads to a rotation of the fetus on its long axis during parturition in order to keep the greater dimensions of the fetal body in harmony with those of the bony girdle through which it is passing, while, in our domestic animals, the cavity is rectilinear and the fetus is expelled in a direct, instead of a spiral line.

In cross section, the pelvic cavity is oval in outline, departing but little from circular, its perpendicular usually being slightly greater than the transverse diameter, though these relations may be reversed. The relations between the perpendicular and transverse diameters do not vary materially between the inlet and outlet, the former being usually the greater for the entire length of the passage. The pelvic channel is direct and almost horizontal but usually directed more or less obliquely upwards and backwards from the inlet to the outlet. This is especially notable in the cow, where the pelvic floor is quite oblique and concave from before to behind and is further emphasized by the prominent ischial tuberosities, placed so closely together that, for practical obstetric purposes, the summits of these may, in some cases, virtually mark the floor of the pelvic outlet because they are too close to each other to permit of the ready passage of the fetus between them. In the mare the pelvic floor is almost level and

the ischial tuberosities so small and wide apart as to be of little significance.

The measurements of the pelvic cavity vary widely in different species, breeds and individuals so that it is virtually impossible to make any general statements as to the dimensions of the pelves of our domestic animals. The variations in size among domestic animals are extreme, owing to artificial selection for the production of giant and dwarf animals, which are widely separated in stature. In the horse it is not rare to find animals weighing 250 lbs. or 2500 lbs., or a ratio of 1:10, and there is naturally a corresponding variation in the measurements of the pelvic passages. In the dog the variations are even greater in size, the ratio in weight being at times as great as 1:100. It is, therefore, quite impossible to give a reasonably approximate measurement of the pelves of the different species of domestic animals. The most important diameters of the pelvis of the mare to be considered by the veterinarian are the supero-inferior, extending from the lumbo-sacral articulation to the anterior point of the pubic symphysis; a vertical diameter of the inlet from the symphysis pubis to the middle of the sacrum; and a transverse from the most concave point of one ilium to the corresponding point on the opposite side. For the outlet, usually but two diameters are considered; a vertical, from the ischio-pubic symphysis to the sacro-coccygeal articulation and a transverse, from one ischial tuberosity to the other. The measurements vary considerably in the experiences of different authors, the supero-inferior for an average horse being 9 to 10 inches according to Baumeister & Rueff; 9.5 by Carsten-Harms; 9 by Arloing and 8.75 by Saint-Cyr. The same authors make the transverse diameters 11 to 12.5; 9.2; 9.2 and 8.1 in. respectively. These authors have evidently secured their measurements from different classes of mares.

In the cow, the average diameters of the pelvic inlet as given by various authors range between 8⅛ and 10½ inches transversely and 6¾ to 7¾ perpendicularly, with an outlet somewhat smaller in each of its measurements.

The ewe and she-goat show a perpendicular diameter of the pelvis averaging about 4.7 in. and a transverse measurement of approximately 3.1 in. The bitch shows a very wide variation in pelvic measurements, ranging from 2 to 2 1-3 in. in the sacro-

pubic and 1.2 to 2 in. in the transverse diameter. Similar variations occur in the measurements taken by the various observers of the other diameters of the pelvis of the mare and of other animals, the differences being so wide as to render the measurements of questionable value. Some investigators have attempted to establish rules for determining approximately the diameters of the pelves of living animals, but, thus far, have been unable to turn pelvimetry to practical account in veterinary obstetrics, in contrast with human practice, where it acquires fundamental importance on account of the frequency of pelvic deformities, which often render normal parturition impossible. These deformities rarely occur in our domestic animals, partly because the osseous system is far more mature at birth than is observed in man and still more because a pelvis weakened by disease is subjected to no such strain in quadrupeds. The horse bears only 45 % of his total weight upon his posterior feet and this is largely made up by the weight of the limbs themselves and the muscles connecting them with the trunk so that the actual weight resting upon the pelvis in domestic animals is inconsequential and represents probably less than 25 % of the total body weight, while, in man, it needs endure the entire body weight, except the legs themselves.

The pelves of domesticated animals are sometimes seriously deformed as a result of fractures, tumors and dislocations, which may render parturition difficult or impossible.

Pelvimetry in domestic animals is impracticable usually in the two chief groups of cases where the size of the pelvis has to do with dystocia. When the pelvis is deformed as a result of tumors, fractures, dislocations or rickets, the constriction is rarely recognized until the veterinarian is called because of dystocia and he faces the question of overcoming it and must determine his method of procedure by a rough comparison of the size of the fetus as related to the capacity of the pelvis, as estimated by manual exploration. He is then in a position to advise the owner in reference to the future of the patient, whether she should be again used for breeding purposes, turned to some other available use, or destroyed. When dealing with such injuries in non-pregnant animals, it is clearly the duty of the attending veterinarian to warn the owner against breeding the animal unless careful examination makes it clear that the patient may normally give birth to young.

In a second group of cases, excessive volume of the fetus, pelvimitry fails the veterinarian as he can not recognize, even if called to do so, this over size, until he is brought face to face with the consequent dystocia, and that fact alone demonstrates the disparity in size between the pelvic canal and the fetus, which is to traverse it. Nor does this occurrence, even when safely overcome by the obstetrist, furnish any safe criterion for future action except possibly suggesting a change of mating. Subsequent fetuses may be of normal size.

It has moreover been asserted that sexual differences exist in the pelves of domesticated animals, especially in the horse. This we have been wholly unable to verify. It is claimed that the pelvis of the mare is more ample than that of the stallion or gelding, that its foramen ovale is larger, that the ischiatic notch is broader and shallower, that the sacrum has less prominent articular ridges ; in other words, that the pelvis of the mare is specially constructed as an organ of reproduction in a manner to facilitate the passage of the fetus at the time of parturition. We have critically examined a number of equine pelves and find among them those of stallions or geldings fulfilling the description given as typical of the mare in every regard and, *vice versa*, a mare pelvis fully meeting all the alleged characters of the male. So far as we have been able to determine, it is impossible to differentiate the sex of any species of domestic mammals by the form or size of the pelvis.

B. The Generative Organs.

The genital system of the mammalian female consists of the ovaries, oviducts, uterus, vagina, vulva and mammæ. Writers variously divide them into internal and external, essential and subsidiary, genital or copulatory ; each, however, is influenced by the other and each is essential to normal reproduction.

1. The Ovaries.

In the protozoa, reproduction is effected by the division of a single nucleated cell into two parts, alike in form and size, the completion of the division establishing two individuals which supplant the parent.

Reproduction in the higher forms of animal life proceeds in a somewhat similar manner from a single specialized cell, the ovum,

which, however, only divides after conjugation and fusion with the male cell, the spermatozoon, while the parental body remains unchanged after the separation and casting off of the male or female reproductive cell.

The ova-producing bodies, the ovaries, appear early during embryonic life, varying in date according to species—usually at about one month in those of long gestation periods. The first traces of the ovaries are the genital ridges, which arise as longitudinal eminences along the median borders of the Wolffian bodies and consist of a proliferation of the peritoneal epithelium at this point, by which several layers of cells are formed. The ridges appear in the human embryo at about 35 days or one-eighth term, in the rabbit at 11 days or a trifle after the first one-third, and in the sheep at 42 days or nearly one-half term.

Connective tissue grows up into the genital ridges from the underlying mesoblastic cells to form the skeletal frame-work and tubules from the Wolffian bodies grow into the ridges to constitute the tubular tissue of the ovary, but they play no known essential part and are said to have nothing to do with the formation of the ova. For a time the genital ridges are alike in both sexes, so far as can be determined, forming the indifferent stage, during which the male and female organs cannot be differentiated.

As the genital ridges develop, the differentiation in sex becomes established and, in the female, the ovary soon assumes the characteristic form of the adult, varying with the species.

While it is held that all ovarian tissues are of mesoblastic origin, the genital epithelium, arising from the peritoneum, the skeletal connective tissue from the sub-peritoneal mesoblast and the tubular portion from the mesoblastic Wolffian bodies, we meet with in various animals, especially in the horse and human family, dermoid cysts and well defined tooth tissues in the ovaries and testicles. These abnormalities are variously explained by pathologists and teratologists. Since dermal structures and teeth are derived normally from the epiderm, it may be well to recall in this connection that the gubernaculum testis of the male and corresponding round ligament of the female extends from the external skin in the scrotal region of the male and the corresponding parts in the female through the inguinal canal and ring into the peritoneal cavity, where it proceeds to a point contiguous to, if not continuous with, the testicle or ovary. Embryologists do

not make it clear whether epidermal cells may thus reach this region or not, nor whether the presence of this gubernaculum accounts for the occasional inclusion and development within the genital glands, of epidermal structures.

It is also alleged by some embryologists that the Wolffian ducts are of epiblastic origin and are formed from a longitudinal invagination of epiblast.

In the outermost layer of genital epithelium, the cells are columnar while, deeper, they are cuboidal in form. In the deeper parts, the skeletal stroma divides the cuboidal or spherical cells into clumps or groups known as egg columns, among which are to be seen, usually one or more in each nest, cells of large size with prominent nuclei, the primitive ova, which continue to form until near the close of intra-uterine life. Primitive ova are present as soon as the genital ridges are well formed and Nagel claims that these are not confined strictly to the genital ridges, but occur here and there in the region of the ducts of Mueller in the thickened epithelium.

This observation of Nagel is highly suggestive in reference to the operation of ovariotomy in females. We frequently find reports of cases where females have been castrated and later have shown signs of estrum, and it has been held by many practitioners that certain of our domestic animals continue to show signs of estrum after they have been properly castrated. In our own experience, we have seen estrum recur in an aggravated form—nymphomania—in the case of cows, where we were sure that we had removed the ovaries completely. Operating a second time, we have found cystic Graafian follicles at the point of removal of the ovary. It would consequently seem that not only may these ova exist in the tissues somewhat outside the ovary, but, when the gland itself has been surgically removed, they are capable of developing ovisacs, especially in a cystic form which will later produce all the symptoms of estrum, but probably have no living ova in them. These facts suggest to us that, in performing ovariotomy, the operation should not be confined to removing the ovary, but should include a large part, if not all, of the oviducts, with the contiguous tissues, so as to be sure that the ova and ovisacs are all removed.

It is contended by Nagel that there are differences in the genital ridges of the sexes in the human embryo at as early a period

as 32 or 33 days, those of the female containing primitive ova, while in the male there appear the tortuous cords, which are to become the tubuli semeniferi and, in these columns are found primitive sperm cells. Nagel doubts if there is any truly indifferent stage in the development of the sexual organs, but believes that they can be distinguished at a very early date and that probably they are at no time exactly alike.

The primitive ova pass inwards toward the center of the gland and, as they do so, undergo a progressive development, at first having granular nuclei of indistinct outline, which soon enlarge, becoming very distinct and of a regular spherical form, having a double-contoured wall, fluid contents and a nuclear reticulum with one or several nucleolar enlargements at the nodes. The whole egg also increases greatly in size, its protoplasm becomes granular and, between the ovum and the follicle or capsule, there is formed an elastic investing homogeneous layer known as the zona radiata. Having undergone this development, they are known as *permanent ova*.

The smaller germinal cells arrange themselves in enveloping layers about the permanent ova in the form of a hollow sphere, from the walls of which, usually near the bottom, a discoid eminence of small granular cells, the *discus proligerus*, appears and, resting in this, is the ovum, while, between the *discus proligerus* and the follicular wall, is the follicular liquid. Outside the cellular wall the follicle is furnished with a fibrous, investing tunic from the stroma of the gland and, when contiguous to the surface, has, in addition, a covering of ordinary peritoneum. Together these structures constitute Graafian follicles or ovisacs.

Of all animal cells, the duration of life of the *permanent ova* is best known. Unless they mature and are discharged into the oviducts upon the rupture of the Graafian follicles, they remain permanent from the date of birth, or soon thereafter, until the reproductive powers of the animal have ceased as a consequence of age. They remain in an unchanged state in the mare, for example, for 20 to 25 years, capable at any time during that period of becoming discharged into the oviducts, and, when impregnated, of developing into a fetus. In all our domestic animals, so far as known, all permanent ova are developed at, or very soon after, birth and hence, whenever such of these as are

capable of impregnation have all perished through ovulation or other means, the fertility of the animal is at an end.

Since the ova are formed from specialized peritoneal cells known as the genital epithelium, while the vessels and skeletal tissues are derived from the sub-peritoneal mesoblast we are prepared to anticipate the occurrence in the ovary of two somewhat definitely marked zones, the cortex and medulla. The peripheral cortex contains the essential ovarian cells, the ova, embedded in prolongations from the central or medullary portion, composed of skeletal connective tissue, vessels, nerves and pale muscles. The multiplication of the ova and ovisacs in the cortex causes it to outgrow the medulla and results generally in the formation of a well marked hilus, where the vessels and nerves enter, at which point ova are usually absent.

The skeletal tissues present an area of increased density at the periphery, where they constitute a firm, dense envelop, the *tunica albuginea*, over which the peritoneum extends. As the ovisacs develop, they tend to pass centralwards toward the medulla, and, continuing to grow as the amount of follicular liquid within them increases, finally occupy the entire thickness of the cortex and, in some species of animals, bulge out beyond the surface as more or less prominent, hemispherical masses or even protrude quite beyond the tunica albuginea as spherical outgrowths. As they mature, the external wall of the ovisac atrophies and finally ruptures at the time of estrum and the ovum is discharged into the pavillion of the oviduct or fimbriated end of the Fallopian tube. (It is claimed that in rare instances in mammalia the ova are accidently discharged into the peritoneal cavity.) Usually a Graafian follicle contains but one ovum but in some cases two have been recognized. The total number of ova in the ovaries of our domestic animals has not been determined. In woman, the number has been estimated at about 70,000, nearly all of which must undergo retrograde changes and not mature. The ova mature in cycles, varying according to species, climate and degree of domestication. In some well housed and fed domestic animals which are not pregnant, ovulation occurs every three or four weeks throughout the year.

During oestrum the ova are discharged either singly, as in the mare and cow ; two or three, as is frequently observed in the

sheep and goat; or in varying numbers, as in the carnivora and rodentia.

It is estimated that the ovaries of a child two years of age are fully developed so far as the new formation of ova is concerned. Ovogenesis must cease much earlier in our domestic animals, all of which may reach sexual maturity within one year from birth and are in most ways more mature when born than is the child when two years old.

In old animals which have ceased to breed or to show sexual desire, the ovaries are much atrophied and contain degenerate ova incapable of fecundation, signifying that the supply of fecundable ova has become exhausted during the span of sexual life. This suggests that any estoppel of ovulation, like pregnancy, where the cycle is longer than that of ovulation, as in all our larger animals, will tend in some degree to conserve the number of ova capable of further development. In harmony with this thought, we find that mares which are regularly bred tend to retain their reproductive powers to a later period in life than those which are not permitted to breed until aged, but here other factors, probably of greater importance, are at work.

The rupture of the ovisac leaves a lesion which usually behaves differently according to whether the discharged ovum becomes impregnated and undergoes development into a fetus or, failing of fecundation, perishes. The ruptured sac becomes filled with lymph, blood or other products of the disturbances of the tissues. Should the ovum perish, the ruptured ovisac tends to heal rapidly, with a faintly yellowish cicatrix, which soon disappears entirely so that no visible trace exists of the ruptured sac. The temporary scar is known as a *false corpus luteum*. The persistence of a corpus luteum, especially if over size, in a non-pregnant animal, inhibits ovulation and induces sterlity. (See under "Sterility." "Persistent Corpus Luteum").

Should the ovum become fecundated and undergo normal development, the scar resulting from the ruptured ovisac normally attains greater dimensions, is markedly yellow in color, projects beyond the ovarian surface and persists nearly or up to the time of parturition, and is known as a *true corpus luteum*. We thus note a bond of functional sympathy between the ovary and the fate of a discharged ovum, a harmony shown constantly between the various organs of the reproductive system. An important

fact in relation to the persistence of the true corpus luteum during pregnancy is a well marked tendency to abortion when the ovaries are removed from a pregnant female, or the corpus luteum is forced out of the ovary by crushing or otherwise.

The size and form of the ovaries differ greatly according to species, age and individual and even the two glands in the same animal are not ordinarily alike and may vary greatly in size.

The ovary of the mare is much the largest seen in the domestic animals, reniform, very dense owing to its thick tunica albuginea, with a smooth surface which is elevated here and there in many cases by the presence near the surface of cystic Graafian follicles. It attains its maximum size at the age of two or three years and begins to atrophy at ten to fifteen years, to finally become very small as age advances. The ovary of the young mare is usually 3½ to 4 inches in its greatest diameter and weighs about 4 ounces, while, in the aged, it may shrink to 1½ inches in its greatest diameter and its weight to ½ ounce.

The ovary of the cow is much smaller, being about one inch in its greatest diameter, weighing but ¼ to ½ ounce ; it is oblong in form, more regular in outline and its tunica albuginea is less dense.

The ovary of the sow is very large comparatively and the numerous ovisacs appear prominently on its surface to such an extent that the most superficial of them stand out entirely beyond the general ovarian line in such a manner that they are attached to the body of the organ by a somewhat constricted neck.

The ovary of the cat is very small, oblong, with pointed extremities and of a bright scarlet color with the ovisacs standing out thickly over the surface in a way to suggest a mulberry.

The ovary of the bitch is very small, dark livid in color, even in outline, and, unlike that of other domestic animals, is completely enveloped in the pavillion of the oviduct, except for a minute oblong opening of so small size that the ovary cannot be exposed to plain view through it.

Forming in the fetus, beneath and on either side of the notochord just posterior to the kidney, and above the peritoneum, the ovary descends into the peritoneal cavity, carrying with it the peritoneum, which thus forms a double layer behind

it which serves to preserve its attachment to the sub-lumbar region, and, between the two folds, the vessels and nerves pass to the gland.

The location of the ovary in the adult varies much with species but, apparently, the size of the gland has little or no influence upon its position. It rests upon the superior surface of the anterior border of the broad ligament, naked in most animals but closely invested in the bitch by the pavillion of the oviduct. The pavillion of the oviduct is attached at one point of its margin to the ovary near its hilus and its connection with the uterus is further maintained by the utero-ovarian ligament, composed largely of connective tissue and pale muscle fibers. The ovary is further influenced in its position by the round ligament, which is analogous to the gubernaculum testis of the male. Arising like the latter from the skin and dartos at the point where the fundus of the scrotum of the male normally appears in the given species, it passes up through the inguinal ring and above the peritoneum to became attached to the uterine cornua or oviduct not far from the ovary. The latter tends with these attachments to follow a line of descent comparable to the testicle but normally becomes arrested in its movement at some point between its place of origin and the internal inguinal ring. In the bitch, it remains closely applied to the sub-lumbar region immediately behind the kidney; in the mare, its movement is arrested early and it remains rather firmly suspended not far behind the kidney and above the middle of the posterior part of the abdominal cavity, while that of the cow lies loosely alongside the vagina just by the internal inguinal ring.

In the sow, the ovary floats quite freely in the peritoneal cavity and at times passes out through the inguinal ring and comes to rest in the perineal region corresponding to the scrotum of the male. The same displacement is said to occur rarely in bitches and it is possible in any species.

In general we might say that in the elongated uteri of multiparous animals the ovaries are situated further forward than in the uniparous or biparous species. The location of the ovary is further modified by the pregnant state, the gravid uterus dragging it downwards and forwards in its own descent.

The Muellerian Ducts; the Oviducts, Uterus and Vagina.

1. The Muellerian Ducts.

Early in embryonic life, before the genital ridges have become well marked, about the second month in animals with extended durations of pregnancy, the ducts of Mueller develop as two ridges beneath the peritoneum near to, but outwardly from, the Wolffian ducts, from which they are said to arise as outgrowths, and extend forwards from near the cloaca to or beyond the Wolffian glands. Appearing first as solid rods, they later become excavated to constitute tubes, which end blindly at their posterior extremity for a time but later open into the cloaca or common vent of the digestive and urino-genital systems. As soon as hollowed out, each vessel opens anteriorly into the peritoneal cavity through a large funnel-shaped mouth, the future pavillion of the oviduct of fimbriated end of the Fallopian tube. At this time there are in this region, lying parallel and near to each other, three separate ducts; the ureter, the Wolffian duct to become the excretory duct of the male genital gland and the Muellerian duct to become the genital tract of the female. The posterior ends of the Muellerian ducts are in close contact at first and later, at about the time of their opening into the cloaca, they fuse together for a variable distance forward, their median walls disappearing, resulting in the formation of a single tube as far as the fusion extends.

The Muellerian ducts later become differentiated into three essentially separate segments through specialization of their development, each having its distinctive function. The anterior segment constitutes the oviduct or Fallopian tube with its ampulla, or pavillion, which serves to receive the ovum from the ovary and bear it, fetilized or unfecundated, into the uterine cornu, or uterus; the second or middle portion of the genital tube constitutes the uterine cavity, in which the fetus may find lodgement, attachment, nutrition and protection during its development; the third or posterior segment, the vagina, extending from the uterus to the vulva, serves first as an essential copulative organ and later as a passage for the fetus at the time of birth.

The distance to which the fusion of the Muellerian duct extends forwards and the extent of the specialization of the different

areas, modifies greatly the form and relations of the various segments.

Arrests in the development of the genital tube may occur at any point, which may interfere more or less with its form and functions. The fusion in the utero-vaginial region may be partly or wholly arrested, resulting in a more or less completely double uterus or vagina or the Meullerian ducts may fail to develop as such but remain as two dense solid cords, as is seen in Fig. 51 where no uterus or vagina exists.

A study of Fig. 51 shows that the uterine cornua and ovaries were apparently well developed, the cornua contained considerable cavities which were distended with fluid, the ovaries showed Graafian follicles and a corpeus luteum. The anterior, or oviduct segments of the genital tubes are widely separated from each other and are not commonly the seat of arrest of development.

The Muellerian ducts in the male commence to disappear at about the middle third of pregnancy, but small vestiges may remain in the adult male as the hydatids of Morgagni, which, in some species of animals constitute small pedunculated bodies between the testis and the head of the epididymis. They are supposed to come from the anterior end of the ducts and are more prominent in man than in our domesticated animals. At the posterior end of these ducts, where they unite together, they are by some supposed to form the so-called uterus masculinus, a small sinus which exists in the superior wall of the urethra between the seminal vesicles, at the point of emergence of the vasa deferentia.

The entire genital tract, having a common origin, has a general type of construction, characterized chiefly by each having three separate coats ; peritoneal, muscular and mucous.

The peritoneal layer, which invests the genital tract almost completely, is derived from that of the body wall, behind which the ducts of Mueller originate. At the anterior extremity the genital tract opens, through the pavillion of the oviduct, into the peritoneal cavity, the continuity of the peritoneum being interrupted at this point to be succeeded by the mucous membrane of the oviducts.

As the broad ligament consists of two peritoneal layers, resulting from the departure of the genital tube from its seat of origin behind the peritoneum, it follows that, along the line of its attachment to the genital tube, the investment is interrupted to

the extent of the area between the two folds, occupied by the vessels and nerves. At the posterior extremity of the genital tract, where it opens into the cloaca of the embryo, the peritoneal investment is interrupted and its place taken by the intrapelvic connective tissue so that, eventually, the peritoneum covers, in addition to the oviducts and uterus, only the more anterior portion of the vagina; the fusion of the two Muellerian ducts moreover, to form the vagina and uterus, eliminates the peritoneal covering on the median plane of each separate tube as far as they coalesce, and, following this, occurs the atrophy and disappearance of the muscular and mucous walls connecting the two, and the adjacent tubes become a single canal.

The muscular portion is composed of transverse and longitudinal layers of pale fibers, varying greatly in the different sections of the tract and also according to whether the animal be pregnant or not.

The mucous coat of the genital tract offers the greatest possible variations and assumes widely differing and highly important functions, according to the particular area occupied.

2. The Broad Ligaments.

Since the Muellerian ducts have their origin outside the peritoneum, it follows that in moving away from the abdominal walls they must carry with them their peritoneal covering. As soon as they drop away from their point of origin the investing folds of peritoneum tend to meet behind to constitute a double peritoneal fold, between which the vessels and nerves, along with pale muscle fibres pass to and from the ovaries and genital tube.

These expanses of peritoneum, with invested vessels, nerves and muscles, constitute the broad ligaments of the uterus, or more correctly speaking, of the genital canal. The ligaments act as a suspensorium for the genital tract, maintaining its connection with the abdominal walls and also furnishing a support for the ovaries, thereby fixing these organs, under certain limitations, in a definite location. The broad ligament varies greatly in its form and amplitude according to species and the functional activity of the genital tract. In the bitch, cat and sow, in which the anterior extremities of the uterine cornua remain throughout the life of the animal, as far forward as or anterior to, the posterior border of the kidney, the broad ligament maintains its anterior attachment

to the abdominal wall at or near the point of origin of the ovary just behind the kidney ; in the cow, where the ovary and the anterior end of the uterine cornua are turned backwards to the immediate vicinity of the internal inguinal ring, the attachment of the anterior border of the ligament likewise moves backwards for a considerable distance so that the middle of the recurved cornu tends to project anteriorly beyond the anterior margin of the ligamentous attachment even when non-gravid. When the uterus of a quadrupedal mammal becomes gravid the weight of the fetus drags the occupied portion downwards and forwards until the organ comes to rest upon the abdominal floor, in front of the anterior point of fixation of the ligament to the abdominal wall. Since the anterior attachment of the broad ligament is more posteriorly situated in ruminants than in other domestic animals, it tends to favor the revolving of the gravid uterus on its long axis in front of the anterior attachment. This disposition attains an important clinical significance in the study of uterine torsion (which see) in which it is observed that the tendency to torsion increases as the anterior extension of the attachments of the broad ligaments to the abdominal walls recedes.

The genital tube is further maintained in its position by its attachment posteriorly to the vulva and also by the round ligament of the uterus, which we have already described on page 18.

3. The Oviducts.

The oviducts, formed from the anterior or ovarian extremities of the Muellerian ducts, are two long, tortuous tubes, varying in length and other characters according to species. Their length is several times the distance from the anterior extremity of the uterine cornu to the ovary, thus throwing it into folds. The distance between the anterior extremity of the cornu and the ovary is fixed by the utero-ovarian ligament and not by the oviduct. In some animals the oviducts are naked and clearly visible while, in the bitch, they are hidden in the fat of the broad ligament and the utero-ovarian ligament is very short so that the anterior end of the uterine cornu is virtually in contact with the ovary while the oviduct, some 3 to 4 inches in length, is thrown into numerous folds to terminate about ½ inch from its uterine end, so that casual observation, without dissection, might lead to the assumption that the Fallopian tube was well-nigh

absent in this animal, whereas it is very similar in actual length to that seen in other species. When divested of any concealing coverings of peritoneum, fat or other tissues, the oviduct appears as a very tortuous, firm white cord about .1 inch in diameter, of variable length in different species of animals. It is very firm to the touch and gives a sensation much like its analogue in the male, the vas deferens. After dissecting it out from the surrounding tissues and carefully eliminating its numerous abrupt curves, a very fine sound, like one of the tail hairs of a horse, may be inserted at one opening and passed through its entire length. The opening is therefore very narrow and being remarkably tortuous in its disposition it becomes difficult to pass either a solid object like a sound or even a liquid through it. While, technically, the oviducts complete a communication between the peritoneal cavity and the exterior, it seems virtually impassable except to ova and spermatozoa and does not, under usual conditions, permit even the forcing of liquids through them when intrauterine injections are made under comparatively high pressure. Clinically, they are also well-nigh proof against the passage of bacteria unless we except some special organisms like those of gonorrhea in woman. Occasionally, however, after abortion, retained placenta, nodular venereal disease, etc., in cows and other animals, infection extends along the oviducts, causing disease of them or, reaching the ovary, induces abscess or other disease causing sterlity.

The intimacy of contact between the peritoneum and oviduct varies according to species, the investment being very close in ruminants and the sow so that they are readily seen without dissection, while, in the mare, it is surrounded by much connective tissue, which serves to conceal it from view until the peritoneal and fibrous coverings are dissected away ; and in the bitch the concealment is further accentuated by large amounts of adipose tissue.

The oviduct opens anteriorly through the ostium abdominale into the pavillion of the tube and posteriorly into the uterine cornu through the ostium uterinum, which usually projects somewhat as a small eminence into the cavity of the cornu.

The muscular coat of the oviducts is characterized chiefly by its density, which gives to it an almost cartilaginous consistency, and its paleness, which amounts almost to translucency.

The superficial layer of the mucosa of the oviducts consists of ciliated columnar epithelium, with the cilia vibrating toward the uterus. The oviduct is the most rigid and undilatable portion of the genital tube and has for its office the conveyance of the ovum, fecundated or otherwise, from the ovary to the uterus, in which function the cilia apparently play an essential part. The duct also provides passage for the migration of the spermatozoa of the male, which, advancing from the uterus toward the ovary, meet the ovum within this narrow passage and fecundate it. In rare cases the fecundated ovum lodges in this duct and undergoes partial development, to constitute tubal pregnancy (which see), but its undilatability serves as a rule to cause a rupture of its walls and leads to the escape of the fetus from the duct into the abdominal cavity to either cause sudden death of the animal from hemorrhage or constitute extra-uterine or abdominal pregnancy (which see).

4. The Uterus.

The uterus is a musculo-membranous sac designed for the reception, attachment, nutrition and protection of the ovum and finally aids in the expulsion of the fetus at the time of birth.

Derived from the ducts of Mueller, it varies greatly in form and disposition, partly dependent upon the degree of fusion between those two structures. There are generally recognized a uterine body and two cornua, each having essentially like functions in varying degrees.

In the rabbit, there exists no uterine body, but two distinct tubular uteri opening separately into the vagina. In the bitch, cat and sow the uterine body is limited in extent and physiologically unimportant, rarely containing even a portion of a fetus except in transit at the time of birth, while the two cornua are extensive and in them develop virtually all the fetuses so that, physiologically, they represent the two separate uteri of the rabbit.

In ruminants, the uterine body becomes markedly greater in size and assumes far higher importance physiologically, while the cornua remain relatively large.

In these animals the one, two, or more fetuses habitually rest almost equally in the body and cornua so that they represent a middle point in the transition between the double uterus of the rabbit and the single uterus of woman, physiologically devoid of

cornua. In the mare the uterine body becomes relatively more important than in the ruminant.

The relative importance of the cornua to the uterine body sustains a close relation to the number of young brought forth at a given birth. In multiparous animals, there are two uteri, as in the rabbit, or the two extensive cornua with functionally unimportant uterine body, as in the bitch, cat and sow. In ruminants, which are largely bi-parous, the uterine body and cornua become approximately equal in extent and function.

In the normally uniparous mare, the cornua are smaller than the body, while, in woman, the uterus is virtually without cornua in size or function.

The uterus and its cornua, within the above limitations, are uniform in their plan of structure and function. They consist of three coats; mucous, muscular and peritoneal.

The mucous coat constitutes the essential physiologic basis of the organ. The mucous epithelium is very elaborate, consisting superficially of columnar cells, while, embedded deeply within it, are numerous tubular structures of a glandular character, the utricular glands, believed to secrete the so-called *uterine milk*, which is presumed to play an important role in the nutrition of the ovum pending the formation of the embryo and the establishment of its intricate connection with the mucous membrane through the chorion. Yet more important, it is through a special elaboration of the uterine mucosa that the highly intricate and essential maternal placenta is formed, to constitute a physical and physiologic bond between the mother and fetus during the span of pregnancy. The uterine mucosa apparently exerts a distinct bactericidal power and ordinarily prevents the gaining of a habitat by bacteria in the uterine cavity.

In the non-gravid uterus, as is common with distensible hollow organs, the mucous membrane is thrown into numerous longitudinal folds, which permit of prompt and extensive dilation of the cavity without violence to this membrane.

The muscular coat consists of two somewhat differentiable groups of longitudinal and circular pale muscle fibers which increase in size, number and activity during pregnancy. The proportion of the longitudinal to the circular fibers varies, the latter being much more prominent in the region of the cervix,

where they serve specially as occlusive agents to establish a separation of the uterine from the vaginal cavity.

The peritoneal layer of the uterus is derived from that of the abdominal walls and completely envelops the organ except at the points of continuity with the oviducts and vagina and the interstice between the two peritoneal sheets of the broad ligament at their points of uterine attachment. The broad ligaments have already been described on page 21.

Those portions of the Muellerian ducts from which the uterus is later developed are formed early in embryonic life behind the peritoneum and later leave the abdominal walls, to float freely within the abdominal cavity, suspended by the broad ligaments or, in the gravid state, to rest upon the abdominal floor.

The uterus is further retained in position by its continuity anteriorly with the oviducts and posteriorly with the vagina. The *round ligament* of the uterus, arising from the skin or dartos in the region normally constituting the fundus of the scrotum in the male and passing up through the inguinal canal and abdominal ring and thence to the cornu or oviduct is functionally of little or no interest.

The uterus of the mare, with its cornua, constitutes a somewhat crucial-shaped organ, the horns leaving the body laterally at right angles or somewhat recurved. It is located immediately beneath the rectum with its two cornua passing obliquely outward and upward on either side. The uterine body is oblong, flattened somewhat from above to below, varying from 5 to 8 inches in length and 1½ to 2½ inches wide. In the non-gravid organ, the mucous surfaces of its walls are normally in contact with each other. Posteriorly, its cavity is continuous with that of the vagina through the medium of the *cervical canal*, a constricted portion of the genital tube which serves to fix a boundary between the two cavities and to, in a measure, close the uterine cavity to the exterior. This canal is a somewhat elongated and tortuous channel, dependable for its length upon that of the *cervix uteri*, which it traverses, and for its width upon the development and degree of contraction of the circular muscle fibers of the latter.

The *cervix uteri* consists of a constricted area of the uterus in which the circular muscle fibers are comparatively much more numerous than in other portions of the organ. Posteriorly the

cervix projects into the anterior end of the vagina for a distance of 1 to 2 inches in the form of an obtuse cone varying in its transverse diameter, but approximating its longitudinal dimensions. At the summit of this conical projection is the *os uteri* or *os externum*, with its mucous membrane thrown into convergent longitudinal folds, suggesting the appearance of a radiating flower, *fleur epanouie*.

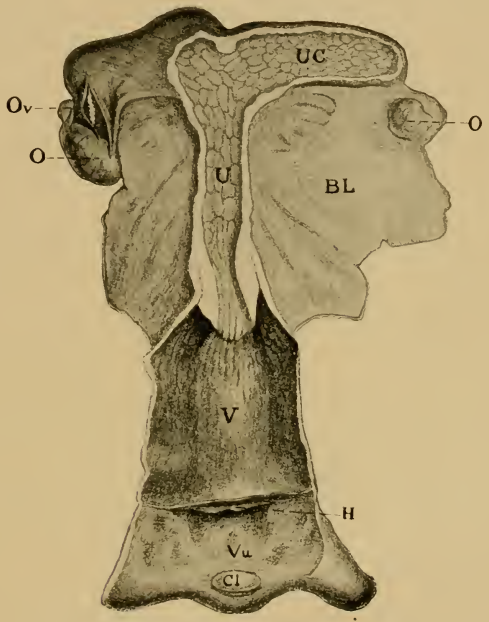

FIG. 2. NON-GRAVID UTERUS OF MARE VIEWED FROM ABOVE, WITH RIGHT CORNU LAID OPEN.

O, O, Ovaries. Ov, Oviduct. U, Uterus. UC, Uterine cornu. BL, Broad ligament. V, Vagina. Vu, Vulva. Cl, Clitoris. H, Hymen.

The origin of this projection of the cervix into the vagina seems somewhat analogous to intestinal intussusception, a partial invagination of the anterior portion of the genital tube into the vaginal cavity. At the time of parturition this projection and the cervix as a whole becomes obliterated and the uterus and vagina temporarily indistinguishable except in the character of their mucosa.

The dimensions and dilatability of the *os uteri* and cervical canal vary widely in individuals and at different times. Normally, the mucosa of the circumference of the *os uteri* should be in contact. In the mare it should permit of the ready introduction of one or two fingers through it and along the canal of the cervix into the uterine cavity.

At the time of estrum the os becomes more dilated and, frequently, readily admits three or four fingers or the entire hand. It is not unusual to find cases where the *os uteri* of the mare is abnormally dilated and flaccid to such a degree as to interfere with fecundation. More rarely in the mare the *os uteri* may be closed or the cervix very much constricted in a manner to render the passage of spermatozoa into the uterine body uncertain and thus tend to induce sterility.

Anteriorly, the cavity of the uterine body of the mare is continuous with that of the two cornua, without a distinct line of demarcation beyond an abrupt turn at right angles or a slight recurvation to its long axis. This peculiar relation of the cornua to the uterine body and to each other renders bi-cornual pregnancy (which see) possible in the mare (see Figs. 2, 120, 121). Each cornu is much like the body and the combined length of the two surpasses the latter in extent. They end obtusely, not far from the ovary, and present, on their interior, conical projections in which there is an opening, the *os uterinum*, or uterine orifice of the oviducts.

In the cow, and other ruminants, the uterine body is less pronounced in size when viewed exteriorly and yet more so upon section, while the cornua are much longer, tapering and more ample than in the mare. The two cornua separate at a very acute angle and for a time extend forwards almost parallel to each other and then, becoming somewhat more divergent, curve downwards, outwards, backwards and then upwards to end above the

broad ligament against the brim of the pubis and the infero-lateral wall of the vagina.

The uterine body and cornua of ruminants are much more dense, narrower and more cylindrical than in the mare, the cervix is longer, intensely rigid, almost cartilaginous to the touch, while the cervical canal is longer, narrower, more tortuous and interrupted by transverse, as well as longitudinal rugæ. It is very difficult and sometimes well nigh impractical to insert one finger through the cervical canal into the uterus. During estrum the *os uteri* and *cervical canal* become more dilatable.

The broad ligament of the uterus of the mare arises anteriorly from the abdominal wall in the sublumbar region not far posterior to the kidney and its parietal attachment passes from this point obliquely downwards, backwards and medianwards, along the median side of the inguinal ring and thence into the pelvic cavity where its two layers of peritoneum become reflected from the vagina upon the bladder, rectum and pelvic walls. As compared with the broad ligament of other domestic animals it is restricted in extent in the mare, especially transversely, resulting in a comparatively rigid fixation of the uterus and, since its anterior attachment is approximately in a direct line with the long axis of the cornua, the entire organ is held well forward in the abdominal cavity in the form of a cross, in marked contrast to the disposition of the organ in ruminants.

As compared with the mare, the broad ligament of ruminants is much more ample transversely, while, in an antero-posterior direction, it is much less extensive. Its anterior point of attachment to the abdominal parieties is much farther back than in the mare. This variation in disposition and relations of the broad ligament produces two well marked clinical differences obstetrically.

In the non-gravid uterus of the cow the anterior parietal attachment of its broad ligament is already posterior to the anterior curvature of the uterine cornua, which, in the gravid uterus, becomes sharply accentuated, almost the entire organ resting anterior to its ligamentous attachments to the abdominal parieties. Thus the broad ligaments become largely powerless in preventing the pregnant organ from revolving upon its long axis, so that torsion of the uterus (which see), becomes quite common in the cow and ewe, while in the mare, the more rigidly fixed organ,

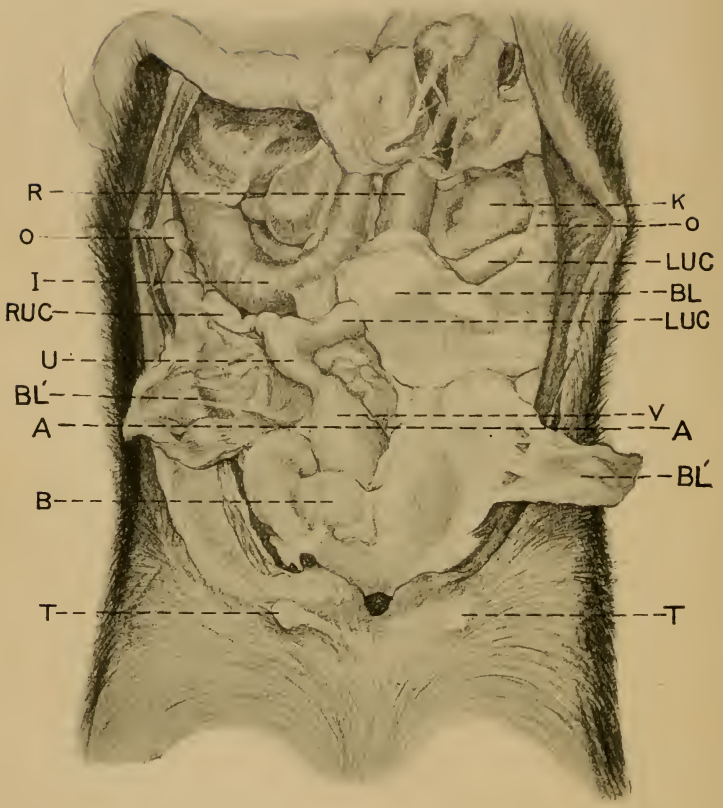

FIG. 3. GENERATIVE ORGANS OF BITCH IN SITU.

TT, Two posterior teats. B, Bladder. V, Vagina. U, Uterus. LUC, LUC, Left uterine cornu with a portion of its broad ligament, BL, lying across it. RUC, Right uterina cornu with its broad ligament, BL′, turned outwards exposing the full length of the cornu. OO, Ovaries. R, Rectum. K, Left kidney. AA, Dotted lines indicating level of the external ilial tuberosities.

with the anterior parietal attachment of the ligament much farther forward, renders the accident comparatively rare.

The comparative amplitude of the ligament in the cow, with its most anterior point of parietal attachment but little forward of the pelvis, permits more readily of inversion and prolapse of the uterus and vagina (which see) than obtains in other animals.

In multiparous animals the broad ligaments are necessarily very extensive and uniformly have their anterior point of attachment to the abdominal walls far forward in the post-renal region. In the bitch, the ligament at its anterior border is very short so that the ovary and ovarian end of the cornu is closely fixed in the sublumbar region just posterior to the kidney and tends to stretch the cornu between this anterior, sublumbar attachment and the vagina.

The ligament being exceedingly ample except at the anterior border, it is much longer than the distance from its parietal attachments to the position of the cornu, resulting in a large antero-posterior fold which drops down on the median side of the cornu and covers it in this double fold of broad ligament. (Fig. 3).

Unlike in other domesticated animals, the broad ligaments of the bitch are uniformly the seat of extensive deposits of fat, which causes them to strongly resemble the gastric omentum in general appearance.

5. The Vagina.

The vagina is a musculo-membranous canal, formed from the fusion of the posterior ends of Mueller's ducts and extending from the uterus to the vulva. Limited anteriorly by the *os uteri externum*, it ends posteriorly at the position of the hymen, just anterior to the meatus urinarius, where the vulva succeeds it.

In the mare it is 8 to 12 inches in length and capable of lateral distension to the full size of the pelvic cavity. Lined with squamous epithelium, its mucosa is thrown into longitudinal folds, which, when at rest, lie in contact with each other.

The mucous membrane of the vagina has in its deeper portions numerous mucous glands which serve to keep the surfaces at all times moist and which become especially active during sexual excitement and at the close of pregnancy. The muscular coat does not differ fundamentally in arrangement from that of the uterus though less in volume.

The peritoneal covering extends backwards from the anterior extremity three to five inches in the mare, where it becomes reflected upon the rectum, bladder and pelvic walls. In the posterior portion of its course the vagina is surrounded by the loose pelvic connective tissue, which permits comparatively free movement.

The function of the vagina is chiefly copulative, receiving the penis of the male during coition ; and during parturition it affords a passage for the fetus from the uterus to the vulva.

In the mare, the organ has the power of "ballooning" or inflating under sexual excitement or physical excitation. In this state it expands to such a degree that it fills the pelvic cavity completely from side to side and from floor to roof, presenting a vast cavity with smooth, rigid walls, which laterally are in close contact with the bony or ligamentous pelvic walls, while, superiorly they lie against the sacrum except in the area where the rectum intervenes and inferiorly with the pubis except for the urinary bladder.

The physiological nature of this "ballooning" has not been determined ; apparently it is of an erectile character. It probably increases the safety of copulation by rendering it impossible for folds of the vagina to become caught by the penis and injured. This power of ballooning differs largely from other hollow organs of the body.

The vagina of the cow has a similar ballooning power but of a less degree and it is possibly a general function, though less marked, in the vaginæ of other animals.

The ballooning of the vagina of the mare is easily induced by intravaginal manipulation, by the injection into the organ of bland, tepid fluids or by various other means. The phenomenon is especially marked and easily induced by introducing the moist hand into the organ at the time of estrum when the inflation at once occurs.

The hymen is a transverse membranous expanse stretching across the genital canal marking the boundary between the vagina and vulva. It represents the partition between the termination of the hind gut and the proctodeum of the embryo, which has failed to disappear in the lower or genito-urinary division of the cloaca. Generally it atrophies and completely disappears in our domesticated animals before their birth but at times it per-

sists, either as perpendicular shreds or in a broad expanse closing one-half or more of the genital canal. We have met an instance in a filly where it prevented copulation until after surgical intervention occurred, and cases are recorded of imperforate hymen which caused an accumulation of utero-vaginal secretions.

6. The Vulva.

The vulva, located immediately beneath the anus, constitutes the posterior termination of the genital canal and, instead of being derived from the mesodermic Muellerian ducts, as in case of the preceding organs, its epithelial covering originates from the epiderm of the embryo. It opens externally by means of a vertically elongated slit, bounded upon either side by the labiæ vulvæ, which meet above and below to form the superior and inferior vulvar commissures.

The vulvar labiæ are covered by a very fine skin, in which the growth of hairs may be inconspicuous, as in the mare, while in others, like the cow, there is a prominent tuft of hairs about the inferior commissure. Since the parts are so scantily haired, their color, which, as a rule, is simply that of the adjacent skin, becomes very conspicuous. In mares with white faces, eyes and feet, the cutaneous covering of the vulva tends also to be devoid of pigment.

The prominence of the pigmentation of the skin of this part serves as an aid in the clinical diagnosis of the venereal diseases of horses (which see), in which important discolorations occur.

The muscles of the vulva are chiefly circular and are divided into two groups, the posterior and anterior constrictors. The posterior constrictor is situated within the vulvar lips and constitutes a true sphincter, analogous to those about other body openings. Above, its fibers become lost in the perineum and the sphincter ani; below some go to the base of the clitoris and some pass downwards to become lost in the skin and other tissues on the inside of the thighs. The office of this group comprises the usual function of a sphincter, their contraction bringing about the closure of the vulvar opening. The anterior group of muscle fibers invests the vulva in the region of the hymen, just anterior to the meatus urinarius, where, by their

contraction, they produce a constriction on the vulvo-vaginal border line.

The mucous membrane, continuous with that of the urinary bladder and the vagina, is covered with squamous epithelium and contains numerous mucous glands, which are largely displaced near the labial margins and about the clitoris by sebaceous follicles, the secretions from which are odoriferous, especially during estrual periods, when the odor becomes very marked in a manner characteristic of the species.

Within the vulvar cavity are to be noted the *meatus urinarius*, *clitoris* and *vaginal bulb*. The *meatus urinarius*, or terminal opening of the urethra, is located along the floor of the vulva at a distance of three to four inches from the external opening in the mare. The urethral canal passes obliquely downwards and forwards through the vaginal floor to the urinary bladder. In most animals, the *meatus urinarius* is comparatively small and inextensible while, in the mare, in general harmony with the large and freely dilatable *os uteri* and genital passage, it is quite ample. One, two or more fingers are readily passed through it into the bladder and it is not rare to find the opening, in heavy, lymphatic animals, sufficiently large to admit, without great difficulty, the entire hand. The dimensions of the meatus urinarius in the mare are of special significance clinically as they favor eversion and prolapse of the bladder, an accident not particularly rare in this animal, while extremely so in others. In the cow the narrow meatus urinarius is further guarded by a valvular membranous fold directed from the posterior border forward in a manner, it is claimed, to prevent the penis of the bull from accidentally entering it and wounding the bladder as a result of the violent copulative thrust of that animal. Nevertheless we have one instance recorded (see under "Accidents of Coition") in which a fatal rupture of the bladder was caused in copulation.

The clitoris is an erectile organ, analogous to the male penis and having in general the same tissues, form and attachments. It is two or three inches in length and arises, like the penis, by two crura from the ischial arch and passes upwards and backwards to protrude from the vulvar floor just inside the inferior commissure and is the principal element in maintaining the form of this part.

Its free end is lodged within a depression in the vulvar floor and over it extends a mucous fold, the *prepuce of the clitoris*. The clitoris and its prepuce are covered by a pigmented mucous membrane in which the mucous glands are displaced by sebaceous follicles, and the characters of the surrounding mucosa are absent.

The clitoris is composed chiefly of erectile tissue like that of the corpus cavernosum of the penis. The clitoris of the bitch, like the penis of the dog, contains a small bone.

The functions of the clitoris are not important, although it is alleged to exert an influence upon sexual excitement. In our observation upon a large number of sows from which the clitoris had been removed by an empiric, it had no influence upon oestrum or fecundation and all bred normally. In the mare it is frequently removed for the relief of nymphomaniac vice, but the results are in controversy.

7. The Mammæ or Udder.

The mammæ are essential organs of generation ; they are normally excited to activity only by parturition and constitute a necessary source of nutritive supply to the new-born animal. Under domestication, the activity of the milk glands has been highly developed in the cow and goat to provide the important food supply to man of milk and its derivatives: cream, butter and cheese.

The milk glands originate from the epiblast by an invagination into the subjacent parts from which is finally elaborated the essential secretory structure and the excretory apparatus.

They are located symetrically on either side of the median line of the ventral surface of the body, varying in numbers approximately in accordance with the number of young usually produced at a birth. Usually the number of mammæ is in excess of that of the young born at one time, but rarely the relationship is reversed.

Each mamma consists of a glandular parenchyma with excretory ducts traversing a conical nipple or teat, from which the young may obtain the secreted milk by sucking. The glands are covered with a very soft, almost hairless skin, containing numerous sebaceous follicles and are closely invested by a firm, fibroelastic capsule derived from the abdominal tunic.

The mammæ belong to the acinous type of glands and consist fundamentally of the milk cells or acini, where the polyhedral or spherical epithelial cells form the active secretory units, and, from these, the milk is poured out through the small excretory ducts into more extensive canals which serve as a common outlet for a group of acini, constituting a lobule.

These ducts continue to unite and form yet larger canals, which are few in number and, according to species, empty either into one, two or more milk cisterns or reservoirs in the teat, or, in the absence of these, traverse the length of the teat to open by separate orifices at the apex. Through these excretory ducts the milk is drawn normally by the new-born animal by sucking; artificially, in dairying, it is forced out by compression with the hand or other means in a manner closely analogous to the sucking by the young.

FIG. 4. Section through the mammary pit of a 20 cm. long female swine embryo after Profé. Magnified about 200. (Bonnet).

The secretion of milk and its discharge from the udder bears some analogy to the behavior of erectile organs. It has been assumed by some that the milk is largely secreted and stored in the galactophorous sinuses and cisterns during the intervals between milking, but this is for the most part erroneous. The milk is chiefly stored in the epithelial cells of the milk acini until, under excita-

tion of sucking or milking, it is poured out into the milk cisterns and teats and thence is readily extracted by the sucking of the young or by the various milking processes. In some cows, mares and other females the sight of their young causes an involuntary

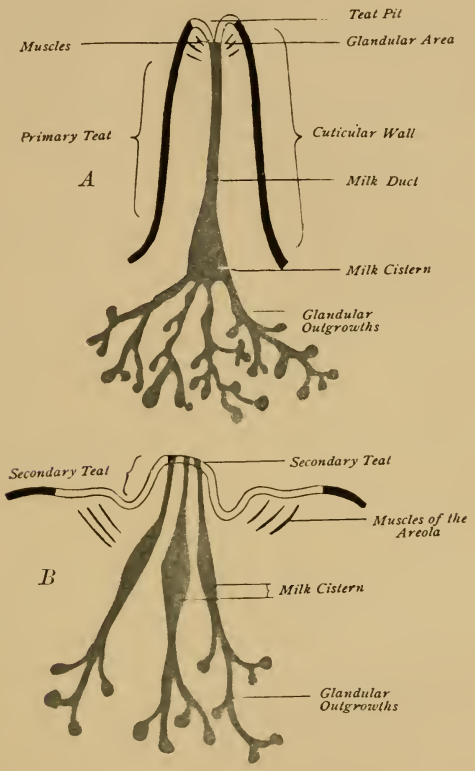

FIG. 5. A and B. Two schematic illustrations of the mammary pit, showing the different forms of teats.

A, Primary teat of the cow.

B, Secondary teat of woman. (Bonnet.)

discharge of milk from the udder, or, when the young is sucking one teat, milk flows freely from the others or, even, when a milkman is drawing milk from one cow, a neighboring one has an involuntary discharge of milk.

Under the influence of anger, fear or other disturbances, the flow of milk, in the process of milking, abruptly ceases, the animal "holds up" her milk and it cannot be withdrawn.

One milker can abstract from an udder a greater amount of milk than another, yet each will withdraw with equal care all the milk which reaches the teat. The flow of milk is not directly subject to the control of the lactating animal, but involuntary on her part, subject to external influences over which she exerts but very imperfect power.

In the mare, there are two hemispherical mammæ, flattened from side to side, situated in the inguinal region and each closely attached in the region of the external abdominal ring, through which their chief vessels and nerves pass.

There are two or more milk cisterns in each gland, from which corresponding excretory ducts pass to the apex of the teats to escape by separate orifices ranged one behind the other in the broad, antero-posteriorly flattened nipple.

In ruminants, the mammæ are also inguinal. In the cow, the right and left halves of the udder are quite distinct from each other although lying in contact, their fibro-elastic envelopes being completely separated by areolar tissue. Each lateral half is divided into two intimately connected "quarters," an anterior and posterior, with separate excretory ducts and teats.

Each quarter has but one milk cistern, and this is of great size, into which all lacteal sinuses lead and from which a single excretory duct opens through the apex of the teat to the exterior.

There are generally one or two rudimentary glands with teats behind the posterior quarter, which frequently function very slightly immediately after calving, while, in some cases, they secrete a noticeable amount of milk. In one cow observed by the author each lateral half of the udder consisted of a single gland or "quarter" with but one teat like that of the ewe or goat.

In the bitch and cat there are eight to ten mammæ and, in the sow, ten to twelve. In the mammæ of the sow there are two or more small milk cisterns to each gland, each of which opens at the apex of the teat by a separate orifice. The mammæ of car-

nivora possess no milk cisterns, each of several large milk canals opening separately at the apex of the teat.

Rudimentary mammary glands occur in male animals in harmony with the general rule that the sexual organs of each sex tend to be repeated or to possess an analogy in the other. In rare cases, the mammæ of males become functional and he-goats and bulls have been known to yield milk.

In the female the secretion of milk normally becomes established only as a result of pregnancy and the milk appears ordinarily only near its termination, within a few days of the birth of the young, and reaches its greatest activity generally shortly after giving birth. This is not constant. If abortion is threatened in a pregnant animal, especially a mare, when the normal period of pregnancy is not nearing its close, the secretion of milk is liable to become suddenly established. In some animals the mammæ become excited, swollen and even function during estrum. Such was the case with a mule observed by the author, from which there was a very profuse and annoying flow of milk, keeping the legs constantly wet during the spring of the year, when she was in estrum much of the time.

If a fetus perishes within the uterus of a uniparous animal without decomposition, its continued presence in the uterus fails to excite lactation and tends to prevent by its presence the occurrence of estrum.

OBSTETRICAL PHYSIOLOGY

Reproduction.

The specific function of the generative organs is the procreation of the species, including conception, the intra-uterine nutrition and development of the fetus, its expulsion after a certain degree of development and its further nutrition for a time after birth by milk from the mammæ, until the young has acquired sufficient development to enable it to lead a wholly independent existence. The two sexes in mammalia are normally wholly distinct so that, before conception can take place, a conjugation of the male and female, coition or copulation, must occur. In all mammalia there are more or less apparent vestiges of each part of the genital apparatus of the opposite sex in each individual. but they naturally become arrested in their development in the embryonic stage and remain wholly functionless; rarely do we meet with anomalies (hermaphrodites) in which the analogous organs of both sexes develop more or less completely; less rarely we observe the development of some of the male organs (testes) and others of the female (uterus and vagina) in one individual. These animals partaking of a bisexual nature are, so far as we have observed, uniformly sterile. In other instances (freemartins), all genital organs may be arrested in the embryonic stage and the animal remain virtually asexual.

Before reproduction becomes possible the breeding animal must have reached the period of puberty or sexual maturity, the period when ova and spermatozoa mature and are discharged and sexual desire is established, up to which time the reproductive organs are dormant in so far as their specific functions are concerned. Puberty or sexual maturity occurs at varying ages in different species, breeds and individuals. Much depends upon the food supply and rapidity of growth. It quite uniformly occurs in both sexes prior to the completion of growth. There seems to be a tendency towards early puberty in short lived species and late in those which normally have a long span of life, but the rule is inconstant. The normal duration of life in the cow is approximately twice that of the bitch, but the former tends to become sexually mature at an earlier age than the latter.

The rate of reproduction varies greatly in different species and is dependent chiefly upon three factors; the age of puberty and duration of sexual competency, the number of young brought forth at a given birth and the frequency of parturition. Uniparity, or single births, is the rule in the larger animals; the smaller ruminants are to a great extent bi-parous, while the smaller classes of animals are quite uniformly multiparous and bring forth from three or four to twelve or more young at a given time.

The frequency of parturition varies greatly and the minimum between two births is fixed by the duration of pregnancy, which, among our domestic animals, finds its extremes between the four weeks of the rabbit and the 21 months of the elephant. The frequency of partuition is further influenced by a dormant period in reproductive activity between the giving of birth to young and readiness to again conceive. In some species the nursing of young tends to inhibit the power of breeding, as is sometimes seen in the mare and is said to be yet more marked in the elephant. In all our larger animals there is usually an interval between the birth of a fetus and the power to conceive, pending the recurrence of estrum and ovulation. In the mare this interval is very brief, frequently but eight or nine days, while in the cow it is longer. In these larger animals there is a tendency toward one parturition each year and in the mare the resumption of the power of conception after foaling needs be very prompt or annual breeding becomes impossible, since the duration of pregnancy is about eleven and one-third months, exceeding 12 months in some cases, leaving an average of but about three weeks, in which pregnancy may recur, and a second foal be born within a year. Under such conditions it is natural that the mare does not usually produce a foal each year over an extended period. On the other hand, in the rabbit, conception normally recurs within a few hours after giving birth to a litter of young, so that she may breed each month. In nature, and still more in the domesticated state, conceptions fall far short of the maximum possibilities and the births are relatively much below the assumed number. Mares used especially for breeding purposes produce ordinarily but two foals in three years or even less, and elephants are said to produce young but once in three to four years. Exceptionally, we

meet with mares breeding annually for ten, twelve or more consecutive years.

Neither do all animals born reach maturity. Their growth and development after birth is predicated upon the available food supply and their immunity from predatory animals and from diseases and accidents. Speaking generally we might safely say that in the wild state the probabilities of maturity are in inverse ratio to the rapidity of reproduction. In those which reproduce slowly, like the mare, with less than one young per annum, which, in turn, needs live about three years before giving birth to young, the new-born animal is born in a well matured state and is quickly able to travel long distances for food or water and to flee rapidly from pursuing predatory animals and enjoys, in addition, highly efficient maternal protection. On the other hand, the young of the rabbit are born in a state of utter helplessness against enemies or of procuring food independently, while the mother is not competent to afford effective protection against foes. Thus, in a state of nature, where there is neither room nor, food for all the young which might be born, agencies which modify the birth rate and the percentage of young which shall successfully mature serve to maintain a balance in animal life.

The rapidity of the increase of a species is also modified by the available nutritive surplus of the mother. Generally speaking the larger the animal the lower the nutritive reserve. The greatest drain upon the nutritive supply is that upon the muscles for locomotion. Large animals need move over a more extensive area in order to obtain sufficient food and, the greater the body, weight, and, especially, the greater the height, the greater the drain upon the nutritive supply within the body.

Among domesticated animals, where food and protection are provided by man, the control of the numbers of animals is brought about through such agencies as slaughtering the immature animals for human food (ruminants and swine), the direct control of numbers by killing the surplus new-born (carnivora), castration and the prohibition of breeding by sexual segregation.

The maintenance of nutrition of the body of the parent must necessarily take precedence over the reproduction of young, and the latter be limited constantly by the nutritive reserve within the parent after the necessities for her own existence have been supplied. The drain upon the maternal system in the reproduc-

tion of young is very great in all mammalian animals but differs widely according to species. In a mare weighing 1,500 pounds, the new-born foal may weigh about 125 pounds, or 8 % of her body weight, to which must be added an additional demand of the young, in the form of milk as food, covering a period of five, six or even more months after birth.

The nutritive demands of the fetus of the mare extend over a long period, comprised of eleven and one-third months of pregnancy and five, six or more months of nursing, or a total period of about one and one-half years. And her average rate of producing young is reduced to approximately one in two, or two in three years. In the cow there is a greater nutritive excess or reserve and, while the young is somewhat larger as related to the size of the mother than obtains in the case of the mare, or about 10 %; the intra-uterine term of existence is shortened from about eleven and one-third to nine and one-third months; and the period of sucking is also reduced somewhat, thus materially decreasing the demands upon the maternal system, with a corresponding increase in reproductive power and the rate of increase of the species. In the natural state, fewer of the young reach maturity. In multipara the young are relatively smaller, but parturition occurs more frequently. In the sow, parturition occurs about twice annually and the number of young may reach ten or more at each birth. A sow weighing 300 pounds may thus give birth to twenty pigs in a year, each of which may weigh two, or a total of forty pounds, equal to 13 % of the maternal body weight.

The character and abundance of food exerts a well defined influence upon the number of young produced, a highly nutritive and well balanced ration with other favorable environment tending to greatly increase fecundity.

The completeness of development of the fetus at birth varies widely and the demands upon the nutritive reserve of the mother correspond to the degree of embryonic evolution attained by the young prior to birth. The new-born rabbit, after four weeks of intra-uterine life, is a very immature animal, incapable of locomotion, its eyes not open and its body almost naked of hair; the young Guinea pig, after the same duration of intra-uterine existence, is born with a dense coat of hair, with eyes open and its locomotory apparatus so completely developed that it can move about with almost the same celerity as its dam.

The young of carnivora are born in a very immature state, while those of ruminants and solipeds are well developed and early ready to follow their dams at will.

In each case, there are probably advantages to the mother and offspring. The rabbit must depend wholly upon flight for protection against foes and would evidently suffer a serious disadvantage from a greatly increased body weight due to the presence in the uterus of a number of very large fetuses ; the bitch, in the natural state, must depend upon the chase for her food, and she too would be hampered by a great weight due to well developed fetuses.

Reproduction is a complex physiologic process, accompanied by or associated with phenomena which bear an important relation to each other. In approximately the following order, we observe the maturation of the ovisacs or Graafian follicles: estrum, copulation, rupture of the Graafian follicles, fecundation and possibly menstruation. The chain of phenomena is finally completed by pregnancy, parturition and the nutrition of the new-born.

Maturation of the Graafian Follicle.—Ovulation.

Recounting briefly our previous allusion on page 11 to the formation of the ovaries and their specific function, the formation of ova, there is observed very early in embryonic life the two genital ridges forming along the median side of the Wolffian bodies. Consisting at first of a mere thickening of the peritoneum, chiefly due to an elaboration of its epithelium, the external cell layer becomes columnar in contrast to the surrounding squamous cells, while the deeper strata assume a more or less cuboidal form, together constituting the germinal epithelium. This continues to thicken and certain of the cells become distinctly larger than the others, to constitute the *primitive ova*, while the deeper epithelial layers are being broken into irregular columnar masses, or *egg columns*, through the growth among them from below of blood vessels and connective tissue. Prior to birth in those young which are born in a well developed state, shortly after birth in the immature young like that of the rabbit, some of the primitive ova become materially changed, to constitute *permanent ova*.

In the process of development the connective tissue stroma throws out a thin layer, the *tunica albuginea*, parallel to the sur-

face of the ovary and serving to divide the germinal epithelium into a superficial, columnar layer and a deeper one broken up into irregular columns or clumps of spherical or polygonal cells. In these cell masses the *permanent ova*, developed from the *primitive ova*, become much larger, while the nucleus or germinal vesicle enlarges and its enveloping membrane becomes distinct. The contents of the nucleus become massed at one point and form a distinct reticulum, in which one or more nodal points enlarge to constitute the nucleoli or *germinal spots*. The neighboring germinal cells become arranged about the ovum in a manner to completely enclose it in a follicle, which has at first a single layer of cells. Later a second layer of cells forms about the ovum within the first.

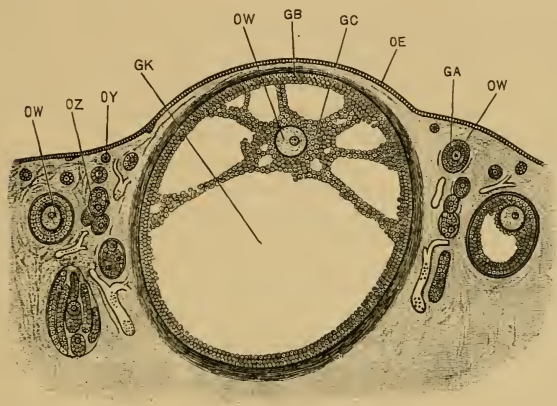

FIG. 6. Section through part of the ovary of an adult rabbit. The section is taken vertical to the surface of the ovary, and shows one fully formed Graafian follicle, and others in various stages of development. × 50.

GA, Follicle cells surrounding an ovum.

GB, outer layer of Graafian follicle, or "tunica granulosa."

GC, inner layer of Graafian follicle or "discus proligerus."

GK, Cavity of Graafian follicle.

OE, Outer layer of columnar epithelial cells, investing the ovary.

OW, Ovum. OY, Primitive Ovum.

OZ, Nests of Epithelial cells derived from the deeper layers of the genital epithelium. (Marshall.)

The cells of the follicle multiply rapidly and, the growth of the external layer being more rapid than the inner, there results a separation between the two, except at the point of attachment of the ovum, revealing upon section, a cresent-shaped cavity which is filled with fluid.

Fully developed, this constitutes the Graafian follicle, which consists of the outer layer of follicular cells or *tunica granulosa*, the inner mass of granular cells or *discus proligerus* and the ovum, attached within or upon the inner cell mass. The cavity of the follicle is occupied by the follicular fluid. The ripening egg sacs lie at first deeply in the ovary ; as the size of the follicle increases they approach more and more nearly to the surface and even project beyond in varying degrees dependent somewhat upon species. They vary greatly in size. In the mare they are not readily observed upon the outer surface owing to the dense, heavy tunica albuginea and to the fact that they ripen and rupture in the concealed hilus instead of upon the free surface as in most other species. The exposed surface of the ovary is frequently occupied by massive cysts, or over-distended follicles.

In the cow, the ripe follicles are prominent upon the ovarian surface while, in the sow, they project entirely beyond and maintain their connection by a constricted neck. As the follicle becomes more and more distended it ruptures at the weakest part of its wall and discharges its ovum or ova, with the follicular fluid and portions of its inner cellular layer, upon the surface of the ovary, where the ovum is normally taken up at once by the pavillion of the oviduct and conveyed toward the uterus. In some cases, the ovum is not discharged promptly or even at all from its follicle, but may become fecundated and developed there, constituting ovarian pregnancy (which see), while in other instances it possibly escapes free within the peritoneal cavity.

During this period of maturation and rupture of the ovisac, the ovum itself undergoes important changes and, prior to its discharge from the follicle, its nucleus leaves its center and passes toward the periphery ; a definite *vitelline membrane* is formed within the zona radiata immediately about the egg : the nucleus becomes indistinct and, while the yolk or vitellus retracts slightly from the vitelline membrane at one point, the first polar body, a small mass apparently derived from an unequal division of the nucleus, is assumed to be extruded, soon after which the

rupture of the ovisac occurs with the escape of the ovum into the pavillion of the tube and, following this, while the egg is moving along the oviduct, before impregnation has taken place, the second polar body is supposed to be cast off.

The exact relation of ovulation to estrum and menstruation has not been determined with complete satisfaction, and conflicting views are held. In my personal experience in spaying cows, it has been constantly found that one in estrum has, in one ovary, a ripe Graafian follicle which is ready to rupture and usually does so on being removed, while, if estrum has occurred on the previous day, a fresh corpus luteum is present. This indicates that, for the cow, estrum normally signifies the presence in the ovary of a mature Graafian follicle, about to rupture, and that copulation with the male usually takes place prior to the discharge of the ovum from its ovisac. Later, menstruation may occur if impregnation has not taken place.

Observations on rabbits are similar. When young are born, there already exists, in the ovaries of the doe, a crop of ovisacs, fully matured and ready to rupture. Estrum follows at once upon the birth, copulation occurs, and it is not until after eight to twelve hours have elapsed that the ovisacs rupture and discharge their contents into the pavillion of the oviduct, there to become fertilized by the male cells already present. Such is probably in a large measure the rule with other animals. There are reasons for believing that ovulation is favored and at times possibly hastened by coition, but there is no definite relation and the ovulation regularly occurs in the absence of sexual contact.

Ovulation occurs in more or less fixed cycles and is modified somewhat by climate, season, food and housing. In the mare it usually takes place at intervals of about four weeks during spring and early summer, is less frequent and more irregular during autumn and may be quite absent during winter, except she be well fed and housed. The cow ovulates with considerable regularity about every three weeks and, if well housed, the cycle is not liable to interruption during the winter months.

In the ewe, ovulation apparently occurs every two or three weeks, but its existence is not very evident, except in the presence of the male. In carnivora ovulation ordinarily occurs semiannually in late winter and early autumn.

In all animals ovulation is normally suspended during pregnancy, but exceptions to this rule occur.

In some cases the Graafian follicles become over-distended with follicular fluid, their walls are abnormally resistant, the ova tend to perish, while the enlarged ovisacs persist and grow, and ovulation does not occur. The presence of such ovarian cysts generally inhibits the ripening and rupture of other follicles and, thus, not only causes sterility (which see) but exerts a profound influence upon the behavior of the animal, tending to cause nymphomania, or sexual insanity.

2. Estrum.

Reproduction among higher animals is fundamentally the result of an irresistible sexual desire occurring simultaneously in the male and female and leading to coition.

The condition is known as estrum in the female and, as related in the preceding section, occurs immediately prior to or concurrently with ovulation. It finds expression in various ways with different species of animals. In general there is a nervous excitability, the external genitals are swollen and vascular, there is an increased secretion of mucus from the vulva and vagina. In the mare there are frequent emissions of urine in small quantities, especially in the presence of other horses, most of all of a stallion, the vulvar lips are frequently opened and the erected clitoris protruded. In ruminants and the sow the female imitates the copulatory act of the male by mounting other animals of its species. In certain pathologic cases, the cow, especially, does not confine her expressions of sexual desire to her own species, but when affected with nymphomania may attempt to mount other species of animals and we have known instances where they have even attempted to mount man and subjected him to very serious danger.

In all animals there is a tendency for the female to wander from home during estrum. This is most noticeable in carnivora, which, if not securely confined, regularly disappear and tend to wander long distances and remain away during a large part or all of the estrual period. In all animals there is a more or less apparent odor characteristic of estrum and peculiar to the species.

3. Copulation. Coition.

Natural reproduction in higher animals can only occur as a result of copulation, which, in its turn, is brought about by the irresistible desire of the female, which we term estrum, and the corresponding sexual excitement of the male. Artificially impregnation is possible and has been practiced to some extent by breeders, by injecting the seminal fluid of the male into the uterus of the female.

During the act of copulation the semen from the male is injected into the vagina of the female, possibly in part into the uterus. We have no definite data as to where the semen is deposited during copulation. It is thought by many that most or all of it is ejaculated directly through the cervical canal into the body of the uterus, the urethral opening of the male coming in direct contact with, or entering, the os uteri. Harms, quoting Duranton (Journal de Lyon, 1888) cites a case of rupture of one of the cornu of the uterus of a cow during copulation. owing to the entrance of the penis through the cervix. On the other hand, as related below, in case of the mare, with a far more dilatable cervical canal, injuries from too long a penis occur in the vagina and not in the uterus. We have also known of a stallion with a considerable portion of the penis amputated which was quite as fertile after as before the operation, although it would seem that the stump of the organ could not well reach the os uteri. The essential condition to fecundation, so far as the male is concerned, is that physiologically perfect spermatozoa shall gain the cervical canal, traverse the uterus and oviducts and meet the ovum. From among the countless myriads of these sperm cells in one discharge of semen, but one of them is essential for the fertilization of an ovum.

THE DANGERS AND INFECTIONS OF COITION.

Injuries and dangers to animals during copulation or preparatory thereto, involving both sexes, are not uncommon and are frequently of a serious character. They include physical injuries to both male and female, the transmission of infectious diseases of a general character and that of specific venereal disorders.

1. Physical Injuries.

In the wild state, severe and fatal battles between rival males are not infrequent and the same prevails to some degree among domesticated animals, although, as a general rule, if several males are kept together with a number of females they lose much of their combativeness without, however, completely eradicating it. The author has seen an instance of a fatal fray between two rams which had been regularly kept together.

When a strange male wanders into a herd or group of females with which a male is regularly consorting there is at once a determined fight between the two, which ends only with one or the other becoming vanquished. In these battles, injuries of the most diverse character occur, according to species and chance. Their only prevention depends upon the proper confinement of male animals.

In most countries there are laws against the running at large of male animals but, by custom, these are not enforced against carnivora, an exception which should be overcome by the confinement of all females.

There are further dangers, chiefly to the male, of injuries in attempting to escape from or break into enclosures in order to reach females, especially with horses and cattle. The appearance of a female in estrum near by the enclosure of a male is a signal for him to make violent attempts to escape from his confinement and reach the female. It is consequently of importance that enclosures intended for the confinement of male breeding animals should be especially secure and, as far as possible, all elements avoided in their construction which would endanger the animal in an effort to escape.

In the preparations for copulation there is little danger except in case of horses. Breeding customs and conveniences bring into the procedure a period of "trying" or "teasing" of the mare by the stallion, both for the purpose of determining the existence of estrum and bringing about the desired degree of sexual excitement before permitting an attempt at copulation. In this act there are numerous dangers, especially to the stallion.

It is desirable, if not frequently essential to safety, that special conveniences for restraint be provided for this purpose. They should consist ordinarily of a strong, solid wall about three feet high and ten to twelve feet in length with a rather broad and rounded top. The chief object of the structure is the avoidance of kick wounds which may be inflicted upon the stallion by the mare. To this end it should be merely of sufficient height to guard against such an accident and sufficiently resistant that the mare cannot kick through it. The use of a single pole to separate the stallion and the mare is insecure and hazardous as either may kick through beneath it and injure the other.

It is also highly essential that the top of the structure be rounded, smooth and free from projections. Either the mare or stallion may get beyond the control of the groom and kick or leap upon the structure and, unless properly built, serious injury is liable to occur. To this end the wall should be low enough that, either animal, getting upon it by rearing or kicking, may readily free itself without injury.

In one instance the author attended a stallion, which, becoming impatient, had passed beyond the control of the groom, reared to mount the mare and became impaled upon a projecting post at one end of the structure, causing a serious hernia and almost eventration. Posts should not extend above the top of the structure or, doing so, should continue so high as to make injury in this manner impossible.

When this preparatory period has been passed and copulation has been decíded upon, there arise fresh dangers to the stallion from kicks by the mare while approaching her or in the act of mounting. Two methods of avoiding accidents at this point are used ; without and with hobbles. In the first method, when both stallion and mare are well broken and controllable and competent grooms have each well in hand, the stallion should be caused to approach the mare's head and then allowed to mount from the

side instead of from the rear. If both are kept well in hand, any attempt to kick on the part of the mare should be at once counteracted by vigorously drawing her head toward the stallion, thus turning her heels from him. After coition has been completed and the stallion is dismounting the same rule should constantly be applied and the mare brought at once to face the stallion in order to avoid kicks.

Owners of valuable stallions generally prefer to obtain yet greater security by the application of hobbles. Two forms are used, of which there are numerous varieties. By one plan, a hobble is buckled about each hind pastern, a rope of sufficient length attached to each, and the two free ends are carried forward between the forelegs and securely tied to a strong collar or the ends may be carried upwards on either side of the neck and tied on the top sufficiently tight to prevent the mare from kicking backward for any important distance. By the second plan, the hobbles are attached to the hocks instead of the pasterns. In this case, each hobble is double and one portion of each is attached above, the other below the hock of each hind leg and by ropes or straps are fixed forward the same as in the preceding. The latter possesses some points of superiority. The mare is not so liable to become entangled in the ropes and injure herself and the stallion is probably also exposed to less danger of getting his foot caught in the securing apparatus. Whatever the form of breeding hobbles or other confining apparatus, they need be secure and strong. Nothing can well be more dangerous for the breeding stallion than insecure hobbles which lead to a false feeling of security and throw the otherwise careful stallion groom off his guard. In a recent instance the author was called to attend a valuable stallion suffering from a compound tibial fracture, the result of a kick during attempted copulation. Because the mare was not properly in estrum or for other reason she was unexpectedly cross and at a critical moment when the stallion was attempting to mount she commenced to kick and the old hobbles, in which the owner of the stallion had trusted, gave way, and the fatal accident at once followed. The breeder should never trust partly to hobbles and partly to the gentleness of the mare or good luck. If hobbles are to be trusted at all, the breeder should know that they are so strong that no mare can break them and always allow a safe margin of strength beyond that

considered essential and the fastenings should be secure in every detail and beyond the possibility of slipping or accidental detachment.

If accidents are to be avoided, it is also highly important that the mare is properly in estrum and that she is not frightened or angered. Gentleness and patience in the handling of both stallion and mare and postponing copulation until the proper moment are always essential elements of safety in breeding. Some breeders place a twitch upon the mare's nose until the stallion has safely mounted her.

In breeding mares to jacks, it is customary to place the mare in a pit where she is closely confined and rests upon a plane a foot or more lower than that upon which the jack stands. This not only gives an advantage to the comparatively small male by affording him an elevation, but also secures him against kicks from the mare, a highly essential precaution because the mare ordinarily resents copulation with the ass, so that the act is largely in the nature of rape.

False copulation, or entrance of the penis into the anus instead of the vulva, is possible in almost any of our domestic animals and Harms records it as occurring in the mare, cow and sow. The author has observed it only in the mare and, in all, four times, though he has known of numerous other instances. It is by no means rare and is highly dangerous. Its causes are various but it is probably largely due to some resistance on the part of the mare as a result of not being properly in estrum or otherwise becoming excited and attempting to kick or move about.

Coition is safe only when estrum is present in the proper degree. The mare has ample power to close the vulva against the ready entrance of the penis and thus cause it to glide upward and forwards against and into the anus, which opening may be more readily forced.

The accident is also invited in aged cows or mares with pendulous abdomen in which the anus is retracted and, drawing the superior commissure of the vulva with it, causes the vulvar opening to approach the horizontal instead of the perpendicular and the penis to glide forward and slightly upward over the oblique vulvar opening to strike against the inferior surface of the tail and be deflected into the anus. It may be purely accidental. Harms

thinks it may result from smallness of the female. All cases we have observed have been in mares of medium or large size, whether viewed actually or comparatively as related to the size of the stallion.

The extent of the injury varies. Apparently, the accident may cause little or no injury in some cases, though, in those which are brought to the attention of the veterinarian, a large proportion are fatal. The extent of the lesions will vary according to the size and form of the penis, the violence of the copulatory act and the quantity and character of the feces in the posterior portion of the rectum. Should the rectum be quite empty or filled only with pultaceous feces, as in a cow, or in the mare on green food, the penis may force its way along in the bowel unless it is caught in the folds. If the rectum is impacted with dry feces, as is usually the case in the mare, the penis is deflected and tends to pass through the rectal walls. The rupture may occur either into the peritoneal cavity or into the periproctal connective tissue. In the former case in the mare, the opening is so great that feces at once drop into the peritoneal cavity and cause profound irritation. No sooner has the stallion dismounted than the mare trembles, looks anxiously at her sides, may pass some feces and blood, moves uneasily and may lie down but does not roll violently. The pulse is rapid and weak, the breathing is shallow and quickened, the abdomen is held rigid and the patient looks as if tympanitic.

The symtoms resemble in many particulars those of rupture of the stomach. The diagnosis is readily made by manual exploration per rectum, the hand easily passing out through the rupture into the peritoneal cavity. In one of our cases of rupture into the peritoneal cavity, the mare lived some eight hours ; in another, less than four hours.

Not all cases lead to rupture into the peritoneal cavity. In one instance under our observation, in an old brood mare, no history of injury was obtainable and apparently it had not occurred during the several years of ownership by her last proprietor. She died under symtoms of colic and an autopsy revealed a large intra-pelvic sac, opening into the rectum, which had been habitually filled with feces but, becoming over distended, had obstructed the bowel and caused a rupture of the sac into the peritoneal cav-

ity. It was almost certainly the result of a long-standing penial wound.

In another case to which the author was called the accident was recognized at the time of its occurrence, blood and feces were voided, the perineal region was swollen. Manual exploration revealed a large rent through the rectal walls into the periproctal connective tissue six to eight inches from the anus, containing a mass of feces equal to about two liters impacted into the readily distensible wound. The feces occupying the sac and those from the rectum immediately anterior to the rupture were carefully removed by the hand and the sac was cautiously flushed out with an antiseptic solution. This method of handling, repeated twice daily, along with restricted, laxative diet and complete rest, brought about a prompt recovery with little sacculation.

According to Harms, false copulation in the sow is usually followed by no more serious consequences than a swollen anus, accompanied by a bloody discharge.

In the mare the accident is preventable by ordinary precautions on the part of the stallion groom, whose duty it is to see that the penis is guided into the vulva or, at least, not permitted to enter the rectum. To this end, it is best not to attempt service in case of a mare not certainly in proper estrum. It is a part of the business of the groom to see and to know that the penis of the stallion is properly entering the vulva of the mare. If the mare is kicking or otherwise violently resisting the stallion, he should be promptly withdrawn, since copulation under such circumstances is unwarrantedly dangerous for both animals. Such violent resistance of the mare is sometimes offered by the groom as an excuse for his failure to see and know that the penis of the stallion was being properly entered in the vulva, but it is not valid. The mare or cow with retracted anus should be placed with her hind feet on a lower level than her anterior members, leaving the ground upon which the male is to stand at a higher level and thus bringing the vulvar opening more nearly perpendicular. In the cow and sow, the accident is not usually preventable.

The prognosis of penial injuries to the rectum must be based largely upon the position and extent of the injury. When the lacerations perforate the peritoneum and cause escape of feces into the peritoneal cavity the injury is essentially fatal, veteri-

narians having not yet succeeded in successfully handling such lesions. When the rupture of the rectal wall occurs behind the peritoneum or otherwise does not perforate it, the prognosis is good if timely surgical aid is given, though, after a long period of time, serious or fatal results may follow the impaction of feces in the sac formed in the pelvic connecting tissue. The pressure of the feces escaping from the rectum tends constantly to push the loose connective tissue aside and, eventually, to form a large sac, which is constantly filled with fecal masses.

The handling in such cases consists of gently removing the feces from the sacculated wound cavity in the pelvic connective tissue and cautiously flushing it out at least twice daily with a mild antiseptic solution. At the same time, the rectum should be manually emptied as far as the attendant can reach and the feces thus prevented from dropping into the sac. The patient should be kept at rest on a very scant, laxative diet during the treatment, which should be continued until the rupture is quite healed as it is highly important to guard against extensive sacculation in the part, which can only be done by avoiding the accumulation of feces in it.

In some instances, the injuries to the rectum from the entrance into it of the penis are comparatively trivial and consist merely of wounds of the mucosa and somewhat of the muscular walls, with the passage of bloody feces, some swelling about the anus and other slight symptoms of injury, which readily pass away under repeated antiseptic enemata.

From a forensic standpoint, the owner of the stallion is probably always responsible for the damages to the mare, since the accident is preventable with proper care upon the part of the groom. Such were the findings in the only case which we have seen tested in the courts.

Harms, quoting Hinrichsen, mentions an instance in which a cow had her tail fractured at the base during copulation.

The vagina, especially of the mare, is not infrequently lacerated or ruptured by the penis of the male. The size of the penis of the stallion does not bear a constant ratio to the size of the body, but is comparatively excessive in coarsely bred animals with long legs and large heads. Such stallions, copulating with small mares, constantly tend to produce vaginal injuries. Sometimes it is merely a slight laceration in the mucous membrane,

which may cause limited hemorrhage and some straining ; sometimes the lacerations in the mucosa and muscular walls are extensive and induce marked symtoms of wound infection in the vagina with tumefaction, discharge and straining ; while, in other cases, the vaginal walls are completely ruptured, with great danger of fatal peritonitis.

In one instance investigated by us a series of injuries was caused by a recently imported stallion, which had been put to service among comparatively small mares. Almost every mare served by him exhibited signs of vaginal injury ; some were severely lacerated; in one there was a fatal rupture. Inspecting the horse, he was found to be an overgrown, coarse, leggy grade draft stallion about eighteen hands high and with an enormous penis which would have been dangerous with heavy draft mares, while, in his neighborhood, most animals were of small roadster or common stock.

When such injuries occur, there is observed an abnormal amount of straining immediately after copulation, with, perhaps, some discharge of blood from the vulva. Later, swelling of the vulva and a muco-purulent discharge may occur.

If the wound penetrates the peritoneal cavity, septic peritonitis is highly probable, with early collapse and death.

Injuries to the mare from this cause should be obviated by means of a roll or padded surcingle encircling the body and passing just in front of the sheath in a manner to prevent the penis from entering the vagina to its full length, the pad or roll being adjusted in size according to the case. The diameter of the roll should always be ample, since little fear need be entertained that the prevention of the entrance of the entire length of the penis will unfavorably affect the results of copulation, as general observations show to the contrary. In constructing this roll or pad an ordinary surcingle may be used and a tube made of sheeting or other sufficiently strong material and this, open at each end, slipped over the surcingle. Padding of cotton, oakum or other material is then to be inserted into the tubular covering until it is tightly filled so that it presents a diameter of 4 to 8 inches in that part of the surcingle to come in contact with the abdominal floor, after which the open ends of the tube are to be secured to the surcingle and closed by tying. When the stallion is ready for service, the surcingle is passed around his body just in

front of the opening of the sheath and secured by buckling. In copulation, only that portion of the penis projecting beyond the roll can enter the vagina.

Non-fatal laceration of the vagina should be handled along general antiseptic lines, the practitioner remembering constantly that this organ reacts strongly to irritants and that thorough disinfection should be brought about largely by mechanical flushing rather than by heroic attempts to destroy the micro-organisms in position.

Lacerations of the vulvo-vaginal canal during copulation somewhat rarely occur because of pathologic changes due to prior diseases, especially to adhesive inflammations leading to important stricture or occulusion. In one instance coming under observation, in a mare, there were old adhesions of the vaginal walls in their anterior portion. An attempt to breed her caused such injury as to lead to violent expulsive efforts, by which she forced the urinary bladder, covered by the vulvo-vaginal floor, out through the vulvar opening—vesico-vaginocele—which persisted in spite of trusses, sutures and other expedients and was only controlled by producing prolonged and deep anaesthesia with chloral.

In cows, adhesions of the vaginal parietes may occur as a result of infectious vaginitis and naturally render coition unsafe if not impossible.

Lacerations of the vagina by the penis are also liable to occur in other domestic animals though less probable than in the mare. Their symptoms, prognosis and treatment are essentially the same.

Duranton (Journal de Lyon, 1888) records a case in which the uterine cornu of a cow was ruptured about 3.5 cm. anterior to the os uteri, supposedly by the penis of the bull during copulation. We consider the record open to question and would think it more probable that the rupture had occurred from other causes.

Injuries to the bladder by the penis of the male have been recorded, though very rarely. Harms, quoting Nebele (Repertorium) mentions one case in a cow in which the bladder was ruptured owing to the entrance of the penis through the meatus urinarius. The probability of such an accident seems especially remote in the cow because of the small valve arising from the

floor of the meatus and extending forwards. In the mare, this accident would seem quite as possible because of the very wide, valveless meatus, through which several fingers may be passed, but the penis of the stallion is much larger and the glans very broad.

In one instance, a somewhat coarse two-year filly, weighing 1700 pounds was presented for service to a 2400 pound stallion with a large penis. Upon mounting her, the stallion entered his penis into the vulva a short distance, where an obstruction was apparently encountered, and after a time he dismounted. After repeated unsuccessful efforts the author was asked to examine her and found a persistent hymen across the lower portion of the vagina, sloping upward and backwards which had directed the penis downward against the meatus urinarius, through which the hand could be easily passed, but no injury from the penis could be detected at the time or later; on the other hand when the penis encountered the obstruction, the stallion desisted from further attempts at copulation.

Injuries to the female because of great weight of the male are not rare though far less common than one would be inclined to expect when the disparity in size is considered. It is not rare to see females served by males two, three or more times their weight and yet escape injury entirely. In the smaller species of animal, like the pig and dog, the female can quite readily drop to the ground under excessive weight and escape injury, but, in the cow and mare there is danger of serious injury when the weight of the male becomes too great. Ordinarily, a cow or mare can readily withstand copulation with a male weighing 150% more than herself, or a cow or heifer weighing 800 pounds can be safely bred to a bull weighing 2000 pounds or slightly more. When this point has been greatly exceeded, danger arises and increases in proportion to the variation in weight. In one instance a heifer of about five months and weighing about 400 pounds was served by a bull weighing 2000 pounds and suffered a fracture of the pelvis, though not sufficiently serious to prevent her giving birth in due time to a calf from the service which caused the injury. In another instance, a sucking filly was ridden by a large stallion, causing dislocation of the sacro-iliac articulation on one side and fracture of the iliac shaft on the other, rendering her useless for labor and, after having been

bred at two years, necessiating her destruction at three years, because of irremediable dystokia. It is, therefore, desirable that young females which come in estrum very early in life, should be securely segregated from mature males, not alone because of the undesirability of very early breeding, but in order to avoid serious injuries from disparity in size. It is also essential to remember that a male breeding animal regularly confined, in case of accidental escape, will attempt rape upon the most immature young as in the foregoing case, with serious or fatal results.

In the mare, injuries to the neck and withers are also liable to occur from bites by the stallion during coïtus. This is probably most common among heavy draft stallions, some of which are very rough and cause more or less serious lacerations or contusions, at times leading to fistulous withers. There seems to be no means for breaking the stallion of the vice and the only effective method of control with which we are acquainted is the application of a muzzle during coition.

Injuries to the male because of over-size of the female also occur, especially in the bull. When young bulls of small size attempt copulation with mature or large cows, they are liable, at the moment of the violent copulatory thrust to take their feet off the ground to such a degree that in coming down they miss their footing, their hind feet glide forwards and they fall heavily backwards, sometimes causing fracture of the spine or other serious injury. It is to be avoided by guarding against too great a disparity in size and by placing the small male in as advantageous a position as possible both as to slope of ground and security of footing, especially avoiding damp, slippery ground.

In one case brought to our attention a similar accident occurred to a cow, which being in heat, mounted one of her mates slipped, fell and fractured her spine so that she had to be destroyed.

Injuries to the penis of the male during copulation are by no rare. The penis of the stallion is most liable to injury from kicks by the mare, the avoidance of which we have considered above while discussing the subject in a general way. These contusions of the penis during its great vascularity in the breeding season are very difficult and refractory to handle. The stallion needs be kept quiet, free from sexual excitement, the penis retained at

rest within the sheath by means of a suspensorium and the resulting local inflamation ameliorated by the application of cooling astringents such as lead acetate, hamamelis, tannin, belladonna, etc., combined in cases of necessity with antiseptics. Generally the patient may have quiet walking exercise, a restricted laxative diet, saline laxatives or in case of serious disturbance, prompt cathartics of the hypodermic alkaloidal group.

Lesser injuries to the penis of the stallion are caused by the pushing of tail hairs of the mare into the vagina by the glans penis. These being drawn tightly across the penis, cut the organ. This is to be prevented by the stallion groom by drawing the tail of the mare aside at the commencement of the copulatory act or better by means of a bandage about the base of the tail extending low enough to secure any hairs that might be caught upon the glans penis or by braiding the upper hairs of the tail upon the dorsal surface.

In bulls and other male ruminants, the penis occasionally becomes caught against the side of the vulva or elsewhere and the animal at the moment of making the violent copulatory thrust, doubles the organ sharply upon itself, "breaking" it or otherwise causing serious injury. Sudden and violent bending of the erected penis causes such injuries to its tissues that the "broken" organ remains curved or bent at an angle, or that portion beyond the point of injury does not become erected, which renders him useless as a breeder (see Sterility) or the injury causes balanitis or inflammation of the prepuce which leads to adhesions so that the organ cannot be protruded.

The prevention of such injuries is more important and practicable than their handling. They are most liable to occur in confined males which are suddenly brought in contact with females in estrum, not always in a proper state for coition. The female may be nervous or timid at the approach of a strange male or, still worse, estrum may not yet have reached its fullness or has begun to decline so that she will not stand well and, as a result of resistance, the accident may occur. Slippery or uneven ground may also render the act insecure and lead to injuries to the penis.

Prevention should be based chiefly on the avoidance of these and other dangers. In cows especially, it is important that they be properly in estrum, that the enclosure in which copulation is to occur is reasonably even and the footing secure. Zschokke

commends (Der Unfruchtharkeit des Rindes, Page 66) service stocks consisting of five posts upon which are fixed two beams which meet in front to constitute an acute triangle, open at the base, into which the cow is led and from which she can not readily escape or make any extensive movements.

In the handling of such injuries to the penis, little can be done beyond the allaying of infection by means of anteseptic douches and the avoidance of sexual excitement, combined with such local and general treatment as would tend to control inflammation.

In the dog, in which, during copulation, the prominent glans penis becomes tightly fixed in the vulva of the bitch, the male may dismount and turn in the opposite direction thus bending the penis abruptly. If disturbed by other dogs or in any other manner, violent dragging upon the penis follows, which leads to injuries of a more or less serious character, chiefly to swelling and inflamation of the parts, occasionally accompanied by paraphymosis. These injuries are not usually observed under proper breeding arrangements but are generally seen where bitches are permitted to run at large and a large number of dogs to congregate, with the resultant fighting.

The handling of such injuries to dogs consists of essentially the same methods as in the bull, chiefly of disinfection. If paraphymosis results, it should be overcome. A solution of eucaine, with perhaps some adrenalin, may be applied to the swollen glans penis, after which, by the application of digital compression or by means of an elastic bandage, the size of the congested organ may be so reduced that it can be pressed back into the prepuce. If not, the margin of the prepuce is to be enlarged by incision sufficiently to permit the penis to return.

Copulation is one of the most common causes of strangulated inguinal hernia in the stallion and the accident is occasionally induced in this way in other male animals. When the stallion mounts the mare, his position subjects the inguinal region to increased pressure from the weight of the abdominal viscera, the position of the abdomen having been changed from horizontal, or a declination downwards and forwards from the inguinal ring towards the diaphragm, to almost the perpendicular, with the entire weight of the abdominal viscera pressing downwards upon the pelvic inlet and inguinal opening. The pressure is further augmented by the abdomen of the stallion becoming forcibly com-

pressed against the buttocks of the mare, as well as by the vigorous contraction of the abdominal muscles during the act and all combine to increase the intra-abdominal pressure and tend to force a small section of intestine through the inguinal ring, where it quickly becomes strangulated unless it promptly returns to its proper position when the stallion dismounts.

In such case, soon after dismounting, in 15 to 30 minutes, or even earlier, the stallion exhibits symptoms of colic, kicks at his belly, looks at his flank, breathes rapidly, sweats profusely and rolls violently.

The agony is excruciating and constant, increasing in intensity, the sweat becoming more profuse until, after ten to twelve hours in very acute and unrelieved cases, the violence abates, the body surface, bedewed with sweat, becomes cold, the pulse rapid and weak or imperceptible, indicating gangrene of the incarcerated bowel, to be soon followed by death.

If the inguinal region is carefully examined a tense fluctuating swelling may be recognized, but, in many cases, the incarcerated intestinal loop is so small that its presence can be determined only by very careful palpation. Examination per rectum usually gives more definite results, and the incarcerated intestine can be felt and grasped, making the diagnosis definite and final.

The handling needs be prompt and usually radical, if the life of the patient is to be saved, although spontaneous recovery occurs in some cases. If the agony of the patient does not prohibit the attempt, the operator may insert his hand per rectum and grasping the incarcerated intestine, drag gently and cautiously upon it and thus attempt its replacement. At times this succeeds.

Should this fail, the animal is to be cast in dorsal recumbency with the hind legs sharply abducted and the inguinal region freely opened. The dragging on the incarcerated bowel per rectum may now be repeated, accompanied by digital manipulation or compression externally with the other hand or by an assistant. If the hernia is not promptly reduced, chloroform anaesthesia should be induced, which further relaxes the parts, and replacement may yet succeed.

Failing in these efforts, herniotomy should be performed with the least possible delay. After thorough disinfection of the region, proper sterilization of hands and instruments, and covering

the adjacent parts, including the hind feet and legs, with aseptic or antiseptic towels or napkins, the scrotum is to be freely and cautiously incised down to the incarcerated intestine, after which the carefully disinfected and moistened index finger is to be passed up along the anterior side of the herniated bowel to the point of incarceration in the internal ring. Using the finger as a guide, a herniotome, probe pointed bistoury, scalpel, or such other instrument as the exigencies of the situation afford, is introduced through the ring at its antero-external angle and the tissues are sufficiently divided in a direction forwards and outwards to permit the incarcerated intestine to return. Sterile or antiseptic gauze is then introduced into the wound and packed closely against the internal ring in a manner to avoid all danger of a recurrence of the hernia and the scrotal wound is closed by sutures. The tampon may be omitted and deep sutures taken in the internal ring, closing it against future hernia.

Twenty-four to forty-eight hours later the antiseptic gauze may be removed, the wound disinfected and closed and thereafter left undisturbed or handled according to indications.

2. General Infections of Coition.

Coition brings the involved animals into such intimate contact that it offers special facilities for the transmission of infectious disorders from one to the other, regardless of the natural avenue of entrance of the microorganism. In their sexual maraudings animals make close approach to each individual of their species with which they meet and thereby tend to contract any contagion which may be extant in the neighborhood or, having such disease, to distribute it everywhere in its path. Thus, the author recalls an instance of a boar pig, wandering from the farm, to return later and, sickening from hog cholera, spread the malady to the entire herd, causing the death of more than 100 animals.

The dangers are little less at times among breeding animals kept confined. A young foal with strangles accompanies its dam to the breeding place, scatters the infection about the premises where other colts may later come in contact with it or the stallion, being young and non-immune, contracts the disorder and transmits it to susceptible animals coming in contact with him, thus disseminating the infection over a wide area. Bierstadt (Woch, fur Thierheilkunde) records the transmission of stran-

gles by a supposedly convalescent stallion to mares, apparently through the genital canal, as abcesses formed in the pelvis about the rectum and vagina. While abcesses occur in these parts from the usual mode of infection, the observations of B. are highly significant and interesting.

In the infections cellulitis or "pink eye" of the horse (see page 68) with the prevailing orchitis in the stallion, the malady is very liable to be transmitted through coition. In contagious abortion, coition is quite generally regarded as one of the most fruitful sources of dissemination, it being assumed that the specific microorganism is carried directly into its native habitat and most favorable position for growth, upon the penis of the bull. In one instance the author has seen actinomycosis of the uterus and broad ligaments of a cow, resulting in her sterility, without other discoverable actinomycotic lesions, which suggested the probability of the infection having been lodged in the genital canal by copulation. The dissemination of general contagions through sexual contact applies especially to males kept for general breeding service and serving females coming from a wide area; the arrival of females from so many different points tends to carry any contagion to the breeding place, thence to be disseminated by him to every part of the territory involved.

If a healthy male escapes from an enclosure, wanders from home and contracts a disease, he carries it back and exposes the other animals of his species; if diseased and he wanders into a neighboring healthy group of breeding animals, he carries the infection to them. Similarly a female, especially when in estrum, may prove an important disseminator of contagion.

It is, therefore, well to consider the breeding place as one of the most important of distributing points for contagious diseases of animals and the veterinarian should constantly regard it as such and be in a position to direct capably how the dangers may be reduced to a minimum. When a breeder has an adequate number of females to warrant the keeping of a breeding male of the desired quality for his own use, it is good economy to do so, to breed all his females to the one male and to accept no females from outside for breeding. This is only rarely practicable. When breeding males are kept for public service, the females offered for breeding should be rigidly scrutinized. Not only

should they show no sign of disease but they should come from a herd where no contagion is known or believed to exist. The manager of public breeding animals should keep himself thoroughly posted upon the prevalence of infectious diseases in his area and should carefully investigate any reported appearance of such diseases. When infectious maladies appear in the community he should ascertain as clearly as possible the extent of dissemination, the location of each center of infection, and then take such measures as are necessary to prevent the contraction of the disease by the breeding male or his transmitting it to other females. Here the general rules of disinfection should be rigidly carried out and, if necessary, isolation and the suspension of breeding be applied. The exclusion from the breeding pen or place of males, females or suckling young affected with contagious diseases, however mild or convalescent, should be rigidly enforced, the place should be kept clean, disinfected if conditions suggest, and, whenever warranted (perhaps it always is), the penis and prepuce of the male should be disinfected before or after each service. This is a matter of but a few moments if proper conveniences are arranged and would frequently avoid serious outbreaks of contagious disease.

The arrangements for the disinfection of the genitals of male breeding animals should be simple and thoroughly convenient and effective. A pail or other vessel of copper, galvanized iron or tin fitted with lid and bail and having a capacity of one to two and one half gallons will readily serve the purpose. At or near the bottom of this vessel have inserted a small horizontal tube, curved downward at the external end, over which the end of a piece of rubber tubing six to ten feet long is slipped and secured. After the disinfecting solution is placed in the vessel, the latter is to be elevated by means of a cord attached to the bail and passing over a pulley or beam, until a sufficient height is reached to supply the desired force by gravity. Usually a height of three to six feet above the part to be treated suffices. The distal end of the tube may then be inserted into the sheath of the penis, the opening of the sheath grasped and held closed for a time and the entire cavity distended with the antiseptic fluid ; or the tube may be pushed far back to the posterior end of the sheath and the current of antiseptic fluid be depended upon to reach every part.

Another very simple method for flushing out the penial sheath is to use an ordinary pure gum horse catheter for a tube, its rounded distal end offering an ideal shape for introduction into sheath, while a small funnel, inserted into the other end, affords facility for pouring the antiseptic fluid through the tube into the sheath and the funnel, held as high as the length of the catheter will permit, affords sufficient force of gravity for the purpose desired. The entire apparatus is cheap, compact, withstands sterilization by boiling and is efficient.

Any reliable disinfectant will answer the requirements but those which tend to dissolve, or are miscible with fats are best, especially about the preputial opening and the surrounding skin. Among these, lysol and carbolic acid take a high place. The antiseptic solutions should preferably be used warm and, in disinfecting the skin adjacent to the preputial opening, soap should be added. The strength of the disinfectant introduced into the sheath should not be great, ½ to 1% of lysol or carbolic acid being as strong as the naked mucosa of the penis, especially of the bull, will readily tolerate.

CONTAGIOUS CELLULITIS. EPIZOOTIC CELLULITIS. PINK EYE. RHEUMATIC INFLUENZA. MUCO-ENTERITIS

Bibliography—Williams, Epizootic Cellulitis; Principles and Practice of Veterinary Medicine, 4th edition, 1888, p. 251. Cave, Pink Eye: Veterinary Journal, 1883, Vol. XVI, p. 336. Whitworth, Pink Eye Disease; ibid, 1883, Vol. XVII, p. 153. Pottie, Jour. Comp. Path. and Therap., Vol. I. p. 37. Clark, ibid. Vol. V, p. 261. Reeks, The Transmission of Pink Eye from Apparently Healthy Stallions to Mares; ibid., Vol. XIV, p. 159 and Vol. XV, p. 97.

Contagious Cellulitis is a highly contagious acute fever of the horse, which has been generally ignored except by British veterinary writers, although it seems to be widely distributed in various countries. It is common in parts of America, but frequently confused with influenza or catarrhal fever, although wholly distinct.

We insert an account of this disease here because of its intimate bearing upon the question of horse breeding, which it affects chiefly in three distinct ways.

It is frequently spread from apparently healthy stallions to mares through copulation, in which respect it approaches the character of a venereal disease, although, as a general rule, this is not the method by which it is transmitted from animal to animal.

It has a relation to sterility because it causes an orchitis in the stallion, which frequently leads to a permanent loss of function in these glands.

It is related to abortion in that it very frequently causes the death of the fetus in utero when affecting the pregnant mare.

Symptoms. The symptoms of the disease consist primarily of an elevation of temperature, sometimes accompanied by chills, dullness and other phenomena, which belong in general to acute contagious fevers. The fever appears very suddenly, usually ranging from 103 to 105° F. although it may exceed this. Generally speaking, the temperature is higher than in influenza and lower than in the contagious pneumonia of the horse. The pulse is hard and full and somewhat quickened, while the respiration is not very greatly disturbed. Some cough is present, though this does not constitute a very prominent symptom of the affection.

Early in the disease there is a manifestation of pain in the limbs, which is shown by shifting of the weight from one foot to another while the animal is standing and by great stiffness and soreness when forced to move, the movements being accompanied by a cracking sound in the joints. After a time the legs begin to swell, commencing at the feet and extending upward until at times it reaches the body. This tumefaction has its chief seat in the subcutaneous connective tissue and is at times very great. As the swelling of the limbs increases, the pain in them tends to abate and at the same time the fever begins to decrease.

The alimentary tract is greatly disturbed, there being a very marked tendency to constipation at first, in which the feces are covered with large quantities of mucus and their color considerably altered. Defecation causes some pain and straining. Later there is a tendency to diarrhoea, which is easily and often fatally intensified by the administration of purgatives, especially of aloes. The conjunctiva is markedly altered in color, becoming a bright, pink hue, swollen and edematous. At times the conjunctivæ are so badly swollen that the eyelids become somewhat everted and the edematous membrane pushed out between them. The eyes are very sensitive to light and the animal attempts to keep them closed. There is a profuse secretion of tears, which flow down over the cheeks. The cornea is frequently clouded so that vision may for a time be interrupted. There is some tendency toward pleurisy, pneumonia and other pulmonary complications.

From an obstetric standpoint, the chief interest lies in the complications of the genital organs. In our experience, the breeding stallion shows a great tendency to suffer from orchitis. We have seen in large importing stables 50 to 75% of the stallions attacked with pink eye suffering from inflammation of the testicles. Along with the swelling of the scrotum and sheath, which accompanies that of the legs, there usually appears a tense, painful enlargement of the testicles, which tends to persist for a considerable period after the general symptoms of the disease have largely disappeared. In some instances we have seen permanent sterility result so that the breeding value of the stallion was completely destroyed.

In other cases we have noted that stallions apparently recovered from the disease have quite uniformly transmitted it,

during copulation, to susceptible mares. These observations are entirely in harmony with those of Reeks, who records an instance where an apparently sound stallion transmitted the disease to susceptible mares almost uniformly over a period of two years. This observation is a not uncommon experience.

It is notable also that, when the disease attacks a pregnant mare it generally causes abortion or, if attacking her just prior to parturition, the living foal is likely to succumb within a few days after birth. Reeks, recording an outbreak under his charge, relates that four pregnant mares, or mares which had just foaled, contracted the disease. Two of the pregnant mares aborted, and the foals of the other two died suddenly shortly after birth. In our experience, in an extensive horse breeding district, the disease quite uniformly leads to abortion in pregnant mares.

Although highly contagious, the affection is of short duration, usually runs a favorable course, in from four to six days, and leaves the animal but little altered, except in those used for breeding. The eyes also may become permanently weakened and invite later attacks of disease. In some unfavorable cases the pulse becomes weak and there is a general depression, which is liable to be followed by sudden death owing, it appears, to heart failure, in which case there are usually found large thrombi in the cardiac cavities.

No specific treatment has been discovered. In our experience the greatest benefit is to be derived from the administration of diffusible stimulants, like nitrous ether or carbonate of ammonia, along with quinine. Purgatives are to be avoided, aloes being especially dangerous. The bland oils might be used in some cases as aperients, or very small doses of eserine, arecoline or other alkaloid hypodermic cathartic, taking care to make the dose sufficiently small to induce no harmful degree of excitement and barely sufficient to induce gentle purgation. There is naturally much divergence of opinion among veterinarians in reference to the treatment of this affection, but in its general handling we are not specially interested.

From an obstetric standpoint, we are chiefly concerned in the question of the spread of the malady from the breeding pen and its tendency to induce sterility and abortion.

When the disease appears in a breeding area it should be handled with the greatest rigor as to quarantine, and breeding quar-

ters should receive special consideration. Diseased mares or mares coming from infected premises should on no account be admitted to the breeding place. Should the malady become general in a neighborhood, as it usually does when an outbreak occurs, breeding should be suspended until the disease is exterminnated.

When a breeding stallion has become infected, aside from the general handling of the malady, special attention should be given to reducing to a minimum the dangers from orchitis and later, after the acute symptoms have passed, to overcoming the lingering chronic infection, through which he may continue to spread the disease to mares.

When it is known that a non-immune breeding stallion has been exposed to this disease, immediate precautions should be taken to guard the animal against a severe attack. He needs be placed at rest, physically and sexually. The usual high feeding of breeding stallions should at once be displaced by a very light laxative diet, such as grass, roots and bran, with an abundance of salt. If these measures do not induce a prompt unloading of the alimentary tract the bowels should be evacuated by means of small doses of eserine or arecoline and the system placed in first class condition to withstand the onset of the disease. Pending the advent of the disease, the animal should have regular daily exercise, great care being taken, however, not to continue it after the advent of the first symptom of the malady, fever, has become established, as indicated by thermometry. Attacked without these precautions, similar measures should still be adopted, the ration reduced and confined to laxative foods, while the bowels are promptly and cautiously evacuated.

The patient is to be guarded jealously against physical or sexual excitement. Strange mares should not be allowed in sight or hearing, and every precaution should be taken against arousing sexual desire. In most stallions the application of the stud bridle occasions excitement, which, at such times, should be avoided.

If orchitis appears, as it frequently does, in addition to the foregoing measures, including the internal administration of nitrous ether and quinine, local applications to control the inflammation in the glands should be applied. First among these in the early stages is local refrigeration by the application of cold

water or ice. Probably the most efficient means is the application of broken ice by means of a suspensorium, which serves the double purpose of refrigeration and supporting the weight of the pendant glands. This treatment should be constantly and faithfully applied until the crisis of the malady has passed, since the effective handling of these glands may determine whether the animal is to be of further value as a breeder or not. Such remedies as belladonna and camphor, applied locally, tend to relieve congestion and overcome the inflammation, but, in a critical case we believe the refrigeration superior.

Later, when the acute symptoms have passed, chronic infection should be considered, precautions taken against the spread of the malady to mares and measures adopted to eradicate the infection from the system as quickly as possible.

For this purpose an extended course of potassium iodide at the rate of ½ ounce per day for each 1,000 lbs. of body weight is, in our judgment, the safest remedy. By some veterinarians, fears are entertained that the prolonged administration of this drug may induce a harmful atrophy of the testicles, but we consider this quite imaginary and without foundation. We would continue the drug for three or four weeks, or longer if necessary.

Abundant time should be allowed to elapse, after the disappearance of all visible symptoms of the disease, before permitting the animal to serve mares. It is advisable, in case the disease attacks the stallion during the breeding season, to withdraw him from the stud for the year. In any case it is wise to begin breeding cautiously and watch closely for evidences of the transmission of the infection to susceptible mares. When a stallion which has suffered from pink eye shows evidences of sterility, careful examination of the genitals and of the semen should be made and, should any restoration of the breeding powers seem possible, appropriate measures undertaken but usually, in our observation, the sterility following pink eye is permanent and irremediable and the animal must be removed from the stud and, with or without castration, used as a work horse.

SPECIFIC INFECTIONS OF COITION

Venereal Diseases.

Venereal diseases have been described in nearly, if not all of our domesticated animals, especially in horses, cattle, sheep and dogs, with briefer references in our literature to such diseases in goats, swine and rabbits. In horses we recognize two well defined venereal affections, *Dourine* or *Maladie du Coït* and the *Eruptive Venereal Disease* or *Genital Horse Pox*; in cattle the *Vesicular Venereal Disease* and the *Infectious Granular Venereal Disease;* in the dog the *Venereal Granulomata*; and in sheep an *Ulcerative Venereal affection.*

1. Dourine or Maladie du Coït. Beschalseuche. Equine Syphilis.

Bibliography. Baldrey; Jour. Comp. Path. and Therap., 1905, Vol. 18, p. 7; de Does, Jahresbericht, 1902. Hutyra und Marek; Spezielle Pathologie and Therapie. Thanhoffer; Ueber Zuchtlähme. W. L. Williams; Report Illionois State Board of Live Stock Commissioners, 1887.

Dourine of the horse is the most serious venereal disease known among domestic animals, both on account of its wide geograpical distribution and the mortality and loss caused by it. It is widely dissemminated in Europe, Asia, Africa and North America. It has been recognized for more that a century and has appeared in all the leading countries on the European continent. In English speaking countries, it was first recognized by the author at Wapella in DeWitt County, Illinois, in the spring of 1886 among imported French draft stallions and the mares which had been served by them. The disease in Illinois apparently broke out in 1884 or 1885, but its nature was not determined until 1886 and even then its seriousness was not fully appreciated so that it was not until 1887 that vigorous measures were undertaken for its control and eradication. In the meantime, numerous animals had been sold from the infected area and widely disseminated over the country in a manner which made it impracticable to effectively trace them to their ultimate destination. When the importance of the malady became recognized it was promptly placed under control and was so completely eradicated that up to the

present time, a period of twenty years, it has not reappeared in that territory.

Since that time the affection has been recognized in Nebraska, South Dakota, and in the province of Alberta, Canada. In these areas of infection the disease has not been definitely traced to its source. The outbreak in Illinois was believed to have been introduced by stallions imported from France, a conclusion which, although unproven, time has not served to change. The affected area in Illinois produced considerable numbers of grade draft stallions and mares, which were sold to go to the West and Northwest for breeding purposes, and, although it cannot be clearly shown, there is good reason to conclude that this outbreak furnished the infection for the others which have occurred in America.

It has now become so widely disseminated, its eradication from among range animals is so uncertain, and the possibility of fresh importation so apparent, that the malady is of great importance to the horse breeding industry of America, since it may, possibly, manifest itself at any time in any breeding district. These facts render it important that veterinary practitioners, in horse breeding districts, should be on the alert and ready to recognize the disease in the early stages of an outbreak, ere it gains a wide distribution and its eradication is rendered difficult and uncertain.

Nature. Dourine is a highly infectious venereal disease transmitted naturally by coition only. Experimentally, it may be transmitted by innoculation and to other animals than solipeds. It is due to a protozoan parasite belonging to the trypanosoma group. This parasite, the *trypanosomum equiperdum*, was discovered by Rouget in 1896 and its relation to the disease clearly demonstrated by Schneider and Buffard in 1899. The trypanosome of Dourine is a one-celled organism provided with a flagellum at the anterior end. It is about 18 to 26 microns in length and, when observed in the living state, is highly motile. It occurs in the blood, spinal fluid, the discharges from the genital organs, in the plaques of the skin and perhaps in other tissues and fluids of the infected animal. It multiplies by longitudinal division. When removed from an animal and kept moist, it will live for several days or even a week.

It is not always easily found. It is said to be most readily dis-

covered in recently formed plaques. Baldrey says, in reference to the appearance of the trypanosoma in the fresh plaques, "If these appear, then a positive diagnosis can be made ; if not, the case is not Dourine." The parasites are said to disappear quickly from these plaques, so that it is dificult or impossible to find them after twenty-four hours. They may be found in the discharges from the vagina or urethra of the infected animal, but it seems that their existence here is not so uniform as in the fresh plaques. Some investigators believe that they are quite uniformly present in the spinal fluid. It is frequently very difficult to discover them in the blood.

This parasite constitutes an exception to the general rule in the trypanosomic group of diseases, in that it is not transmitted from animal to animal by the bite of an insect. For laboratory uses it is generally cultivated in dogs.

Symptoms. The period of incubation following natural infection is not definitely determined and varies considerably in different cases. Generally there appear some physical signs of disease in from eight to ten days after exposure, but these may not be very marked and may pass unnoticed by an inexperienced observer.

The symptoms of the disease may be divided into three important groups ; the local lesions of the genital organs and the contiguous parts ; those of the skin and other mucous membranes than that of the genital organs ; and the symptoms which emanate from the central nervous system.

The local symptoms in the genital organs are the first to appear after infection and usually the last to disappear in case of recovery.

In the stallion there usually appears after eight or ten days, subsequent to infection, a swelling of the penis and prepuce, with some degree of protrusion of the penis from the sheath, still covered by the prepuce. The prepuce shows a tense, elastic swelling and has a smooth, glistening appearance. If the uretha is exposed to view, its meatus will be found swollen, dark red and intensely injected. From it exudes a small amount of a thin, dirty, muco-purulent discharge. As the disease progresses, the tumefaction of the prepuce and penis increases and extends to the sheath and scrotum, which may eventually become enormously swollen and remain in an indurated condition for one to

two years or more. The animal gradually becomes less able to retain the penis in its position, and the swollen organ protrudes farther and farther out of the sheath, sometimes extending entirely out of the prepuce and hanging flaccid and fully exposed. The discharge from the urethra may become somewhat ichorous and, with the general, soiled condition of the penis and surrounding parts, may lead to ulcerations or erosions upon these. Later in the course of the disease, the weakened condition of the tissues of the part may lead to purulent infection and the forma-

FIG. 7. DOURINE.

Arab pony at beginning of the second stage of the malady, showchiefly the enormously swollen sheath and penis and depressed aspect of the patient. (Baldrey.)

tion of abscesses in the sheath, scrotum and inguinal region. (See Figs. 7 and 8).

The testicles may undergo inflammation and swelling, which after a time may be followed by atrophy, and they may be pushed upward by the swelling or abscesses in the scrotum until they rest high up in the inguinal space, where they can not be readily felt. *No vesicles or pustules occur upon the genitals as an essential part of this disease*, but there occurs with considerable uniformity a depigmentation of the skin and covering of the penis so that it may largely lose its pigment and become white. This depigmentation begins upon the penis and may extend to the prepuce, sheath and scrotum. In studying this symptom, it is well to bear in mind that in gray horses and in those having white eyes, faces or feet it is quite common to observe an absence of pigment

FIG. 8. DOURINE IN FINAL STAGE.

English Thoroughbred stallion showing paralysis and edema of penis. (Baldrey.)

on the penis, but this is regular in outline, whereas in dourine the depigmentation spreads out in patches.

In the mare, about eight to ten days after infection there appears a well marked swelling of the lips of the vulva. The mucous membrane of the vulva and vagina is intensely injected and swollen and from the vulva there escapes a more or less profuse discharge of a mucous or muco-purulent character, which soils the tail and surrounding parts. The mare urinates frequently in small quantities, which causes pain, as indicated by straining, stamping with the feet and switching of the tail.

There seems to be an increased sexual excitement, which may be, to some degree, misleading, depending largely for its expression upon the frequent urination, rather than upon genuine sexual desire.

As the disease progresses, the volume of the discharge tends to increase, in some cases, assumes a dirty grayish character and may become fetid. The swelling of the vulva increases, the labiæ become much enlarged, are tense, elastic and glistening. Their margins stand somewhat apart, so that the vulva is partly open, especially at its lower commisure.

Within a few weeks, after the advent of the disease, there appears quite regularly, a characteristic loss of pigment in the skin of the vulva and the neighboring parts. This depigmentation begins along the margins of the vulva, without prior vesicular or pustular eruptions, as simple, white patches, and thence extends onward in irregular lines, or spots, until it may involve the entire vulva, perineum and anus. The white patch, or patches, have irregular borders and are of various shapes and sizes. They persist for several months, and, in case of the recovery of the animal, they tend, finally, to disappear; fading first at the periphery, while upon the margins of the vulvar lips they persist for six months or a year. (See Fig. 9).

Of even greater significance, are the changes which occur in the clitoris. Comparatively early in the course of the disease, this organ becomes swollen, and, the vulva being somewhat open at the inferior commissure, it becomes visible, ordinarily, without mechanically parting the labiæ. The secretion of sebum in the prepuce of the clitoris apparently ceases, and the swollen organ seems dry and glistening. Depigmentation of the clitoris and its prepuce occurs early and persists for one to two years

in those mares which apparently recover and is the last symptom, in our experience, to disappear. The swollen, depigmented clitoris, with gaping vulva, constitutes one of the most uniform and persistent symptoms of the malady, and gives to a young mare the appearance of extreme old age, in this part.

Following closely upon the first appearance of local lesions, within a few weeks after infection, there appear peculiar and pathognomonic cutaneous eruptions in the form of **placques**,

FIG. 9. DOURINE IN MARE.

Depigmented spots on labiæ vulvæ and extreme emaciation. (Hutyra and Marek.)

elliptical elevations or "talerflecke." These eruptions appear suddenly, largely about the flanks, neck, shoulders, sides and thighs as more or less circular elevations, one to several inches in diameter. The margins of these are very abrupt and stand up above the level of the healthy skin like the eruptions of urticaria, the hairs upon them being erect. They appear suddenly, not, usually, in great numbers, but only one to five or six at a time, remain a few days and disappear without leaving a mark, to be succeeded by a new crop. It is claimed that, in these placques, the trypanosomes are very abundant during the first stages of their existence, but as the eruptions grow old the parasites rapidly disappear from them.

It has been stated that these placques may cause intense itching and lead the animal to bite or rub the part and that they sometimes suppurate. None of these symptoms have been observed by us.

It is not uncommon to observe in the latter stages of the disease a more or less profuse discharge from the nostrils. This nasal discharge may in some cases be suggestive of glanders and superficial ulceration of the mucous membrane may rarely be present. These erosions, when present, have no specific character in appearance and suggest rather a necrosis of a greatly debilitated tissue as the result of an irritant applied externally. It must not be forgotten that glanders and dourine may coexist and that the latter would, naturally, greatly intensify the former.

The general debility or cachexia of the disease shows itself clearly in lesions of the skin. Any wound of the part heals tardily and, if the animal is so weak that it is recumbent a large part of its time, it suffers from extensive decubitis gangrene.

The symptoms, which are largely referable to the nervous system, appear at about the same time as the placques or not long afterward. The first and most pronounced of this group is usually a progressive paresis, which is chiefly observable in the hinder parts. At first there is an unsteady gait, the animal bringing the hind feet forward in a difficult and somewhat uncertain manner. There is a tendency to drag the toe along the ground or to strike it at the middle of the stride. When weight is placed upon the foot the toe is usually brought down first, with the fetlock flexed, and the heel is then lowered suddenly. While standing, there is a tendency for the fetlocks to be maintained in

a flexed position or somewhat knuckled over. This knuckling over, whether standing or during progression, is a rather common symptom in trypanosomic, if not protozoan diseases generally.

This imperfect control may appear in one or both hind limbs or may alternate between the two and is subject to great variation from day to day. Sometimes this partial paralysis is of a somewhat spasmodic nature, faintly resembling stringhalt. At times there may be swelling about an articulation and the animal may seem to be decidedly lame in the joint. As the disease advances, the paresis tends to increase until there is such complete paralysis that the animal is unable to rise when down. When the patient becomes unable to rise, a fatal termination usually occurs in the course of a few days to several weeks, largely hastened by the decubitis and the accompanying complications. In other cases, after being recumbent for days or having had to be assisted in rising for weeks, the animal improves and eventually recovers.

With, and even before, the advent of the paretic symptoms, there appears a very rapid emaciation, which is especially prominent in the posterior parts of the body. This emaciation is noticeable from the fact that it occurs in spite of a good appetite, and the allowance of abundant food with apparently good digestion. It seems that both the paralysis and emaciation are largely dependent upon changes taking place within the spinal cord and that these symptoms naturally become most marked in those portions of the body posterior to the locality in the cord where the chief destruction has occurred. The symptoms of the disturbances of the nervous system are not confined to any portion of the body, and there is frequently observed a paralysis of an ear or eyelid or of the lips or nose. In the stallion there is frequently a well marked change in the voice so that he can not whinny naturally.

The sexual desire may remain unaffected throughout the disease, and, in many stallions, the power to copulate is but little impaired, but in the earlier stages, during the tumefaction of the prepuce and penis, either from excessive erection or other cause, the stallion fails in many cases, to effect coition, and, late in the course of disease, the same inability may arise from loss of power in the penis or from extreme paralysis of the posterior parts.

The effect of the disease upon the powers of reproduction is very profound. In the earlier stages, the stallion may be capable of impregnating mares and, failing to infect them with the disease, they may give birth to healthy foals. As the disease progresses, while the stallion may still be capable of copulating, he is usually sterile. The mare which becomes infected does not, generally, conceive, or, if so, aborts so early that the conception is not observed. In the Illinois outbreak, it could not be determined that a living foal had been born among 100 diseased mares. Some writers claim that, occasionally, a diseased mare will produce a living foal.

Recovery may, and does, occur even after extreme emaciation, and when paralysis has been so complete that the animal could not rise without assistance.

The duration of the disease may extend from three months to as many or more years, and recovery, either apparent or real, take place at any intervening time.

Pathological Anatomy. In animals which have succumbed to the malady or been destroyed in its last stages, there is seen, quite uniformly, an evident degree of anaemia and emaciation. Distributed throughout nearly every tissue in the body, there is found a characteristic yellowish exudate of gelatinoid appearance, especially abundant in the subcutaneous and intermuscular connective tissue, in the mesentery, and all parts rich in connective tissue. Nearly every organ of the body partakes of the general yellowish tinge. The muscles, especially those of the thigh and croup, are pale and soft.

The intestines are pale, and, in some cases, show signs of previous inflammation on their peritoneal surface. The mesentery presents a pale saffron color, thickened by a gelatinous exudate. The mesenteric lymphatics are enlarged, pale yellow and friable. The spleen is pale, small, shriveled, tough and hard. The liver is soft and filled with dark blood. The kidneys are usually found somewhat enlarged, very pale and edematous.

The genital organs fail to exhibit the extraordinary changes one would naturally expect to find.

Autopsies made by us on several stallions, all diseased for one and one-half to over two years, showed the general conditions above indicated, while, in addition, in some cases the genitals showed marked changes and, in others, there were only very

slight deviations from the normal. One very bad case, an imported French draft stallion, showed very great enlargement of the scrotum, which was hard and unyielding to the touch. The skin of the scrotum was enormously thickened and of a pale yellow color. The inguinal glands of the right side were the seat of an extensive abscess, opening at the upper part of the scrotum. A large abscess, occupying the usual position of the testicle, was filled with dark yellow, hard, cheesy pus, which had pushed the gland from its place up into the inguinal canal. The testicle was small, atrophied, soft, flabby and pale yellow in color, with the serous covering firmly adherent at every part. The surface of the penis offered no evidence of disease. The urethra contained a small amount of a dirty, purulent secretion ; the lining membrane was rough, grayish-yellow in color, without any appearance of ulcers. The seminal vesicles and enlarged portions of vasa deferentia contained thin, grayish, purulent accumulations. The left testicle was normal in size, with coverings firmly adherent at every part. No appearance of ulcers was found in the urethra or upon the penis of either of the several stallions examined.

Investigators have observed inconstant changes in the nervous system, principally of injection of the coverings of the brain and spinal cord, softening of the lower part of the cord and occasional extravasation of fluid into the ventricles of the brain. Thanhoffer describes extensive degeneration of the nuclei of the nerve cells in the spinal cord. The nasal mucous membrane usually shows catarrhal inflammation.

Differential Diagnosis. Few contagious diseases of animals have been so confusedly described by veterinary writers. At first there was a very general confusion between *Dourine* and *Genital Horse Pox*, a condition which still continues in many descriptions of the malady.

According to our observations, the most reliable local symptoms for the diognosis of Dourine in the stallion consists of the doughy, elastic swelling of the prepuce, with varying degrees of penial paralysis, the penis hanging somewhat out of its sheath, usually retained within the prepuce. The urethral opening is usually inflamed and, from it, a slight discharge escapes, but there is nothing visible to the naked eye to mark this as differing from lesions of these parts due to other causes.

Later a depigmentation of the penis and prepuce may occur, not in small circular spots, as in genital horse pox, but in large, irregular patches, which gradually spread from the periphery. In the mare, the most important local symptoms for purposes of diagnosis consist of the doughy, edematous swelling of the vulvar lips, the enlargement of the clitoris, the gaping of the vulva at its inferior commissure and the depigmentation of the clitoris, and its prepuce, and of the skin of the vulva, perineum and anus.

Once it is decided that an equine venereal disease exists in a stud, the presence or absence of specific pustules or vesicles may serve largely to differentiate between the two maladies.

Eruptions upon the external genitals may, of course, occur in Dourine, but those writers who have mentioned them uniformly fail to describe them in a manner to enable one to differentiate those of Dourine from those of Genital Horse Pox, and, as a rule, it might well be suspected that such descriptions are based upon diagnostic error. In some cases, doubtless, erosions or ulcers have appeared as the result of irritation from ichorous discharges or from the accumulations of filth about the genitals, accompanied by low vitality in the cutaneous tissues ; but such eruptions are devoid of diagnostic value, their relation to the disease, so far as we know, being quite secondary.

Specific eruptions of vesicles or pustules upon the genitals do not occur. When abundant and specific eruptions occur on the genitals of the horse, they indicate Genital Horse Pox, not Dourine.

Dourine and Genital Horse Pox may readily coexist and thus add confusion in diagnosis.

In the outbreak of Dourine in Illinois in 1886–7, we were in great doubt for a time as to our diagnosis in the case of a young stallion showing abundant pustules and vesicles on the penis, prepuce and sheath. The urethral meatus was inflamed, dark livid in color ; from it there was a thin grayish discharge ; the prepuce and sheath were swollen. Though the animal was within the zone of infection, no exposure could be traced. He transmitted Dourine to no mares, and recovered completely and permanently in a few days. Had it been possible to connect him in any way with the outbreak, it would have been difficult to attribute the eruptions to anything but Dourine, and, had he been actually affected with that malady, we have no reason to believe that it would have prevented his becoming simultaneously in-

fected with the far more common Genital Horse Pox. In the table on page 88 this animal is designated as No. XI.

Some writers, in describing Dourine, accept the presence of depigmented areas about the vulva and anus as conclusive evidence of precedent ulceration, but depigmentation of the skin does not necessarily follow vesicular or pustular eruptions nor does its presence indicate that eruptions have occurred. We had excellent opportunity for observing, day by day and week by week, the depigmentation of the skin of the vulva and anus in Dourine and saw it begin and gradually spread, without the presence of any visible vesicles, papules or ulcers. It was a depigmentation without ulceration.

Fleming, (Veterinary Sanitary Science and Police); Williams, (Principles and Practice of Veterinary Medicine); Law, (Veterinary Medicine); Moore, (Pathology and Diagnosis of Infectious Diseases) and numerous other writers place emphasis upon the presence of specific eruptions in Dourine, but fail to describe their characters, and do not intimate that they have personally observed them. The only definite assertion by any author, so far as we have been able to find, that he has personally observed ulcers, papules or vesicles is that of Thanhoffer, who records instances of mares with eruptions about the perineum and inside the thighs and presents illustrations of cases; but there is nothing in their character of diagnostic value and it does not appear that the diagnosis in these cases was verified.

In the extensive Illinois outbreak, which was under our personal charge, among more than 100 cases of the disease, not an instance of eruptions was observed nor could the most diligent inquiry among owners reveal any history of such in any animal. In this outbreak, the cases were observed daily for some months, and we were especially careful to search for these eruptions in recent and old cases because, relying upon the descriptions of various writers, we expected to find them, and were disappointed and confused when we did not.

European writers are generally inexact in reference to vesicular and pustular eruptions and white spots upon the genital organs. One of the first writers to point out the distinction between Dourine and the Genital Horse Pox and to assert that the former was without eruptions, was Rodloff. Baldrey, after an

extensive experience with the malady in India, fails to record the occurrence of vesicles and pustules.

In the United States of America, there have occurred approximately 300 cases of the disease, and so far as we can determine, no vesicles or pustules have been observed in any instance. Hutyra and Marek describe eruptions but, on page 464 of their Spezielle Pathologie und Therapie, they present the illustration, (Fig. 9), of a mare with depigmentation about the vulva, which they attribute to prior ulceration, but they do not illustrate any of these ulcers and the appearances in the picture are identical with the depigmented spots observed in America, which occurred without the prior existence of vesicles, pustules, ulcers or other visible destructive processes in the epithelial surface of the skin.

In the Jahresbericht for 1902, de Does is quoted as having observed the depigmentation of the skin of the external genitals without precedent vesicles or pustules and regarded this loss of pigment as a marked symptom of the affection.

It seems to us that the apparent differences in observation and view in reference to vesicles, pustules and loss of pigment is due to the constant confusion of the two wholly distinct venereal diseases and to accepting the erroneous conclusion that depigmentation indicates prior pustular or vesicular eruptions.

It should be further remarked in reference to the alleged occurrence of eruptions that the character of the micro-organisms said to cause the disease is contradictory to the appearance of such lesions. Trypanosoma, in general, have little or no tendency to produce eruptions or suppuration, and it would seem unique to expect that, in this one disease, alone, of this great group, there should occur characteristic vesicles or pustules.

The elliptical swellings or "talerflecke" in the skin of the flanks, hips and other parts of the body have long held a high place in diagnostic value, but they do not always exist.

In the Illinois outbreak, the enlarged and pigmentless clitoris constituted a noteworthy and highly diagnostic symptom in the mare, persisting for at least two years after all other physical signs of the malady had disappeared.

The paresis of Dourine is fairly characteristic; accompanied by other lesions and symptoms it is pathognomic, while the peculiar jerky movements in the hind limbs during progression,

and the knuckling over at the hind pasterns are rarely seen in other forms of disease.

In addition, there is the clinical history of infection by coition, along with the malignancy of the malady.

Finally, the finding of the *trypanosomum equiperdum* in the blood of the animal serves to definitely establish the diagnosis. In many cases it seems to be very difficult to find the parasite in the blood of the animal and, consequently, this proof of the character of the disease is not always readily produced.

The Mortality from Dourine is very great and the loss amounts, upon the whole, to far more than the total value of the diseased animals. When it has once become widely disseminated in a breeding district, it practically ruins the industry for a time because its character is so insidious that it is exceedingly difficult to trace in it all its ramifications. The mortality among the affected animals reaches 60 to 80 %, which places it among the most fatal of infectious diseases. Those which recover do so very slowly and the time consumed before they are again fit for work is so great that it almost destroys their value. We have no data to show that an animal once affected can ever be bred again with safety, however completely they may have apparently recovered or how long a period may have elapsed.

The tabulated list on next page of affected stallions in the Illinois outbreak, copied from the author's report upon the disease, is of interest, as showing the transmissibility and mortality of the malady.

Control and Eradication. There is no specific treatment known for the disease and, at present, the most that can be done is the securing of rest with favorable food and environment. Complications may be handled according to circumstances. Some investigators have obtained apparently favorable results from the administration of arsenic and other antiseptics but there is no definite evidence of specific action of these, though they are worthy of trial. In the Illinois outbreak, some animals recovered their general health after having been so completely paralyzed that they constantly required assistance, for several weeks, in getting up. As a general rule, however, animals which become so weak and paralytic as to be unable to get up when down, soon succumb to the disease.

LIST OF DISEASED AND QUARANTINED STALLIONS, IN THE ILLINOIS OUTBREAK, WITH NUMBER OF MARES SERVED AFTER EARLIEST SUPPOSED EXPOSURE. Latin numerals refer to mares, Roman to males.

No.	Owners.	Post Office Address.	Breed.	Condition at Date of Quarantine	When Exposed.	To What Mare Exposed.	When Quarantined.	No. of Mares Served	No. of Mares Affected	Percentage of Mares Affected	No. of Mares Dead.	Percentage of Mares Dead.
I & II	Harrold & Culbertson	Wapella, Ill.	French dft	Affected	1884–6	377, 378 (1)	July 25, 1887					
III-VI	" "	"	"	"	1886	"	" 21, "	177	36	$20\frac{2}{3}$	29	$80\frac{5}{6}$
VII	" "	"	Grade	"	"	"	" 21, "					
VIII	W. R. Carle	"	French dft	"	'	Unknown	" 22, "	9	2	22	2	100
IX	Geo. Halsey	"	Grade Fch draft	A'par'ntly well	1887	145 (2)	" 15, "	1	-			
X	Smith & Ledden	"	French dft	"	"	5, 131, 142 (3)						
XI (9)						356, etc.	Aug. 5, "	(47)				
XII	Foley & Seniff	Wapella, Ill.	French dft	Affected	1884–6	377, 378 (1)	July 27, "					
XIII	" "	"	"	"	"	'	" 27, "					
III	" "	"	"	"	"	"	" 27, "	106	44	$41\frac{1}{2}$	28	61
XIV	Jos. Fischer	Clinton, Ill.	"	"	1887	Unknown	" 19 "					
XV	"	"	"	Affected	?	?	" 19, "		1			
XVI	"	"	"	Ap'par'ntly well	1887	Mares from XIV & XV	" 19, "	48	2	$6\frac{1}{2}$	?	?
XVII	Simpson, Franklin & Co.	"	"	Affected	1886	186, 187 (5)	Aug. 18, "	33	1	3		
XVIII	Lisenby & McNamara	Fresno, Cal.	Grade Fch draft	Affected	"	164	Not q'ru't'd	123				
				Total	mares			396	86	$21\frac{2}{3}$	59	$68\frac{2}{3}$
				(10) Total	stallions			* 17	† 14		§ 12	
				Total	animals			413	100		71	

Remarks—I, died Sept. 16, 1887. II, III–VI, VII, killed Oct. 19, 1887. VIII, died July 28, 1887. IX, castrated 1888. X, released from quarantine, Mar., 1888 XII and XIII, killed Sept. 20, 1887. XIV, XV, in quarantine. XVI, died 1887, from the effects of castration XVII, killed Nov. 30, 1887 XVIII, last heard from at Fresno, Cal.; still affected and under no restrictions.

(1) See foregoing report, under Origin in DeWitt County. (2) Became affected 1886, by being bred to I–VI. (3) Exposed 1886, but not diseased. (4) Exposed and diseased, autumn 1885 by XII and XIII. (5) Bred to and infected by XII and XIV, early in 1886, and bred late in 1886 to XVIII; probably served no mares after 164. (9) Had served a mare which had been bred to a stallion affected with *Dourine*, did not contract this disease but later became affected with *Genital Horse Pox*, was temporarily quarantined, recovered promptly and remained well. (10) From this total XI is omitted. * Exposed. † Affected. § Dead or killed since quarantine.

The plan of control adopted in the outbreak in Illinois was to make a rigid inspection of every breeding stallion within the infected zone and in the adjoining territory and to keep them under constant observation. In the case of each stallion which showed symptoms of the disease or which had served a diseased mare or a mare which had later become diseased without other known exposure, his breeding record was examined in detail and each mare which had been bred to him was placed under quarantine and subjected to repeated observation. All animals which were found diseased were either destroyed and the owners compensated, or they were placed under a strict quarantine for life, by the terms of which they were allowed to be worked, but not to be bred, sold or exchanged.

Under these conditions, almost all the affected mares were killed and the few remaining ones were closely watched. The affected stallions were all destroyed. The mares which had been exposed to the disease, but had not become affected, were kept under quarantine for a year or more and subjected to rigid inspection from time to time and were finally released when it seemed perfectly clear that they were not, and had not been, diseased. The effect of these measures has been highly satisfactory and no recurrence of the disease has come to light during the twenty years which have elapsed since the outbreak. At that date the *trypanosomum equiperdum* was unknown and its presence or absence could not enter into the question of diagnosis or control, physical symptoms alone being relied upon.

Upon one occasion, during the early stages of control work, the owner of a stallion, who doubted the diseased condition of his animal, clandestinely permitted him to serve a mare, which became infected. The destruction of all affected stallions shortly thereafter put a stop to such accidents.

It is of primary importance in all outbreaks of the disease to provide early for the entire cessation of breeding, or, we might more strictly say, of copulation or attempts at copulation between animals. In this respect, it is important that colts which are reaching the breeding age should be properly castrated or otherwise made secure. Stallions of breeding age, which have become affected, should be destroyed promptly, or placed under safe quarantine, since they constitute the greatest source of danger. Destruction of the affected animal is highly important, since in

many cases the owner is not fully convinced of the dangers from the disease and may carelessly violate any quarantine regulations imposed.

There is the additional danger that employees of the owner, or others, may violate the quarantine without his knowledge or consent, and thereby start the disease anew in a way which may be exceedingly confusing, or might work serious injustice to the owners of healthy stallions. The feeling between competing stallion owners in a community is not always of the best, and they may seek to do a rival a very great injury.

The castration of stallions does not insure inability to spread the disease. It is a well known fact that such castrated animals, which have previously been used for breeding purposes, will continue to copulate with mares which are in estrum and may, thereby, spread the disease. It has been recorded that geldings have contracted the malady and it is perfectly reasonable to suppose that the accident occurred in this manner. The castration of stallions is, consequently, not wholly safe and, if it is at all allowed, it should be accompanied by other safeguards which would prevent any accident. If such stallions are removed from breeding areas to city stables, where they are put to work, in case they have sufficiently recovered, they may cease to be dangerous so long as they are under reasonable supervision.

The castration of mares has not been largely applied to the control of this disease, but may prove of important police value. If a mare has been exposed, but apparently not infected, there may still linger a question of her safety, even though she has not shown symptoms of the disease and, unless she is highly valuable for breeding purposes, it may be better, in some cases, to completely exclude her from breeding by causing her castration. Since this operation is comparatively safe upon the mare and is readily carried out by an ordinary operator, it might well be largely employed in these outbreaks, and the animal then put to work.

Diseased mares should, in the present state of our knowledge, be destroyed. They occasionally recover their general health and ability for work but, as already stated, we have no data to show that such mares ever become entirely safe as breeding animals and the danger to the horse breeding industry, as compared o the small value of the few apparently recovered mares, is so

overwhelming that it would seem poor policy to take the risk of a violation of quarantine regulations and the breeding of these animals by the owners. In the Illinois outbreak the opposite course was pursued and a small number of mares was allowed to live and used for work purposes under strict quarantine against breeding or disposal. Though the plan has not been followed by any disaster, it was unsafe and necessitated prolonged vigilance.

In the community where they were, however, each neighbor knew the history of each of these previously diseased mares and would probably have reported any open violation of the quarantine very promptly. It is needless to say that careful watch should be kept over the breeding animals, especially the stallions, in the infected area for several years and prompt and rigid investigations made upon the slightest suspicion of a recurrence of the malady.

2. GENITAL HORSE POX. COÏTAL EXANTHEM

Eruptive Venereal Disease of the Horse.

Genital Horse Pox is a highly contagious disease, which, under ordinary conditions, is transmitted by coition only and consists of a local infection of the genital organs. It is far more readily transmitted than Dourine and has a shorter period of incubation.

Symptoms After a period of two to five days subsequent to exposure, there appears in the mare an inflammation of the mucous membrane of the vulva and vagina, in which there arise small reddish papules, which soon become vesicular or pustular and rupture, leaving small erosions on the mucosa. From the vulva, there occurs a more or less copious, muco-purulent discharge, which soils the tail and neighboring parts. Urination is somewhat frequent and the contact of the urine with the denuded mucosa irritates that membrane and causes straining.

At the same time, similar eruptions, appear upon the externa surface of the vulva, anus, perineum and surrounding parts. They behave somewhat similarly to the eruptions within the vulva and vagina. At first, a small papule arises in the skin, which soon becomes vesicular and this, in turn, pustular and assumes a yellowish-white color; these mature quickly and soon rupture, to be followed by tough, yellow scabs, ⅛ to ¼ inch in diameter. After a few days, the crusts drop off and leave behind white scars very slightly depressed. These depigmented spots are circular in form and, in very severe cases, may coalesce somewhat. They tend, however, to remain distinct circular spots. The pigment returns after two or three weeks and no visible scar remains. The vesicles appear in continuous crops over a period of one to three weeks, so that, at a given examination, there may be eruptions in every stage.

Accompanying these eruptions, there is swelling of the vulva, with some tenderness of the parts. Some writers have described also a prurigo or intense itching of the parts, causing the animal to violently rub the tail and vulva. Although we have personally observed a number of outbreaks, we have not seen this symptom in any case. Neither have we been able to find in the literature upon the subject any case where such a symptom has been recorded as a personal observation.

In the stallion, the symptoms are virtually parallel. Eruptions, of the same character as described upon the vulva and anus of the mare, appear upon the penis, prepuce and sheath of the horse. The opening of the urethra is swollen and congested and from it there is a muco-purulent discharge. There is some swelling of the prepuce and possibly, to a less degree, of the penis. Ordinarily, there are no constitutional symptoms in either animal, there is no loss of appetite nor appreciable emaciation and the general condition of the animal remains undisturbed. In one case observed by us, there remained a year afterward an extensive chronic inflammation of the vagina and bladder, which virtually ruined the animal. In this case, the mucous membrane of the vulva and vagina was greatly thickened, corrugated, sensitive and bled easily upon touch. The bladder was highly inflamed, its mucosa greatly thickened, the urinary salts were deposited over its inner surface and its cavity was largely obliterated. The meatus urinarius was open and the urine dribbed away involuntarily, so that the tail and thighs were kept constantly befouled and presented a very repulsive appearance.

The course of the disease is usually mild and brief. Most cases recover spontaneously in from two to three weeks and, under proper handling, recovery is hastened and rendered increasingly certain.

The nature of the disease is not precisely known. A given outbreak is not usually traceable to any definite source of origin, but seems to become established in a community without having been imported by a diseased animal. Once it becomes established, almost every mare bred to an affected stallion contracts the disease with great uniformity. Presumably, it is just as transmissible to the stallion, but this is not so often observed, since the mares are not usually bred to different males during the same season. Experiments have shown that the vesicles and pustules contain the element of contagion in a virulent form.

Handling. The handling of the disease depends essentially upon disinfection and a temporary cessation of breeding. Any disinfectant will answer the purpose, but it should not be highly irritant, since the parts involved are very sensitive.

The handling of the stallion is most urgent so that he may resume service as promptly and safely as possible. From our experience we have come to prefer an antiseptic wash composed

of about 1 ounce of carbolic acid with 2 ounces of tannin and 6 ounces of glycerine in 1 gallon of warm water. After washing the penis and prepuce thoroughly with soap and water, this solution is applied freely twice daily and a quantity of it is injected up the urethra until it is supposed to reach nearly to the bladder.

The extent of disease in the urethra has not been investigated. We only know that there is a urethral inflammation and discharge and that it is infective. The mere washing of the penis and prepuce cannot, therefore, bring about effective disinfection, but the urethra needs be included. The urethral injection is best made by means of a rubber bulb syringe or a gravity irrigating apparatus. The syringe or irrigator nozzle is inserted into the urethral opening and retained there while the antiseptic solution is forced upward as far as is deemed necessary. Should some of the fluid reach the bladder, it will not prove dangerous but it would be well not to overfill the urethral passage at first so that the infective discharges may be largely expelled before taking the risk of forcing them up into the bladder by an excess of the solution. The external ulcers resulting from the pustules may be touched lightly with stick nitrate of silver. The animal needs be kept as free as possible from sexual excitement, but should be allowed gentle exercise, along with a restricted, laxative diet. The stallion may be returned to the stud as soon as all evidences of disease have disappeared but, for a time, it might be advisable to continue the disinfection, especially after each service.

The handling of the mare should be along the same general line and should be persevered in until all symptoms have disappeared. As a general rule, she will recover sufficiently during the interval between two estrual periods that she may again be bred at the first return of estrum since the contraction of the disease, should she not prove to be in foal.

The differentiation of this affection from Dourine is highly important, but has already been discussed on page 83.

There is little need for police control of this disease, since its symptoms are so prominent that laymen promptly note it and voluntarily withdraw the affected animal from breeding until recovery has occurred. Should there at any time be a negligent tendency shown, the affected animals should be promptly quarantined until all danger has passed.

VENEREAL DISEASES OF CATTLE

1. Vesicular Exanthem. Aphthous Venereal Disease.

The vesicular venereal disease of cattle is one of the most common and wide-spread of the entire group of venereal diseases of animals. It is a highly contagious malady, transmitted ordinarily by copulation.

The Symptoms are very similar to those of the Genital Horse Pox, already described. The first evidence of the disease in the cow is an intense vaginitis, in which the mucous membrane of the vulva and vagina become greatly injected and swollen, soon followed by dark red points or petechiæ, which quickly develop into vesicles of very small size. These are at first transparent, but may later become pustular, although they largely rupture while yet in the vesicular stage. From these, very shallow ulcers result and give rise to a muco-purulent discharge, which collects upon the tail and neighboring parts in the form of dry crusts.

In severe cases, the ulcers may acquire considerable depth, with irregular borders, and, in healing, may temporarily leave a stellate scar, though there is usually no prominent mark. In any case, they tend to develop completely in a short time. The cow expresses pain and irritation by stepping to and fro with the hind feet and by movements of the tail. The act of urination is painful and causes straining because of the irritant effect of the urine upon the denuded mucous membrane. In some instances there seems to be an excessive estrum.

When very severe, the cow may show some difficulty in moving, owing to the tenderness of the inflamed organs. Manipulations of the swollen vulva cause very evident pain and the inflamed mucous membrane bleeds very readily. The discharge from the vulva is somewhat parallel to the degree of ulceration in the vulva and vagina. If excessive, it may become irritant and cause excoriation of the parts with which it comes in contact. In very severe cases, patches of the mucosa may become necrotic and slough away.

The infection may or may not prevent impregnation and, when affecting a pregnant cow, it rarely causes abortion. The general

functions of the animal are not usually affected, the temperature and appetite remaining very nearly or quite normal. The affection may lead to chronic catarrh of the vagina; or it may result in adhesions between the walls of the vagina, more or less completely closing that canal.

In the bull, the penis and sheath are inflamed, swollen and tender. Eruptions of the same character as we have described in the cow appear also upon the penis, first as papules, which develop into vesicles, to be followed by ulcers. The urethra is similarly involved, as expressed by a muco-purulent discharge. This is further shown by the urine being frequently voided in small amounts, with appearances of pain. The swelling of the penis and its sheath tends to produce phimosis.

Erection of the penis causes bleeding and this is especially evident immediately after copulation. Kampmann records a case of extensive necrosis of the penis with a permanent deformity. The duration of the disease is usually brief and generally ends in spontaneous recovery in from one to four weeks. An outbreak in a stable may continue for a long time by being transmitted first to one and then to another animal. One attack apparently confers little or no immunity and, when an animal has almost recovered, the disease may be renewed through copulation.

This affection should be differentiated from the granular venereal disease of cattle. In the latter, vesicles and pustules are absent throughout and it runs a far more chronic and virulent course. We find no record of the latter affection in America, while the vesicular venereal disease is widely distributed.

The prognosis is highly favorable and it is only rarely that material loss follows.

The control of the disease must rest fundamentally upon the isolation of the affected animals. It is highly essential that the two sexes should be kept entirely apart. Even steers should not be allowed in an enclosure with cows, because they sometimes attempt copulation and may thereby serve to transmit the disease. A diseased cow should not be permitted to stand in close proximity to healthy ones because the infection may be transmitted from one animal to the other through the medium of the tail, by soiled bedding or other means. Affected animals should on no account be bred until they have fully recovered.

Thorough disinfection of the stalls and of the diseased and soiled parts of the animals contributes materially to the control of an outbreak and the shortening of its duration.

The treatment consists of the disinfection of the copulatory organs and those parts which become soiled from the discharges. The choice of a disinfectant is not of essential importance. Thorough mechanical cleansing by washing constitutes a highly important part of the handling. The disinfectants used should constantly be of such a character as to cause little irriation to the highly sensitive parts. One of the chief dangers to be anticipated is adhesions between contiguous mucous surfaces of the vagina or of the sheath of the penis. If the walls of the vagina or vulva adhere, because of the denudation of epithelium, breeding may be prevented, owing to the narrowing of the canal to such an extent that copulation cannot occur. In the bull, the penis may become adherent to the sheath so that it cannot be protruded, and coition thus be prevented.

Such untoward results may be best anticipated, and recovery hastened and assured, by douching thoroughly with such mild disinfestants as ½% solution of carbolic acid, 1% alum solution or .1% permanganate of potash, repeated twice daily. The solution should be used at about the body temperature and introduced into the vagina or sheath by means of an irrigator, until the cavity is well distended, when it should be allowed to escape. Should the patient give indications, by straining, that the douche is painful, it should be reduced in strength until it is well borne.

2. Granular Venereal Disease of Cattle. Infectious Vaginal Catarrh. Vaginitis Verrucosa

Bibliography: Zschokke, Die Unfruchtbarkeit des Rindes; Hutyra und Marek, Spezielle Pathologie und Therapie; Hess, Schweitzer Archives f. Tierheilkunde, Band XLVIII, S. 351; Thoms, Monatshefte fur Praktische Tierheilkunde, B. XVII, S. 193.

In many portions of continental Europe there exists a widely spread and highly contagious venereal disease of cattle, which causes very serious losses in dairies. So far as known, it is purely venereal, transmitted clinically, generally, if not always, by coition, though capable of being transferred by other means.

We have seen no record of its existence in America, but its wide dissemination in Europe, the chronic and somewhat insidious course of the disease, which may render it difficult of detection at ports of entry, render it possible of importation. The want of any record of its presence, in this country, is not final proof of its non-existence, as it may be confused with the far less serious eruptive venereal disorder described in the preceding chapter.

The malady has been recognized for twenty years and has been observed and described by numerous veterinary authors in Switzerland, Germany, Italy, Denmark, Austria and other countries, from some of which America imports large numbers of dairy cattle.

While not of importance, as related to the life of the affected animal, it becomes in other respects a very serious malady as affecting the dairying interests. It is highly contagious, involving, in the infected zones, as high as 80 to 90% or even more of the total number of cows. Hutyra und Marek, citing Mueller, states that in East Prussia alone the disease involved 30,000 dairy cows, while, in Switzerland and other countries, it has acquired a similarly extensive dissemination.

It is a fertile cause of enzootic abortion. Thoms states that more than 50% of cows affected abort. In one outbreak, involving 300 cows, about 70% aborted ; in another group of 296 cows there were 48 live calves. After the malady has prevailed in a dairy herd, a large proportion of cows become sterile. partly because of cystic ovaries, accompanied by nymphomania. In fact, this malady appears to be one of the common exciting causes of nymphomania with ovarian cysts. It may also lead to sterility in other ways.

During the course of the malady and as a result of the direct irritation from the abortion and other interruptions, there is a great loss of milk. Thoms estimates the average losses upon each cow at 30 M. ($7.·0). According to those authors who have had extensive experience with the malady, it deserves to rank amongst the most serious of dairy plagues.

Etiology. According to Ostertag and Hecker, the affection is due to a streptococcus consisting of 6–9 cocci, which are held together by a delicate capsule.

In artificial cultures, either alkaline or acid, and at the body or room temperature, the organism grows vigorously. It does not liquefy coagulated blood serum or gelatin nor coagulate milk. It forms neither gas nor indol.

The disease is readily induced in healthly cows by vaginal inoculation with pure cultures or by discharges from the vagina of a diseased animal.

Attempts at experimental transmission to other species of animals have resulted negatively.

Naturally, the infection is transmitted almost wholly by copulation, an affected bull infecting almost all the cows with which he copulates. A bull which has recently served a diseased cow may transmit the malady to a sound one without becoming diseased himself. Sometimes the transmission occurs through ordinary contact, without sexual intercourse. It may be accidentally transmitted to heifers or calves.

The streptococci, having gained the vagina, penetrate the mucosa and are found between the epithelial cells and deeply within the papillæ. The organisms have also been identified in nodules in the uterus, in the uterine mucosa and in the ovaries which have undergone cystic degeneration.

In this way, apparently, they cause the very frequent sterility, while the wide area of distribution of the organisms and their depth within the tissues render disinfection and cure a complex and difficult problem.

Symptoms. According to Ostertag, a vaginal catarrh becomes established within 2–3 days after artificial inoculation, while, by natural or coital infection, one or two more days elapse before the catarrh becomes apparent. Raebiger observed vaginitis and catarrh in 24 hours.

The first symptoms of the malady to be noted consist of swelling of the labiæ of the vulva and a diffused or streaked reddening and swelling of the vulvo-vaginal mucosa, with tenderness of the parts. The inflamed area is covered somewhat by a mucopurulent discharge.

A day or two later there develop in the vestibule of the vulva along the floor and sides about the clitoris numerous small nodules $\frac{1}{16}$ to $\frac{1}{8}$ inch in diameter, which are at first dark red, later becoming lighter in color. These nodules are smooth and of very

firm consistence and are somewhat regularly arranged in parallel rows, as shown in Fig. 10.

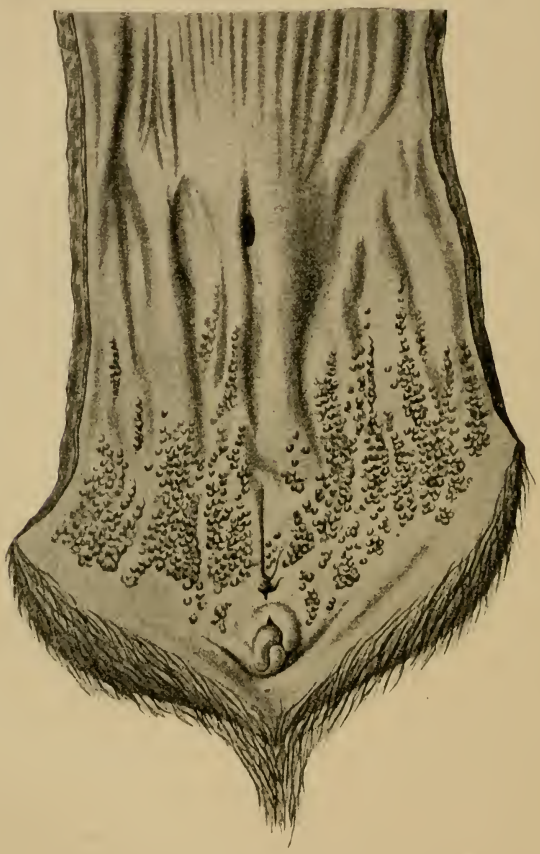

FIG. 10. INFECTIOUS GRANULAR VAGINITIS.

Mucosa of the vestibule after three months duration of the disease. (Hutyra and Marek, after Ostertag.)

The nodules consist essentially of hypertrophied papillary bodies. If the vulva is held open and reflected light thrown into the cavity, the nodules can be readily distinguished ; they are also readily recognizable by the sense of touch.

The mucous membrane is swollen, red and sensitive, bleeds easily upon manipulation and is covered by an inodorous mucous or muco-purulent secretion, which, flowing from the vulva, soils the labiæ, tail and adjacent parts, where it dries in brown crusts or, if in larger amounts, may flow from the vulva in long, ropy masses. The denudation of the mucosa renders it quite sensitive to the passage of urine over it, and the pain and irritation in the part tends to cause urination with abnormal frequency.

When the disease extends into the cavity of the gravid uterus, which appears to be almost the rule, abortion occurs, while, in the non-pregnant cow, nymphomania and sterility are common results.

The acute stage of the malady continues for 20 to 30 days, when the swelling and tenderness abate and the nodules lose their red color to become somewhat yellowish or grayish, perhaps somewhat transparent ; but the discharge and the granules persist for 90 to 100 days, or more.

Vesicles, pustules or ulcers do not ordinarily occur, though ulcers and phlegmon have been very rarely recorded. Bulls show a comparatively high resistance to the infection, and, though they constitute the chief vehicle for the contagion, apparently suffer slightly, if at all, in most cases.

When affected, they show analogous symptoms to those observed in the cow. The penis is studded over with nodules, like those of the vagina, which are easily seen when the organ is extruded. Erection, copulation or manipulation of the penis causes bleeding. There is a muco-purulent discharge from the sheath of the penis, which adheres to and soils the parts.

Treatment. The handling of the malady consists essentially of local disinfection, and, as in other localized infections, there should be a thoroughness in application conformable to the intricacy. We have stated above, that the cocci are found deeply insinuated between the epithelial cells, and yet deeper within the papillary bodies, that they may extend to the mucosa of the os uteri, to the oviducts and even to the ovaries. Safe recovery includes the successful destruction of the organisms in all

these organs and tissues. The disinfectants used must not be too irritant to the highly sensitive mucosa of the genital passages, since they induce straining, inflammation, adhesions and other disagreeable consequences. Disinfecting douches, ointments, powders and tampons have been commended, all having a common aim. Among douches there have been suggested 2 to 2½% solutions of lysol, creolin and similar drugs; .5% silver nitrate, .1% potassium permanganate, 5% ichthyol, etc. Likewise, with powders, a wide variation is available, such as zinc sulphate, alum, tannin and others, reduced by mixing with starch or other inert powder. In this group, we should also mention iodoform, because of its local anaesthetic action, its weight, which would cause it to drop into the depressions between the elevations of the mucosa, and its comparative insolubility, causing it to remain in position for 24 and more hours, presumably to be slowly converted into iodine. It has one very serious objection in the dairy, its odor, which is at all times liable to taint the milk. If it is to be used, great care should be taken in its application, some person other than the milker applying it, since his hands inevitably become somewhat saturated with the drug.

It may be best introduced by means of a gelatine capsule, to be later broken and the powder liberated. Other drugs, like lysol and creolin, require cautious handling in the dairy, to avoid the contamination of the milk. In the use of tampons, the vulvo-vaginal cavity may be packed with gauze or cotton saturated with a disinfectant. Usually animals resist the presence of a tampon in the vulva or vagina and tend to expel it.

Some experienced practitioners praise antiseptic ointments very highly. They may vary greatly in composition and consist of well nigh any disinfectant, incorporated with a heavy fat, like cocoa butter, wax or tallow. The latter is very cheap and may have added to it a little wax in order to give it the proper firmness. Along with the desired antiseptics, the mixture may be placed over a fire and brought to the melting point, when all ingredients are mixed, and, while still soft, may be molded into suppositories, say in form of a candle, about one-half to one inch thick by five to eight inches in length. Such suppositories are very readily introduced through the vulva, and, unless containing highly irritant antiseptics, are well borne by the patient.

Affected bulls are to be handled along the same general lines as described for cows.

The prophylaxis and control of the malady is highly important and, in a general way, demands the enforcement of the usual regulations for the control of contagious diseases. Of the first importance is sexual isolation ; coition must be prohibited until the disease has wholly disappeared in the two animals to be mated, not alone because a diseased animal will quite surely transmit it by copulating with a sound one, but because coition tends constantly to arouse the disease to new and increased activity. In addition there needs be general isolation of the diseased from the healthy, with thorough and efficient disinfection of the stalls and all portions of the stable.

In a suspected herd, the penis and sheath of the bull should be thoroughly disinfected by means of a reliable douche, both immediately before and after copulation. This is easily accomplished by placing a barrel or other container, filled with a reliable antiseptic, in a convenient elevated place, from which the fluid may flow by gravity, and attaching to it, by means of a faucet, a piece of rubber tubing 10 to 15 feet long, the free end of which may be inserted into the opening of the sheath and the cavity thoroughly douched. In regions where the malady exists or is suspected, efficient quarantine should be enforced against the entrance into the herd of diseased or suspected animals.

VENEREAL DISEASE OF THE DOG. VENEREAL GRANULAMOTA. LYMPHO-SARCOMA

In the dog, there is observed a specific venereal disease consisting of granulomata upon the genital mucosa. The disease is somewhat wide-spread in Great Britain and continental Europe. It is observed in various portions of the United States, largely in dogs recently imported. It seems most common in large cities. In the male it affects chiefly the penis and prepuce and sometimes invades the adjacent tissues. Metastatic disease of the inguinal glands may follow. In the female it involves primarily and chiefly the vulva. It is naturally transmitted by copulation only, but may be otherwise spread by artificial or accidental inoculation.

FIG. 11. INFECTIOUS VENEREAL GRANULOMA OF DOG. (C. A. White.)

Symptoms. The first symptom usually noted is a bloody discharge from the prepuce or vulva, accompanied by tumefaction of the parts. If the penis is exposed at this time, there are seen pink or grayish red vegetations, largely upon the glans or at the base of the penis where the penial mucosa passes over to the sheath or,

at times, upon other parts of the mucosa. These tumors are soft and friable and bleed freely upon being touched. They may be sessile or somewhat pedunculated, resembling warts. The affection is of a chronic character and seems to have no definite limitation, the vegetations continuing to increase in size month by month and

FIG. 12A. INFECTIOUS VENEREAL GRANULOMA OF BITCH. (C. A. White.)

finally become firm, lobulated masses, so intensely injected that they assume a dark color.

In the bitch, the symptoms are very similar. There is first a bloody discharge from the vulva. Examination of the vulva and vagina reveals vegetations of the same appearance as already noted in the male. These appear chiefly along the floor of the vulva and, when very large, may protrude externally. The discharge from the vulva is usually fetid. According to French,

males sometimes show an aversion to mating with affected females.

Beebe and Ewing (Jour. Med. Research, Sept., 1906, do. Vet. Jour., July, 1907) record the presence in these tumors of spirochæte in one out of a series of cases, but failed to connect their presence with the cause of the malady.

FIG. 12B. INFECTIOUS VENEREAL GRANULOMA OF BITCH. (C. A. White.)

Later, Mettam (Veterinary Journal, February, 1907) records the discovery of an organism in this disease belonging to the group of spirochæte, which he believes to be the specific cause.

Histologically, the tumors consist of large round or polygonal cells, which multiply rapidly and push the contiguous tissues aside without their becoming involved in inflammatory or other disease changes.

The disease has been repeatedly transmitted experimentally by inoculations in the genital mucosa and other tissues.

In clinical and experimental cases the neoplasms may not remain confined to the genital organs, but may involve the skin, the lymphatic glands of various portions of the body, the liver, spleen and other glands,

The treatment is not highly satisfactory unless undertaken early. It consists chiefly in excising the vegetations, along with a small area of the healthy mucosa, after which the edges of the wound should be drawn together with catgut.

In the male, it may be necessary to divide the prepuce and, in the female, the perineum, in order to reach all the diseased parts. Afterwards, these wounds should be sutured. It is well to place the animal under general anæsthesia for the operation, which should be repeated within one to three weeks if necessary, and in some cases, cautery may be resorted to. In inveterate cases it may be necessary to amputate the penis and prepuce. Hobday states that the disease may be favorably affected by castration.

VENEREAL DISEASE OF SHEEP.

Flook (Jour. Comp. Path. and Ther., Vol. XVI, p. 374) records an outbreak of a venereal disease among sheep which came under his observation. He relates that, in a herd of fifty-two yearling ewes and two ram lambs, which had been recently purchased, it was noted that one of the rams had a discharge from the sheath, while the other had extensive eruptions about the mouth and nose. Nothing was seen amiss with the ewes. Soon after purchase, the two rams were taken from the band with which they had been purchased and placed with a small flock of old ewes. After one week F. found nine of the old ewes showing great swelling of the vulvæ, with raw, bleeding sores upon the mucous and cutaneous surfaces of the lips of the vulva. An examination of the rams revealed ulcerating sores in the sheath of one and eruptions upon the upper lip of the other. The general health of the animals was not apparently disturbed.

The rams had been marked with color upon the breast between the forelegs so that each ewe which was served could be identified and, by this means, it seemed to be determined that two of the latter had contracted the disease without coition. F. suggests that, in these two, the disease may have been transmitted by the ram which had the eruptions on his upper lip, through smelling of the vulvæ of these two animals, or that it might have been caused by flies bearing the disease from one animal to another, since the affection appeared during the month of August. The affected ewes were isolated and the sores dressed with antiseptics. Gradually they all recovered.

On the following page of the same journal, Sir John McFadyean contributes observations made by himself upon an outbreak which he considers identical with that described by F., which he also observed. He saw twelve ewes affected in one flock, showing intense inflammation, swelling and tenderness of the vulva. The vulvar mucosa was inflamed and some ulcers were present, both on the mucous membrane and the skin. There was a slight purulent discharge from the vulva. As these ewes had been served by a hired ram, which had been returned to his owner six days previously, McFadyean failed to see the

animal. McFadyean attempted to produce the disease experimentally by collecting the discharges upon pledgets of cotton, one of which was introduced into the vulva of a ewe, another into that of a cow and a third into the sheath of a wether.

Though two of these experiments proved negative, in the wether, a swelling of the sheath was apparent two days after the inoculation. This was still further increased on the 4th day and accompanied by a slight discharge. The swelling, at this time, was sufficient to make the exposure of the penis impossible. The symptoms continued over a period of about two weeks. On the third day there appeared on the skin near the opening of the sheath a small sore, which was covered with a brownish scab. This sore continued to spread around the opening of the sheath. On the fifteenth day after inoculation, two small abscesses had formed on the prepuce near the primary sore; these ruptured the next day, leaving shallow ulcers. At this time, a third small abscess had formed. All the ulcers were covered later with brownish crusts, after which they began to heal. Attempts to artificially transfer the disease from this animal to another wether and ewe failed. McFadyean did not succeed in isolating any organism which he believed to be the cause of the disease. While both outbreaks here mentioned have been comparatively mild in their course, McFadyean remarks that it is worthy of careful observation and that newly purchased rams might well be examined with a reference to this affection before being used for breeding.

G. H. Williams (Vet. Jour. Vol. XVII, p. 64) records two more outbreaks of this disease. In his first, in a flock of eight ewes and one ram, two ewes and the ram were affected. There was balanitis and ulceration of the penis. He used chinosol and zinc sulphate, in solution, to the parts and they recovered in about two weeks. In his second outbreak, three rams and forty ewes, in a flock of fifty, showed the same symptoms as described by Flook and M'Fadyean. In one ewe, eruptions occurred upon the nostril. In some of his cases, the vulva was greatly swollen and distorted and, in others, there were extensive granulations of a dark color, which protruded out through the vulva. The graulations and ulcers were penciled with silver nitrate and the entire parts were washed with a solution of zinc sulphate and chinosol.

In another flock of ewes, which had not associated with this one, except that one of the rams had been with them, it was found that some twelve of them had eruptions about the lips and and noses, but no genital affection was present. A second ram, in this lot, escaped the disease, so far as seen. In the larger flock of ewes, the rams were isolated and the affected ewes removed immediately from the herd. Daily inspection was made of the apparently well ewes, and any which developed the symptoms of the disease were promptly separated. A few weeks later breeding was resumed without recurrence of the disease, and, in due time, the ewes dropped healthy lambs.

INFECTIOUS VENEREAL DISEASE OF RABBITS

Friedberger and Frohner (Spezielle Pathologie und Therapie, 1904, page 501), describe an infectious disease of rabbits which was transmitted chiefly, or wholly, through copulation. The affection appeared in an extensive breeding establishment of rabbits, and consisted of an inflammatory disease of the organs of copulation. It was transmitted by coition from buck to doe, and vice versa. There were extensive swellings of the genital organs in both sexes, accompanied by a muco-purulent discharge. The disease was finally eradicated by injections of a solution of sulphate of copper, 1 to 2%, extending over a period of some weeks.

VENEREAL DISEASES OF SWINE AND GOATS

Hutyra und Marek mention the occurrence of venereal disease in swine, and Friedberger und Froehner state that it occurs rarely in swine and goats, but neither of these authors record any definite observations upon either malady.

OTHER INFECTIONS OF THE GENITAL ORGANS

Bursattee of the Penis and Prepuce.

Genital bursattee presents characters suggesting, to the inexperienced, a venereal disorder, and constitutes an annoying disease in breeding stallions. It is not infrequent in those countries where this malady prevails in other portions of the body. In our experience, bursattee shows a distinct tendency to attack the penis and prepuce of breeding stallions, especially of heavy draft animals. The infection is, persumably, not coital but is transmitted by other means: accidental wounds, flies or other carriers.

The usual symptoms of penial bursattee, when first observed by the groom or owner, is the presence about the urethral opening of an angry-looking fungoid growth, which bleeds upon the slightest touch and is generally observed to bleed immediately after coition; or, during erection, blood will drip from the tumor. Another fungoid mass of similar appearance exists at the preputial ring upon the inferior or urethral side near the middle of the organ when erected; that point where the urethral opening rests when the penis is fully withdrawn within its sheath. When the penis is at rest, therefore, the growths about the urethral opening and on the preputial ring are in immediate contact; the preputial growth has emanated from that about the urethral opening, as a consequence of contact.

The bursattic growth may begin at other points or may extend from the seat of infection to neighboring parts. In one instance, we observed the disease beginning upon the scrotum.

If the new growth is closely inspected, it is usually possible to recognize readily with the naked eye the small yellow concretions or "kunkurs" characteristic of the malady. In some cases, the penial bursattee is accompanied by infections upon the feet or other parts.

So far as we have observed, the disease is not transmitted to mares through copulation, though, clinically, it behaves as an infectious malady and it seems not impossible that danger of transmission to the mare through the vagina may exist.

The micro-biology of the disease has not been fully determined, some attributing it to nematode worms, others to the presence of a fungus.

Like bursattee of other parts, it is active in temperate countries only during the hot season and undergoes apparent spontaneous recovery upon the advent of winter, to remain dormant until the return of warm weather. It thus incidentally assumes its greatest activity during the breeding season and interferes seriously with stud duties. Aside from the remote possibility of transmission, it is very noticeable,and owners of mares naturally do not care to breed them to a stallion so palpably diseased. Furthermore, the sexual excitement incidental to breeding greatly influences the disease and adds to its virulence, each erection of the penis. with the consequent congestion of the organ, causing the bursattee growth to bleed.

The handling of the disease consists of the destruction or removal of all infected tissues and the avoidance of venereal excitement. If undertaken early, the disease is usually confined to the urethral tube, filling it and protruding beyond the navicular fossa, and may extend up higher in the urethra. Whatever the extent, the diseased tissues are to be excised or curetted away and the parts well cauterized with silver nitrate or the thermocautery, after which the wound may be dressed with iodoform, which apparently exerts a very beneficial influence upon the course of the disease, should any remain.

Before operating, it is well to apply local anaesthesia, though the sensitiveness of the part is not marked, as is usually the case with bursattic growths. Successful handling demands the withdrawal of the animal from the stud and the prevention of sexual excitement. If necessary, erection of the penis should be prevented by the application of a stallion guard.

At the preputial ring, at that point where the opening of the urethral tube rests when the penis is completely withdrawn, the secondary bursattic growth is more amenable to management. Here the operator can freely excise the diseased tissue without danger of unpleasant deformity.

After excision or destruction of the diseased tissues, the parts should be kept scrupulously clean, to which end it is advisable to wash the penis, prepuce and sheath twice daily, with soap and water, to which ½ @ 1% of carbolic acid may be advantageously added. After cleansing, the parts may be dressed with powdered iodoform, or iodoform ointment. Before applying the iodoform, any suspicious areas may be cauterized with stick nitrate of silver.

Actinomycosis of the Genital Organs.

In cattle, actinomycosis of the external or internal genital organs may occur in such a manner as to suggest venereal infection or, by their presence, may interfere with coition or fecundtion.

In a Galloway bull, we observed an actinomycotic tumor weighing about two pounds, which was located in the elongated naked prepuce and prevented the protrusion of the penis. There were also similar actinomycotic new-growths present in the inguinal lymphatic glands. In another case, to which we shall again have occasion to refer when considering sterility, actinomycotic abcesses occurred in the broad ligament of the uterus, without actinomycotic lesions in other organs. This would suggest that the infection had been introduced into the vagina during coition.

MENSTRUATION

In all domestic mammals, there occurs in those females of breeding age, at the time of estrum, an excitation of the genital tract with increased activity of the mucous glands, especially of the vagina and vulva, which leads to a more or less pronounced discharge of mucus.

In addition to this increased production of mucus, there occurs in some animals, during or immediately subsequent to estrum, an evident discharge of blood from the vulva, which, mixed with mucus and epithelial debris, is known as the menstrual fluid; the process, as menstruation. The phenomenon is not so conspicuous in any of our domestic animals as is ordinarily observed in woman, and, for the most part, usually passes unobserved, if present. It is quite commonly noted in the cow and bitch. It has been recorded in the mare by Fleming (Veterinary Obstetrics) and Kaiser (Magazine, 1859). Many regard estrum and menstruation as synonymous. While they are intimately related, we prefer to regard them as two separate phenomena, as observed among domestic animals.

While estrum is common to all mammalian animals of breeding age at the breeding period, menstruation, or a muco-sanguinous vaginal discharge, is not observable in most species at all, and, in the cow, where it is most conspicuous, it ordinarily does not occur *during*, but *subsequent to*, her very brief estrual period. In the bitch, the relation is not so well determined, the estrual and menstrual phenomena being of greater duration and overlapping or occurring simultaneously. In the cow, there is very frequently noted at or near the close of the period of sexual desire a well marked discharge of blood from the vulva. The amount varies greatly, usually being limited to a sufficient quantity to plainly stain the tail and surrrounding parts so that they are distinctly bloody, but sometimes there is a large amount of blood of a bright red color, mixed with mucus, seen hanging from the inferior vulvar commissure. In a few cases we have observed quite a voluminous discharge of blood, amounting at times to several ounces and accompanied by some constitutional disturbance, consisting chiefly of decreased appetite and a loss of milk. This sanious discharge in the cow continues usually for only a

very brief period of five to twelve hours. During this interval the cow may copulate but estrum is not well marked. In the bitch the discharge appears during estrum and continues for some days without usually being very profuse.

Fertilization.

Fertilization is the successful union of the male generative cell or spermatozoon with the female egg or ovum, by which the resulting cell acquires the power of segmentation and is enabled to develop into an embryo.

According to Marshall and other embryologists, fertilization in the rabbit occurs in from eight to twelve hours after copulation. This interval is not due to the time required for the migration of the spermatozoa from the posterior portion of the genital canal to and through the oviduct, but to the fact that the ova are not discharged from the ovary until eight to twelve hours after copulation. In the rabbit, the spermatozoa are found to travel the length of the uterus and oviducts in from fifteen minutes to two hours and, in the ordinary course of events, are already in the pavillion of the tube, awaiting the discharge of the ova. The doe rabbit copulates with the buck immediately after giving birth to young, the interval between estrual periods being the same as the duration of pregnancy.

We are not aware that any exact observations have been made in our larger domestic animals demonstrating the length of time elapsing between copulation and fertilization. In spaying cows, we have regularly observed that one which is in estrum has ripe ovisacs, which generally rupture the moment the ovary is grasped. If the cow has been in estrum on the previous day, we have found the Graafian follicle freshly ruptured. This would indicate to us that in the cow, as in the rabbit, ovulation occurs late in the estrual period or just at its close so that, under normal conditions, copulation would precede ovulation and hence that, in the cow, as in the rabbit, ovulation and fertilization occur some hours after the act of coition. In the rabbit, fertilization usually takes place immediately after the eggs enter the oviduct, which is probably the general rule in mammalia.

If eggs be taken from the upper portion of the oviduct, spermatozoa will usually be found imbedded in the zona radiata or

lying in the space between the vitelline membrane and the egg. The exact process of fertilization has not been fully determined in our higher animals. It is generally held that a single spermatozoon fuses with the female pronucleus.

The Relation between Estrum, Ovulation, Fertilization and Menstruation.

The relationship existing between the phenomena of estrum, ovulation, fertilization and menstruation has not been clearly determined. Owing to the very brief duration of estrum in the cow, she offers a specially favorable opportunity for study. As already related in our personal experience in the spaying of cows, it has been found that estrum is the first of these phenomena to present itself and that, if the ovaries be examined during the estrual period, it is found that there is an enlarged, mature Graafian follicle ready to rupture and that the walls give way under ordinary manipulation allowing the follicular contents to escape.

If the ovaries be examined during menstruation, it is found that the ovisac has ruptured and its contents have escaped. It seems, therefore, that, in the cow at least, the chronologic order of these phenomena is estrum, ovulation and menstruation, provided that this cycle is not interrupted by copulation and fertilization, when the order would be estrum, copulation, ovulation, fertilization. If successful copulation ensues early in estrum, it is the general observation that menstruation does not occur. Thus, its advent would seem to indicate the death and expulsion of the ovum along with some of the epithelium of the uterus, accompanied by hemorrhage in a manner to correspond in a way to the lochial discharge of parturition.

It would appear that, in our higher animals, the phenomenon of menstruation is analogous in a way to parturition itself. In animals having a duration of pregnancy greater than the interval between two estrual periods, estrum becomes interrupted during gestation, except in rare pathologic cases. The following table by Simons (Graduation Thesis, Library of New York State Veterinary College, 1903) shows some interesting observations in reference to the relationship existing between this group of phenomenona and brings out especially the influence of impregnation upon the occurrence of estrum. In those

animals where menstruation occurred, it is indicated by +, while, in those in which no sanious discharge could be recognized, the fact is indicated by —.

RELATIONSHIP BETWEEN ESTRUM, OVULATION, FERTILIZATION AND MENSTRUATION.

Number of Cow.	Beginning of Estrum.	Served.	Duration of Estrum before Service	Menstruation.	Recurrence of Estrum.
I	8.00 A. M. 6–14	6.00 P. M. 6–14	10	—	0
II	5.30 A. M. 6–16	5.00 P. M. 6–16	12	—	0
III	3.00 P. M. 6–16	5.30 A. M. 6–17	15	—	0
IV	8.00 A. M. 6–17	4.00 P. M. 6–18	32	+	July 8
V	6.00 A. M. 6–17	6.00 P. M. 6–17	12	—	0
VI	12.00 A. M. 6–20	9.00 A M. 6–21	21	+	July 12
VII	5.00 P. M. 6–20	5.00 A. M. 6-21	12	—	0
VIII	3.00 P. M. 6–23	9.00 P. M. 6–25	6	—	0
IX	11.00 A. M. 6–25	9.00 P. M. 6–25	11	—	0
X	5.00 P. M. 6–27	9.00 P. M. 6–28	4	+	August 8
XI	4.00 P M. 6–29	8.00 A. M. 6–30	16	—	0
XII	6.30 P. M. 6 29	5.30 A. M. 6–30	11	—	0
XIII	5.00 A. M. 7–2	6.00 A. M. 7–2	2	—	0
XIV	12.00 A. M. 7–5	7.00 P. M. 7–5	7	—	0
XV	5.30 A. M. 7–8	6.00 P. M. 7–8	13	—	0
XVI	4.00 P. M. 7–12	9.00 P. M. 7–12	5	—	0
XVII	5.30 P. M. 7–24	7.00 A. M. 7–25	13	—	0
XVIII	5.00 A. M. 7–13	----------	34	+	7–25
XIX	8.00 A. M. 7–6	----------	40	+	7–27
XX	10.00 A. M. 7–12	----------	23	+	7–31

"In cases IV and V, two heifers subject to the same conditions, the second was bred early during estrum, while the other was allowed to go until menstruation was well established, then served and, as a result, was not fecundated. Nos. VI and X were handled in the same way as No. IV and they also failed of fecundation. These cases were taken from a number for the reason that they were the most typical. They show that after service, which, in the successful cases, occurred before menstruation, the latter did not take place. Instead, the animal quickly returned to its normal condition and continued as before estrum was present. Cases Nos. IV, VI and X, at the end of 21 days or thereabouts, were again in estrum with the same regularity as though they had not been bred, when they again were served, but this time before menstruation began, and became fecundated.

Some observations were also made upon the length of time between successive periods of estrum. This occurs quite regularly in cycles of from 20 to 25 days, usually about 21 days being given, though this is, of course, subject to variation."

A careful study of this table would indicate that, in the breeding of cows, it should be the constant aim to cause copulation to occur somewhat early during the period of estrum. Whether it is possible for it to occur too early after the establishment of estrum is not very clearly determined, but it would seem that, ordinarily, it should take place in the cow within twelve hours from the beginning of the period. In the twenty cases observed by Simons, the longest duration of estrum prior to successful copulation was sixteen hours in case XI.

In abnormal or pathologic conditions of the genital organs, these relations become somewhat varied and unreliable. In a typical instance related by Simons of a nymphomaniac cow which was in estrum each eight to twelve days, repeated service was ineffective. The removal of the ovaries showed them to be about double the normal size and cystic. This cystic condition prevented alike ovulation and impregnation. Other conditions serve to interrupt the normal order and lead to variations in the cycle of estrum and menstruation.

These observations, although brief and fragmentary, suggest that successful impregnation prevents the occurrence of menstruation and that, consequently, its presence, in a cow after breeding, may be accepted as important evidence that fertilization has not taken place.

STERILITY

Standing at the threshold of success in livestock breeding, is the question of the capability of the animal, set aside chiefly or wholly for the purpose, to reproduce living young. Without this capacity, pedigree and individual excellence count for nothing. From a practical standpoint, it matters little to us whether the failure to reproduce its kind depends upon a want of impregnation, a failure of union between the ovum and spermatozoon or if it be due to the death of the embryo or fetus while yet in the uterus, or even to its premature expulsion from the uterus in such a defective state of health or development that it cannot continue to live ; each results in a defeat of the aim of the breeder and practically constitutes sterility.

We shall here limit our consideration to the failure of the ovum to become fertilized by a spermatozoon. The question of the life of the embryo and fetus and the birth of the latter in a state which will favor its development into a mature animal, we shall consider under the head of abortion and related subjects.

Great variations are noted in reference to the prevalence of sterility in our domestic animals, it being, apparently, more common in the larger species. There is a somewhat general belief also that it is more common in high bred individuals but this may be largely erroneous.

It certainly increases in all animals as domestication and close confinement increases, so that it is most common in those animals which are kept closely housed and, in this way, it becomes highly important in so intensely used as dairy cows.

With many of our domestic animals, sterility does not attract much attention, especially with females, because it makes comparatively little difference to the owner whether they breed, or go to the butcher. We are, therefore, most interested in sterility when it appears among animals in which their principal or sole value depends upon their reproductive powers. Among these, failure to breed may prove a great financial disaster. If a large harem of valuable brood mares, kept exclusively for breeding, is mated for a year with a sterile stallion, no foals are produced the following season and a total loss of anticipated income results. In addition to this loss, each mare has deteriorated

through her increase in age and, having been idle for a year, has, probably, become very fat, the sexual system somewhat weakened and the tendency to sterility intensified.

In dairy cows, the results of sterility may be equally, or more, disastrous. The production of milk is an essentially sexual function, enduring, as a rule, but for a year or two, when it may be re-established or reinvigorated only by bringing forth young. Hence, in a dairying establishment, a failure to breed causes not only the loss of the value of the young, but, generally of far more importance, a serious diminution in the amount, or total loss of the milk. The sterility of a large part of, or an entire herd, is a not uncommon observation in the experience of breeders and veterinarians, and, while such instances are very impressive, they do not equal in the aggregate, the widely disseminated and oft repeated individual cases.

If a highly valuable dairy cow fails to produce a calf in a given year, the fact is somewhat masked by the success with other portions of the herd, but the loss occurs and, add these individual instances together, the total cost to breeders becomes enormous. If a given cow fails to breed for several years in succession, she becomes far more than a total loss, because the owner retains her, year after year, in the hope that she may yet breed before he sends her to the butcher, where, at best, her value is usually trivial.

The function of reproduction being exceedingly complex, the causes leading to sterility are correspondingly varied.

In higher animals, reproduction can only occur as a result of union under favorable conditions of a spermatozoon, or male cell, with an ovum, or female pronucleus ; the first elaborated by the testicles of the male, the second by the ovaries of the female. Anything which may interrupt normal coition of the two sexes, or the physiologic activity of either male or female, may end in sterility.

We consequently meet with sterility in both sexes but, in the female, the genital apparatus is more complex and sterility more common and widely diffused though intrinsically of no greater importance than in the male. The function of the male parent ends with the ejaculation of healthy semen into the uterus or vagina of the female. In the female, there is still to occur the migration of the male cells through the uterus and oviducts until

they meet the ovum and, after the fusion of these two cells to constitute fertilization, the female organs must protect, and afford nutrition to, the embryo for a long period of time.

While there are certain analogies between the causes and nature of sterility in the two sexes, it is desirable to consider them separately.

A. Sterility of the Male Animal.

In order that a male animal shall be fertile, it is essential that living, virile spermatozoa shall be secreted and that the animal be competent to copulate with the female and give effective emission to the normal semen.

The testicles constitute the basis of the male genital system, since they produce the male cell or spermatozoon. In mammalia, the testicles are two in number, a right and a left, variably located according to species. In all our common domestic animals they are normally located in adult life outside the abdomen in the scrotum, which is situated, according to species, in the inguinal or perineal region, the testicles passing through the inguinal ring in order to reach the scrotal sac. In the elephant, the testes are normally retained within the abdomen throughout life.

The testes vary somewhat in form and, necessarily, in size in the different species and present some marked differences in their relations. Their general form is oblong or spheroidal and, when they come to rest in the scrotum, their long axes may be perpendicular to the spinal axis, as in the bull, or parallel, as in the horse.

In addition to its peritoneal coverings, the testicle consists of its fibrous framework, the proper or secretory tissue, excretory ducts, and the vessels and nerves.

The fibrous framework forms externally a very firm, inelastic capsule, the tunica albuginea. This serves to render the functioning testicle one of the most dense, incompressible glands in the body, the very firmness of which bears an important relation to fertility, since any disease causing swelling of the gland tends to seriously affect the proper glandular tissue by the severe compression.

From the tunica albuginea, fibrous septa pass toward the center of the gland and divide the secretory tissue into small lobules.

Somewhat near the surface, toward the epididymis, the connective tissue stroma becomes very prominent in the central portion of the gland to constitute the *corpus Highmori*.

The glandular tissue proper consists of numerous convoluted tubules, *tubuli semeniferi*, which, commencing in a cul de sac, terminate in a central system of canals. These, passing through the *corpus Highmori* empty into the vasa efferentia, which finally converge to form the vas deferens.

The tubules consist of a basement membrane lined with an epithelium of three or four layers of cells. The deeper ones are polygonal in form while, more superficially, occur the spermatic cells or spermatoblasts, from which, finally, the spermatozoa are elaborated, the nucleus constituting the head, while the tail consists of protoplasm.

The interlobular connective tissue stroma affords passage for the vessels and nerves to every portion of the gland and, within it, are numerous interlobular cells, which are believed by some to serve as nutritive agents for the *tubuli semeniferi*.

The seminal canalculi are lined with ciliated epithelium, which disappears in the seminal duct, to be succeeded by a single layer of epithelial cells.

The vesiculæ seminales of the stallion consist of two commodious pouches situated above the urinary bladder and the vasa efferentia, communicating with the latter. They have been thought by some to act as seminal reservoirs. Hence their name. However, it is generally considered that such is not the case and that their sole function is the elaboration of a mucoid or watery secretion, which becomes mixed with the semen while being ejaculated. Fleming (Chauveau's Anatomy) asserts that they serve as seminal resevoirs, but investigators, apparently, uniformly fail to find spermatozoa in them.

The seminal vesicles of the bull have the character of ordinary acinous glands. Zschokke has been unable to find spermatozoa in them. They have only a very small cavity.

In the boar, the vesiculæ seminales are very large acinous glands, secreting a watery fluid and not containing spermatozoa. The vesiculæ seminales are absent in the dog and cat.

The prostate glands of the horse are situated above the urethra, at the neck of the bladder. They are acinous in type, and secrete a transparent viscid fluid, which becomes mixed with

the secretions of the other glands. In the pig, there are two prostates, while, in the dog and cat, there is one large gland completely surrounding the urethra.

Cowper's glands are also acinous in character. Chauveau states they are absent in ruminants, but Zschokke claims they are present. They are absent in the dog, but present in the cat.

The physical characters of the secretions from the seminal vesicles, prostate and Cowper's glands varies somewhat, is chiefly of a clear, watery character, that from the Cowper's glands being somewhat more viscid. They are neutral in reaction.

The function of the secretions from these subsidiary glands has not been very accurately determined, but they apparently serve a useful purpose as lubricants and, still more, they dilute the secretions from the testicles, adding volume to the semen and giving a wider dissemination to the spermatozoa. Furthermore, it is believed that their presence invigorates the spermatozoa.

The semen, at the time of ejaculation, consists of an admixture of the secretions from these accessory glands, with the spermatozoa and accompanying fluids from the testicles. It is a whitish, viscid fluid of feeble alkaline reaction, and has a specific odor.

The spermatozoa in this fluid show very vigorous motion, induced by the contractions of the tail, which cause a progressive movement comparable to that of a fish or an eel. Hensen states that they may move 1.2 to 3.6 mm. per minute. Their vigor is greatest at about the body temperature and is decreased or stopped by heat or cold or by the addition of water, acids, metallic salts, etc., while the vigor of the movements is increased by the addition of weak alkalies, blood serum and estrual discharges.

The commencement of the secretion of spermatozoa marks the age of *puberty* in the male and is expressed by the appearance of sexual desire. Its advent varies greatly according to species, in the horse from 10 to 18 months, in the bull from 8 to 10 months and in most other species, at an earlier date.

The amount of semen ejaculated during a single coition has not been well determined. In the bull, it is 5-6 c m.^{3} (Zschokke) and contains more than 60,000 spermatozoa per mm.^{3}

In order that successful copulation may occur, it is essential that the testicles, excretory ducts, urethra, penis and accessory glands be normal in structure and function, and that the locomotory apparatus be sufficiently normal to enable the male to mount

the female, and otherwise to perform the physiologic essentials of copulation.

Sterility of the male may be outlined as follows:

I. Azoospermie.

a. Congenital Defects of Testes.

1. Anorchidy.
2. Congenital Malformations and Tumors.
3. Cryptorchidy.
4. Hybrids.
5. Hermaphrodites.

b. Acquired Diseases of the Testes and Scrotum.

1. Tumors.
2. Orchitis and Epididymitis.
3. Spontaneous Degeneration of Testicles.
4. Hydrocele.
5. Torsion of the Testicles.

c. Azoospermie from Systemic Disease or Debility.

1. Debilitating Systemic Diseases, Overwork.
2. Idleness and Overfeeding.
3. Excessive Sexual Use.
4. Onanism or Masturbation.

II. Defective Secretions of Accessory Glands.

III. Inability to Properly Copulate.

1. Arrested Development of the Penis.
2. Tumors, herniæ, etc., near the penis, which serve to misdirect it and prevent its entering the vulva.
3. Tumors of the Penis and Prepuce.
4. Penial Paralysis.
5. Excessive Erection. Spasm of Penis.
6. Broken or Curved Penis.
7. Inflammation of Penis.
8. Adhesions of the Penis to the Prepuce.
9. Constriction of the Preputial Opening. Phymosis.
10. Paraphymosis.
11. Lumbar or General Paralysis.
12. Painful Diseases of the Posterior Limbs and other Parts.
13. Size of Male.
14. Age of Male.

IV. Infectious Diseases.

I. Azoospermie.

In the rearing and selection of male breeding animals, it becomes of importance to determine at the earliest possible date whether they may prove efficient sires or not and it is essential, first, to know whether they possess normal testicles capable of producing vigorous spermatozoa.

Although these organs, derived from the Wolffian bodies, are formed in the sublumbar region, they normally descend into the scrotum in all our domestic animals except the elephant and are, consequently, with the one exception, quite freely available for physical examination.

In our large herbivorous animals, these organs normally descend into the scrotum prior to birth, so that, when one of these is born without this having occurred, that fact may well become an object for suspicion.

1. **Anorchidy.** In some cases these organs are entirely wanting or have been arrested in their development so that they are wholly insignificant and devoid of physiologic power. Such animals fail to develop sexual desire in the least, do not acquire the usual characters of the male in conformation, head, neck, horns, voice, or other attributes, but remain neuter or asexual in character save in respect to the penis and sheath and even these may be defective. No testicles are present in the scrotum and none are distinguishable by rectal exploration. On post-mortem examination, one may find within the abdomen a mass of tissue which, by its attachments and relations, is identifiable as the representative of the testicle, but devoid of any tissue of a true genital character. Such are the findings in some twin calves, as well as in some single births, and the same conditions are met, far more rarely, among other animals.

2. **Congenital Tumors.** In other cases, instead of the normal glandular tissue, the male animal is born with a tumor representing the genital gland, which may be either teratologic or pathologic. Among the teratologic, the most common are dermoid cysts, containing hair, teeth and epithelial debris, along with more or less fluid.

A possible mode of origin of these structures has already been discussed on page 12.

In other animals, the primitive gland may become the seat of

calcareous deposits, which invade the entire primitive gland and efface every trace of glandular tissue, inducing a state equivalent to anorchidy. In yet other instances the primitive testicle becomes the seat of a malignant neoplasm. In one case, we observed in a cryptorchid pig a testicle which was the seat of a malignant new-growth which had contracted firm adhesions with adjacent loops of intestine. Each of these conditions serves ordinarily to prevent the descent of the testicle into the scrotum. The affected organs are necessarily and incurably sterile. Except in cases of malignant disease of the glands, castration is not ordinarily demanded.

FIG. 13. DERMOID CYST OF TESTICLE

Showing dental tissues. Horse. (Hinebauch.)

3. **Cryptorchidy** also constitutes a uniform cause of sterility when both testicles are retained within the abdominal cavity. We speak of abdominal and inguinal cryptorchidy but, ordinarily, only the former may exist as a permanent condition, while the latter is a transitory state, in which the gland is descending from the abdomen into the scrotum, which it will eventually reach. It is only very rarely that inflammatory adhesions or other conditions may permanently arrest a testicle in the inguinal region during its descent.

Typically, cryptorchidy is an arrest in the development of the testicle, the organ being small, flaccid and soft. Histologically, it partakes of the character of the fetal testicle and no sperma-

tozoa are formed by it. If such a testicle descends and passes from the abdomen through the internal inguinal ring, it tends to at once develop normally and become fertile. However, it is essential that the gland itself shall descend. In some cases, the epididymis descends into the scrotum, while the gland remains in the abdomen, the testicle retaining its typical cryptorchid character and remaining sterile. While the typical abdominal croptorchid testicle is regularly sterile, it nevertheless induces a sexual reflex, causing the development of the ordinary male attributes, such as the characteristic head, neck, horns and voice and usually a sexual desire of an intense and more or less perverted character, in which vice assumes a prominent role. If only one testicle is retained in the abdomen, the other being normally located and developed or even having undergone compensatorial hypertrophy, the animal may be fertile, that is, the normally developed gland is capable of performing its function regardless of the presence of the sterile gland within the abdomen. The perverted sexual desire, akin to nymphomania of the female, persists so long as one testicle is in the abdomen, even though one has descended into the scrotum, and functions. The defect is of further interest to the breeder because of its pernicious hereditary transmission from parent to offspring. The condition is beyond practical remedy. While it is surgically possible to procure the descent of the testicle into the scrotum and thereby cause the gland to so develop that it will perform its normal function, this would not prevent the transmission of the defect to the offspring.

4. **Hybrids**, chiefly the mule, are regularly sterile, the testicles partaking of the fetal type histologically, though normal in position, form and volume. In this animal, the sexual desire is well developed. In rare cases, well authenticated, the female has bred, but we do not recall instances of recorded fertility in the male, although they probably occur. The opportunity for the demonstration of such power in the male is generally excluded by castration.

5. **Hermaphrodites**. In all species of domestic animals we meet, occasionally, with hermaphroditism in which the two systems of sexual organs are each found more or less developed in the same animal. They incline to assume a prevailing type according to species.

In the horse, hemaphroditism tends, generally, towards the development of testicles, which are largely retained within the abdomen and attached and located the same as the ovaries, but may descend into an imperfect scrotum ; the vulva, vagina and uterus may develop almost perfectly, as in one case occuring in the clinic of this college (Fig. 54), where the vulva and vagina were sufficiently developed that the animal was castrated through the vagina in the same manner as mares are spayed. The rudimentary penis, or enlarged clitoris, usually ends either in the vulva or in the vicinity of the ischial arch, with the urethal opening directed backwards. In other cases, this organ is prolonged down between the thighs, but, still, as a rule, is directed backwards at its extremity. The mammæ are usually moderately developed in these animals and, upon casual examination, have the appearance of the mare, although, as in one case operated upon by us, there were, just above these rudimentary glands, small scrotal pouches containing the imperfectly developed testes.

These animals present chiefly the sexual characters of the cryptorchid horse with all his deranged sexual desire and tendency to viciousness. In the case illustrated by Fig. 54, the head, neck, voice and disposition were those of a cryptochid horse, and the vulva, vagina and uterus were those of a normal mare. When castrating the animal, the vagina underwent the customary ballooning, which indicated functional activity. The erectile organ occupied a middle place between the clitoris of the mare and the penis of the horse.

In Fig. 14 is shown the generative apparatus of a pig, in which the hermaphroditism is of quite a different character, one of the glands having developed into a typical ovary, the other a testicle, the two sides of the genital apparatus thus representing the two sexes.

Sections of these genital glands show one to be a typical cryptorchid testicle with tubuli semeniferi, the other a primitive ovary with scattering Graafian follicles containing ova. The Muellerian ducts have developed into typical oviducts, uterus and vagina, and, from the Wolffian ducts, have formed typical vasa deferentia and the penis is normal in form and extent.

We have found no records of fertility in hermaphrodites of the equine or other species.

FIG, 14. HERMAPHRODITISM.
Pig.

T, Testicle. O, Ovary.
P, Penis. CC. Uterine Cornua.

B. ACQUIRED DISEASES OF THE TESTICLES AND SCROTUM.

1. **Tumors.** We have already referred on page 125 to congenital tumors of the testicles.

Malignant tumors of the testicles are occasionally seen in the stallion and other adult male breeding animals. When the tes-

ticle is in its normal position, such a new growth reveals itself as a very tense swelling, inclined to be more or less nodular, not very painful, but does not tend to cause any marked swelling of the surrounding parts. The affected gland becomes sterile as soon as the glandular tissue is generally invaded and, probably, in a large proportion of cases, as soon as any increased pressure is exerted upon the parenchyma of the gland.

When tumors of any kind involve the testicle to a marked degree and determine its loss of function, it should be promptly removed for general curative reasons as well as to anticipate any unfavorable influence which it may exert upon the other gland.

The prognosis in case of maglinant tumor of the testicle is good if the gland be removed early, because the disease tends to be confined closely to the gland itself for a considerable period of time. The fertility of the normal gland may thus be preserved for an indefinite period.

2. **Orchitis and Epididymitis** are not readily distinguishable clinically as distinct affections. So far as we are aware, they are due to essentially the same causes, present similar symptoms and have like dangers for the fertility of the animal. Judging from the standpoint of post-castration observations, it would appear that, in the stallion at least, epididymitis is more common than orchitis. (See Fig. 15).

Inflammations of the testicle and epididymis arise from a great variety of causes. In all animals, external wounds are liable to cause inflammations of the gland especially when occurring during the active breeding season. Scrotal wounds, especially those penetrating the peritoneal sac of the testicle are very liable to terminate in an inflammation of the glandular tissue.

Contusions of the testicles without wounds of the skin are more or less common in domestic animals and may at all times lead to orchitis. In ruminants, and especially in the ram, where the scrotum is sometimes large and very pendulous, the testicles are bruised by coming in contact with obtacles or by being violently struck by one of the hind limbs and thence thrown against the other during rapid progession In the stallion, especially in trotters used for track purposes, there is a well marked tendency for contusion of the testicles to occur by being thrown from one thigh to the other when the animal is going at

a rapid pace. When the horse is employed at this work, the testicles become more pendulous than when used for breeding. Contusions of the testicles of the stallion, and of a very dangerous character, also occur occasionally from kicks by the mare at time of service.

Orchitis and Epididymitis occur, in some cases, independent of any history of traumatism, as an apparently idiopathic malady. By some, this is ascribed to excessive venery, or coition. We have no definite data to show that it so occurs. It is not improb-

FIG. 15. EPIDIDYMITIS. STALLION.

T, Testicle. E, Epididymis.

able that such untraced cases are due to infection of some character passing through the vas deferens into the testicle, as suggested by Zschokke. This may be favored by excessive coition or by any debilitating influences.

In other cases, the disease is directly traceable to an infectious malady. In the stallion, we meet, not infrequently, with strangles abcesses in the testicle or about it. In these, the ordinary symptoms of strangles are usually present in other portions of the body, such as intermaxillary abcesses, with the other general symptoms. In the contagious cellulitis, or pink eye, as we have already stated on page 68, orchitis is the rule. Orchitis in the stallion has been recorded also as result of glanders.

In the bull, orchitis occurs as a result of tuberculosis. Zschokke (Unfruchtbarkeit des Rindes) records tuberculous orchitis as the most common form of inflammation of the testicle in the bull, and has observed it both uni- and bilateral. It assumes a chronic course. The tubercular nodules are generally disseminated throughout the glandular tissue and may extend to the tunica albuginea and to the serous membrane. The tubercles present their usual characters, with an increased amount of connective tissue and greater density of the organ. If the nodules are superficial, there are adhesions between the two serous coverings. Tubercular deposits may also exist in the epididymis and spermatic cord.

The clinical diagnosis of the tuburcular orchitis must chiefly rest upon the enlargement and hardening of the testicle, its adhesions, thickening of the spermatic cord and tumefaction of the inguinal glands. Other symptoms of tuberculosis are usually present and the diagnosis may be verified by the tuberculin test.

While the sound areas of tuberculous testicles may generate normal spermatozoa, it should be remembered that the semen emanating from such a testicle will, probably, also carry tubercle bacilli, and thus be capable of directly transmitting the disease from the bull to the cow.

Ehrhardt (Schweizer-Archiv fur Tierheilkunde, Vol. 38, p. 79) records a case of orchitis in a bull due to the vesicular venereal disease of cattle.

Wallruff (Reperotorium, 1846, p. 206) records an epizootic of inflammation of the testicles in horses, cattle and goats, accompanied by the formation of abscesses. Others record inflamma-

tion of the testicles as a result of the presence of nematode parasites.

The anatomy of the testicle is of such a character as to render acute inflammation very serious for its functional life. The tunica albuginea constitutes the most dense and inextensible capsule possessed by any gland in the body. When the volume of the contents of the capsule is augmented by engorgement or inflammation, the pressure exerted upon the encapsulated gland tissue is very great and at once threatens its functional activity or life. It is, consequently, very common for orchitis to permanently destroy the integrity of the gland. Sometimes, the inflammation ends in a total necrosis of the organ.

From whatever cause orchitis may arise, it should always be treated as a very serious disease, in so far as the reproductive powers of the animal are concerned, and should be handled with the greatest possible promptness and care. As with all diseases of the sexual organs, it is especially true of those of the testicles that the fundamental principle in their handling should be the removal, as far as possible, of all sexual excitement. The animal may be exercised and, possibly, benefited thereby, but it should be done in a manner to avoid any sexual stimulation. In most stallions the application of the stud bridle is in itself a sexual suggestion because the animal constantly associates it with service.

So far as possible, a breeding male affected with disease of the genital organs should be removed from sight or sound of any female of his kind, especially from those which are in estrum Every arousal of sexual appetite intensifies any existing irritation or disease in the sexual organs and successful handling of these accidents and diseases demands, first of all, sexual quietude.

Wounds to the scrotum of male breeding animals should have very careful surgical attention. Strict antiseptic precautions should be taken from the very outset and continued until all danger to the glands has been safely passed. If the wound is penetrant, infection of the peritoneal sac is to be very carefully avoided by thorough disinfection and closing of the wound. If there is a want of good drainage, this should be freely provided and no accumulation of wound discharges be permitted. The food should be of a light, laxative character.

Contusions of the testicles should be avoided by the removal of the causes. Rams with very large and pendulous scroti should be confined in enclosures free from rough elevations and from obstacles against which the testes may strike when the animal is moving about and should be guarded against being chased by dogs or otherwise compelled to run. Injuries from contusions of the testicles of trotting or pacing stallions are effectively obviated by the use of a stallion suspensorium. The protection of the testicles of the stallion against kicks or other contusions during service has already been considered on page 51.

Purgatives should usually be administered in cases of acute orchitis unless contra-indicated by some general systemic disease like pink eye. Even then, it would probably be desirable to prescribe such hypodermic cathartics as arecoline or eserine, combined with pilocarpine, which will act quickly without causing any great depression or inducing super-purgation. They should be given in small doses and may be repeated, if necessary, in one hour. In such animals as have pendant testicles, it is advisable to apply a suspensory bandage, which favors the circulation within the organs and tends to overcome the congestion.

Locally, cold water may be applied to the testicles, or, when this cannot be continued, it may be advantageous to use an ointment or liniment consisting of camphor, belladonna and olive oil, applied with abundant and repeated massage.

Febrifuges may be used to lower the temperature in event of fever, but, since any elevation of temperature will usually suggest, if not indicate, the presence of infection in the gland, internal medication should be chiefly directed toward the elimination of the infecting element itself or of the products of infection. For this purpose, eserine and pilocarpine and, to a much less degree, the slower acting cathartics, exert a beneficent influence. Potassium iodide in full doses not only serves to favor the elimination of bacterial products, but tends to exert a distinct bactericidal action. Some writers advise against its use lest it cause atrophy or degeneration of the testicles but, so far as we are aware, there is no evidence of such action of the drug in domestic animals.

Hoffman recommends compression of the testes of dogs by means of strips of adhesive plaster over the scrotum, thereby tending to support the circulation in the part. When abscesses

occur in the organ, they should be promptly opened, the pus evacuated and the cavity treated antiseptically.

Castration is always to be considered in case of orchitis, whether acute or chronic. In cases of acute orchitis or epididymitis involving one gland only, there is a constant tendency for the other to become involved. If the life of the animal is threatened by the intensity of the inflammation, if the function of the gland is apparently wholly and permanently destroyed, or if there appears to be danger of the sound gland becoming involved, the removal of the affected testicle should occur without delay. In chronic recurrent orchitis of both testicles, especially if examination of the semen indicates the absence of spermatozoa or if the animal has proven sterile in the stud, total castration should be performed and such salvage obtained from the animal as conditions may permit.

In animals affected with acute orchitis, there is some hesitancy at times about castration lest the patient cannot well endure the operation but, in our experience, it is a most efficient therapeutic agent and the operation at once improves the general well-being of the animal. When orchitis is present as a complication of an acute infectious fever, like "Pink Eye," we should regard castration as unsafe, until the acute stage of the malady has run its course and the disease has become chronic and located chiefly or wholly in the testes. Since, in orchitis, there are usually intimate and extensive adhesions between the peritoneal layers, it is safer and more convenient to castrate by the covered operation. The removal of one of the testicles, providing the other is sound, does not interfere with the reproductive power of the animal.

3. **Spontaneous Degeneration of the Testicles.** Zschokke records spontaneous degeneration of the testicles as a not uncommon cause of sterility. He attributes it largely to the action of toxines upon the secretory cells of the organ, thus causing their destruction. He assumes that these toxines reach the glands through the blood or lymph, during the course of some systemic disease, in which the deleterious poisons are generated, and that the effect of these toxines will be most noticeable upon those tissues which are most sensitive, among which are the secretory cells of the testicles. When these toxines act upon the spermatoblasts, their first effect is the destruction of their physiologic function. If the toxicity is slight and temporary, the cells soon recover their

function, but, if intense and continuous, it leads to disease changes and death of the cells.

The anatomical changes observed by Zschokke under these conditions in the testicles of bulls, without apparent external cause or symptoms, accompanying the sterility, were now and then, sclerotic connective tissue degeneration ; fatty infiltration ; and the formation of bone, or the total calcification of the seminal tubules. He asserts that calcification is not at all rare and that it is easily recognized upon a microscopic examination of the excised gland, the white, calcified tubules being easily visible and evident to the touch. The diagnosis of this condition cannot be made by palpation in the living animal with the organs in position, or by other means than histologic examination of the excised gland, except by examining the semen and determining the absence of spermatozoa, which would point with considerable certainty to a degeneration of this character. It is evident that no method of handling can result in any restoration of the breeding power, under such conditions, and castration is indicated.

4. **Hydrocele**, or dropsy of the scrotum, in which there is an accumulation of fluid in the scrotal sac between the two peritoneal layers, probably, exerts an unfavorable influence upon the affected glands and tends to produce sterility. If the accumulation of fluid in the sac is the result of a general dropsy of the peritoneal cavity, ascites, the systemic debility of the animal would usually determine sterility. When the affection is local, as is usually the case in the stallion, and depends upon a chronic inflammation of the scrotal peritoneum with the accumulation of the secreted fluids in the sac and involves but one organ, it may not induce complete sterility, but affect the formation of spermatozoa in the diseased testicle only.

The symptoms of hydrocele consist of a painless enlargement of the scrotum, appearing gradually and usually without recogizable cause. The general health of the animal is not usually involved. The swelling is even, soft and suggillating, indicating that it consists of fluid. It is to be differentiated from tumors and orchitis by the firmness of the latter ; it may be distinguished from hernia by rectal exploration, determining, thereby, the presence or absence of a segment of the bowel in the internal inguinal ring. Its diagnosis may be further established by intro-

troducing an exploratory trocar and withdrawing a portion of the contents.

The handling of hydrocele is not usually highly successful. Sometimes good results may be had by aspirating the fluid and injecting tincture of iodine or Lugol's solution into the cavity. When these measures fail, a radical cure of the local disease may be brought about by castration, the covered method being used. When the hydrocele is dependent upon a general constitutional malady, with dropsy of the abdomen, there is, usually, no successful method of treatment.

5. **Torsion of the testicles,** it is claimed, operates at times to cause their atrophy and inhibit the formation of spermatozoa because of interruption of their nutritive supply. The reversal of the testicle of the stallion, so that the tail of the epididymis is turned forward, is alleged to interfere with fertility. Such a result from this slight and common displacement is, probably, purely mythical. It is well known that emasculation can be produced in ruminants by the process known as double subcutaneous torsion, in which the testicles are twisted and turned upside down in a manner which interrupts their vascular supply and induces atrophy, with disappearance of sexual desire and power.

c. Azoospermie from Systemic Disease.

1. **Debilitating Diseases and Overwork.** Any constitutional disease which produces profound depression of the general system is usually accompanied by suspension of the powers of reproduction. Most serious constitutional disorders not only destroy the sexual desire for the time being, but also prevent the formation of spermatozoa and thus lead to essential sterility during the period of the existence of the disease. In some acute fevers, the sexual powers are not in complete abeyance and male animals affected with a disease accompanied by a high fever may be fertile. In one case, we observed a stallion affected with brustseuche, with a temperature of 107° F., which, in spite of the very high fever, served a mare and successfully impregnated her.

In chronic debilitating diseases, there is sometimes seen a tendency to sterility, especially in the constitutional bone dis-

eases, like osteoporosis, rickets and in other chronic disorders which depress the general vigor of the animal.

Overwork serves to inhibit the breeding functions, so that animals subjected to severe work are strongly inclined to be sterile for the time. In animals which are severely, but not overworked, as in stallions which are being trained for the turf, there is usually a temporary sterility, without any evidence of disease or degeneration of the glands. The resources of the animal are wholly consumed in the physical work which is demanded and there remains no reserve force to provide reproductive energy during this period.

Starvation has a like effect upon the reproductive powers so that any animal which does not receive sufficient food to maintain the general vigor of the system and afford a moderate reserve for reproductive energies tends to become sterile during the period of want.

The remedies for these conditions are suggested by the causes, they are usually but temporary and run a parallel course to the causes themselves. Whenever these are removed or naturally cease, the reproductive powers become spontaneously restored.

2. Idleness and Over-feeding. Impotence of the male is frequently expressed chiefly by an absence of sexual desire, without any changes of the sexual organs which can be detected. The male shows but slight sexual desire or none at all in the presence of females which are properly in estrum. At one time he may pay some attention to the female, with a more or less complete erection of the penis, and then desist in his attentions, and turn away. When the next female is presented, he may show normal sexual vigor.

In some cases, there is alleged to be an individual psychic influence which prevents the male from copulating with a certain female. This is alleged to be especially true of some stallions, to which certain mares seem to be repulsive, and they refuse to serve them. The presence of young at the side of the dam is sometimes alleged to repress the sexual appetite of the male. This is usually seen, however, only in those males depressed in their vitality by improper handling. It is almost, if not always, erroneous to attribute this trouble to the caprice or idiosyncracies of the male by which a female of a certain type or color becomes

repulsive to him and fails to arouse his sexual appetite ; the real cause lies in bad management.

In some cases, there is a general depression of the sexual desire, especially in those animals which are lethargic or of a phlegmatic temperament. In very active, nervous animals this peculiarity is rarely seen. It is most common in draft stallions, but is observed in bulls, especially of the beef breeds, and in all kinds of male breeding animals.

The tendency to loss of vigor on this account increases with the age of the animal. It is usually not noticeable in the young, but, as soon as the animal has become mature and grown quite fat, the disposition becomes marked. This form of impotence is seen almost exclusively in those animals which are closely confined, highly fed and not properly exercised. It tends to disappear promptly upon a correction of the method of keeping, providing that it be applied sufficiently early. The most careful search fails to find any anatomical reason for the difficulty, and it seems to be of a purely functional character. The difficulty should be prevented by not forcing the young male designed for breeding purposes too rapidly in his development, but by allowing him only a moderate diet, with plenty of exercise and freedom, and, whenever practical, permitting him to consort with females during his period of growth.

Upon the appearance of these defects in the mature animal, much can be done, if handled opportunely, by restricting the diet and causing an abundance of exercise. In our experience, a healthy draft stallion refused almost wholly to serve mares. He was being highly fed and was getting a very limited amount of exercise, at a slow walk. Being appealed to for advice, we reduced his food ration one-half and prescribed eight miles exercise, daily, at a brisk walk. Within a few days, his sexual desire had fully returned. He finished his season's work in good form, and was effective as a sire. The same general principles apply to other breeding males. In countries where cattle are habitually worked, the bulls are largely kept in breeding condition by moderate draft service. It might be well to imitate this plan in America, where they are not habitually used for work purposes, but could readily render considerable service, while being greatly benefited by the vigorous exercise which would be secured in this way. Under general conditions, it is perhaps the best possible and most economic manner in which we can insure sufficient

exercise for these animals. Incidentally, it should be noted that such exercise or work tends very strongly to prevent that viciousness in bulls and other breeding males, which renders them dangerous to their keepers.

Zschokke emphasizes the value of the proper selection of food for the purpose of arousing a sexual desire and especially insists that the hay should be of an aromatic character, as should also the oats. Not only should they be well cured and sweet smelling, but he believes that the admixture of certain stimulants like calamus, pepper, powdered mustard, and even powdered cantharcides, are advantageous. He recommends that these remedies should be fed with cut hay and should be allowed for two or three days in succession and then omitted for a like period, when they may be given again.

We doubt very greatly the value of aphrodisiacs, or sexual stimulants, in breeding animals. Sexual instinct is so normal a phenomenon and so universal in animals of breeding age and proper health that we fail to see the value of exciting sexual desire artificially. The function belongs normally to every male or female of breeding age and, if it is absent, it is because of some depression in the general vigor of the animal, which cannot readily be removed by aphrodisiacs. It has not been shown that the arousal of sexual appetite by means of these drugs insures or even favors fertility. A constant and wide distinction must be drawn between copulation and fecundation. The fundamental function of the male is the elaboration of virile spermatozoa or male cells, while copulation merely serves to transfer these fecunding cells from the testes of the male to the vagina of the female. Copulation is in vain without vigorous spermatozoa and we have no data to show or suggest that any drug may directly cause or favor their development.

Certainly, we must admit that tonics, alteratives, or other drugs which are capable of favorably influencing the restoration of a diseased animal to a healthy state must also improve its reproductive powers by restoring the equilibrium of the body and enabling it to better perform all its normal functions, among which is reproduction. The highest state of the general vigor of the body is, consequently, the most favorable condition for the production of virile spermatozoa, which constitute the first essential in the fertility of the male animal.

Zschokke further remarks that there is sometimes an absence of sexual desire in young bulls which have not previously served cows. This seems to be an absence of the sexual instinct and he suggests that such animals should be turned loose with cows which are in estrum. Under these conditions, they soon become sexually awakened and learn to serve females. This difficulty is not so prominent in other domestic animals, though the same condition is observed to some extent in young stallions. Under normal conditions the sexual desire of healthy young animals is awakened and intensified by the presence of the opposite sex. Breeders of pedigreed stock recognize this fact and cautiously keep young males of some species entirely away from females which may be in estrum, lest their mere presence awaken the sexual desires of the immature male and thereby interrupt his growth.

The preparation of breeding animals for the show ring is always very dangerous for the sexual vitality of the individual. In order to get them in high condition, they are frequently closely confined in the stall and fed in such a manner as to produce the greatest amount of fat, in order that they may make a better showing and more certainly win a prize. It is an unfortunate fact that many of our most richly bred animals, which are designed for breeding purposes and which capture the most coveted prizes at the livestock fairs, have their breeding powers either temporarily or permanently destroyed in the process of feeding them for the show. There is no effective method for overcoming this except by the exercise of greater intelligence on the part of the owners of show animals, which may be furthered by judges in livestock exhibitions paying less attention to the amount of fat and more to the form and general vigor of the animal, in the allotment of premiums. In order to show breeding animals with safety, it is absolutely essential that abundant exercise should accompany the preparing process if the sexual vigor of the animal is to be safely preserved.

The result is not the same with all individuals. There are some which can withstand almost unlimited abuse in this direction and continue to breed regularly, while others are very susceptible and soon become temporarily or permanently sterile. Once this sterility is established, the only thing that can be done is to correct errors in care by moderating the diet and enforcing

vigorous exercise, which will, as a rule, though not always, restore the sexual powers.

In a general way, the food of a breeding male needs be rich in protein, as compared with the amount of hydrocarbons and carbohydrates. The most common foods, when well grown and cured, are the best for the breeding animal, such as bright, aromatic hay and clean, well developed oats, along with grass, to which may be added, in the winter, roots and tubers. Rarely, if ever, is it necessary or even advisable or permissible to add to the food any sexual stimulant like pepper or mustard.

3. **Excessive Sexual Use.** The number of services which a male animal can effectively render is an important question for the breeder. It probably varies greatly with different individuals. Naturally, the power of a male does not rest so much upon the number of females which he is expected to serve as upon the number of copulations essential to cause fertilization. It has been determined by careful investigation that, when the number of copulations during a given day is increased, the abundance of spermatozoa in the semen rapidly decreases and, if this service is pushed too far, the spermatozoa fail almost entirely, causing an interruption of the fertility of the animal. Much will depend upon the age and vigor of the male animal. Zschokke states that 80 to 100 cows may be bred to a single bull when the animal is kept confined and his service somewhat regulated by the breeder but, if allowed to consort with the cows at pasture, not more than 50 should be allowed. In the western range country of America, the allowance is very much smaller and it is considered safer that there be one bull to each 20 or 25 cows. This is necessitated largely by the fact that, during the principal breeding season, the bulls have not yet fully recovered their vigor from the long and trying winter with scant food supply. Zschokke further holds that the bull should not be allowed to serve more than three cows in any one day and that, under such conditions, there should be one or two days per week of complete rest.

In the stallion, similar rules as to numbers and conditions are applicable. The total number of females, however, may be greatly increased over that suggested by Zschokke, if the service is distributed throughout the year, and noted stallions have been known to serve successfully, and without apparent injury, two

or three hundred mares during the year but, in such cases, the service was evenly distributed over the entire period.

Zschokke draws attention to the erroneous belief that a long abstinence from coition serves to store up a large amount of semen, which will answer for a series of copulations. There is no reservoir in the animal body for such purpose, and all semen which may be secreted and not used in copulation soon disintegrates and is expelled or absorbed. On the other hand, he points out that, perhaps, the glands undergo some atrophy from long inactivity and that their function is best preserved by moderate use.

Excessive sexual use is largely a comparative term and indicative rather of a relative over-use under surrounding environment.

There is no question that a breeding male may be readily overdone, nor that such is not a frequent occurrence, but, more commonly, the use becomes excessive under bad management, where proper handling of the male would enable him to make the number of services demanded, safely and efficiently.

Zschokke also draws attention to the very important fact that moderate work during the breeding season is not injurious, but favorable, to fertility and that permanent confinement in the stall tends contantly to a decreased secretion of semen and consequent sterility. It is a constant observation that a male breeding animal which is regularly exercised is capable of rendering a greater number of effective services than one which is closely confined.

The feeding has much to do with the breeding capacity of the male. In quality, some writers condemn such foods as oil cake and malted grain and prefer the various forms of grains and, especially, of oats, barley, peas and beans in moderate quantity. To these should be added hay and grass in sufficient amount. Roots, tubers, meal and molasses are not essential as a part of the food supply for breeding males, but may aid in maintaining a good state of digestion and thus contribute to the general vigor.

The feeding of salt has long been regarded as important in reference to fertility, but it is not known whether it acts directly or merely serves to favor fertility, indirectly, by aiding digestion and assimilation.

4. **Onanism or Masturbation.** Masturbation, as a cause of sterility, is observed chiefly in the stallion and bull. It is very

common in improperly kept stallions. Spinola (Handbuch der spec. Pathol. 1858, II Bd.) records this vice in the bull.

The stallion has an erection, the penis is moved up and down, imitating coitus, until finally an ejaculation of semen occurs. In the bull, the ejaculation is induced by an erection and the alternate protrusion and withdrawal of the penis. This is largely seen in idle males which are closely confined, over fed and sparingly used for breeding and in track stallions when sexual debility is brought about by hard work. It is a question whether the Onanism causes the impotence or the sexual weaknesses induces the masturbation.

Corrections may be brought about by such feeding, exercise and other care as will maintain the general vigor of the animal and, as far as possible, he should have something to divert his attention and exert a favorable psychic influence. Moderate work or exercise and judicious feeding, or, in animals which cannot be worked or artifically exercised, the allowance of freedom in a commodious paddock, or, still better, in a properly enclosed pasture, and especially in company with pregnant females, tends largely to prevent or cure the vice. Once the habit has become fixed, it should be prevented by a shield so arranged as to cause pain whenever the penis is protruded and thus prohibit erection. It is to be constantly viewed as a vice of idleness and debility, and it must be remembered that any and all remedies must fail in their aim until the return to normal vigor is attained.

II. Defective Secretions of the Accessory Glands.

Bass and Furbinger (Deutsche Zeitschr. f. Th. Med. B. XX. page 147) claim that the absence of the prostate secretions leads to an immobility and loss of vigor in the spermatozoa. The general belief of investigators is that the secretions of all the accessory glands—the seminal vesicles, the prostate and Cowper's glands—when added to the semen, tend to stimulate the movements of the spermatozoa, invigorating them and prolonging their life, thus acting as an important accessory in the phenomenon of fertilization. How often sterility may be due to disease or improper function of these glands is not known.

III. Physical Inability to Copulate.

1. **Arrested Development of the Penis,** which we have al-

ready noted on page 127 as occurring frequently in hermaphroditic animals, especially in the horse, is not rare in foals which are otherwise apparently normal, and similar defects may occur in other animals. In these animals, copulation may be impossible, either from the smallness of the organ or its misdirection. The defect is usually not subject to correction, nor is it desirable to correct it, lest the malformation prove transmissible.

2. **Tumors or Herniæ** situated about the opening of the sheath may tend to push the penis aside as it is protruded and thus to so misdirect the organ that copulation becomes uncertain and difficult, if not impossible.

3. **Tumors of the Penis or Prepuce** in male breeding animals are not rare, and constantly tend to interfere with, or prevent, copulation.

We have already, on page 104, alluded to the *infectious granulomata* or *lympho-sarcoma* upon the penis of the dog ; on page 112, to *bursattee of the genitals of the horse* and, on page 113, to *actinomycosis of the genitals of the bull.* Various types of tumors, both benign and malignant, involving the penis or prepuce, are not rare in the stallion, bull and other males. They are quite largely of papillomatous type and, as soon as they attain a moderate size, prevent copulation. Their usual seat is upon the glans penis, where they are easily diagnosed by examining the exposed organ.

In all cases, their removal should occur early, ere they involve the organ to such a degree that their ablation will result in its serious mutilation. In the stallion, the glans penis may be amputated and the copulatory and procreative powers fully retained. In the bull, with the long, tapering glans, amputation is not practical, since copulation is thereby rendered difficult or impossible. In breeding males, the early ablation of penial tumors consequently becomes very urgent, if their breeding powers are to be retained.

4. **Paralysis of the Penis** occurs in all animals, but especially in the stallion. It is usually of central origin and frequently occurs as a symptom of a constitutional affection, like the so-called cerebro-spinal meningitis, dourine, etc., and is a common accompaniment of lumbar paralysis, or of injuries to, or diseases of, the internal pudic or great sympathetic nerves. It is rarely

remediable, and depends for its recovery upon the removal of the cause.

In other cases, the paralysis is local and more or less temporary in character. Any injury to the penis which causes swelling and inflammation tends to induce paralysis, both directly through the disease of the tissues and indirectly as a result of the dragging on the organ due to its increased weight. Rough handling by the groom or violent strains of the organ during copulation may also lead to paralysis. Large tumors on the penis, by their weight, tend to cause paralysis and prolapse of the organ. In penial paralysis, the protruded organ is further exposed to wounds, abrasions and, in cold weather, to freezing.

The handling of penial paralysis in breeding males should be prompt and energetic. The paralyzed organ should be at once supported, in order to overcome the injurious results of pendency. In recoverable cases, the longer the penis protrudes, the greater the danger that the prolapse itself may lead to permanent paralysis of the organ.

5. **Excessive erection of the Penis** (Spasm) sometimes occurs in the stallion and possibly in other animals. It is accompanied by a peculiar interruption of copulatory power, closely analogous to the *vaginismus* of the female. We have personally observed one case in the stallion and have known of a second, both imported French draft horses. These stallions were very amorous and would quickly get an erection, the glans penis becoming excessively large. They would promptly mount mares, introduce the penis momentarily into the vulva for a short distance, suddenly withdraw it and dismount with the penis still fully erected and without the ejaculation of semen having occurred. Repeated efforts were unavailing and constant and prolonged failure to copulate resulted. Zschokke records the case of a bull (Unfruchtbarkeit des Rindes, page 58) in which the symptoms were somewhat similar.

Careful examination fails to reveal any anatomical defect or pathologic changes. The difficulty appears to be wholly functional.

No remedy is certainly known. Vigorous work on a light, laxative diet may be tried. We attempted to overcome the nervous irritability by means of potassium bromide, but failed. Possibly we did not give a sufficient quantity. The horse passed

from our observation before we had an opportunity to fully investigate.

6. "**Broken Penis.**" When the penis becomes violently and abruptly bent while erected, the tissues at the point of curvature become severely injured, inflammation and swelling occur. the erectile tissues become infiltrated and undergo sclerosis. After a tardy recovery, distortion remains; the penis is bent or curved. In addition to the deformity, there is sometimes an interruption of the vascular or nerve supply to the portion of the penis distal to the seat of the injury and, in this part, erection may be wholly wanting, while normal in the proximal portion of the organ. The deformity and want of erection in the distal portion serves to prevent copulation.

Treatment is usually impracticable. The defects cannot, as a rule, be remedied and generally occur too high to permit of successful amputation from a breeding standpoint. In some cases of broken or curved penis, where copulation was still possible, sterility is claimed to have resulted because the semen ejaculated from the bent organ was thrown laterally against the side of the vagina instead of forwards against the os uteri and the spermatozoa failed to enter. The difficulty in such cases was apparently overcome by artificial insemination, the semen being collected from the posterior portions of the vagina and introduced into the os uteri.

7. **Inflammation of the Penis** may arise in a variety of ways. We have already referred to the *Venereal Infections* which generally lead to more or less inflammatory disease of this organ.

In addition, inflammation occasionally results from physical injuries during coition, from kicks in stallions, from lacerations when breaking from enclosures while the penis is erected, from the tail hairs of the mare becoming caught by the penis and cutting it, by the "hanging fast" of the dog during copulation and in many other ways.

The effects of inflammation of the penis upon copulatory powers varies greatly. Some males, like the bull, affected with one of the venereal diseases, may copulate in spite of the fact that the process causes profuse hemorrhage from the penis, which must be accompanied by pain. The stallion with bursattee of the urethra proceeds to copulate regularly, although he bleeds

freely after each service. In this case, as in bursattee of other parts, there is usually, no evidence of pain. At other times, moderate inflammation of the penis may cause a male to desist from coition, although the sexual appetite is unimpaired and erection occurs; in others, the inflammation inhibits erection.

Inflammation of the penis should be promptly and energetically handled, not only that we may thereby cause its eventual subsidence, but also to anticipate and avoid deformities and paralysis. In general, the handling is to be based upon antisepsis, combined with astringents and cold, not neglecting to effectively support the organ, retaining it within the sheath if possible. The patient should be removed from sexual excitement and any internal medication which conditions suggest applied. Should the inflammation be acute and the swelling great, no time should be lost in inducing prompt catharsis by means of eserine, arecoline or other drugs of this group; delay in awaiting the action of aloes or oil may prove serious.

8. **Adhesions between the Penis and Prepuce** are especially liable to occur in the bull and other male ruminants, and constitute very serious obstacles to copulation. Resulting usually from some chronic inflammation of the penis and prepuce, the contiguous mucous layers, their protective epithelium having been destroyed, adhere in such a manner as to prevent protrusion of the penis. We have observed such a case in a valuable bull. Where possible, the adhesions should be surgically overcome and their recurrence prevented but, as a rule, they are not subject to remedy.

9. **Phymosis** occurs in various animals as a result either of tumors or enlargements of the glans penis, which prevent its passage through the normal preputial opening; more generally, the preputial opening becomes narrowed by inflammatory processes, possibly intensified by the deposit of urinary salts and epithelial debris. Naturally, it is most liable to occur in the ruminant and the dog, with narrow preputial openings. It is rare in the horse, where the opening is very ample.

In the bull, it is liable to ensue from the deposit of urinary concretions in the sheath, as a complication of intense preputial inflammation, with great swelling. It is readily recognized by the pain, heat and swelling of the parts, and the very fetid preputial discharge.

The handling of phymosis consists essentially of the control of the infection which has caused it. The prepuce and sheath need be thoroughly and repeatedly douched with a warm antiseptic solution, not too powerfully irritant, such as a ½ % solution of potassium permanganate, or a 1 % solution of carbolic acid or creolin. The solution should be used in large volume so that the sheath and prepuce are repeatedly filled until the entire cavity is thoroughly cleansed and disinfected. In the bull, the preputial tuft of hairs should be removed in order to facilitate cleansing.

When the preputial opening is too greatly constricted, especially in the bull, so that cleansing the cavity through the normal opening is difficult or impracticable, the sheath is to be freely opened, either by surgical enlargement of the preputial opening or by a perforating incision through the inferior wall of the sheath at its posterior extremity. The latter method affords excellent facility for thoroughly cleansing the narrow, elongated sheath of the bull. With the latter plan, the antiseptic fluid can be injected through the preputial opening and allowed to escape through the incision at the posterior extremity of the sheath.

10. **Paraphymosis,** or the protrusion of the penis through an incarcerating preputial opening, interferes with normal erection and copulatory power. The incarcerated glans penis becomes engorged, swollen and inflamed so that it is too painful to permit of copulation, and functionally incompetent.

Observed chiefly in the dog, it more frequently follows than prevents copulation, but, having occurred, prevents coition until remedied. It is to be remedied by a reduction of the paraphymosis. The incarcerated glans penis is, usually, greatly swollen and exceedingly painful and cannot be readily returned to its position. After cleansing with tepid water, to which a little lysol or soda bicarbonate has been added to render the parts unctuous, the enlarged glans is to be decreased in volume by digital compression and finally pressed back through the preputial ring. Failing in this, the preputial opening needs be dilated by a small incision with a probe-pointed bistoury, enlarging the opening just sufficiently to permit the return of the glans. This may be followed by antiseptic dressing.

11. **Lumbar or General Paralysis,** as a bar to copulation,

is most frequent in the stallion, but is possible in all males. We have already referred to the paresis of Dourine as rendering the stallion unable to mount the mare.

Usually, when any marked lumbar or general paralysis is present, the male is unable to mount the female and, hence, fails to copulate. In many cases, paralysis of the penis, to which we have already referred, accompanies these affections and also serves to inhibit copulation, even if the animal be able to mount the female.

Usually this group of affections is not subject to cure or alleviation and can be successfully handled only in those extremely rare cases where the cause is removable.

12. **Painful Diseases of the Feet and Limbs** or of other parts, which may cause great suffering during coition, serve to render copulation uncertain or to prevent it. Diseases of the bones, like osteoporosis, spavin, ringbone, or painful diseases of the hind feet, such as wounds, quittor and others, serve to cause great and even unendurable pain when a male, like the stallion, is compelled to bear his chief weight on the two posterior members while mounting the female. Aside from this difficulty, in some of these there is a decreased formation of spermatozoa as well, owing to constitutional disturbances and loss of general vigor.

13. **Diseases or injuries** along the inferior part of the chest or abdomen, so situated that they come in contact with the female during the act in a way to cause great pain to the male, tend to cause him to desist from attempts at copulation.

Their prognosis will vary greatly according to cause, being favorable where the latter can be removed, unfavorable and permanent where the causes are fixed.

The handling is along general surgical lines according to conditions.

14. **Over Size** of the male apparently acts as a bar to copulation in some cases. An old bull may become so heavy and fat that it becomes difficult for him to mount cows. Zschokke also suggests that overfilling of the rumen may so weight a bull as to render his mounting a cow exceedingly difficult. The nature of the condition, itself, indicates the rational method of handling.

15. **The Age** of the male, especially as related to size and maturity, may affect his ability to copulate. We have already

referred to the danger to small or young bulls in attempting to serve mature cows of large size. If this disparity in size be too great, copulation may be not only unsafe but even impossible.

With an undersized young male, care should be taken to give him an advantage in the breeding place. The hind feet of the cow should rest upon lower ground than that upon which the bull stands and the ground should be dry and of a character to afford secure footing. The breeding stocks recommended by Zschokke and briefly described on page 61 may here be used with benefit.

IV. Infectious Diseases.

In describing the venereal diseases, (page 73) we have already recorded their tendency to the production of sterility, especially in the dourine of the stallion and infectious granular venereal disease of cattle. On page 68 we have alluded to the tendency of epizootic cellulitis, or pink eye, to cause sterility in the stallion.

The Examination of the Male in relation to Sexual Efficiency.

The ultimate test of sexual efficiency in the male is the regular production of young. This test is not always before us nor is it always essential. Such conditions as abdominal cryptorchidy, chronic orchitis with enlargement and induration of the testicles and numerous other conditions, require no physiologic test, but the anatomical conditions alone warrant a verdict of sterility of an incurable kind. When he fails in the test, the question arises as to the cause of sterility, its prognosis and handling.

An animal may be highly fertile at a given time, be fatted for the show ring or sale and, a few months later, may prove to be wholly and irrecoverably sterile. In our examination, we need first secure from the owner or caretaker a history of the animal as a breeder, the breeding anamnesis. The veterinarian should determine the presence or absence of sexual desire by bringing the male into the presence of a strange female and observing his actions. A careful distinction should be made between an absence of sexual desire and a failure of erection of the penis.

In the presence of sexual desire, his ability to mount the female and copulate should be tested. It should be determined

whether ejaculation occurs or not. The act of ejaculation may be observed by watching over the course of the urethra for the wave-like movements caused by the propulsion of the fluid through the channel. If ejaculation has not occurred, when the male dismounts, the penis is still erected, probably more than at the commencement of the effort. This is especially notable in the stallion.

In some animals, especially the mare, a large portion of the semen is at once expelled from the vagina and may thus or otherwise be readily secured for further observation.

The manual exploration of the sexual organs needs be careful and complete. The testicles should be normal in size, form, location and density and free from adhesions. Their surfaces should be smooth and even and the spermatic cords normal in size, soft, movable and regular. The accessory glands—vesiculae seminales, Cowper's and prostate—and the vasa deferentia may be examined manually in the larger males and digitally in the smaller, and any disease or marked abnormality noted. For this purpose, the veterinarian in a breeding district should make himself expert in the palpation of the internal genital organs by rectal exploration. The novice can draw no safe conclusions by rectal palpations, which acquire diagnostic value only by repeated application in practice.

The penis needs be completely exposed for proper examination, when diseases and deformities may be readily detected. The urethral opening should be carefully inspected and, if necessary, explored to any desired distance with a sound or catheter.

The quantity and quality of food should be carefully determined and the amount of exercise or work permitted or enforced should be learned.

Finally, much may be learned, if the animal copulates, by an examination of the semen. While the seminal fluid can be preserved for hours and carried a long distance, it is preferable to examine it at the breeding place. Immediately after service by the male, semen should be taken from the vagina and placed in a watch crystal or on a slide with a cover glass and examined under a low power microscope.

If this is not practicable and it is desired to make the examination at a point distant from the breeding place, freshly ejaculated semen may be placed in a flask, which should be immersed in

water at about 100° F. and maintained at this temperature until the examination can be made. This should be done with as little delay as practicable.

The spermatozoa should be abundant and show very vigorous movements. Even then, it is at times difficult to judge exactly. We have examined semen from stallions of very low fertility, which contained abundant motile spermatozoa. The low fertility apparently depended upon a want of vigor or virility in the spermatozoa, not distinguishable under the microscope. But the presence of abundant living spermatozoa leads to the valuable conclusion that the glands are functioning and that the fertility may be heightened or perfected by bringing about a higher degree of bodily vigor of the male through properly regulated food, work and other agents and the virility and fecundating power of the spermatozoa themselves raised thereby to the normal.

B. Sterility of the Female.

The consideration of sterility in the female may be outlined as follows:

I. Diseases and Defects of the Ovaries.

1. Congenital Defects.
2. Oophoritis.
3. Tuberculosis.
4. Tumors.
5. Edema.
6. Cystic and Fibrous Degeneration of the Ovaries. Nymphomania.
7. Persistence and Hypertrophy of the Corpus Luteum.
8. Senile Atrophy.
9. Debilitating Diseases, Emaciation, Overwork.

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I. DEFECTS AND DISEASES OF THE OVARIES

1. Congenital Defects of the Ovaries.

The fundamental basis of fertility in the female is the living, fertilizable ovum, which must be elaborated by the ovary, discharged therefrom, canght up by the pavillion of the oviduct, met and fertilized by the spermatozoa of the male and, migrating along the oviduct, reach the uterine cavity and establish intimate relations with the uterine walls, by which it may secure nourishment.

The function of the ovary is fundamental in character, elaborating the ovum and discharging it when the ovisac ruptures. This completed, the direct function of the ovary ceases and its relation to fertilization and the maturation of the fetus is chiefly at an end. Still, it exerts an influence. If the ovaries of a pregnant animal are removed, there is a definite tendency toward abortion and it seems that it is not the ovaries as a whole which exert this influence upon the fetus, but the corpus luteum, which remains at the seat of the ruptured ovisac, from which the impregnation has resulted. According to Hess, if the corpus luteum is forced from the ovary of a pregnant cow, she will abort. Very rarely also the fertilization of the ovum occurs while it is yet in the ovisac, but presumably only after its rupture, while the egg remains adherent to the walls. Eventually this causes the exceedingly rare phenomenon of ovarian pregnancy. The completed function, therefore, of the ovary includes ovulation, since it is immaterial how many ova the gland contains until, by discharge, they become available for fertilization.

The causes of non-ovulation are numerous and may consist either in the failure of the ovaries to produce mature ova or of the intervention of some obstacle to the rupture of the ovisac and escape of the egg.

Arrest in development or absence of the ovaries occurs with approximately the same frequency as the analogous condition of the testicles, with the exception that the female gland does not fail to attain functional maturity because of defective location, its normal adult position being within the abdomen, not widely separated from the point of embryonic origin.

In rare cases, the ovaries are displaced by passing beyond their normal adult position and, escaping through the abdominal ring, come to rest in the region corresponding to the scrotum of the male. However, this false position does not interfere with their function, like the abdominal retention of the testicles.

Freemartins. In bovine twins, we meet, frequently, with an interruption in the sexual development of one of the pair, which is generally known by the term "freemartin." The general belief among breeders is that when both twins are of the same sex they are normally developed but that, when one is a male and the other a female, the latter undergoes an arrest in development and becomes a freemartin. As a matter of fact, this is not always true and a pair of twins representing both sexes may be completely developed and capable of breeding, but very largely the rule holds that a freemartin is one of a pair of twins, the other of which is a perfect male.

The origin of this peculiarity has not been well determined. While similar arrests in development are seen occasionally in all species of animals, whether twins or not, there is no other instance where such a condition is expected with such regularity. It is a quite possible that the defect is due to the fact that, in such cases, we have to do with homologous twins which have originated from the division of a single ovum, after impregnation, and that one of these has suffered from an arrest in sexual develment. Why the other should be always, or usually, a male has not been discovered.

The character of these animals is generally quite uniform In form, voice, behavior and other attributes they are frequently asexual. The head and neck partake neither of the character of the cow nor bull, but remind one more of an animal which has been castrated very young and has developed no sexual characteristics. The horns are fine, usually straight and not very large. The head and neck are fine. They behave and feed like castrated animals, and usually show no trace of sexual desire.

Examined externally, they usually show at the ordinary location of the vulva a small urethral opening, having the general appearance of that organ, though very diminutive.

Examined internally, the genital organs are generally found to have been arrested in the indifferent stage of development where the sexual characters are not yet far enough advanced to

state whether it be male or female. The vagina and uterus may be somewhat developed but are very rudimentary, while the essential glands may resemble more or less the testicle or the ovary but, as a rule, can scarcely be classified as either but simply as a genital gland in the indifferent state.

Freemartins are frequently spoken of as hermaphrodites and, in a certain sense, they may be so regarded but, since they frequently have neither sexual desire, character, nor power, it would be better to speak of such as neuters.

It is sometimes important that it be determined as early as possible after the birth of twin calves if one of the pair is a freemartin or not. At an early age the question may sometimes be satisfactorily answered by observing the size and form of the vulva, especially by comparing it with a normal calf of similar age and size. If the vulva is normal, it is probably a normal heifer; if small, it is probably a freemartin. In a freemartin, the cavity of the vagina is frequently absent, which may be recognized by the inability to introduce a sound or a finger beyond the meatus urinarius. As the age of puberty approaches, the differentiation between heifers and freemartins becomes greatly facilitated. The vulva does not grow or it might better be said that a vulva does not exist, but rather a urethral opening in the perineal region, very narrow, constricted and scarcely admitting of the insertion of a man's finger. No clitoris is recognizable. The animal fails to develop sexual characters in form, voice or behavior. In some cases there is present a definite vulva into which two, three or more fingers may be passed. Rectal exploration may reveal ovaries and uterus or cornua in varying degrees of perfection and estrum may occur.

Hermaphroditism habitually leads to an arrest in the development of the ovary, by which it retains more or less of its fetal character and fails to function.

In mules and other hybrids the ovaries fail to produce fertilizable ova as a rule, to which there are rare exceptions. In these animals there is usually a well marked or even exaggerated sexual desire, presumably due to the development of imperfect ova, followed by ovulation.

Like the testicles, the ovaries are sometimes the seat of **dermoid cysts,** which may contain hair or teeth. They are necessarily congenital and may attain indefinite size. Usually involv-

ing the gland to such a degree as to compromise the formation or persistence of normal ovarian parenchyma, ovulation from the affected gland does not appear and sexual desire is not induced by the presence of such glands, though, if one be normal and the other has undergone aberration, estrum and even fertilization may result from the presence of the one normal ovary.

Calcareous degeneration of the ovaries may occur as a congenital defect, the gland assuming a variable form and size and consisting essentially of a mass of calcareous matter devoid of proper ovarian tissue. The condition leads to sterility and absence of sexual desire.

In many cases of arrested development of the ovaries, the sexual desire and attributes are wholly absent. In most instances of the undeveloped ovaries, except in hybrids, the condition may be suspected by the diminutive size of the vulva. In cases of dermoid cysts and congenital calcification of the ovaries, the condition may, usually, be determined by rectal or vaginal exploration.

This group of affections is essentially incurable, from a breeding standpoint. When the ovaries are so defective that they induce no sexual desire and cause no inconvenience to the patient, no interference is demanded. When dermoid cysts or other defects induce undesirable conditions, the removal of the involved gland is indicated. In all those cases where nymphomania, or perverted sexual desire, is present, castration is indicated.

Oophoritis. Inflammation of the ovaries is rare in the domestic animals and the symptoms are, usually, not recognized during life. Upon post-mortem examination, it is not rare to find the ovaries, especially of cows, studded over with fibrous tufts, pointing to an inflammatory origin, or the glands adherent to the pavilion of the oviduct. Adhesions of the ovary to the pavilion of the oviduct is sometimes recognizable by manual exploration per rectum, but the condition is not subject to remedy, so far as breeding is concerned. Such animals may be castrated and prepared for the butcher.

3. **Tuberculosis of the Ovaries** is observed in cows as a cause of chronic oophoritis and sterility and may occur, more rarely, in other animals. Zschokke denies that tubercular ovaries constitute a common cause of sterility, and records that among 110 sterile cows but 2 % were referable to ovarian tuberculosis.

According to this authority, ovarian tuberculosis does not, as a rule, cause nymphomania or produce other symptoms during life beyond sterility, which may be further identified by palpation of the glands, when they may be found enlarged and nodular. A further aid in diagnosis may be secured by the tuberculin test. The affection is beyond remedy.

4. **Tumors of the Ovaries** are somewhat rare in domestic animals but are found, occasionally, in all species.

They may be malignant in character and tend to acquire large size before their presence is suspected or discovered. There are sometimes seen adenoid tumors of great size. In the museum of the New York State Veterinary College is an adenoid ovarian tumor from a sow, weighing 38 pounds. Becoming sterile, she was fatted and upon slaughter the immense tumor was discovered. Cystic tumors are occasionally seen of immense size, especially in the mare.

Ovarian tumors tend constantly to cause sterility with or without nymphomania. A tumor of one ovary constantly tends to inhibit ovulation from the other gland. It is usually either the sterility or accompanying nymphomania which attracts attention to the animal and leads to an examination per rectum or vaginam, which discloses the presence of the tumor.

Tumors of the ovary are to be identified by their location, the absence of the normal ovaries and the presence of the tumors to which the corresponding uterine cornua lead and are attached. The ovarian tumor may contract extensive and firm adhesions with the walls or viscera of the abdomen or pelvis and thus complicate the question of diagnosis. Its true character is then to be determined by tracing along the uterus, cornu and oviduct to the ovary and thus indentifying it by its relation to the uterus. We have observed the tumor displaced by such adhesions, so that it occupied a quite abnormal location. If essential to a correct diagnosis, an exploratory incision may be made through the vaginal walls in the mare or cow or through the abdominal walls in the smaller animals. If discovered while it is of operable size, it should be promptly removed. When involving one ovary only, the successful removal of the tumor will usually restore to functional activity the remaining normal gland.

5. **Edema of the Ovaries** is described by Zschokke as occurring, in his experience, in old, nymphomaniac cows. The ovaries are somewhat enlarged and contain a few small follicles but no corpora lutea. Upon incision, the dropsical fluid is easily pressed out from the cut surface. The cut surface is grayish red in color and shows the usual characters of edema, which is confined to the gland itself.

The abnormality is to be differentiated chiefly from cystic ovaries and persistent corpora lutea. Examining the glands carefully per rectum, the touch reveals the somewhat large, soft, yielding ovary in contrast to the firm fluctuating and sharply defined cysts of cystic degeneration or the prominently enlarged and comparatively firm, non-fluctuating persistent yellow body.

The dependent sterility is usually beyond remedy and, in case of nymphomania, ovariotomy should be performed in order to cure the vice and permit the cow to be fatted for the butcher.

CYSTIC AND CYSTO-FIBROUS DEGENERATION OF THE OVARIES OF COWS. NYMPHOMANIA[1]

The most frequent and important disease of the ovaries is cystic degeneration, to which Zangger was the first to draw attention, in the Schweitzer Archiv. für Tierheilkunde, Volume XXII, 1859, page 280.

It is essential to a proper comprehension of the subject that we have in mind a brief outline of the formation, rupture and obliteration, or astresia, of the Graafian follicles and that we recognize the significance of the formation and degeneration of the corpus luteum for the further development of ovisacs and the origin of ovarian cysts, in which we follow the highly scientific and meritorious investigations and contributions of our anatomist, Professor Doctor Rubeli.

It is known that the reproductive cells originate from the germinal epithelium, which sinks down into the stroma of the ovary in the form of cell tubes. The formation of ova in hoofed animals is generally completed at the time of birth. According to Bonnet, there may, in exceptional cases, be a possibility of a new invagination of the germinal epithelium upon the margin of a ruptured ovisac.

The primitive ova in the young ovary either lie somewhat scattered, as in ruminants and swine, or arranged in groups in the peripheral layer of the ovary. When the germinal epithelium has ceased its invagination, the *tunica albuginea* is formed as the outermost zone of the stroma, over which the ovarian epithelium extends. The primary eggs then become s parated from each other by the ingrowth between them of the ovarian stroma, which pushes in between the cells and leaves each ovum surrounded by a single layer of smooth cells, constituting the primary follicular epithelium. Heitz (Archives für Wissensch. u. Prakt. Tierheilkunde, Vol. 32, 1906) recognizes that, in the ovaries of calves, the epithelium may consist of a single

[1] In the following pages, (161–234) so far as they deal with sterility and nymphomania due to cystic or cysto-fibrous degeneration of the ovaries, to persistent *corpora lutea*, or to pyometra in cows, we have, with his permission, inserted, essentially entire, the admirable report of Prof. Dr. E. Hess of the Bern veterinary school, entitled "The Sterility of Cows", presented at the Annual Convention of Swiss Veterinarians at Freiburg the 19th of October, 1905, and appearing in the Schweizer Archiv. für Tierheilkunde, No. 6, 1906, page 351. The illustrations and some brief additions, in [ ] are our own.

layer of endothelium-like cells or of a concentrically arranged double layer. From the primary follicular epithelium there develops from the cells a cylindrical epithelium, which thus forms several layers. Regarding the origin of the follicular cells, opinions vary. While, in the lower vertebrates, these cells certainly originate from the germinal epithelium and this source for the mammalia is accepted by many investigators, Kölliker, Ronget and Bühler believe that, in the formation of the follicular epithelium, the medullary fibres, or genital portions of the Wolffian bodies, play an important part, or, indeed, in the case of the dog, cat and fox, constitute the exclusive source of these cells. Heitz observed in the calf, in the neighborhood of an ovum surrounded by so-called primitive follicular epithelium, a group of granulation cells, which so increased at that point where the ovum was located that an excavation took place and, thereby, completely encompassed it. The granulation mass either already contained the ovum before the development of a follicular cavity or else acquired this cavity after the egg was completely surrounded. One of the foregoing conditions appears, from these observations, to be the ordinary course in the calf.

As soon as the follicle has acquired a certain size, it ruptures and discharges the egg and the follicular fluid. There is still a division of opinion as to the cause of the rupture of the follicle. It is highly probable that there occurs a sudden augmentation of follicular liquid owing to vasomotor irritation of the nerves and, consequently, a greater pressure on the part of this fluid, along with simultaneous thinning of the follicular walls at that part of the vesicle where it is to rupture. Hölzl, on the other hand, compares the rupture with that of the formation of an abcess, in that, between the granular membrane and the *theca fol iculi* there occurs an important accumulation of migratory cells which form the so-called *theca fotliculi interna*.

Under the pressure of this infiltrated cell mass, the contents of the follicle are expelled in the direction of least resistance, that is, upon the external surface. Zschokke holds a similar view, though he does not attribute the rupture to the infiltration of the migratory cells, but to the multiplication of the cells of the theca itself at the base of the follicle. From the view-point of these two investigators, the thickening of the *theca interna* at the base of the follicle and the thinning of the wall upon the surface of the ovary has a special importance. However, it is essential to remember that the unequal thickness of this membrane must be referred to the condition of the blood supply since, indeed, the vessels become atrophied in that part of the follicle where the rupture is to occur, and, hence, the nutrition of this part of the theca becomes deficient. If now the membrane increases in thickness on one side and decreases on the other, so will the follicular contents be massed against the thin portion of the wall. The rupture of the follicle, consequently, does not become inevitable except there occurs a simultaneous increase of the intra-follicular pressure and an atrophy of the wall at the most prominent point, where it is to be ruptured. If the latter were not the case, there would necessarily occur more or less hemorrhage when the follicle breaks, which, however, Zschokke himself denies for the cow.

Against the Hölzl-Zschokke view there is, first of all, the occurrence of

atresia of the follicle, since, in this case, indeed, the theca interna becomes extraordinarily thickened yet does not lead to rupture of the follicle because, in that case, the follicular fluid becomes decreased and the pressure, as a consequence, is lessened.

Zschokke believes that a simple increase of the follicular fluid can not occur through hyperaemia because artificial or inflammatory hyperaemia does not cause ovulation; on the contrary, it is to be observed that a local hyperaemia which affects the *theca folliculi* alone evidently exerts a different influence from an artificial or inflammatory hyperaemia which involves the entire ovary. It is, moreover, to be remarked that the pressure of the follicular fluid in follicles of different sizes is variable in degree because the amount of fluid evidently varies with the size of the follicle, whereas the intrafollicular pressure alone can have the power to rupture the follicle.

Zschokke believes also, a conclusion based upon personal observation, that ovulation often occurs in the beginning of estrum and that it is, consequently, to be held that the rupture of the follicle occurs, in some cases, before estrum has reached its zenith. We hold, on the one hand, from facts known for many decades, that ovulation, which is to be regarded as the manifestation of vaso-dilation, ushers in estrum; we might however, on the other hand, emphasize the fact that the most evident normal clinical symptoms of estrum are not to be regarded as occurring at the same moment as the highest degree of ovarian hyperaemia. It seems to us far more probable that hyperaemia of the ovary precedes that of the uterus and vagina and that such a view is more plausible and correct. One argument for this view lies in the fact that, when cows, especially those in pasture, are bred at the beginning of estrum, they become pregnant.

In regard to ovarian cysts, we have found small cystic follicles in ovaries of calves, ten to twelve days old, which were investigated by Heitz. These investigations showed that 80 % of the ovaries of cows contained cysts at least 3 mm. in diameter. In numerous cases, the cysts had a diameter of over 10 mm. and four times they reached 13 mm. Often there occurred in certain of these ovaries one or more cysts so greatly developed that the proper tissue of the ovary appeared as an unimportant appendix. By microscopical examination these were recognizable as internal follicles. The granulosa exhibited no marked changes, whereas degenerative processes existed in the egg. These follicles do not rupture spontaneously, since nowhere could there be seen yellow bodies or other evidences, like scars or fibrous tufts, which indicated ruptured follicles. Many of these follicles retrograde, many, perhaps, become cysts, because they show absolutely no decrease in size, in spite of the fact that the egg has already undergone serious degeneration. Cysts are not infrequently observed even before the first pregnancy.

Also, in new-born calves and heifers, one meets, according to Waldeyer[1] and others, with follicles as large as peas, containing normally developed ova. The same is true for various other species of animals. On the

[1] Waldeyer in Hertwig's Handbuch der Entwicklungsgeschichte, p. 374.

whole, these are rare exceptions in other animals, while, in the calf, they are extraordinarily common.

It is readily understood that the prematurely appearing follicles do not rupture, for there is wanting, at this time, the hyperaemia of estrum, through which, after the advent of puberty, the intrafollicular pressure in adults becomes increased.

Heitz could further determine that all follicles existing in calf ovaries had emanated from simple primordial follicles and had no relation to sheath follicles or ovarial adenoma.

According to Simon[1] the large, distended, degenerated granular cells appearing so numerously, lying in the inner zone against the inner walls of the cyst, play an important role in the genesis of these cystic follicles.

The most convincing argument of all would be the recognition of an ovum in such cysts. This evidence it has thus far been impossible for us to adduce, since the cysts, in the preparation of the material, were incised or ruptured, permitting most of the contents to escape. Zschokke has searched many cysts for ova but was unable, in a single case, to detect any. According to this author, it is well nigh impossible to secure the entire follicular contents and adequately search them microscopically. The exact contents of these follicles in the cow need be fully determined.

I believe it is possible to explain the cause of the existence of cysts directly by the structure of their walls, without taking into consideration the formation or nonformation of the corpora lutea, which view, however, as is made clear by the preceding quotations, is by no means established in a manner free from objection.

If we study the delicate tissues which make up the Graafian follicles of the ovary, we are at once impressed with the thought that the least general or local pathologic changes must serve to interfere with the nutritive processes in them.

If the contents of such a follicle perish as a result of these changes, the theca, which no longer receive adequate nutrition, cannot fill the cavity and thus obliterate the existing defect. This may be seen in follicular atresia, in which a fine-meshed connective tissue network grows out into the follicular cavity from the *theca interna*. Through transudation from the few existing vsesels, the *liquor folliculi* becomes increased and the follicular capsule then surrounds a cavity filled with a fluid poor in cell contents.

Contemporary with the destruction of the follicular contents, there occur changes in the follicular wall. It becomes markedly poor in cells and vessels. The previously round cells assume a polygonal form and show polar outgrowths, which establish connections with neighboring cells. There are now observed, in relatively large numbers, round cells appearing scatteringly amongst the polygonal ones. The inter-cellular substance, at first fibrous, becomes more homogeneous in the outermost zone, which is almost wholly devoid of cells, and stains intensively with eosin. The vessels

[1] A. Simon, Anatomisch-histologische Untersuchungen der Ovarien von 95 Kastrirten Kühen, Berner Inaugural-Dissertation, 1904.

ultimately atrophy completely, except upon the margin of the external zone, where there are still seen a few vessels.

It is precisely this non-vascularity which is generally typical of the cyst walls investigated by us and, according to our view, constitutes the best indication for the explanation of the development of cysts from Graafian follicles.

After the follicle has ruptured there occurs, in its place, the residual body, corpus luteum. It is a more or less spheroidal body, attaining a variable size, according to whether impregnation has occurred or not. In the first instance, it becomes extraordinarily large. It may exceed by several times the volume of the gland itself and persists throughout the period of pregnancy, to disappear only after birth. We have in this instance to deal with the *corpus luteum vera*, or the yellow body of pregnancy. In the latter instance, it remains smaller and disappears a few weeks later; here we have to do with a *corpus lutea spurium*, or the yellow body of estrum.

Among the alleged causes of the formation of these larger *corpora lutea* and their longer duration, are increased or decreased blood supply to the ovary during the period of pregnancy. Schulin sees the cause for the greater growth of the true *corpus luteum* in the decreased supply of nutriment to the ovary. In this connection, from observations made in pathology, he emphasizes the fact that soft granulation masses persist, not in vigorous, but only in feeble, sickly men. Bonnet states explicitly that the disappearance of the yellow body is delayed because the ovary becomes anæmic owing to the fact that, during pregnancy, the hyperæmia of estrum becomes stable in the uterus, vagina, etc., as he has been able repeatedly to demonstrate to his personal satisfaction. Hölzl takes directly the opposite view. According to him, the ovaries should receive a larger amount of nutrition during pregnancy owing to the increased flow of blood to the genitals. He believes that, during pregnancy, the ovaries hypertrophy, whereas a badly nourished organ does not. According to his view, the true *corpus luteum* persists for a longer period because, during pregnancy, there is a regular diapedesis and hemorrhage into the yellow body so that one finds, in gravid animals and those in the puerperal state, yellow bodies, which are greatly enlarged as a consequence of hemorrhages into them and have in their center a well-defined blood clot, completely enclosed. Similar observations have not yet been made in the cow since, in this animal, hemorrhage into the follicular cavities is unimportant or wholly absent. Hence the alleged causes for the longer continuation of the yellow bodies which have been observed in woman are not present in cattle.

The *corpus luteum* consists of a brownish-yellow or ochre-yellow capsular layer, which contains lutein cells, and a soft, gray, transparent nucleus, which consists of newly formed connective tissue containing few cells and supplied with blood vessels; sometimes there exists blood debris derived from cells which have undergone disintegration or fatty degeneration, perhaps mixed with cells, connective tissue fibres, etc. As the yellow body undergoes retrograde changes, there develops a form of connective tissue, which contracts to constitute the *corpus fibrosum albicans*. The remnant then represents merely the contracted nucleus of the yellow body, *corpus*

fibrosum simplex; or it may contain a large amount of blood pigment, *corpus nigrum.*

Regarding the formation of the yellow body, there is still much difference of opinion. According to Bischoff, Schrön, Pflüger and others, this structure emanates from the *membrana granulosa;* von Baer, Kölliker, His, Spiegelberg, Paladino and others consider that it is formed from the *tunica interna folliculi.* Large spheroidal, polygonal lutein cells occur within the fine fibrous connective tissue stroma of the yellow capsule wall and contain large spherical nuclei, nucleoli, nuclear debris and a finely granular pigment (lutein lipochrome) permeating the protoplasm. According to Sabotta, in the mouse and rabbit, and to van Beneden and Honoré, in rabbits, these certainly arise from the membrana granulosa. The same origin holds good, according to Giacomini, and also Mingazzini, for reptiles and birds. Van der Stricht saw these cells derived, in part, at least, from the granulosa in *vesperugo noctula.* On the other hand, Clark, Nagel, Bühler and Stökel are of the opinion that the lutein cells are derived from the cells of the *tunica interna folliculi.* Zschokke speaks in much the same way of the origin of the yellow body in cattle. He says, "I have for a long time thoroughly studied and sectioned dozens of ovaries of various animals and am fully convinced that they are derived from the *tunica interna.*" He found a distinction in the nuclear staining of the granulosa cells and those of the tunica; the first was more intense. He further observed that the debris of the granulosa could be differentiated by their form from the growths emanating from the *tunica interna.* It is impossible, however, for one to determine these differences in the illustrations in Zschokke's work and to recognize which tissue one is observing because the magnification is too feeble.

The destiny of the yellow bodies is chiefly that they shall occupy the cavity which occurs as a result of the rupture of the follicles.

According to Bohn, who agrees with Fränkel and Cohn, the yellow body consists of a substance secreted by the system, being derived from the blood through the influence of the attachment of the egg to the uterus. Closely allied to this, also, is the view that the yellow bodies, through these secretions, exert a restraining influence in a certain way upon the ovary and the further development of follicles. In relation to the latter point, perhaps, the simple pressure of the yellow body upon the ovary is partly responsible for the result. Zschokke asserts that, where large *corpora lutea* exist, as a general rule, large, ripe follicles are wanting, while, at the same time, in these animals, estrum is usually absent. Other veterinarians have, on the other hand, observed that the existence of yellow bodies does not always prevent the occurrence of estrum.

In reference to the number of ovarian cysts occurring in one animal, we have found in ovaries secured by castration or after slaughter that one gland may be normal while the other has undergone cystic degeneration in an extremely variable degree. Very frequently both ovaries suffer, sometimes equally, but far more

commonly in a different degree. Not infrequently one observes in an ovary, both superficially and deeply, one to four cysts; in other cases, one large cyst. Ovaries containing two to three large and two to four small cysts are by no means rare. While, under normal conditions, the ovary of the cow varies in size between a bean and a large hazelnut, the gland which is affected with cystic degeneration shows, upon its nodular surface, varying numbers of stellate, radiating or linear scars. The special position of the cysts, which always develop from the follicles, is the *stratum parenchymatosum* and especially the *stratum vasculosum*. In the former, the location of the cyst is more superficial or peripheral, while, in the latter, it is central, The cysts, usually with smooth walls, are found located, as a rule, at the inferior or superior pole of the ovary or occur simultaneously in both positions, and, generally 3 mm. from the mesovarian or ligamentous border and 1–10 mm. from the free border. Cysts also occur imediately upon the free border, especially in the middle of the organ. It is, moreover, quite common to find in the center of the ovary, one

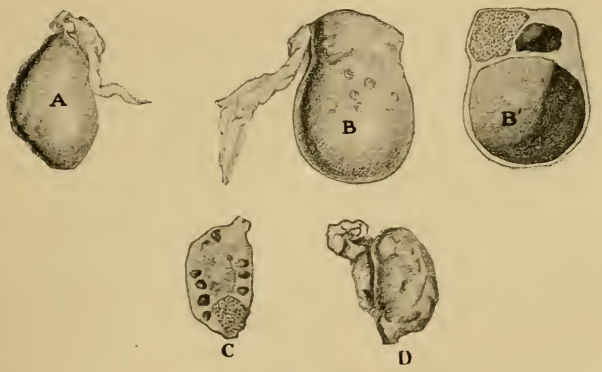

FIG. 16. NORMAL AND CYSTIC OVARIES OF COW.

A, B, B′, Cystic ovaries.

B′, Section of B, showing it to consist of two large cysts and one corpus luteum with no visible ovarian tissue.

C, Section of the normal ovary, D, showing ovisacs and one corpus luteum. One-half size.

to four follicles of the size of a pea or small hazlenut. These do not project beyond the surface of the gland, but occupy the place of the vascular stratum, around which the external part of the ovary continues to form a tissue capsule 3–8 mm. in diameter. In isolated instances, also, the ovary may undergo atrophy because of the formation of abnormal follicles, until it becomes merely a remnant, in which only a few small follicles can be distinguished. Many times, in the sound portion of the surface of the ovary, there are observed numerous follicles.

In regard to the extremely variable thickness of the walls of peripheral cysts, it is to be emphasized that, in many cases, their walls are as thin as paper, consisting of a very delicate cuticle, which is easily ruptured upon pressure; in other cases, on the contrary, there is a thickness of 6–8 mm., which explains the fact that spontaneous rupture of the cyst may occur or that a variable degree of force may be necessary in order to crush it.

Analogous to the variations in the strength of the exterior walls, there are also differences in the thickness of the sheath walls of the ovarian tissue of the cyst in one and the same ovary, ranging from 1–8 mm.

According to the anatomo-histologic investigations of Simon, already quoted, under the direction of our esteemed colleague, Rubeli, in the Veterinary Anatomy Institute of this college, the average volume and weight of the ovaries of 95 castrated cows was as follows:

	Right Ovary.	*Left Ovary.*
Maximum weight	25.4 gr.	20.3 gr.
Medium weight	14.33 gr.	10.11 gr.
Minimum weight	6.8 gr.	5.2 gr.
Maximum length	7.0 cm.	5.1 cm.
Medium length	4.3 cm.	3.71 cm.
Minimum length	1.0 cm.	2.1 cm.
Maximum width	4.0 cm.	3.8 cm.
Medium width	2.8 cm.	2.36 cm.
Minimum width	1.7 cm.	1.6 cm.
Maximum thickness	3.9 cm.	3.9 cm.
Medium thickness	2.53 cm.	2.15 cm.
Minimum thickness	1.3 cm.	1.3 cm.

According to these tables the right ovaries are, on the average, greater than the left, both in weight and volume, a fact which, concerning the size, can be readily determined by rectal

exploration. This indicates a probable greater functional activity of the right organ.

According to Zschokke, the ovaries of medium sized animals weigh approximately 14–19 gr. The dimensions of the ovaries of healthy cows vary between 42 and 47 mm. in their greater, or longitudinal axes, and 12–15 mm. in their transverse diameters; in heifers they are approximately 23–27 mm. and in aged cows 31–36 mm.

It is to be observed that the weight and size of the ovaries is, in a large measure, dependent upon prior physiologic occurrences, such as estrum, conception, etc.

There is frequently observed upon the surface of the ovary linear or stellate scars, the most prominent linear scars of which we attribute to the rupture of cysts because these occur especially in those ovaries in which we have crushed various cysts. The stellate scars are referred by Zschokke and Simon to the rupture of follicles in which the corpus luteum does not, as is the case in most instances, project beyond the surface.

Aside from these cicatrices, there is often found upon the surfaces of many ovaries fibrous tufts as much as 1.6 mm. long which possess no clinical importance, and which, according to Simon, consist of numerous capillaries and embryonal wavy, connective tissue fibres with a few small spindle cells and elastic fibres and often arise from the margins of old yellow bodies.

We have personally found that in cases of cysto-fibrous degenerated ovaries, which had been vigorously crushed two or three times within a few weeks in consequence of cystic degeneration in the deeper parts of the organ, not only an evident enlargement of the gland, but that, after castration or slaughter, there was present on the surface of such ovaries a great number of intensely red, fresh, thick tufts, partly in sheet-like groups, partly as solitary projections.

ETIOLOGY.

According to the teachings of our extensive statistics, here omitted in order to save space, cystic degeneration occurs most frequently in highly bred, early maturing valuable breeding and milch cows of from five to eight years of age and in well kept heifers of 1½ to 3 years. However, ovarian cysts, in young calves and in aged animals, are not at all rare. We have also

observed ovarian cysts in mares, sheep, goats and swine, always in the latter animals without nymphomaniac symptoms. (vid. Post Mortem Findings 7 and 8), [We have operated for nymphomania due to ovarian cysts in the bitch.]

In regions with very intensively forced cattle-breeding and dairying, upon estates where large quantities of artificial fertilizers are used, artificial foods are employed, and where pedigreed breeding animals are overfed, especially on rye, distiller's grains, malt and, in addition, are constantly stabled, the disease is indigenous, while, in animals more naturally and moderately fed and kept much at pasture, the disease is far more rare.

Aside from the fact that nymphomania is especially common in highly fed, stabled cows and in certain establishments it is also apparent that there is a casual connection in the frequency of its appearance according to the character of the season, the change from grass to hay feeding and in connection with parturition.

On the other hand, there is not sufficient evidence to warrant the conclusion that ovarian cysts are directly inherited, although, in some cases found among cows of the same family. Nevertheless, we believe that the disposition to the formation of cysts is hereditary and that this tendency becomes emphasized through intensive feeding, constant stabling, deep milking, frequent breeding and through attacks of the nodular venereal disease. The tendency to cystic degeneration may also be favored by all conditions by which certain uses, like milking or breeding, become hereditarily emphasized, or the vital energy is greatly depressed, that is, a predisposition is established for diseases of the milk glands, ovaries and uterus.

The primary causes of the formation of cysts are, as yet, unknown. Among other causes which have been suggested, we may mention that proposed by Giovanoli,[1] who believes that it may be due to cerebral disease. According to the investigations of Simon, the occurrence of ovarian cysts cannot be referred to a chronic oophoritis with secondary thickening of the albuginea because he failed to find in any such ovaries a thickening of this tunic, although they were generally cystic in a high degree.

[1] Giovanoli. Schweizer-Archiv. fur Tierheilkunde, 1897, page 77.

In how far the frequently occurring ovarian cysts in new born calves and the presence, in ovarian follicles, of the *coccidium oviformæ*, first recognized by Professors Rubeli and Guillebeau and Dr. Simon, exert an influence upon the cystic degeneration of the ovary, requires further investigation.

A disease which, according to our view, certainly possesses great etiologic importance is the granular venereal disease (*vaginitis et metritis follicularis infectuosa*) because the relative frequency of diseases of the ovary and uterus is much greater after the appearance of that plague than before ; likewise, one finds, in cows and heifers affected with diseases of the ovaries, extraordinarily severe symptoms of *vaginitis et metritis follicularis infectuosa*.

In one case we observed primarily, in a cow, a prolapse of the vaginal portion of the uterus and, four weeks later, a large cyst in each of the ovaries.

Undoubtedly, also, the normal occurrence of birth and unilateral castration exerts an important influence upon the formation of ovarian cysts.

It is highly interesting to note that the data drawn from over 200 nymphomaniac animals observed by us during the year 1905, among which were three heifers, show that 92% were affected with cystic ovaries and, among these, were found 4 head which had aborted and later suffered from retention of the placenta, while all the others, aside from the 3 heifers, had completed the normal duration of pregnancy.

Of the 92 % above mentioned, 5 cows had suffered from delayed expulsion of the after birth and secondary septic endometritis, 4 from torsion of the gravid uterus and 7 from parturient paresis. So far as we could determine, these cows, which later became nymphomaniac had given birth to approximately the same number of male and female young.

It is worthy of record, also, that, in one case, there was found a follicle as large as a hazelnut in the left ovary of a cow which had been slaughtered during the sixth month of pregnancy because of agalactia, she being fat.

Symptoms.

For decades past, the symptoms induced by ovarian cysts have been designated by the terms *bulling* or *nymphomania*. In the

latter term, we recognize a true or erethetic nymphomania and the so-called dumb estrum (stillochsigkeit), in which latter, regardless of the existence of the sinking of the great sciatic ligaments, symptoms of estrum are either entirely wanting or are only of a very feeble character.

A. Nymphomania.

General Symptoms.

Under normal conditions in non-pregnant cows, estrum occurs every three weeks and, if the milk secretion is not too intense, it begins from 6–8 weeks *post partum*. Vascillations of the estrual periods between 21–28 days must still be regarded as normal, while less than 21 or more than 28 days, as for example, estrual periods of 6–9 weeks, according to our statistical observations extending over several years, can no longer be viewed as normal because experience teaches that animals with reduced or prolonged estrual periods either fail to conceive, or do so only with difficulty. On the whole, we have observed that the normal duration of estrum in the cow is 15–24 hours and that its prolongation to 30–36–48 hours, progressively diminishes the probability of conception.

The probability of conception is also decreased if the duration of estrum is very brief or if it is excessively intense or goes to the opposite extreme and is very weak, as well as when there is a marked or abundant sanguineo-mucous vaginal discharge after the cessation of estrum. Only in exceptional cases have we observed conception to occur at the first service in well nourished cows, which, at times, remain in vigorous heat for fully 48 hours.

All the varied deviations from the above described normal estrum fall within the designation of "bulling" or of "dumb estrum" and especially do we designate as nymphomania those cases in which the estrum is excessive and irregular or is of too permanent a character.

In reference to the relation between estrum appearing at the normal period, the anatomical character of the ovaries and the sinking of the broad ligaments of the pelvis, we may relate the following details in cases presenting the common characteristic that they fail to conceive.

Quite exceptionally we met with cystic degeneration of the

ovaries in cows which were in estrum regularly every 21 days and showed constant slight sinking of the broad pelvic ligaments. In one instance we recognized a small cyst in the right ovary and a large one in the left, in one case a cysto-fibrous degeneration of the left ovary, in another animal *endometritis catarrhalis chronica*, and in a third, an *endometritis purulenta chronica*.

The usual case of nymphomania runs a chronic course without fever and shows, among its complex symptoms, many variations. Often one scarcely notes any disturbance of the general health; in other cases, it is clearly linked with nervous symptoms. The pulse varies between 60–66 per minute, the respirations from 12–24. The state of nutrition varies widely according to the age, environment, feeding of the animal, and the duration of the malady, While nymphomaniac heifers and young cows which are handled early are generally in a good state of nutrition with glossy coat and soft skin, in aged breeding and milch cows the condition is only moderate or even bad. The live weight of large nymphomaniac Simmenthaler cows, according to our records, varies between 400–800 Kg. (1 Kg. = 2.2 lbs.)

Among the earliest symptoms of nymphomania, is the failure of the milk yield to increase during the few days following parturition and the so-called "hidebound" condition of the animal, which maintains well nigh constant connection with the formation of ovarian cysts in conjunction with slight *endometritis catarrhalis acuta* and more rarely rests exclusively and wholly upon *endometritis catarrhalis acuta* and is characterized by a vicious and restless behavior of the cow, nervous movements, with glassy eyes, the eyelids opened wide, the animal easily terrified, staring, wild, vicious expression and dry hair. Sooner or later there appears, also, a loss of appetite and condition and decreased lactation. The animal feeds more and more erratically, becomes agitated without visible cause, the agitation not unfrequently amounting to a veritable storm, accompanied with pawing, lowing and bellowing (bellowing disease.)

Should the latter symptoms develop during the night, other cattle in the same stall are made to suffer and even the people of the house may be disturbed. In some cases the diseased animal may escape from its fastenings, and opportunity be given for the fracture of the external angle of the ilium, the pelvis, etc. Hand in hand with these symptoms goes sexual excitement of great

intensity but not identical with normal estrum; sometimes it follows a very slight estrum, in other cases it is brought to light only when a cow standing beside the diseased one comes into heat and very often is first observed when the animal is out at pasture. Sexually excited cows seldom lie down and only for brief periods. They assume an aggressive behavior, attempt to rub their posterior parts upon other cows or objects, elevate the tail, urinate frequently, less frequently exhibit vaginal straining and neither drink deliberately nor even graze quietly. In the pasture these animals graze badly, run about, annoy the herd, and tear up the earth with horns or hoofs. If the nymphomania is intensely developed the animal becomes very vicious toward surrounding objects, especially strange persons or glistening bodies in bright colors and falls upon them, as we have repeatedly observed, in maniacal fury. In some cases of nymphomania, the affected animals attempt to mount neighboring cows, bulls, oxen, and even persons and continue to ride the former for a long interval; on the other hand, they permit bulls and also other cows to mount them constantly. [The viciousness of nymphomaniac cows and their tendency to mount persons when not on their guard make such animals a positive menace to keepers or others who come in contact with them, as we have had occasion to personally observe. In one instance observed by us, a previously kind cow became dangerously vicious toward women and would attack them furiously at every opportunity.]

There occur nymphomaniac cows with cystic ovaries, however, which, on the contrary, resist all attempts of bulls or of other cattle to mount them. After a variable duration of the malady the affected cow, which has already become markedly unthrifty, shows an elevated croup, a forward sinking of the anus and vulva, lordosis, stiffness of the loins, associated with an upright direction or knuckling-over of the hind fetlock, "kuhhessige" position and often a slightly staggering gait. That a nymphomaniac cow may suffer simultaneously from other diseases, such as capped knee, pelvic fractures, foul in the foot, etc., is to be regarded merely as a coincidence and that old, oft recurring cyst formation may lead to an exaggeration of all the symptoms described is readily understood.

According to the duration of time between the last parturition and the advent of the nymphomania, there is a somewhat corre-

sponding variation in the character of the udder and milk. In most of the cases observed by us, the udders were large and finely developed and yielded, before the advent of nymphomania, 8-12 liters of milk per milking and only in a dozen cows were we able, in the year of 1905, to recognize a small and flaccid udder and in but a single animal a fleshy udder and, in harmony therewith, a yield of but 2½ to 6 liters of milk per milking.

In nymphomaniac cows which had been in milk for a long period the milk from one or more of the quarters was, in some cases, white and without coagula but usually somewhat alkaline or bitter. Occasionally there was a "holding up of the milk" during one milking, a phenomenon which we attribute to vasomotor paralysis and debility of the vascular muscles of the teats.

Special Symptoms.

Among the special apparent symptoms of ovarial nymphomania, sinking of the broad ligaments of the pelvis takes the first place. Although not pathognomonic, it is constant. This symptom may reveal itself in varying degree and it is necessary for its proper observance that the animal be stood in a normal position on even ground.

Concerning the relaxation of the great sciatic ligaments, Goubaux first suggested that it was the result of a serous infiltration of these structures, leading to their elongation and decreased tension. In a similar manner Franck expressed the opinion that, in addition to this cause, the gravid uterus exerted an influence by dragging the anus and vulva downward and forward, thus pulling the sacro-sciatic ligament inwards into the pelvic cavity. Berdez[1] was the first to describe the sinking of the sciatic ligaments as a purely mechanical result of a flexion of the pelvis at the sacro-iliac articulation by which the ligaments became relaxed, permitting them to sink inwards. He constructed a highly ingenious model for that purpose, by which he showed how the weight of the gravid uterus upon the abdominal floor served to stretch the sacro-sciatic ligaments. Shortly prior to birth the uterus contracts, the load—fetus, fetal membranes and waters—is lifted from the abdominal floor and is largely supported

[1] Berdez, Schweitz Archiv. für Tierheilkunde u. Tierzucht, vol. 4, 1882, page 188.

by other agencies, such as the mesometrium, vagina, diaphragm of the pelvis, etc. The pelvic ligaments are thereby relaxed and sink inwards. This very simple and plausible theory of Berdez is opposed by Zschokke because, according to his investigations, drawing in the direction of the rectus abdominis muscle does not produce the effects described nor can the unilateral sinking frequently observed in practice be explained by that theory. What effect the contraction of the rectus abdominis muscle exerts is not stated by Zschokke.

Fuhrimann[1] was enabled for the first time, in our ambulatory clinic, to recognize that sinking of the sciatic ligaments occurs in various diseases of the genital organs, as well as of the milk glands, and is not at all confined to diseases of the ovaries. He was further able to induce sinking of the broad ligaments of the pelvis experimentally by inserting kelp pencils in the *cervix uteri*. From these data it follows that any sufficiently powerful irritation in any portion of the genital tract is capable of inducing sinking of the broad ligaments of the pelvis. The previously accepted theory of infiltration of the ligaments must, therefore, be abandoned.

The measurements taken by Fuhriman on the prepared pelvis have further indicated that the stretching and relaxation of the pelvic ligaments through flexion of the ilio-sacral articulation may be induced, as claimed by Berdez, and that these movements are greatly favored in the cow because of the extraordinary mobility of the lumbo-sacral articulation, especially by the sinking of the loins. It is recognized that a mild grade of physiologic sinking of the broad ligaments of the pelvis occurs often during normal estrum, also in a normal manner 8 to 15 days before calving or, under some conditions, such as high feeding and having to lie on sloping floors, it even occurs 4 to 6 weeks *ante partum*, and normally disappears inside of 8 to 12 days after parturition.

In cases where the relaxed condition of the pelvic ligaments persisted on one or both sides throughout the entire duration of pregnancy and at times even embraced several consecutive preg-

[1] Fuhrimann, Über die Senkung der breiten Beckenbänder beim Rinde. Berner Inaugural-Dissertation 1906 und Archiv. fur wissentschaftliche und praktische Tierheilkunde, Bd. 32, 1906.

nancies, in many instances to a marked degree, we observed now and then—and these cases afford striking evidence—that sinking of the hips and pregnancy are not incompatible. We also now and then see the so-called false estrum, especially during the second half of pregnancy, probably as the result of active hyperaemia of the genital canal. We have observed this false estrum continue throughout the period of pregnancy and, according to our observations, it is very similar to the normal estrum of non-pregnant cows. In one cow in which there was sinking of the right broad pelvic ligament throughout pregnancy there was a constant sexual excitement, as evidenced by her mounting other cows. We here recognized a salpingitis of the right oviduct, which had not prevented conception. In another case, a cow five months pregnant had to be returned home from the mountain pasture because she constantly permitted the bulls to copulate with her.

We recognize the abnormal sinking of the broad ligaments in the following diseased conditions: in 92% of the cases of ovarial cysts as well as in advanced fibrous degeneration of the ovaries, in *hydrops tubarum* (cystic distension of oviducts) with sound ovaries, in acute and chronic catarrhal and purulent metritis, pyometra, prolapsus of the vaginal portion of the uterus, vaginal prolapse, infectious nodular metritis and vaginitis, septic metritis, tubercular metritis, severe traumatic vaginitis and collitis, large retention cysts in Bartholini's glands, severe mastitis 40 hours after its development, bacterial pyelo-nephritis, orchitis and, in old, heavy nonpregnant cows and in one breeding bull from over fatigue from transportation on foot.

We have now and then observed a slight sinking of the broad ligaments of the pelvis in cows which, in spite of regular estrum, do not conceive and in which the cervical canal remains open as a consequence of chronic catarrh. A similar condition is also seen in profuse milkers 2–3 weeks after parturition due to a general debility and atony of the genital organs in connection with insufficient uterine involution, especially a slight catarrhal metritis.

In reference to the date of the advent of the sinking of the broad pelvic ligaments in newly calved cows, a study of those cases in which data upon this point have been secured and

which include but a very small percentage of the total number of cases of nymphomania recorded by us, it appears that, in 12 cases out of 120 observed during the first six months of 1905, a complete return to the normal elevation of the hips or recovery in tone of the broad ligaments did not occur within the normal period after calving but that the sciatic ligaments retained their relaxed condition during the first 12 days or increased somewhat after 3–7 days. In 100 cases the normal tension of the broad ligaments was reestablished within 12 days after calving which, however, after the following periods of time, again became relaxed, namely :

In	2	cases	inside	of	16	days	*post partum*
"	7	"	"		3	weeks	" "
"	4	"	"		4	"	" "
"	6	"	"		5	"	" "
"	5	"	"		6	"	" "
"	5	"	"		7	"	" "
"	14	"	"		2	months	" "
"	12	"	"		3	"	" "
"	10	"	"		4	"	" "
"	7	"	"		5	"	" "
"	9	"	"		6	"	" "
"	3	"	"		7	"	" "
"	3	"	"		8	"	" "
"	2	"	"		9	"	" "
"	4	"	"		10	"	" "
"	5	"	"		12	"	" "
"	1	"	"		14	"	" "
"	1	"	"		15	"	" "

According to these exhibits, the relaxation of the broad ligaments of the pelvis occurred during the period of most intense lactation, the first 4 months after calving furnishing 77 cases, as against 35 cases at a later date, or about 2:1.

In regard to the relation between the sinking of the broad ligaments and nymphomania, the 120 cases cited above furnish the following clinical data :

The 120 cases of nymphomania showed in 112 cases a sinking of the broad ligaments, and in 8 cases no sinking.

Of the 112 cases, the sinking of the sciatic ligaments was associated :

8 times with regularly recurring estrum every three months, which was very intense and was prolonged for 3–4 days ;

14 times with irregular estrum ;

59 times with nymphomania.

In 31 cases estrum failed to occur at all, or occurred but rarely and was very slight.

In 13 cases the sinking of the ligaments was slight.

In 36 " " " " moderate.

In 63 " " " " severe.

The 8 cases of nymphomania, without sinking of the ligaments, occurred wholly in vigorous cows, in high condition, partly in animals yielding a heavy flow of milk. The group included 4 cows with bilateral ovarian cysts as large as hazelnuts ; one cow which showed irregular estrum and, in addition to a cyst as large as hickory nut in the right ovary, exhibited a chronic catarrhal metritis ; another cow which had a cyst as large as a hen's egg and a *corpus leutum* in the right ovary ; another showing in the right ovary, a cyst of the size of a hen's egg, in the left a small yellow body, and, in addition to these, a slight catarrhal endometritis, and in the last cow we found in the right ovary a cyst as large as a hickory nut.

The failure of the ligaments to sink when ovarial cysts exist depends, apparently, on the one hand, upon the slight individual susceptibility, and on the other, upon the evidently vigorous constitution of the patient.

As to the relation of the sinking of the sciatic ligaments to the presence of ovarial cysts, our statistics revealed the following :

In the 112 cases of sinking of the broad ligaments it was found that :

in 32 cases, there was a bilateral sinking of the broad ligaments accompanied by bilateral ovarian cysts ;

in 24 cases, the sinking was bilateral and the formation of cysts unilateral, in the right ovary ;

in 10 cases, the sinking was bilateral and ovarian cysts occurred only in the left ovary ;

in 4 cases the sinking and ovarian cysts were alike found on the right side only ;

in 3 cases the sinking and cysts were found on the left side only ;

in 1 case the sinking was bilateral, the right ovary cystic, the left had undergone fibroid degeneration ;

in 2 cases the sinking was bilateral and only the left ovary had undergone fibrous degeneration ;

in 1 case the sinking was bilateral, the right ovary showed fibrous degeneration and the left was cystic ;

in 1 case the sinking was bilateral, while only the right ovary showed fibrous degeneration ;

in 2 cases the sinking was bilateral ; the right ovary contained 2 yellow bodies and the left, one cyst ;

in 7 cases the sinking was bilateral and both ovaries had undergone fibrous degeneration ;

in 1 case the sinking was bilateral ; the right ovary appeared normal, and the left contained a cyst as well as 2 yellow bodies ;

in 1 case the sinking was bilateral ; the right ovary had undergone cystic and fibrous, and the left, fibrous degeneration ;

in 3 cases the sinking and cystic degeneration were bilateral and accompanied by *prolapsus vaginæ* ;

in 4 cases the sinking was bilateral while the cystic degeneration, accompanied by *prolapsus vaginæ*, affected the right ovary only ;

in 3 cases the sinking was bilateral, while the cystic degeneration, accompanied by *prolapsus vaginæ*, involved the left ovary only ;

in 1 case the sinking was bilateral and the ovaries normal, but *prolapsus vaginæ* existed ;

in 1 case there was bilateral sinking ; the right ovary was tuberculous, the left cystic ;

in 1 case the sinking was extreme, with bilateral cystic degeneration, to which was added fibrous degeneration of the right ovary ;

in 1 case the sinking was severe and bilateral ; the right ovary was cysto-fibrous degenerated ; the left only cystic ;

in 1 case the sinking was severe and bilateral ; the left ovary was cystic ; the right ovary contained a greatly hypertrophied yellow body ;

in 1 case the sinking was bilateral ; there was revealed a cyst and a yellow body on the right, and a cyst on the left ;

in 1 case the sinking was bilateral ; the right ovary contained a cyst, while in the left there was a yellow body the size of a hickory nut ;

in 1 case the sinking was bilateral ; the right ovary contained 2 large cysts, the left was normal ;

in 1 case the sinking was bilateral ; the right ovary contained a cyst the size of a hen's egg, the left was normal ;

in 1 case the sinking was bilateral ; the right ovary normal ; the left contained a yellow body as large as a man's thumb and to this was added the complication of a chronic purulent metritis ;

in 1 case the sinking was bilateral and also there was present cystic and fibrous degeneration of both ovaries and *prolapsus vagina* ;

in 1 case the sinking was bilateral ; the right ovary, of the size of a hickory nut, was cystic and had undergone fibrous degeneration ; the left contained a hypertrophied yellow body ; the os uteri was open and chronic purulent endometritis present ;

in 1 case the sinking was bilateral ; the right ovary contained a cyst the size of a goose egg ; the left was normal.

This tabulated summary indicates that sinking of the hips generally indicates some affection of the sexual organs, especially of the ovaries, and that a good, firm tension of the broad ligaments of the pelvis constitutes excellent evidence of sexual soundness in the cow because, between the character of the tension of these sciatic ligaments and the specific sexual organs, there exists a relationship quite analogous to that in man between the posterior portion of the eye and cerebral disease.

It further appears that the relaxation of the sciatic ligaments does not always indicate bilateral cystic degeneration of the ovaries, that in individual cases it may occur in the absence of cystic degeneration and that the right ovary was found cystic twice as frequently as the left.

In general, we have determined that, when the relaxation of the sciatic ligaments is unequal, the ovary on the side of the greatest relaxation is the one which has, most probably, undergone cystic degeneration. On the other hand, now and then, the broad ligament is appreciably more relaxed on the side of the sound ovary than upon that of the cystic gland and, in the bilateral formation of the cysts in the periphery of the glands, the greater sinking tends to occur on that side where the cyst or cysts is the larger, firmer and older. Also, in unilateral sinking of the sciatic ligaments, cystic degeneration may likewise be unilateral and involve only that ovary on the side corresponding

to the relaxed ligament, and this presumption is not changed by the presence of fibrous degeneration in the other gland. Finally, in fibrous degeneration of the ovaries, the sinking of the hips is only slight or moderate, never severe.

In one nymphomaniac cow, the right sciatic ligament was slightly sunken ; the left one, very markedly. The right ovary showed a cyst the size of a hen's egg, with slight increase in circumference of the right uterine cornu ; the left ovary was of the size of a hazel nut and the left cornu the thickness of a man's arm.

The question if, probably, the size and age of the cysts exert a definite influence upon the degree of the uni- or bilateral sinking of the broad ligaments must be answered in the negative. Our observations teach that small, and especially the very small cysts in heifers, often cause a very marked sinking of the ligaments, and vice versa ; furthermore, now and then, the sinking on the side corresponding to the smaller cyst is materially greater, and in cases of cysts varying greatly in size in the two ovaries, the sinking in of the hips may yet be alike on both sides.

From the standpoint of age, it seems clear, from our observations, that cows with old and large cysts, because of the chronic reflex irritation upon the sexual organs, through which the relaxation of the broad ligaments is caused, generally show also a greater degree of sinking than those with newly formed cysts.

When the sinking of the broad ligaments does not occur immediately after calving, the anamnesis usually indicates that the affected animal had already been in estrum several times at too short intervals and too intense in character or continued for an abnormally long period, without conception occurring.

The degree of the sinking of the hips, which is sometimes more marked at the the posterior border, and sometimes upon the flat surface of the hips, but is usually equally evident in both areas, is, as already stated, extremely variable. The sinking is very greatly emphasized by a high croup, which has no real influence upon the sinking of the ligaments and has, under normal conditions, merely the value of a blemish. In exaggerated cases, the sunken broad ligaments of the pelvis constitute an almost flat surface beneath the tail and, at the sides of the root of the tail, cause cavities the size of a fist.

Out of the 120 nymphomaniac cows of our statistics, 47 exhibited more or less evident changes in the vulva, consisting of an edematous swelling of variable intensity, exceptionally greater on one side, and an elongation and widening of the vulvar commissure. In 12 cases there was a slight active hyperaemia evidenced by a redness of the labiæ of the vulva, referable to a pressure upon the vasodilators in the ovaries. In a few cases, where prolapse of the vagina coexisted, there was an evident wrinkling, either chiefly in the superior half or involving the entire circumference of the vulvar lips, as well as invagination, that is, an entropium of the vulvar lips.

It is of symptomatic significance that, in heifers suffering from dumb estrum (stillochsigkeit), the variable edematous swelling of the vulva, under some conditions, constitutes the only notable external symptom which, omitting the abnormal findings in the ovaries, can not at all be explained.

Among our 120 cases there existed in 42 a very variable vaginal discharge. In 30 cases, this was slight, vitreous and slimy; in the other 12, on the contrary, muco-purulent or, when it had to do with old purulent metritis or pyometra, wholly purulent. In a combination of nymphomania with prolapse of the vagina or of the vaginal portion of the uterus, there was found a muco-purulent discharge mixed with fecal particles, which were later drawn into the vagina by the spontaneous reduction of the prolapse when the cow assumed the standing position.

If vaginal discharge exists, the hairs of the vulvar tuft are matted and the ventral surface of the tail, next to the vulva, soiled.

The vaginal mucosa, in 15 % of the cases of nymphomania, is reddened, injected and swollen, the latter especially marked when prolapse of the vagina or vaginal portion of the uterus coexists. Very often one finds the symptoms of chronic infectious nodular vaginitis (nodular or granular venereal diseases of the cow), such as a yellowish hue of the vaginal mucosa in those parts no longer inflamed, blanched vesicles and nodules no longer surrounded by inflamed areas, either grouped in one part or disseminated over the entire vaginal mucosa. More seldom, the mucosa is superficially eroded as a result of therapeutic efforts.

A comparatively frequent finding is retention cysts of the glands of Bartholini, varying from the size of a hazelnut to a fist and,

more seldom, vaginal polypi. There also occurs, quite exceptionally, at the line of demarcation between the vestibule and vagina or in the roof of the vagina about a hand's breadth posterior to the mouth of the uterus, a thin walled fluctuating retention cyst the size of a large fist, containing a grayish sero-mucous, odorless fluid. The location and character of these cysts may best be determined by simultaneous examination *per rectum et per vaginum* and through causing the former viscus to glide over the tumor.

To the symptomatology of nymphomania also belongs the oft observed extraordinarily great relaxation and widening of the vagina, which here and there shows evident, horizontally directed scars and a very notably increased facility for palpating this organ, now so much more roomy.

Very seldom one finds by the *os uteri externum* an abcess as large as a hen's egg containing thick, white pus and now and then beneath the *os uteri externum* as many as 6 polypoid growths varying in size from a pea to a pigeon's egg, or one to several fluctuating, spherical, cordiform retention cysts of Gaertner's ducts as large as a small hen's egg.

Not at all rarely, there is found the vestigial remnants of the incompletely resorbed median walls of the Muellerian ducts, which we have already described[1], that is, there exists immediately behind the vaginal portion of the uterus, perpendicular bands 1-3 fingers in breadth and 1-3 cm. thick. They are easily engaged by the index finger, elastic, nonvascular and, in non-gravid animals with a thoroughly mobile uterus, are readily drawn far back into the vagina. These evidently may interfere, under certain conditions, with the ejaculation of the semen into the cervical canal.

Contrary to the views of Zschokke, who holds that, in nymphomania, the *os uteri* is closed, we are able to state that the nymphomania resulting from ovarial cysts is intimately related to the abnormal dilation of the mouth of the uterus and of the cervical canal and that it is only very rarely, and chiefly in cases of small cysts occurring soon after calving, that nymphomania exists without dilation of the *os uteri*.

Approximately two to three times, annually we find an accumu-

[1] Schweizer-Archiv. fur tierheilkunde, 1896, page 252.

lation of urine in the vagina [urovagina (*Vagina urinalis*)]. This malady attacks old, feeble, nymphomaniac cows with large, wide vaginæ and uni- or bilateral ovarian cysts. The quantity of urine found in the vagina varies between 500 and 750 grammes, is feebly slimy and shows with the Nessler reagent within 12 hours after its removal a marked ammoniacal reaction, and after a few hours standing a very marked ammoniacal decomposition, which undeniably points to cow urine and excludes the suggestion of its being some injected fluid or an excretion discharged from the uterus. The accumulation of urine in the vagina is explained by the low pressure of the urinary stream while the animal is standing and the low lying, excavated vaginal floor about the urethral opening.

The external os in cases of nymphomania in cows which have recently calved, also in all prolonged and well developed cases of nymphomania, is constantly penetrable for a lead pencil, little finger, index finger or, in cows very recently calved, for two fingers, and it was only in very recent cases of nymphomania and along with the existence of acute and severe chronic infectious nodular vaginitis (and especially when the latter has been handled with powerful irritants) that the *os uteri* was found closed in spite of the existence of cystic degeneration of the ovaries and sinking of the broad pelvic ligaments. Frequently the external os is penetrable for one or two fingers while further forward it is much narrowed or entirely closed.

Under normal conditions, in non-pregnant cows and heifers which are not in estrum or have not been for a few days, as well as in those nymphomaniac cows in which the internal os is closed, there is found on the external os only a very small clot of a clear, tough mucus, while, in all cases of nymphomania with completely open *os uteri*, there is as a rule a hypersecretion.

The exudate discharged from the cervical canal and *ostium externum* and accumulating first in the vagina in varying quantity consists usually of vitreous, transparent, tenacious mucus; more rarely of slimy, whitish, or yellowish white, thick or thin liquid pus, which, in cases of prolapse of the vagina or mouth of the uterus, may in addition be mixed with fecal particles.

If closed, the *os uteri* is small, not at all or but slightly swollen, and is often recognizable merely as a small rosette, which may be moved backwards or forwards and projects but little beyond the

surrounding tissues, with which it is continuous. In case of an open cervical canal, the lips of the *os uteri* are enlarged, smooth, velvet-like, infiltrated. In many instances, especially when there exists a *prolapsus portionis vaginalis uteri* due to recurrent cystic disease of the ovaries, there are one or two flaps which are readily recognized in the vagina as bodies as thick as the hand, broad and long, tongue-shaped and often infiltrated with blood, upon the surface of which one may recognize, by palpation, the *os uteri*.

Now and then there exists, as a result of chronic irritation in connection with the pathologic dilation of the cervical canal and the swelling of the vaginal portion of the uterus, in cows suffering from cystic or fibrous ovarian degeneration, an enlargement and conspicuous firmness of the *cervix uteri*, sometimes slight, sometimes the thickness of the forearm or arm, and without any increase whatever in the size of the cornua.

Passing to the changes in the uteri of nymphomaniac cows and heifers, recognizable by palpation, it is to be pointed out that the size of the organ in quite recent and not severe cases must now and then be regarded as normal. So, for example, we observed in one mild and very recent case of nymphomania in a cow which had aborted at the end of the fourth month of pregnancy, eight weeks after the abortion, a bilateral sinking of the broad pelvic ligaments, a large ovarian cyst in the right ovary, normal volume of the uterus and closed uterine os.

However, in the great majority of nymphomaniac cows, the patients show a very variable degree of increased volume of the uterus, either *in toto* or chiefly only in one horn. Often the uterine body at the point of origin of the cornua is only slightly thickened, the size of a child's arm; in other cases, as thick as a man's arm.

Simultaneous with the increased circumference, there occurs also a varying elongation of the uterus to the extent of 2 to 3 times its normal length, whereby its anterior end projects far into the abdominal cavity.

In asymmetric uteri the right horn is greater in 75% of cases and only exceptionally is one horn found to be normal while the other is importantly increased in circumference and length. The consistence of the uterus, which is never abnormally sensitive,

is uniform, soft-elastic, more seldom tense-elastic, and then during the existence of estrum.

From the above facts and the post mortem findings yet to be related, it is indicated that cystic and cysto-fibrous degeneration of the ovaries almost uniformly lead to a non-infectious chronic catarrhal endometritis and only seldom to chronic muco-purulent endometritis or to chronic purulent endometritis, which makes it self evident that an impregnated ovum could not become attached to the uterine wall to undergo development into a fetus. Relations analogous to those existing between cystic and cysto-fibrous ovarial degeneration and the sinking of the sacro-sciatic ligaments hold good also between the former and the enlargement of the uterus.

In bilateral cystic degeneration of the ovaries there exists no definite relation between the size of the cysts and the increased circumference of the uterus, which is usually symmetric, rarely asymmetric. In cases of unilateral formation of cysts the entire uterus is frequently uniformly larger and longer or, on the other hand, the enlargement may be confined to the cornu leading to the affected ovary.

Finally, it must be conceded that, as a general rule, the symptoms of nymphomania are referable to the ovaries themselves, which are the chief and almost exclusive seat of the anatomo-pathologic changes, and that diseases of the uterus and vagina, without involving the ovaries, can only very rarely lead to symptoms of nymphomania. On the other hand we have observed, and verified our diagnosis by *post mortem* examinations, that in both uncastrated and castrated cows, cysts in the broad ligaments and in the oviducts, and hydatids in the oviducts or ampullæ can cause well marked nymphomania.

As abnormalities of the ovaries which we have definitely recognized and verified in connection with nymphomania in cows we may relate :

1. The formation of cysts or vesicles of the follicles—hypertrophy of the ovisacs.

According to Zschokke three genetic forms of these may be differentiated :

a. Those which spring from the Graafian follicles and are to be designated as hydrops folliculorum.

b. Those which emanate from the Pflüger sheaths or from yellow bodies.

c. Cysts which originate in hemmorrhages or colloid degeneration of cells, especially in malignant neoplasms.

Because subclasses *b* and *c* produce nymphomania only very rarely and consequently possess no great clinical importance, the subject, as related to these, will not be pursued further here. We will simply remark that not every ovarian disease induces nymphomania and that an ovary, under some conditions, may possess a tumor as large as the fist without producing symptoms of nymphomania ; indeed a cow may have a badly degenerated ovary, as we found in one particular case, and nevertheless show normal estrum and become pregnant. We have also repeatedly observed that, when but one ovary has undergone even severe cystic degeneration, estrum may be normal and impregnation occur.

Undoubtedly, the most important and common disease of the ovaries leading to nymphomania is the cystic degeneration, which may be confined to only one or two ovisacs and then be designated as solitary cyst formation, in contradistinction to multiple cyst formation, in which numerous Graafian follicles become hypertrophied in equal or unequal degrees.

In regard to the formation of solitary cysts and fibrous degeneration of the ovaries, we would here make the supplementary statement, or more properly, repeat that the right ovary is more frequently found diseased than the left, a fact which stands in an intimate relation with the greater functional activity of the right gland and the more frequent occurrence, approximately 70%, of impregnations in the right horn.

It is also interesting to note the fact, amply verified by us, that large cysts, which, it is to be assumed, have required a longer period of time for their development than do smaller ones, cause no visibly greater symptoms of nymphomania, but that the volume of the cyst stands in no constant relation to the intensity of the symptoms.

The size of the solitary cysts varies from that of a hazelnut to a hen's egg or a goose egg or even as large as a fist. In this relation, it should be here remarked that, in cattle, Graafian follicles measuring 1.5 cm. and upwards in diameter are to be re-

garded as cysts, since, in these, according to Rubeli, (vid. pages 163 and 164) no ova are ever found.

They are located either comparatively peripherally or centrally and lead, in both instances, to atrophy of the ovarial parenchyma, which, under the pressure of the cysts, may completely disappear. By rectal palpation, the peripheral, solitary cysts, which are frequently thin walled, may be diagnosed by the enlargement of the ovary, upon which they appear as elastic, tense, smooth, fluctuating eminences. In thick walled peripheral cysts the gland feels more firm and elastic.

More difficult than the diagnosis of solitary peripheral cysts is the recognition of the solitary central cysts, which are common and lead to every grade of nymphomania. One or two of these may be located in the center of the gland, never project above its surface and are surrounded by a layer of ovarian tissue as much as 8 mm. thick. Here, the diagnosis is to be based upon the size of the ovary, the increased tension, the less readily compressed, elastic surface and the non-crushable character of the gland *per rectum* and especially *per vaginam*.

It is an interesting observation that, in a cysto-fibrous degenerated ovary, there is now and then found one, rarely two large solitary cysts, after the crushing of which there still remains an abnormally large, firm, solid ovary. We have also found that after vigorous crushing of a cysto-fibrous degenerated ovary in exceptional cases there develop, after the lapse of a few weeks, cysts from the size of a hickorynut to that of a small hen's egg and that, by periodic compression and massage, the development of small central cysts may be accelerated, as a consequence of which they may then approach the periphery.

Another finding, to which we have already referred and which admittedly occurs rarely in nymphomaniac cows, consists in the formation of multiple cysts by which several ovisacs in various parts of the ovary hypertrophy and acquire the dimensions of large peas, owing to which those most peripherally located project slightly beyond the surrounding surface of the ovary. The disseminated arrangement of the numerous follicles of approximately uniform size, as well as the general, though not constant, absence of *corpora lutea*, indicates multiple cyst formation and that they are not normal, ripe ovisacs.

2. A quite frequent cause of nymphomania consists of the

formation of multiple cysts, accompanied by connective tissue hypertrophy or scelerosis of the ovaries, in which a cut surface reveals several Graffian follicles, very small, up to as large as a pea, embedded in much firm, white connective tissue. Such ovaries vary in size from that of a hickory nut to a hen's egg, are firm and hard, can not be crushed, and, now and again, there are still present yellow bodies.

Contrary to the deductions of Zschokke and Simon, we were in a position 14 times during the last year to recognize with certainty the presence, sometimes of large, at others of small, corpora lutea in cystic or cysto-fibrous degenerated ovaries, and, indeed, one, two, or even three of them in one ovary, (vid. post mortem findings in Nos. 2 and 3.) On the whole, there is no substantial ground for the opinion that, in intermittent nymphomania in cows, yellow bodies may not still be formed.

Definite sclerosis of the ovaries (*sclerosis ovarii*) in which all appearances of ovulation cease, such as normal Graafian follicles and fresh *corpora lutea*, never determines nymphomania, but leads, according to our observations, when bilateral, to absence of estrum, though, when one ovary remains normal, the animal may conceive. Selerotic and cicatricially contracted ovaries are the size of a hazelnut to that of a hickory nut, smooth, and of a uniformly firm or hard, nodular consistence.

3. Yet another disease of the ovaries, which, however, leads to "Stillochsigkeit" or dumb estrum consists of the development of ovarial cysts containing yellowish, sero-fibrinous, pap-like fluid or of blood cysts. The first mentioned formation, which is very rare, varies in size from a hen's egg to a fist and feels like a sac filled with quicksilver. When these are crushed in living cows a granular, thick, gravy-like mass escapes.

4. In aged, good milk cows there occurs in rare instances, as a cause of nymphomania, ovarial dropsy (hydrops ovarii). In this disease the ovaries are soft, flabby and flattened.

5. A very rare cause of nymphomia in cows, not to exceed 0.5 % in our clinic, so far as we could determine, is tubercular ovaritis (oophoritis tuberculosa).[1] These cases run their course with and without symptoms of nymphomania and sinking of the sacro-sciatic ligaments.

[1] E. Hess, Schweizer-Archiv. für Tierheilkunde, 1891, page 161.

In one cow with ovarial tuberculosis, which led to abortion in the sixth month of pregnancy, the left ovary revealed one cyst the size of a hazel nut and one yellow body. The right ovary in the living cow was the size of a child's head, uneven, nodular, slightly mobile and adherent to the right horn of the uterus. In another case, each ovary was like a large, hard bunch of grapes, covered over with firm round nodules from the size of a pea to that of a hazel nut. Both oviducts were as large as the index finger, serpentine, rigid and likewise invaded by hard nodes from the size of a pea to a hazel nut.

Finally, as further causes of nymphomania there occur very rarely: oophoritis, abscesses in or near the ovaries, angioma of the ovary, hydrosalpinx or dropsy of the oviducts, perimetritic abscesses following perforation of a uterine horn, and cysts in the broad ligaments of the uterus.

As a result of retention of the placenta and consequent septic metritis there follows adhesion of the ovaries and uterine horns to the surrounding parts, which may cause nymphomania, and the ovaries become so hidden by the adhesions that they are scarcely, if at all, recognizable by rectal palpation and are but very slightly mobile. In a great many cases, in addition to these changes, the ovaries undergo cystic or cysto-fibrous degeneration, and attain the size of a hickory nut or hen's egg; at times, although quite seldom, the septic metritis, in addition to the adhesions, leads to the formation of abscesses in the ligamentous apparatus of the ovary and in the ovary itself, which latter condition from a therapeutic standpoint warns one to be cautious.

In a 3½-year-old, valuable premium winning cow, which had suffered from retained placenta following abortion and later from purulent endometritis, there developed, as a result of rough handling of the vagina by the owner, which irritated the uterus, an extensive adhesion of the *valvula vaginalis* and, within a few days thereafter, there occurred an extensive accumulation of pus in the vagina (*pyovagina*) amounting to fully 3 liters. After operative withdrawal of the very fetid pus, an examination of the sexual organs revealed an open cervical canal, which permitted the passage of the little finger. There was also present purulent metritis; the right ovary was the size of a hazelnut and in the left uterine horn there was a tumor (abscess) as large as one's

fist, round, smooth and fluctuating. The cow showed normal estrum 14 days after the operation.

6. Supplementary to the foregoing, we shall here submit, through the courtesy of Professor Dr. Gillebeau, the appended postmortem findings relative to cystic degeneration of the ovaries:

1. A cow which had been handled by us for a long time was castrated on December 3, 1903. The right ovary weighed 20 grammes and contained in its center 2 follicles the size of peas; the one had the ordinary contents, the other was filled with clotted blood, evidently the result of preceding severe crushing. Otherwise, the ovary was in a state of advanced fibrous degeneration. The walls surrounding the follicles were 7 mm. thick.

The left ovary, weighing 30 gr., was as large as a hen's egg, 4 cm. in diameter and contained 6 peripheral Graafian follicles, as much as 5 mm. in diameter, and one central Graafian follicle, 1 cm. in diameter, with yellow walls and contents consisting of a yellowish-red fluid serum and blood clots, which was likewise referable to the previous crushing of the organ. Otherwise, this ovary also showed extensive fibrous degeneration.

Anatomo-pathologic diagnosis: sclerosis of the right ovary and cysto-fibrous degeneration of the left.

2. A 6-year-old cow. Six months previously, ovarial cysts had been crushed for the first time; later, they recurred. The patient suffered also from vaginal prolapse. Slaughtered on the 21st of December, 1905. The vagina was decidedly wide, the mucosa covered with much tenacious mucus. The habitually prolapsed portion was intensely hyperaemic, the lips of the *os uteri* swollen, the cervical canal penetrable for one finger. Weight of uterus 900 grammes, as against a normal weight of 600 to 700 grammes. The exaggerated weight is referable to the hyperaemia of the cervix.

Uterine cavity normal. Left ovary somewhat enlarged, tissue dense with one follicle of the size of a pea and 2 yellow bodies. The right ovary consists of a cyst the size of a hen's egg, with clear contents, a moderately large yellow body and a vestige of normal ovarian parenchyma.

Diagnosis: Chronic colpitis and cystic degeneration of right ovary.

3. A 2½ year heifer, which had not been pregnant, was first handled on May 8, 1895, because of a cyst in the left ovary of the size of a hen's egg. On the 28th of the same month there was recurrence of a cyst in the same ovary, and 4 weeks later a recurrence of cysts in both glands. She was slaughtered August 10th, 1895.

Anatomo-pathologic findings:

The dorsal vaginal arch is disproportionately deep, so that the *os uteri externum* is not directly toward the vulvar opening but downwards against the vaginal floor. Above the os externum there lay a broad lip, which, in the usual condition, scarcely covered the os, but when hyperaemic certainly must have covered it completely. Uterus and oviducts were normal.

The right ovary weighed 110 grammes. Its length was 3.5 cm., breadth 2.5 cm. and thickness 1.5 cm. At various points on the surface there appeared yellow bodies 3-7 mm. broad. Through the dense fibrous tissue of

the gland there could be seen several Graafian follicles. The contents of one cyst of the size of a hickory nut were bloody. The left ovary weighed 55 grammes. Its length was 3.3 cm., its width 2.3 cm. and thickness 1.3 cm. The periphery was smooth. Upon section, this ovary was found to have undergone extensive fibrous degeneration and it contained a few follicles.

Pathologico-anatomical diagnosis: indurative cystic ovaritis of right ovary, and indurative oophoritis of left.

4. In an aged nymphomaniac cow which was slaughtered on the 12th of November, 1904, the mouth of the uterus was penetrable for one finger, the lips of the os were slightly swollen, the uterus somewhat enlarged, the right uterine horn was empty. To it was suspended an abscess in the form of a pedunculated tumor. The right oviduct was dilated, its ovary the size of an apple and affected with two cysts as large as hickory nuts.

The left uterine cornu contained some mucus and was adherent to the anterior extremity of the bladder. The left oviduct was as thick as a man's finger and contained some pus. The left ovary was small and contained some pea-sized follicles.

Pathologico-anatomical diagnosis: encapsulated abscess of right uterine horn, adhesion of left uterine horn to the urinary bladder, left pyosalpinx and cystic degeneration of both ovaries.

5. A three year old cow, which had not been pregnant, had shown normal estrum for 3 months but had not conceived; ovarial cysts and nymphomania then developed.

Post mortem examination on December 13th, 1905 revealed: the lips of the os uteri externum small, the cervical canal closed. In the cervical canal there was some viscid mucus. Weight of uterus 375 grammes. Uterine cornua very small. Uterine mucosa pale. Cotyledonal nodes normal. Right ovary, weighing 6 gr., contained several small yellow bodies and 6 pea-sized follicles. Left ovary weighed 11 grammes and was normal. Pathologico-anatomical diagnosis: Multiple formation of cysts.

6. A cow which had been nymphomaniac for ten months, with marked sinking of the broad ligaments of the pelvis, revealed the following upon post mortem examination: lips of os uteri somewhat swollen, injected clear mucus in the cervical canal, in the walls were very hard areas suggestive of cancer. The uterus somewhat enlarged, peritoneal surface smooth. In the right horn was an intensely pigmented area, 3 x 1 cm. in extent. Right oviduct dilated, its walls thin, its ampulla adherent to the ovary and distended into a thin walled, pear-shaped cyst 15 x 9 cm. in size, filled with a clear, serous fluid. The ovary, concealed in the adherent ampulla, was normal in size and contained yellow bodies.

Left oviduct also dilated. Fimbriated end adherent, leading to the existence of an hour-glass-shaped sac 12 cm. long and 9 cm. broad at its widest point. It was thin-walled and filled with a clear yellowish serosity. The left ovary was normal in size, concealed in the ampulla and contained one large corpus luteum. The arteries of the broad ligament were somewhat large and inflexible.

Pathologico-anatomical diagnosis: bilateral serous salpingitis with obliteration of the opening of the ampullæ through adhesion of their margins to the surface of the ovaries.

7. A yearling goat which had not shown estrum at all, nor nymphomania, was slaughtered on October 26th, 1905.

The post mortem examination revealed: uterus symmetric, its body 3 cm. and its horns 7 cm. long. From the right ovary there hung by a pedicle 6 cm. long a spheroidal, free-swinging tumor 8 cm. in diameter. This 2 celled tumor contained a freely flowing yellowish fluid with numerous fibrin floccules. The left ovary was likewise enlarged, 3 cm. broad, fluctuating, three chambered, the cavities containing a clear, pap-like fluid. Pathologico-anatomical diagnosis: congenital ovarial cystic degeneration.

8. A 2 year old brood sow, apparently perfectly sound, which had already borne two litters of pigs, being fat, was slaughtered on May 8, 1906, and revealed the following:

The ovaries were each as large as a fist and weighed together 500 grammes. Each consisted of numerous thin-walled fluctuating cysts, varying in size from a nut to an egg, the contents consisting of a transparent serum. In the right ovary there was a yellow body as large as a pea.

Pathologico-anatomical diagnosis: cystic degeneration of both ovaries.

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The contents of solitary ovarial cysts usually consist of a watery, transparent fluid having an alkaline reaction and containing albumen; less frequently the contents are yellowish, reddish or bloody.

It has been recognized for several decades that the thin walled peripheral ovarian cysts tend to recur. The recurrence involves largely for a long duration of time the same ovary; at other times it alternates, first one, then the other; or both may become involved simultaneously or in rapid succession. It is worthy of note that, strictly speaking, the symptoms of nymphomania resulting from recurrent ovarian cysts are frequently more marked and intense than those accompanying primary cysts. Exceptionally in cows which have developed "stillochsigkeit," or dumb estrum, as a result of ovarial cysts, and these have been crushed, intense erethetic nymphomania may occur 8–14 days later because of the recurrence of the cysts.

An additional, though very rare, observation included three cows which were handled because of recurrent cysts, after which conception followed but, during the entire span of gestation, sexual desire was easily excited so that they would neither graze quietly nor could they be turned out with other cows to drink and, even on the day before calving, attempted to ride other cows. In two of

them (the third was sold) the ovaries felt normal a few days after parturition and contained no yellow bodies; four months after parturition both animals showed bilateral cystic degeneration of the ovaries and again well marked nymphomania.

The length of interval between recurrences is very variable in different individuals and ranges between a minimum of 3 and a maximum of 120 days, between which occur periods of 8, 12, 14, 16, 20, 27, 30 and 60 days. Often we find, in heifers and young cows, at the beginning, long and regular intervals; later short and irregular, or the reverse. So, for example, we observed the:

first formation of cysts 110 days after calving, in both ovaries;
second formation of cysts 120 days after calving, in the right ovary;
first formation of cysts 60 days post partum, in both ovaries;
second formation of cysts 120 days post partum, in right ovary; and
third formation of cysts 160 days post partum, likewise in right ovary.

One three year old cow which had not yet been pregnant showed cysts in the left ovary three times in succession at intervals of one month each. Three months later, both ovaries had undergone cysto-fibrous degeneration and estrum now recurred every 8 days.

In another three year old cow which had not been pregnant, estrum recurred at first every 28 days and lasted 2 days; later the patient, suffering from recurrent bilateral ovarian cysts, was in estrum every 12 days.

A 2½ year old heifer, which had not been pregnant, showed at first a small cyst in the left ovary, eight days later a cyst as large as a hazelnut in the same gland, and, further, 15 days later, a cyst in each ovary the size of a large hazlenut.

When the period elapsing between the recurrence of cysts is comparatively long, there frequently occurs one or two normal estrual periods, the cow appearing in all ways normal but failing to conceive.

The frequency of recurrence is extremely variable. In 50 % of the cases, after the cysts have been crushed, they do not recur until after the next calving. In individual cows, the formation of cysts occurs almost immediately after each calving, and relatively such animals very frequently conceive after proper hand-

Recurrent ovarian cysts in a 6 yr. old cow which calved wholly normally for the third time on December 20, 1904.

Month.	Day.	Condition of Right Ovary.	Condition of Left Ovary	Behavior of Sacro-sciatic Ligaments.	Vagina.	Other Noteworthy Symptoms.
1905.						
Jan.	4	Cyst size of hen's egg	Normal.	Sinking of broad pelvic ligaments		
"	20	" " " "	"	" " " "		20 liters milk per day.
Feb.	5	" " " "	"	" " " "		
"	28	" " " "	"	" " " "		
March	22	" " " "	"	" " " "		
April	19	" " " "	"	" " " "	Prolapsus Vaginae	
May	1	Fibrous degener't'd ovary size of small hickory-nut	Ovary size of large hickory nut, partly fibrous degenerated with small cysts	" " " "	" "	16-18 liters milk per day.
June	7	Ovary smaller and fibrous degeneration more extensive	Ovary as large as the fist with 2 cysts	" " " "	" "	14 liters milk per day.
June	16	" " " "	Ovary contained cyst size of hazelnut	" " " "	" "	
July	5	Ovary with cyst size of hen's egg	Ovary with cyst size of hen's egg	" " " "	" "	10 liters per day.
July	14	Ovary small with yellow body	Ovary firm, size of a bean	Broad pelvic ligam'ts tense	Prolapse disappeared	Normal estrual symp's.
"	29	" " " "	" " " "	" " " "	" "	" " "
Sept.	3	Ovary small and firm	Ovary has cyst size of goose-egg	Sinking of broad pelvic ligaments	Prolapsus Vaginae	well defined nymphomania.
Oct.	31	Ovary size of hickory nut, fibrous degenerated	Ovary with cyst as large as goose-egg	" " " "	" "	8 liters of milk per day.
Nov.	21	" " " "	Ovary size of hickory nut with small cysts	" " " "	" "	5 liters milk per day; turned dry.
Dec.	13	The cow being in good condition, was slaughtered.				

ling. The recurrence of cysts for 3–6–10–15 times is not rare; it then frequently leads to atrophy and a fibrous thickening of the ovary (vid. table).

The size of the cysts and thickness of their walls stand in a certain relation to the intervals of recurrence, in that in shorter intervals the cysts are small and thin walled, in longer intervals they are usually larger, their walls thicker and their rupture more difficult.

The post mortem findings in the case detailed in the table upon the opposite page were as follows: In the right ovary there were recognizable four scars and a very thin-walled cyst the size of a hen's egg which, in consequence of the formation of partitions, was separated into three sections. Of real ovarian tissue only a trace remained. The left ovary, also exhibiting four well defined scars, was the size of a hickorynut and contained a hazelnut sized cyst. The slightly enlarged uterus weighed 1 kilogram and contained some mucus. It is an interesting fact that all the cysts could be ruptured *per rectum*, that, further, there was constantly a restoration of the tension of the broad ligaments of the pelvis after 4 days; the quantity of milk increased and the prolapse again vanished four to ten days after the operation.

B. ABSENCE OF ESTRUM

Dumb Estrum. "Stillochsigkeit."

We have already related that sinking of the broad ligaments of the pelvis, in connection with cystic or cysto-fibrous degeneration of the ovaries, is not necessarily associated with nymphomania or abnormal sexual excitement but that there occur cases in cows in which there is an absence of, or only a slight degree of, sexual excitement. In these animals, absence of sexual excitement does not interfere with their feeding and they constantly tend to become fat. Accompanying this difficulty, there is usually present the same sinking of the hips as in nymphomania. The history of the animal is about as follows: after calving there is an entire absence of estrum or the broad ligaments of the pelvis recover their normal tension in spite of the existence of the light, clear, albuminous discharge from the vagina; no estrum appears. After 3-5 weeks *post partum* there appears, and remains constant, a sinking of the broad ligaments of the pelvis although, during 4-6 months after calving, the cow exhibits no signs of estrum. Or, in other cases, estrum has occurred for the last time 6-8 months previously, at which date the cow was bred and, because of the non-recurrence of estrum and the general behavior of the animal, it has been supposed that she was pregnant. This, in spite of the absence of a vaginal discharge, was evidently an erroneous view.

The condition is generally due to a cystic degeneration of the ovaries, in which the cyst wall is not usually so tensely stretched as in nymphomania but is more flaccid; atrophy of the ovary; connective tissue degeneration (cicatricial degeneration, ovarial sclerosis) and, in a few cases, to parturient paresis, that is, as a result of the consequent changes taking place in the ovaries after parturient paresis. In such cows we were repeatedly able to recognize, after many weeks, a persistent yellow body with absence of estrum or a cystic, or more especially a cysto-fibrous degeneration of one or both ovaries, with sinking of the sacro-sciatic ligaments, the os uteri open to a degree to admit the passing of a finger, and the uterus enlarged as a result of mild chronic catarrhal endometritis. Seven times we recognized ovarial cysts

in cows which had previously suffered from parturient paresis and then showed dumb estrum with sinking of the broad pelvic ligaments. In one instance these phenomena were associated with a persistent yellow body in the right gland. In five of these cases, in spite of extreme sinking of the broad ligaments of the pelvis and marked bilateral cystic disease, there was not a trace of estrum to be seen.

In one dumb estrual cow, presumed to have been 6 months pregnant and showing extreme sinking of the broad ligaments, there was present in the right ovary a large cyst and, in addition, an extensive pyometra with purulent discharge. In another dumb estrum cow, affected with extreme sinking of the broad ligaments, the two ovaries hung far down in the peritoneal cavity and each contained a large cyst, in addition to which there was a perivaginal abscess present.

A fat young cow, a few hours subsequent to normal parturition, exhibited sexual excitement and attempted to mount the milker. The broad ligaments resumed their normal position very promptly but sunk again to an extreme degree on the sixth day and remained permanent thereafter, while estrum failed entirely to recur. In the right ovary there was recognized a cyst the size of one's fist, in the left a cyst the size of a large hazelnut.

One observes now and then, in fat cows or deep milkers which are kept stabled, a marked sinking of the broad ligaments of the pelvis with large cysts in the ovaries without any symptoms of nymphomania. The latter tends to appear first after the animal has run at pasture for several weeks. In addition to the symptoms of cystic degeneration already related, the following phenomena are of great clinical interest.

C. Prolapsus Vaginæ.

There occurs with relative frequency in non-pregnant cows, seldom in heifers, far more frequently in dumb estrual cows, an habitual prolapse of the vagina. According to our investigations, extending over a number of years, at least 50 % of the cases of prolapse of the vagina occur in nymphomaniac animals, which must generally be referred to the persistent occurrence of small or large ovarian cysts, seldom to cysto-fibrous degeneration of the ovaries or to ovarial cysts in combination with chronic catarrhal or purulent endometritis. We have good proof that

the existence of the prolapse of the vagina in non-pregnant cattle is due to a chronic, permanent irritation of the genital organs owing to the presence of diseased ovaries, because, if we can bring about a normal state of the ovaries, the sinking of the broad ligaments, the swelling of the vulva and the flaccidity of the vagina all cease in from seven to twelve days, while the milk flow increases. Furthermore, if ovariotomy be performed upon these animals, the prolapse of the vagina disappears in 95 % of the cases, thus demonstrating the co-ordination between the cysts and the vaginal prolapse.

We should not underestimate, as a cause of continued or newly occurring prolapse of the vagina during the first two to six weeks after birth, an acute or chronic catarrhal or purulent endometritis due to the relaxed state of the pelvic diaphragm.

As prodromata of vaginal prolapse due to ovarian cysts, there is observed a sinking of the sacro-sciatic ligament and a swelling of the lips of the vulva. As a general rule, the prolapse does not occur at the same time as the formation of the ovarian cysts or the sinking of pelvic ligaments, but follows these some days or weeks later. It often appears simultaneously with a well marked erethetic nymphomania. Now and then the quantity of milk sinks one-half and along with it sometimes occurs a "holding up" of the milk. In rare cases, some time after the appearance of prolapse of the vagina there also appears a slight prolapse of the rectum. In one such case we identified on the right side an ovarian cyst the size of a hazelnut and in the left ovary a greatly hypertrophied corpus luteum.

The prolapse often involves only the superior wall of the vagina. The swollen lips of the vulva are clearly sunken forward and apparently small; in many cases they hang loosely; in the superior half of the vulva they are folded and wrinkled. The wrinkles extend regularly from above and outward, downward and inward, and are almost wholly caused by the muscular contraction of the walls of the vestibule of the vagina or possibly are a result of the flaccidity of the radiating muscle of the vulva and common fibers of the *sphincter ani externus* and *constrictor cunni*, causing an invagination of the lips of the vulva, that is, an *entropium vulvae spasticus*, from which, in place of the normal mucous margins of the vulva, two haired cutaneous surfaces come in contact. The last related symptoms (wrinkling and en-

tropium formation of the vulvar lips) are, from a diagnostic, pathonogmonic and superficially visible standpoint, of much importance. Moreover, the vulvar opening is frequently much elongated, the vestibule of the vagina markedly enlarged and flaccid, so that, in individual cows, air may readily become aspired into the enlarged vaginal cavity, which may become greatly distended, so that, upon palpation per rectum, the vagina may be found tensely inflated with air, in order to evacuate which it is necessary to apply pressure and backward massage to the vagina, per rectum.[1]

If, in addition to the prolapse of the vagina, there is also endometritis, the os uteri is found sufficiently open to admit the index finger : out of it flows a mucous or muco-purulent exudate and the uterus shows an increased size. In cows which have suffered from prolapse of the vagina dependent upon ovarial cysts and have not been treated for these, but have had vulvar sutures applied to overcome the condition, there is now and then violent straining and pressing, on which account practitioners who are not experienced replace the vulvar sutures by a vaginal bandage or truss in order to give the prolapse more room. It is scarcely necessary to suggest that, in order to determine the etiology and rational therapeutics in each case of prolapsed vagina in non-pregnant cows, palpation per vaginam and per rectum should be employed and that these rules are constantly applied in this clinic.

D. Prolapsus Portionis Vaginalis Uteri.[2]

Quite analogous, from the standpoint of cause and curative means, to the prolapse of the vagina is the prolapse of the vaginal portion of the uterus. In very great flaccidity of the genital organs this prolapse can be brought about artificially by drawing backward upon the os uteri.

E. Prognosis.

Cystic degeneration of the ovaries offers a favorable prognosis in general, since, in our statistics, certainly 70% of nympho-

[1] In this relation it needs be borne in mind that the vagina possesses the power of ballooning, much as related here.]

[2] E, Hess, Schweizer Archiv für Tierheilkunde, 1886, p. 74 : 1890, p. 212 and 1896, p. 228.

maniac cows have been restored to fertility and again become pregnant. The remainder were mostly rendered at least temporarily quiet. The prognosis is the more favorable when the veterinary handling is begun early and the animal is not fed too intensely.

The prognosis becomes doubtful in fat heifers which have never been pregnant, in old, deep-milking cows with depressed regenerative powers, as well as in cases of old standing and those in which the cysts have recurred six or more times.

Estrum and pregnancy do not occur in cows whose ovaries have undergone senile atrophy or which have suffered atrophy from the rupture, by compression, of ovarian cysts. It should be noted, however, that a very small remnant of ovarian tissue may possess much regenerative power because there may form within six days in some cases either large corpora lutea or one or two cysts, as our collections very well show.

A spontaneous recovery or rupture of the cysts has been observed by us in a few cases of cows which had calved normally two to six weeks before. And it is well to observe in our present state of knowledge that it was not the use of posset or sillabub that caused the rupture of the very thin walled cyst any more than the extreme filling of the rumen, which pressed upon the ovaries while the animal was lying down on a slanting floor, or to severe pressure of feces.

Nymphomaniac cows which are not handled tend to become emaciated, wasted and, finally, to succumb to cachexy.

In reference to the prognosis of prolapsus vaginæ of non-pregnant cows, experience teaches that, in so far as the causes can be removed, and the atony of the pelvic diaphragm is not extreme, the prolapse disappears within twelve to twenty days or, if the cysts recur, the prolapse likewise returns.

In hydro- and pyometra, the outlook needs be based upon the duration of the affection, the volume of the collection, and chiefly upon the facility with which the ovaries may be reached and restored to their normal condition through rectal or vaginal manipulation ; if these can be corrected, the results are often excellent.

THERAPY

A. Medicinal.

We cannot undertake to discuss all the remedies which have been proposed by veterinarians of early times for the relief of nymphomania in cows, nor those which have actually been put in use and have from time to time won high repute in those regions where inner palpation of the genital organs of nymphomaniac cows is very rarely practiced.

To these belong venesection, magnesium sulphate and sodium sulphate, in combination with amaris, aromatics and etherial oils, as: *Rad. Gentian, Herb. Centaur minor, asafetida, Rad. Angelic, Rhiz. Calami, Cantharid. pulv., Fol. Menth. Piperit., Fruct Foeniculi, Fruct Junperi, Piper Nigr. pulv., Rad. Valerian;* also such depressant drugs as Camphor, Potassa Bromid, etc.

Slight sinking of the sacro-sciatic ligament dependent upon atony of the genital organs frequently recovers promptly after the use of the following:—

℞	Magnesium Sulphate	300 grams
	P. Gent. Rad.	
	" Cinchonae Cort. aa	150 grams
	" Cascarilla "	100 grams
	Aq. font. q. s. ut fiat	
	decoct. ad. colat.	8000 cc.

Sig:—One pint internally 2–3 times daily.

Sulphate of iron, 5–10 grams dissolved in 4 liters of water or camomile tea, is used for the same purpose.

A yet greater reputation for influence upon the relaxed sacro-sciatic ligaments and genital organs is accredited to resinous and balsamic substances, especially Ol. Terebinth. The latter may be given in doses of 15–20 cc. in ½ liter of milk three times daily. Turpentine, camphor and asafetida has each the disadvantage that, when given for several days, it imparts an unpleasant flavor to the milk, and, although we have prescribed turpentine or myrrh frequently, we have never been able to observe the disappearance of ovarian cysts as a result of its use.

In earlier times, they bathed the loins and sunken sacro-sciatic ligaments daily with cold water or applied with massage

spiritous, feebly stimulant drugs or even volatile liniments, ol. turpentine, rape oil 1:5, or compound cantharides ointment. Frictions over the sunken pelvic ligaments are merely of theoretic interest.

The value of medicinal handling is doubtless frequently overestimated; nevertheless, it constitutes, in many cases, when applied alone, a valuable method, which is not to be underestimated, and in many other cases, a highly important adjunct in combination with operative handling. In those cows where estrum appears shortly after parturition and the uterus has not undergone normal involution and is flaccid and slight catarrhal endometritis arises without being caused by any recognizable anatomical changes in the ovaries, but resulting rather from a depression of the vital energy, stimulants and tonics exert a very beneficial effect.

In catarrhal, muco-purulent or purulent endometritis, in addition to internal medication, it is advisable to douche out the vagina daily with astringent and disinfectant decoctions or solutions, such as sol. plumbi. subacet. 15:1000, alum ust, 0.5–1%, Zinc Sulph. 0.25–0.5%, Creolin 0.5–1%, Lysol 0.25–1%, etc.

Under all conditions, the beginning veterinarian has to behave, in the handling of nymphomaniac cows, so far as he will not seriously injure his repute or practice, with some respect toward ancient customs and psychologic considerations and, in opposition to views recently expressed in veterinary periodicals, endeavor to express himself frankly, tactfully and without reserve to the owner.

B. Operative Handling of Ovarian Cysts.

The operative therapeutics of ovarian cysts should always be preceded by a painstaking consideration of the anamnesis and a thorough examination of the special reproductive apparatus, as well as the other organs of the body. The proper arrangement of the data derived from the study of the case absolutely demands the entrance of all notes in a special journal.

The investigation and examination is best conducted, from the standpoint of light and cleanliness, outside the stable, in which case the numerous simple and cheap stocks very common in this region serve an excellent purpose.

Should this be wanting, the cow should be closely secured to a

ring in the wall or to a wagon, by means of a strong halter or horn rope. The position of the examiner should not be too low, and should be clean and dry. Cows which are sensitive about the handling of their genitals should be secured so that they can not move very freely, by forming a triangle by means of a wall with a wagon placed obliquely against it, the cow being tied short in the apex of the triangle so that she can neither move forwards nor backwards, while lateral movements are controlled by pushing the heavy wagon toward the wall and closing the base of the triangle. In very cold weather or when flies or gadflies are numerous, the animal may be secured and examined in a horse stall. Prior to the examination, the external genitals, anus and vagina should be well cleansed by means of a clean handtowel.

If the right hand is to be used by the examiner, the tail should be turned to the right and held by an assistant standing on the left side of the cow, and reversely. The proper examination of the special genital organs requires a blouse to protect the clothing and two, or better three assistants, much patience, at all times great cleanliness, removal of all finger rings, thorough oiling of the hand and arm, as well as closely trimmed nails. The evacuation of the rectum, especially in winter and in animals not greatly excited sexually, is most conveniently brought about by inserting the fingers, up to the metacarpus, in the anus and, spreading the digits apart, permitting air to enter the rectum, upon which defecation usually occurs spontaneously ; otherwise the rectum needs be evacuated with the hand. A special flushing out of the rectum with the addition of anaesthetics we deem unnecessary.

In order to avoid as far as possible the troublesome arching of the back and pressing upon the rectum, which renders the examination and handling difficult and, especially when upon green food, becomes very disagreeable, it is recommended to gather the skin in folds just behind the withers, to pinch the skin of the back between the fingers, to press upon the anterior dorsal region by means of a round beam, and to strike sharply upon the horns with a small stick. [A wooden beam 5 to 6 feet long placed across the back and borne down by a man on either side, is, in our experience, the most effective plan for preventing straining.]

In locating the ovaries it is to be first remembered that the normally involuted, symmetrical, unimpregnated uterus, weigh-

ing 600 to 700 grams, may be grasped in the open hand and carried relatively far backwards into the pelvic cavity. As a result of estrum, the uterus is normally quite hyperaemic for three days, abnormally for four to six days, so that it is consequently larger, denser and firmer, which condition causes it to be readily felt just beneath the rectum.

It is to be noted that the uterus frequently does not lie exactly on the median line but either to the right or left, and indeed far more frequently to the right side. The finding of the ovaries and their identification, which for the beginner is often very trying and sometimes accompanied by errors leading to fatal consequences, requires much training. The latter increases, however, the self-confidence in the proper examination and handling of the case and renders inner palpation, in the course of time, more and more easy, until it finally becomes no longer disagreeable. In case of veterinarians with limited experience, the ovary is most safely discovered by first grasping the uterus and thence palpating along the uterine cornu on the concave side until the apex is reached, from whence, slightly laterally, the ovary is loosely attached in the anterior border of the broad ligament, where it can be picked up. More experienced practitioners search directly for the ovary on the anterior border of the broad ligament and draw it backwards. In cases of pregnancy or pyometra the ovaries are carried far forward and downward into the abdominal cavity and thus render it difficult or impossible to reach and detect them. They are also frequently difficult to locate and grasp when the animal strains violently and the rectal walls are tensely stretched and also where the ovary is enclosed within the ovarian sinus, that is where we have to do with a so-called encapsulated ovary. In such cases it avails nothing, even if the os uteri projects into the vagina far enough to be grasped, to draw upon the cervix, either with the naked hand or with it wrapped in a small clean towel. In case of slight filling of the uterus with pus or other liquid, the ovary lying beneath the uterine horn may be made accessible by turning the uterus on its long axis or the hand, with which the palpation is being made, passed underneath it, but not by elevating the abdominal floor by means of a beam.

The examination of the ovaries includes the size, form, character of the surface, consistence of the tissues and presence

or absence of pain on manipulation. Normally, ovaries without fresh corpora lutea, according to the age of the animal, as already related on page 168, are the size of a pea, bean or large hazelnut, ovoid and of firm-elastic consistence. Large, ripe follicles vary in size from a pea to at most the size of a hazelnut and are recognizable as soft, elastic, fluctuating spots, slightly elevated above the surface. Corpora lutea, when fresh, vary in size from a hazelnut to a hickorynut, project beyond the ovarian surface as slightly elastic, wart-like outgrowths; older and partly resorbed and persistent corpora (corpora albicantia and persistentia) are only the size of a pea to that of a hazelnut, protrude less, and are of a more firm and solid consistence.

In the handling of ovarian cysts we have for many years relied upon the following methods in this clinic:

1. The rupture of the cysts by compression per rectum.
2. The rupture of the cysts by compression per vaginam.
3. The puncture of the cysts through the vaginal roof.
4. The injection of disinfecting liquids into the ovaries.
5. Unilateral or bilateral castration.

1. Rupturing the Cysts per Rectum.

By this process, which was first described by Zangger, the cystic degenerated ovary is grasped through the rectal wall, and the cyst ruptured, either by compression with the entire hand or by grasping it between the volar surfaces of two fingers and the thumb bent at a right angle or by pressing it between the hand and the ilial shaft or border. Care is to be taken that the bowel contains no feces, and it is to be remembered that the operation is more difficult in freshly fed cows on account of the more abundant defecation and, therefore, when practicable, should be undertaken during the afternoon, which has the further advantage that, in case of the advent of fatal hemorrhage, the emergency slaughter need not be undertaken until the following morning, instead of during the night. In a large proportion of cases, moderate pressure suffices to bring about the rupture of the cysts, the accomplishment of which is to be recognized by a sudden collapse of the ovary in the hand.

In reference to the possibility of rupturing the cysts, those which are solitary, thin walled and of recent formation are uniformly most certain and easiest. In our experience with many

thousands of cases of cystic ovaries, we find the recent and easily rupturable ones chiefly in heifers and in cows which have recently calved and indeed with equal certainty whether the duration of pregnancy has been normal or not. The same is true of nymphomaniac cows which have only recently become affected, and of cases previously treated, in which the cysts have recently recurred.

By mere accident apparently, in certain herds in which the cows and heifers run at pasture the entire summer and where they receive very little artificial food, the cysts are generally thin walled and easily ruptured.

If the peripheral cysts be of long standing and possess a thick, tough capsule, earnest warning need be given, before the rupture of the cysts per rectum is undertaken, against the accompanying dangers of severe maiming or tearing of certain, or of all the tissues of the rectal walls.

It makes a bad showing if—in cases where the operation has been very difficult, as for example, where the patient is very resistent, shows great uneasiness and strains violently, or great sensibility in the ovaries which have already been subjected to the crushing of cysts several times, or difficulty in locating and grasping them, etc.,—the operator withdraws from the rectum a bloody hand, since these unfavorable appearances do not tend to increase the esteem in which the operation is held, nor the standing of the operator.

In peripheral cysts of varying ages, a cyst in one ovary may be easily crushed while, in the other gland, one of equal size will be very difficult or impossible of rupture. In cases of two or more cysts in one ovary, first one cyst and then the other is felt to rupture, after which there is recognizable a minute fragment of the ovary, which, however, amply suffices for inducing the occurrence of normal estrum, although the remnant consists merely of an empty, collapsed capsule; a small, empty, flat bag. If, in addition to one or two cysts, a corpus luteum is found, the latter usually becomes ruptured or pressed out first and then the cysts often burst spontaneously; however, it sometimes occurs, as shown by our collection, that the cysts rupture while a small corpus luteum remains intact in the ovary, and for its dislodgement a still greater pressure is necessary.

2. The Rupture of the Cysts Per Vaginam.

For a long time we have, in addition to the rupturing of ovarial cysts per rectum, also practiced rupturing them per vaginam, an experience devoid of danger throughout, easily accomplished and accompanied by excellent results.

The operation per vaginam is to be recommended in all those cases where ovarial cysts cannot be easily and safely ruptured per rectum. In this regard it is to be preferred in all those cases of peripheral cysts with thick walls, such as usually form in dumb bullers, "stillochsigkeitt," and also in old, recurrent, thick-walled cysts, as well as in multiple and central cysts. Likewise, it constitutes an excellent method for dislodging very firmly embedded hypertrophied corpora lutea which require removal.

The operation is uniformly possible in cows of the spotted and brown breeds so long as the vulva and vagina are free from strictures and also in large two-year-old heifers with sound vaginæ it succeeds almost without exception if certain precautions are observed. Palpation per vaginam is difficult or impossible in heifers with fresh *vaginitis follicularis infectiosa*, in heifers and cows which have been handled for this disease with powerfully irritant or caustic remedies; also in animals with strictures or adhesions of the vagina, to which there is almost uniformly a well marked tendency after vaginal injections of a 2% pyoktanin solution in a vagina affected with infectious nodular disease; and finally in two or three-year-old animals which have aborted during the first half of pregnancy or have suffered from placental retention and whose vaginæ have been irritated and lacerated by palpations by inexperienced and incompetent persons.

Besides the customary precautions, palpation of the genital organs demands a thorough oiling of the vulva and the hand. The hand, usually the right, which is naturally the stronger, is then gently pushed through the vulva with a rotary motion until it reaches the os uteri externum. After the right hand has been successfully introduced, the left can then readily be inserted without special difficulty. After completing the examination of the vagina, the manual displacement of the ovary is carried out. Following the grasping of the cyst per rectum it is then pushed backwards with the right hand and held down-

wards. First the diseased ovary is firmly grasped and drawn as far backwards as possible. The left hand, carefully prepared, is then inserted with the greatest caution into the vagina and the ovary, now held in the right hand per rectum, is grasped firmly with the left through the roof of the vagina.

Should the ovary escape because of sudden straining, search for and grasp it again with the right hand, per rectum, for which purpose it is best to partly withdraw the left until the gland is again located and secured. By lifting and pushing the rectum aside, the ovary is freed from the bowel and lies now surrounded only by the superior vaginal wall. Grasping the gland, either between the thumb, index and middle finger, or in the entire left hand, it may then be pressed and ruptured with all the force at command without any important injury to the vagina. In one exceptional instance, indeed, in a case of sclerotic ovary, the albuginea was ruptured, which was followed by no ill consequence. Should the left hand for any reason whatever become exhausted, it should be withdrawn and the right used in its stead.

The bursting of thick-walled, large cysts is recognizable by the sudden disappearance of resistance and is now and then evidenced by a slight cracking sound. It is highly advantageous that the rectal straining generally exerts no, or in other cases, only very slight influence upon the fixation of the ovary per vaginam, as a consequence of which the final compression is very much easier and more possible than by fixation of the ovary through the rectum. The thinner and more flaccid the superior vaginal wall and the farther the ovary can be drawn backwards, the easier the operation, and vice versa

We have attempted to rupture central cysts through the superior vaginal walls by a specially constructed instrument similar to the lithotrite of Weiss, but without result, as it was impossible to secure the affected ovary through the superior vaginal wall even though ample and flaccid.

In cows with large, wide, relaxed vaginæ we have also attempted to secure the ovary through the superior vaginal wall by means of an ecraseur chain and then to rupture or puncture the cysts, but we have found it a very exhausting task, which rarely succeeds, and our experience has not warranted recommending it.

In cystic degeneration with adhesions of the ovaries to neigh-

boring parts so that they cannot be pushed backwards per rectum, as well as in cases of abscess of the ovary, it is good policy to abandon manual handling and, instead, to castrate the animal by intra-abdominal ligation. And, finally, in cases of encapsulated ovaries which cannot be detached and which resist attempts to rupture them in their sinuses, there only remains castration with ligation of the ligamentary apparatus.

3. The Puncture of the Cysts Through the Superior Vaginal Wall.

This operation is indicated in cases of very thick-walled peripheral or central cysts which cannot be ruptured per vaginam.

It may be carried out with a very small concealed bistoury or with equal facility by means of the 5.5 cm. long intestinal trocar without canula such as we have used for some years and is made by Hauptner in Berlin. The strictest possible antisepsis of the external genitals, of the hand introduced into the vagina and disinfection of the instruments, is essential. The operation is simple and is not followed by important sequelæ. The affected ovary is grasped and fixed with the right hand per rectum while the instrument, carried into the vagina with the left, is passed through the superior vaginal wall into the cysts.

The puncture of the cyst causes a disappearance of resistance and by light pressure complete evacuation is readily induced. The ovary then consists essentially of an empty capsule. If the first effort is unsuccessful, draw the trocar back into the vagina somewhat and insert it at a different point in the ovary.

In this operation, owing to the fact that the ovary is fixed by the hand in the rectum, it occasionally happens that the intestinal wall is wounded, but this is of no consequence since the muscles, being both circular and longitudinal, promptly close the small wound and prevent any escape of contents. This occurrence may be avoided in old cows with roomy vaginæ by grasping the ovary through the vaginal walls with the left hand and holding it far backwards, and then passing the right hand, armed with the instrument, alongside the left and making the puncture with entire safety.

When the ovary can be drawn far backwards we have been enabled to make the puncture with the intestinal trocar by

merely inserting the fingers of the right hand into the vestibule of the vagina.

4. Injection of Disinfectants into the Ovaries.

Quite analogous to emptying the ovarian cysts by puncture is the injection of them with disinfecting and dispersing agents. This was first recommended by Bertschy (Schweitzer-Archiv. 1906, p. 155) in cases of cystic ovaries, especially those undergoing fibro-cystic degeneration or containing central cysts. We use for this purpose a Dieulofoy syringe fitted with a special rubber tube from the syringe to the canula, through which we inject a 1:10 Tr. Iodine solution.

The practical results of puncture of cystic degenerated ovaries, as well as the intra-ovarian injections, according to our statistics, are evident only in rare cases, a fact which supports our teaching throughout that, when cystic ovaries cannot be restored to their normal condition and function by rupturing the cysts by compression, either through the rectum or vagina, the last and only rational resort is the uni- or bilateral castration of the animal.

When the cysts are successfully evacuated early, there is recovery from the nymphomania in from two to eight days. First the sexual excitement abates ; the animal becomes more quiet in from 12 to 24 hours, more docile and can again be turned with the other cows to water or pasture. The sunken sacro-sciatic ligaments become normal, the vulva smaller and firmer, the vulvar opening and vagina narrower and the vaginal entropium ceases. Because of the contraction of the uterus and closure of the cervical canal, the slimy mucous discharge ceases. The heretofore wild expression of the eyes becomes again normal and docile, and in a short time there is distinct improvement in the body nutrition, besides a qualitative and quantitative improvement in the milk secretion, changes which clearly increase the worth of the patient. Within about twenty days after the operation another notable result appears—the disappearance of the *prolapsus vaginæ*, or *prolapsus portionis vaginalis uteri*. It is to be observed in reference to the latter that the recovery occurs without vulvar sutures and without the notable vulvar cicitrization, which decreases the value of the animal. Only in old cases with debility are vulvar sutures demanded. Furthermore, in about three weeks the normal estrum

appears, when it is advisable to allow the animal to be bred. The custom, in some regions, of causing the cow to be served immediately after the operation is not favorable to conception according to our observation and raises the question whether this premature copulation and excitation of the genital system does not really do harm and tend to cause the recurrence of the cystic degeneration. Especially in well nourished heifers and in deep milking adult cows, ovarian cysts sometimes recur again and again so that they may be ruptured three to fifteen times, which puts a heavy tax on the time and energy of the veterinarian.

It is interesting to note that exceptionally in cases of dumb estrum, after the cysts have been ruptured, normal estrum follows or erethetic nymphomania with a recurrence of the cysts. Further, in rare cases, thick walled cysts, present at a first examination and impossible of rupture, are readily ruptured under moderate pressure two or three weeks later.

We have also noted rarely that fibrous degenerated ovaries, after vigorous vaginal pressure and massage, sometimes develop, in the course of fourteen days, cysts as large as small hen's eggs.

In general the rupture of ovarial cysts, when carefully undertaken, is easy of accomplishment and without danger, and only requires after attention in the exceptional cases already mentioned. Serious or fatal sequelæ have not followed the rupture of ovarian cysts or the dislodgement of persistent or hypertrophied corpora lutea in this ambulatory clinic in spite of the many thousands of cases operated upon, but we have had the fortune to observe such accidents elsewhere.

Among the sequelæ we may mention :

A. Great Hyperesthesia of the Rectum and Genital Organs.

Now and then one meets with a cow which has been rudely palpated per rectum several times by an inexperienced person ; or affected with a chronic intestinal catarrh or intestinal tuberculosis ; adhesions of the uterine cornua and ovaries to the surrounding organs ; abscesses in the ovarian ligament ; or, from handling for granular venereal disease, has become uncommonly sensitive and strains violently, accompanied by the inspiration of air into the rectum. The straining may be somewhat controlled by pinching or nipping the dorsal spine for 30 to 60 minutes,

while the inspiration of air into the rectum may be obviated by pressure on the anus or, still better, by covering the anal opening with a folded hand-towel.

Heifers and cows which have been previously handled for infectious granular venereal disease, with irritant remedies, or are still suffering from the malady, are frequently so irritable and afraid of the handling of the vulva or vagina that they are very resistent and require very careful and close securing and, even in the stocks, may either lower the hind quarters, rear, or throw themselves down and thus render the examination very difficult. As a general rule the hyperesthesia of the rectum and vagina disappears spontaneously after eight to ten weeks.

B. Kinking of the Lumbo-Sacral Symphysis.

By this term we understand a sudden and rapidly alternating elevation and depression of the lumbo-sacral articulation, with a cracking sound. It occurs in young, timid animals and now and then also in animals suffering from a serous infiltration of the superior vaginal wall. As soon as, or just after, the hand is passed into the rectum or vagina there occurs a sudden elevation and depression of the symphysis, which painfully injures the operator's arm and causes him to let go the ovary, which has already been grasped. This very annoying symptom usually ceases spontaneously in a few minutes but disappears more promptly by tapping the horns, pressing upon the back and leaving the arm wholly passive in the rectum.

C. Serous Infiltration of the Superior Wall of the Vagina.

This condition is rarely seen except as the consequence of repeated rude palpation of the vagina or as a result of the injection of irritant remedies, especially in the treatment of granular venereal disease. As a result the vagina becomes as much as 5 cm. thick with extensive serous infiltration, is sensitive, and the folds are obliterated so that grasping of the ovary through the vaginal wall is exceedingly difficult, if not impossible.

By suspending the vaginal palpation, recovery occurs spontaneously in 4–6 weeks.

D. The Detachment of the Ovary.

In the operation of securing the ovary per rectum preparatory

to rupturing cysts or detaching persistent hypertrophied corpora lutea, it has happened to us in four cases in high bred, excitable heifers and young cows (never in adults), owing to sudden straining or the sudden dropping of the lumbo-sacral articulation, that the grasped ovary, attached to the fine, tense ligament, is unexpectedly torn away from its attachments and remains in the hand, to later fall into the abdominal cavity. The same misfortune can occur by drawing the ovary too far backward when grasped *per rectum* or *vaginam*. In all such cases, the ligamentous apparatus should be immediately and carefully examined in order that hemorrhage, if present, may be controlled by compression. In two of these cases we clearly felt per rectum the pulsating, bleeding ovarian artery, which we compressed, as well as possible, for twenty minutes. Of the four cases, one failed to again show estrum, but the other three all conceived.

It is well to bear in mind that, after the total ablation of an ovary, as also after the pressing out of large, fresh corpora lutea and vigorous after-compression of the ovary, the animal now and then shows, for 30–60 minutes, slight colic symptoms (castration colic), such as uneasiness, suspension of feeding, elevation of the tail without tympany, which symptoms spontaneously disappear in a short time.

F. Laceration of the Rectum.

This accident occurs mostly in delicately built heifers with a narrow rectum, or in good milch cows in which the rectum possesses very slight resistant power and, even by very slight pressure, is lacerated. These rather frequent lacerations, due constantly to improper palpation, may involve only the mucosa or include the muscular, and even the serous coats.

While scratches and lacerations in the mucosa of the pelvic portion of the rectum from too long finger nails is as a rule inconsequential, extensive lacerations of the mucosa and muscularis lead readily to rectal strictures and to adhesions of the rectum to the surrounding parts. Small penetrant wounds in the pelvic rectum, which quickly close, lead to extensive suppuration or septic phlegmon in the peri-rectal or peri-vaginal connective tissue and thereby cause compression of the rectum with long continued straining and pressure upon the feces, marked narrowing of the rectum and vagina, adhesions of the rectum to its sur-

roundings, slight pyaemic fever, emaciation, lumbar weakness and septicaemia. Now and then the abscesses break into the vagina, following which complete recovery may occur. Severe penetrant wounds of the rectum lead to fatal hemorrhage or septic peritonitis.

G. Fatal Hemorrhage From the Ovarian Artery.

(*Hemorrhagia arteriæ ovaricæ.*)

The most to be dreaded and certainly also more common sequel of ovarian operations than generally believed, is the slow bleeding to death from the ovarian arteries. Because of the non-vascularity of the capsule in peripheral ovarian cysts, hemorrhage does not occur from them, but serious or fatal hemorrhage is at times observed after the dislodgement of corpora lutea by compression, after severe crushing and laceration of the ovaries, and is possible also after the inadvertent tearing away of the ovary from its attachments. In ovaries affected with angioma and blood cysts, fatal hemorrhage may readily be caused.

In the last case, which is very rare, the ovary feels soft, elastic, flabby, spheroidal, varies in size from that of a man's fist to a child's head and, in case of an angiom, possesses a spherical or slightly nodular character. Upon pressure, the angiom diminishes in size but when the compression is removed the refilling of blood soon restores it to its former dimensions. We have twice had the opportunity of observing cows in which ovarian angioma had been lacerated through improper handling, followed by severe, though not fatal, intra-abdominal hemorrhage.

The symptoms which serve to indicate ovarian hemorrhage and which appear a few hours after the operation are as follows: decreased or wholly suspended appetite, fullness in the upper flank, weariness, weakness, quickening of the respiration, violent heart beat, feeble pulse, muscular tremblings, cold horns, ears and feet, anaemia of the visible mucosa and the skin of the udder. Death usually follows 15–36 hours after operation.

Aside from these fatal hemorrhages, others of a less serious character occur and become spontaneously stopped. The condition may cause a more or less complete loss of appetite and rumination for one or two meals and a varying degree of fullness in the upper flank region. After 24–96 hours the animals recover

their normal health. Evidently, fatal hemorrhage may also accompany more or less extensive lacerations of the rectum.

In one cow we ruptured by compression on two occasions, April and August, 1906, what we believed to be thick-walled abscesses the size of a hen's egg in the right ovary, which was followed in each case 24 hours after operation by symptoms of severe peritonitis, which persisted for 14 days, so that our view was supported that in this case we were not dealing with a cyst, but with an ovarian abscess.

With a view to prophylaxis of fatal hemorrhage, we believe the chief danger lies in too hasty, too careless operations, and in a too loose generalization of cases. If, therefore, each case is judiciously considered separately, as is undeniably demanded, there is no fear of after-hemorrhage. The careful, experienced practitioner will find cases of diseased ovaries which it is injudicious to handle.

From a prophylactic standpoint, it is desirable, in all those cases where it is not perfectly certain that it is a cyst which is being ruptured, that digital compression should be applied to the ovary for 10 to 20 minutes after the operation, or, this being impracticable, the compression may be applied per rectum or per vaginam to the ovarian artery, which lies just beyond the apex of the uterine cornua. While the after-compression carried out per rectum has the disadvantage of being rendered difficult by the straining, and is more certain, reliable and easier per vaginam, either is efficient and trustworthy. In addition, the owner or milker should keep the patient under observation, whether day or night, for some fifteen hours after operation.

5. CASTRATION

This final therapeutic agency, the last resort, the indications for which have become constantly more precise during recent years, and the worth of which in certain cases is unquestioned, is also to be considered here.

The reasons for castration, as revealed by our numerous observations, are as follows :—

a. Recurrent peripheral cyst-formation in one or both ovaries, accompanied by nymphomania, when, in spite of frequently repeated rupturing of the cysts, a restoration to the normal condition cannot be effected. These conditions apply especially to aged cows yielding more than three liters of milk per milking, in which, in spite of repeated rupturing of cysts, a slight sexual irritation, such as a slight falling in of the broad ligaments of the pelvis and swollen vulva, persist. On the other hand, we have not castrated any young breeding cows for years, because of peripheral cysts, until after we had ruptured the cysts 6–8 times in an attempt to bring about recovery, and in several cases it was not until after the cysts had been ruptured 8–12 times that normal estrum and pregnancy resulted.

b. Central or multiple cysts which cannot be broken by compression nor evacuated by puncture.

c. Finally, ovarian edema and ovarian abscesses.

The operation is contraindicated :

a. In dumb estrum, loss of estrum due to atrophy and sclerosis of the ovary ;

b. In ovarial tuberculosis ;

c. In cancer of the ovary ;

d. In nymphomania dependent upon disease of the oviducts, the ovarian ligaments, the uterus or the vagina, such as serous salpingitis, cystic formation in the ligamentous apparatus of the ovary, tuberculosis and cancer of the uterus and vaginal polypus.

e. In tuberculous, poor, cachectic animals.

f. In cows with too narrow vaginæ due to vaginal stricture.*

[*The author apparently has in mind only the vaginal ovariotomy which the pathologic condition prevents, but which could not influence the flank operation.]

From the foregoing it will be seen that the indications for castration have been reduced to a more limited compass than during earlier years, and there can be scant objection thereto because of the present enormously high price of breeding cattle, so that it becomes one of the greatest duties of the practicing veterinarian to resort to every possible means to preserve to the utmost the breeding power of well bred and valuable animals.

We hold therefore that the wholesale castration of nymphomaniac cows without first resorting to earnest attempts at curing, the malady, robs them of their parturient function in a manner contrary to the interests of science, veterinary practice and stock-breeding.

According to veterinary authors cows may be castrated by :

a. The flank incision ;

b. The vaginal incision ;

c. Ligation of the ovary through the inferior rectal wall (Experience of Trachsler-Berdes, Koch's Encyclopaedia der gesammten Thierheilkunde und Tierzucht).

For a number of years we have endeavored to perfect the method of castrating cows. We have made the following investigations upon cows designed for slaughter :

a. Castration by tearing the ovaries from their attachments. In heifers with thin, weak ligaments the detachment of the ovaries per rectum or vaginam is comparatively easily and quickly effected, while in old animals with strong broad ligaments the operation becomes impossible even per vaginam. The character of the lesion after division by tearing the ovary away in young animals is analogous to that induced by the ecraseur, while, in old cows, the ligamentous apparatus of the ovary tears very irregularly and sometimes involves the uterine cornua.

The danger from fatal hemorrhage may be excluded by after compression, the artery being compressed between the thumb and fingers for a few minutes, but in one case we observed in the abdomen, one hour after castration, about one liter of blood. We have further found that the power of ovarial regeneration in the heifer is astonishing and that if a fragment of ovarian tissue as large as a pea or even a pinhead is left on the ligament it may rapidly develop and within 9–10 days contain one or two large corpora lutea or a cyst. [Upon the western plains of

America where removal of the ovaries by linear tension or tearing away is practiced in the spaying of heifers for fattening, estrum and nymphomania are reported common, surely as a result of leaving behind some vestiges of ovarian tissues.]

b. Castration by torsion of the ovary from the rectum or vagina. While, in the cadaver, the detachment of the ovary by torsion requires 6–10 complete revolutions, we failed in every case to bring about its removal by this means in the living animal because of the firmness of its attachment to the broad ligament and the smoothness of the ovary, which caused it to inevitably slip away.

c. Equally impracticable to the two preceding methods have proven our attempts to ligate the ovary through the superior vaginal wall, including the latter with strong silk or elastic ligature, which was attempted by us in old cows with wide, flaccid vaginae. Apparently our failure was due to the violent straining following the operation.

d. On the other hand, the method of castration which we have regularly applied in our work and which has yielded excellent results is based upon the modern surgical principle that only the diseased part is to be removed, so that for some years we have practiced *unilateral castration by vaginal incision*.

This operation is indicated in valuable pedigreed animals with only one ovary involved in cystic degeneration, of a character which can not be removed by manipulation and which is causing nymphomania or sterility. Its success depends upon the soundness of the remaining ovary, which can be readily verified by direct palpation through the vaginal opening during the operation. The practical results of this operation, showing its great economic value, we are able to show from our experience that, if the remaining ovary is wholly normal, estrum ensues in three weeks after castration and that, after another three weeks, the animal can be successfully served and impregnated. On the other hand we freely confess that the one sided castration, by increasing the nutritive supply to the remaining sound ovary, may lead to its cystic degeneration, and that experimentally we may cause the development of cysts by unilateral castration. If the remaining ovary is only slightly enlarged, the increased nutritive supply to it resulting from the removal of the diseased organ causes the regular occurrence of peripheral cysts in from 2–4 weeks after

the operation. The repeated rupture of these by compression is indicated, but the constant tendency is toward an eventual sclerosis of the organ. More seldom the operation is followed at first by an exaggerated estrum with a large corpus luteum and, after its dislodgement by compression, solitary or multiple peripheral cysts appear and the ovary becomes sclerotic. Should the changes in the ovary seem incurable and be accompanied by nymphomania, the castration needs be completed.

In a very valuable Simmerthal cow which had been under treatment for nymphomania for nine months, we found the left ovary the size of a hen's egg and affected with multiple cysts. The right ovary was divided into two spherical parts, which were separated about 4 cm. from each other and possessed a dumb-bell form in miniature. In this patient the left ovary was completely removed with an emasculator and, from the right organ, only one of the two spherical masses was removed with the chain ecraseur. Examination of this mass showed it to be a large, round, firm corpus luteum permeated by connective tissue. Ten days later the cow showed nymphomania, from a cyst formed in the right ovary, and eight weeks later it became necessary to completely remove the remainder of the right ovary because of extensive cystic disease after the cysts had been ruptured eight times in vain.

e. The results of *complete castration* are similar in many respects to the successful handling by rupture of the cysts. The animals become quiet, sexual excitement disappears completely and the sacro-sciatic ligaments resume their normal position. As a result of the decreased vascularity, the uterus, vagina and vulva become distinctly smaller, *prolapsus vaginæ* or *prolapsus uteri portio vaginalis* disappears and nutrition is increased, that is, the animal is more readily fatted and, while the animal yielded but about three liters of milk per milking before castration, by inhibiting the sexual functions and reflexes, the milk is materially increased in quantity and the "holding up" of the milk is stopped. The influence of castration upon the course of tuberculosis—whether it ameliorates the disease and tends to cure it or not and what general influence it exerts upon soundness and vigor, as indicated by cardiac and muscular power—it would be interesting to determine by further experiment.

The sequelæ of castration as observed by us in the course of

years are by no means of so harmless a nature as many would have us believe and there is good room for differences of opinion as to its value in many cases. Among these unfavorable results are to be counted severe or fatal hemorrhage, in connection with which it might be urged that, in the castration of cows, the most rigid antiseptic precautions should be observed and that the prevention of even the slightest hemorrhage from the ovarial arteries is of very great importance in relation to infection, because any hemorrhage, with the resultant formation of hematoma or blood coagula, tends to favor the development of severe complications, the blood clots serving as a culture medium for bacterial growth.

Hemorrhage from the ovarian artery also tends to induce ichorous-purulent and sero-fibrous peritonitis, indigestion and gastric catarrh, accompanied often by a permanent reduction of the milk secretion; also serious phlegmon in the periproctal -vaginal and -vesicular connective tissue, complicated by difficult urination; abscessation in the stump of the ovarian ligament, with or without rupture into the rectum; pelvic abscess, with rupture into the vagina or later into the peritoneal cavity; encapsulated intra-peritoneal abscesses, leading to great emaciation; cysts as large as the fist forming in an ovarian ligament, leading to emaciation; as well as incomplete removal of the ovary, leading to the recurrence of cysts and nymphomania.

Young and old castrated cows in a moderate or good state of nutrition, according to our observations, fatten well; but when slaughtered the flesh is yellowish, spongy, coarse-grained and not to be called prime in quality, for which cause in this region old, fat castrated cows are not sought after as first-class butchers' stock. It is, however, to be remarked, as we have frequently observed, that thin, castrated cows are largely sold fraudulently as dry, farrow animals.

II. Collections of Pus in the Uterus.

Pyometra. Hydrometra.

By pyometra or hydrometra we understand the collection of a varying amount of pus or muco-purulent, (pyometra) or sero-mucoid fluid (hydrometra) in the uterus. This is comparatively common in the cow, more rare in the goat, and is accompanied or succeeded by various diseases of the genital organs It oc-

curs chiefly in 4–8 year-old cows, mostly in breeding and good milking cows, seldom in farrow animals. It is largely caused by abortion, premature birth, retained placenta, catarrhal or purulent endo-metritis, maceration of the fetus and, according to our observations, very often by the infectious granular venereal disease.

Although the symptoms vary somewhat they show a notable constancy.

First of all, contrary to our literature on the subject, our numerous clinical records teach that cows with abnormal collections in the uterus *do not* longer come in estrum, which condition, in cases where the pyometra had been preceded by estrum and coition, *very often leads to the false assumption of pregnancy.* Furthermore, the condition of the broad ligaments of the pelvis, the size of the vulva, the extent of the vulvar and vaginal canal, are ordinarily normal or but slightly altered, and only very seldom is there a marked sinking of the sacro-sciatic ligaments. Vaginal discharge is frequently absent in spite of the fact that the uterus is greatly distended and the cervix uteri is open sufficiently to permit the passage of a pencil, the little, or even the index, finger. Now and then there is seen in the stall, especially in the morning, a mucous, muco-purulent or flocculent purulent vaginal discharge behind the recumbent animal. This may be temporary or constant and variable in amount. It is also observed that the opening of the uterine cervix sufficiently for the passage of a pencil or of the little finger, and especially the vaginal discharge, tends to recur about every three weeks and persist for 2–3 days, or after about the same interval of time that estrum should normally recur and enduring for about the length of time that estrum should continue. In connection with the open cervical canal, the cervix and uterus are slightly enlarged or increased to the dimensions of a man's arm. The enlarged, painless uterus, which is not to be confused with pregnancy, is either symmetric or now and then asymmetric, the one horn, most generally the right, being somewhat more distended.

The size of the diseased horns varies between three and six inches in diameter and naturally their length and thickness vary greatly. If each horn does not contain to exceed a few liters of contents the point of bifurcation of the horns is very evident as is also the arching and curvature; one may also grasp the

curvature of the uterus *per rectum* and draw the former backwards and, what is of still greater practical value, may rotate the uterus 90° or ¼ revolution on its long axis, by which means the ovaries may be grasped and examined. Every collection in the uterus causes a displacement in the ovaries, they being drawn downward, forward and toward the median line, beneath the distended uterine cornu, so that finding and recognizing them, especially in cows which strain hard, is rendered very difficult, and in the presence of great filling of both horns becomes wholly impossible.

The uterine horns are smooth and of varying degrees of distension, at one time being relaxed and flat, at others more tense, rounded and sugillating. The contents consist of a thin or thick liquid, which is white, whitish-gray or grayish-yellow; either sero-mucous (myxometra), or, more often, purulent or muco-purulent, odorless or fetid (pyometra). According to its etiology, one may find fragments of fetal envelops, a macerated fetus or individual bones, which latter one may distinguish by careful palpation.

The ovaries are usually normal and there is found, what should not be underrated from a therapeutic standpoint, in one of them, one, two or three various sized persistent corpora lutea firmly imbedded in the organ, their presence depending upon the failure of their physiologic atrophy to take place. The other ovary has undergone fibrous or cystic degeneration and is from the size of a hickory nut to that of a hen's egg.

Therapeutics of Pyometra.

At variance with the general practice and the teachings of obstetric authors concerning the handling of pathologic collections in the distended uterus, we have for years followed a course of treatment which has yielded good results in 50 % of all our cases and has been accepted by many of our colleagues as a reliable method.

Each practitioner well knows that the therapy proposed in our literature for this disease, the prognosis of which is often unfavorable, consisting of the injection of astringent and antiseptic agents into the diseased uterus, has a higher theoretic than practical value because, with the closed or but slightly opened os uteri, the sufficient dilation of the cervical canal and the subse-

quent introduction through it into the uterus of the douching tube, is accompanied by enormous difficulty and great loss of time.

The therapeutics of the malady is not faciliated, either, by the fact that, after the completion of the first dilation, there follows several hours of severe straining and pressing, with loss of appetite, which leads the owner to become dissatisfied and desist from further treatment.

With a view to facilitating the dilation of the cervical canal and rendering it easy, as well as avoiding the afterstraining, irrigation of the vagina with water warmed to 39° C. is recommended before and during the mechanical operation. The evacuation of the pus is brought about by depressing the funnel attached to the end of the rubber tubing, which acts as a siphon. Now and then, though very rarely, one evacuation followed by flushing with lukewarm water suffices to bring about recovery and cause the recurrence of estrum.

The treatment employed by us consists of the pressing out of the corpora lutea and the per rectum stroking or massage of the uterus from before to behind. As already related, the elimination of the yellow body is only practicable when the uterus contains only a few liters of pus, that is, so long as the ovaries can be grasped and fixed per rectum. The detachment of the yellow bodies is brought about by compression through the rectum or vagina. The ovary is grasped between the volar surfaces of the thumb and two fingers or between the thumb, index and middle fingers and thus compressed. In old standing cases of pyometra—when the animal is irritable and strains violently, the rectum is very tense, and the corpora lutea are not very large or prominent and are solidly bound by connective tissue, that is, almost completely encapsulated—the operation becomes very difficult, in which case it is our practice to not press out the yellow bodies, but to vigorously massage and rub the ovary between the fingers. If a voluminous collection exists in the uterus and, in spite of drawing it backwards, the ovaries cannot be brought in reach, the cow should be at once fed for early slaughter.

After dislodgement of the corpus luteum, contraction of the uterus follows, the os uteri opens from before backward and the uterine contents are evacuated; in approximately 18–72 hours

after the operation there is observed, especially when the animal is recumbent, an astonishingly abundant, purulent vaginal discharge. It should be seen that this drains away promptly and that the floor, where the cow lies, and the gutter are well disinfected. As soon as the discharge ceases, which is usually after a very brief time, the uterus is small and empty and estrum often appears as early as the 4th day, still more commonly between the 4th and 10th days, after the dislodgement of the yellow bodies, and tends afterwards to recur regularly. Upon the second return of estrum it is advisable to permit her to be served and conception usually follows.

Exceptions to the type of cases described are seen in those cases in which, after the dislodgement of the corpora lutea, the patient shows pain, evidently the result of uterine contractions, and, for the first six hours after the operation, shows loss of appetite and slight tympany. With the advent of the vaginal discharge, these symptoms promptly disappear. In more tardy contraction of the uterus the profuse vaginal discharge extends beyond a week and, in the place of the dislodged yellow body, a second fresh one as large as a hickorynut develops which, in the interest of the evacuation of the uterus, is again to be eliminated and indeed this operation should be repeated as long as is needful and until the volume of the uterus returns to, and remains, normal.

In other cases, as a consequence of the prolonged treatment with repeated massage of the ovaries and uterus, pain and chronic purulent endometritis (whites) are shown by the patient, accompanied by slight emaciation. Nevertheless normal estrum eventually appears and conception takes place.

In one cow with recurrent pyometra and dense ovaries without yellow bodies, we crushed the right ovary per vaginam, upon which, after 18 hours, a complete evacuation of the uterus occurred and, after 8 days, normal estrum followed.

Besides the dislodgement of corpora lutea, the kneading and massage of the ovaries and the gentle pressure and stroking of the uterus, I have, upon the advice of my colleague, Anderegg, in Meringen, administered internally for pyometra, bicarbonate of soda in doses of 150–200 grammes a day as an emmenagogue. The results from this plan were indeed superior to the irrigations but not so prompt as by operative interference. After a few days our cows showed a profuse vaginal discharge and evi-

dent decrease in the size of the uterus. Recovery or the recurrence of estrum occurred in one cow 4 weeks after the commencement of the treatment.

When symptoms of soda poisoning appears such as weakness and diarrhoæ, the administration of the sodium bicarbonate must be suspended for a few days.

III. The Dislodgment of the Corpus Luteum.

According to our observations, extending over many years and including a large number of cases, we have reached the conclusion that this operation has not yet received the deserved attention. When carefully carried out it is not dangerous, causes little pain and the succeeding straining rapidly disappears. Aside from the fact that the elimination of the yellow bodies by inducing an active hyperaemia of the uterus, which awakens its contraction and increases the auto-antiseptic power of the genital canal when affected with pyometra and thus serves a fundamentally useful purpose in this direction, we have also been led to apply this new therapeutic measure to other cases with now and then good results.

It has proven useful in chronic purulent and catarrhal endometritis when combined with massage of the uterus, provided that the condition was not dependent partly upon tuberculosis or malignant neoplasms.

It has also proven valuable in the induction of artificial abortion in young heifers which have been impregnated too early, and in cows with large callus formation in the pelvis which would prevent parturition at full term. The expulsion of the fetus accompanied by the membranes follows in from 24–72 hours after the operation.

This plan of handling, at least so long as the ovary can be reached and grasped, is far preferable to the use of drugs described in our literature as competent to induce labor pains. The elimination of corpora lutea, in combination with gentle massage, is ineffectual in cows in which a mummified fetus is lodged in the uterus, a fact which must be attributed to the condition of the uterine walls themselves.

The fact that estrum does not appear while the yellow body persists is of great scientific and practical interest. The condition that, so long as a corpus luteum persists, estrum does not

recur and that, if it is removed, the estrum promptly reappears, has long been known. Upon this point our statistics teach some important lessons. In addition to the persistent absence of the symptoms of estrum, such animals show the normal tension of the sacro-sciatic ligaments as well as a normal uterus and vagina.

There is regularly found, in those cases which have not yet been handled, in one ovary a yellow body varying in size from a pea to a hazelnut or small hickorynut, sometimes inconspicuous, sometimes prominent and firm, often easily detached and many times removable only with difficulty or even not at all, especially when completely encapsulated in connective tissue. In rare cases, in addition to the foregoing, there may exist in the same gland a cyst the size of a hazelnut to a hickorynut; consequently the ovary is enlarged, smooth and fluctuating on one end, while at the other it appears lumpy.

It is to be observed in the dislodgement of the persistent yellow bodies per rectum or per vaginam that, when these coexist in both ovaries, the elimination of the larger corpora lutea as a rule suffices, and, when both a corpus luteum and a cyst exist in one and the same ovary, the cyst should first be ruptured if possible and then the yellow body pressed out. In this connection, we have noted at times that, after rupturing the cyst, the yellow body, which could be clearly recognized but could not be dislodged, soon became absorbed and, after a time, estrum spontaneously recurred; on the other hand we have also seen under like conditions, after an operative elimination of the cyst and with the presence in the same ovary of a persistent yellow body which failed to be absorbed, that the cyst only very rarely returned. If the yellow body is small and not detachable, there is yet hope for bringing about estrum through invigorating the ovarian circulation and causing the resorbtion of the corpus luteum by the application of vigorous massage to the affected gland. After squeezing out the corpus luteum, it should never be neglected to apply after-compression to the ovary for 10-20 minutes. If possible, the tip of a finger, either *per rectum* or *per vaginam*, should be pressed into the cavity from which the corpus luteum has been removed. In the walls of either the rectum or vagina the pulsation of an artery is occasionally to be felt, which is not to be confounded with the ovarian artery.

The artificially aroused estrum is identical with that occurring normally and the percentage of impregnations is as high as in spontaneous heat. The artificially aroused estrum appears in 50 % of the cases on the evening of the third day or on the morning of the fourth, in 20 % from 4–10 days, and in 10 % from 10–28 days after the operation. In 20 % of the operated animals, estrum failed to appear. At the point from which the persistent yellow body was dislodged there often develop, but not always, one or several new corpora in the course of a few days, which, in case estrum fails to appear, should again be pressed out.

IV. Hypertrophy of the Corpus Luteum.

In this region there is observed not rarely a condition which, up to the present, has not been considered in veterinary literature as a cause of sterility in cows, the same consisting of a *hypertrophy of the corpus luteum*.

The animals which have been affected with this lesion have been young cows and heifers, which have in all cases suffered, a few weeks to 2 to 4 months previously, from infectious granular vaginitis and, after recovery, in spite of estrum having recurred regularly and normally every three weeks or in rare cases every 19-20 days and having been regularly bred to healthy bulls, first to one and then another, yet fail to conceive. All animals affected with hypertrophy of the yellow bodies show as a rule a shortened estrual period of 12–15 hours duration. Rarely, it is normal or persists for 48 hours and is too severe, and as a rule these animals show for 2–4 days after estrum a voluminous discharge of sanious mucus, which is always prognostically bad for conception. Examination reveals normal tone and tension of the sacro-sciatic ligaments, constant traces of infectious granular vaginitis, constricted vulva, normal os uteri and uterus.

One of the ovaries, and indeed almost always the left, appears normal; the other, even when examined only a few days prior to the appearance of estrum, is found affected with one to three greatly hypertrophied corpora lutea, and presents prominent, deeply fissured, clearly defined outgrowths, as thick as one's thumb and as much as 4 cm. long, spherical, papilliform or wart-like, at times soft, in other cases firm, elastic in consistence.

Our method of handling consists either of administering daily for 6–10 days before breeding, 25–40 grammes of powdered

myrrh in a liter of water, or, what is more rational, the complete elimination of the yellow bodies, followed by compression when possible of the remnant of the ovary with three fingers or the entire hand, through the vaginal wall.

In pressing out hypertrophied yellow bodies, it occurs exceptionally that the ovary or enlarged yellow body splits into two portions, which remain loosely attached to each other. In such cases each portion, which is soft and elastic and consequently consists only of tissues characteristic of the yellow body, is to be removed. After the operation the animal shows for from 20 minutes to three hours a slight arching of the back and elevation of the tail, at first slight straining and very rarely a diminished appetite at the next feeding time.

At the point where the corpus luteum has been pressed out, one to several fresh corpora, less developed, generally form within 3–12 days and indeed we have observed two new corpora in the left ovary nine days after operating and three in the right organ after twelve days.

The normal duration of estrum is not affected by this operation but in those cases where it was previously abnormally short it tends to become normal and our clinical records indicate clearly that 95 % of animals so handled conceive at the first service. The hypertrophy of the corpora lutea, like so many other phenomena in the sexual life of cows, is referable to the irritation to the sexual apparatus due to the prior attack of infectious granular venereal disease.

Finally, not only with reference to the indications for castration but also from the view point of butter and cheese production, we should consider the influence of nymphomania and castration upon the quality of the milk.

Prof. Dr. Schaffer, Canton Chemist in Berne, has favored us with the following milk analyses and explanatory text with reference to the influence of nymphomania and castration upon the character of the milk :

Our literature is contradictory to a marked degree regarding the influence of sexual excitement of milking animals upon the quality of the milk. While Fleischmann (Landw., Jahrbuch 20, Erganzungsband II. S. 192) found a marked diminution of butter

fat, Wryssmann and Peter (Schweiz. Milchztg. 1902, No. 30) found the milk of cows in estrum, in general, somewhat richer in cream. They showed especially in several cases that the per cent of fat was decidedly higher for one or two days before estrum than during it. Also G. Schroeder (Milchztg. 1874, No. 104) and F. Schaffer (Mitteil. d. Naturf. Ges. in Berne 1884 u. Milchztg. 1885, S. 151) found that the milk of cows in estrum showed a high per cent of fat. In the same publication the latter mentions a case of continued nymphomania, in which the per cent. of albuminoids and solids was very high, and the rising quality of the cream markedly weak, for which two reasons were suggested, on the one hand the increased density, on the other, the want of large fat globules.

The influence of castration upon the milk, and especially in cases of nymphomania, is, according to all the above investigators, favorable. Still our literature contains but few contributions upon the matter. Dieulafait (Journ. d'Agric. Pract. 1864 I., P. 519, ff.), as well also as L. B. Arnold (Milchztg. 1873, S. 337) has observed, by castration experiments, that the solid contents of milk increased and the flavor improved, but the quantity decreased. The analyses made by these investigators vary in their contents within the boundaries of normal milk. Since castration, especially in nymphomaniac cows, is very common in Switzerland, the analysis of the milk from these appealed strongly to us.

For the investigations, milk was taken from nymphomaniac and castrated cows. On the whole, the experiment animals under our control were constantly in good general health, the udders completely sound and the milk macroscopically normal.

As experiment animals there were used the cows. Stor, Reh and Graf; Stor and Reh during nymphomania, and Stor and Graf after their castration.

Cow No. I, Stor, Simmerthal breed, about 10 years old, in medium condition. The cow calved the last time on June 24, 1903, and still yielded in January, 1904, three liters of milk per milking, and weighed 620 Kg. Since early in December, 1903, she had shown well-marked nymphomania, but on account of the experiment was not handled. Castration occurred on February 18, 1904, and the results were favorable. The first milk taken for chemical analysis, after castration, was on May 3, 1904.

Cow No. II, Reh, Simmerthal breed, was about 12 years old and weighed 610 Kg. The cow calved the last time on May 25, 1903, and still gave 3.5 liters of milk per milking, in January, 1904. The first signs of nymphomania occurred late in October, 1903, and the neglected disease became very severe in January, 1904.

Cow No. III, Graf, Simmerthal type, 7 years old, in good general condition. She calved last on the 23rd of February, 1903, became highly nymphomaniac during the summer of 1903, and was castrated on the 3rd of the following December. Early in January, 1904, she weighed 800 Kg. and on January 13, yielded 5.5 liters of milk per milking.

The analysis gave the following results :

A. MILK OF NYMPHOMANIAC COWS.

	Milk of Cow, No. I.			*Milk of Cow, No. II.*		
	Jan. 13 '04	Jan. 26 '04	Feb. 15 '04	Jan. 13 '04	Jan. 26 '04	Feb. 15 '04
Specific Gravity at 15° C.	1.0342	1.0346	1.0347	1.0340	1.0358	1.0342
Solids, %	13.18	13.83	13.88	13.56	14.43	13.75
Fat, %	3.55	3.98	4.05	3.88	4.3	3.95
Albuminoids, %	3.86	4.03	4.03	3.86	4.12	4.07
Salts, %	0.75	0.75	0.78	0.76	0.80	0.79
Chlorine, % of the ash	--	12.08	11.48	--	14.59	15.09
Phosphoric acid % of the ash	--	29.18	29.21	26.25	25.32	26.18
Acidity of the milk (after Soxhlet, in 100 cm^3)	7.0°	7.1°	6.9°	6.3°	8.4°	7.0°

The reaction to rennet was not remarkable in any test made. The milk coagulated under the casein test in 9½ to 13 minutes. The coagulation was in no test abnormal. Tests of the behavior of the milk in the incubator likewise showed normal characters.

On the other hand, the tests showed, on the whole, a defective rising of cream in that, at a temperature of 10 to 12° C., no evident line of demarcation between cream and milk appeared. Measured by the micrometer, the fat globules, in the milk of cow I, showed a diameter of 0.0022 to 0.0104, and in cow II, of 0.0017 to 0.0104 mm.

B. MILK OF CASTRATED COWS.

	Milk of Cow III. (Castrated on Dec 3, 1903.)			*Milk of Cow I.* (Castrated on Feb. 18, 1904	
	Jan. 13 '04	Jan. 26 '04	Feb. 15 '04	May 3 '04	May 3 '04
Specific Gravity at 15 C.	1.0325	1.0329	1.0329	1.0320	1.0337
Solids, %	13.08	12.98	13.11	13.02	13.28
Fat, %	3.95	3.80	3.88	3.75	3.40
Albuminoids, %	3.88	3.43	3.45	3.53	4.01
Salts, %	0.70	0.68	0.70	0.70	0.77
Chlorine, % of the ash	12.76	12.64	13.17	13.47	--
Phosphoric acid, % of the ash	29.37	29.97	28.80	27.74	29.31
Acidity of the milk (after Soxhlet, in 100 cm^3)	7.0°	6.7°	6.8°	7.0°	8.0°

The behavior toward rennet was not abnormal in any case. In the casein test coagulation occurred in 11–13½ minutes. The behavior in the incubator was also parallel to that observed in any good, fresh milk. The rising of cream showed nothing extraordinary in the milk from either cow. The measurement of the fat globules in the milk of cow No. III, showed a diameter of 0.00135 to 0.0193 mm., while that of Cow No. I, gave a measurement of 0.00119 to 0.0149 mm.

If we now compare the data under tables A and B with each other we first observe a higher specific gravity in table A and a larger amount of solids than in table B. It is thereby indicated that the milk of nymphomaniac cows is not only somewhat richer in its contents than that of normal, but also of castrated milk animals. In castrated cows, it approaches more nearly the character of normal milk.

In conclusion, it should not be forgotten that a thorough clinical examination and a rational handling of diseases of the genital apparatus of cows, in spite of the many disagreeable features connected therewith, belong nevertheless among the most important, prominent and appreciable duties of veterinary practice, and not alone contribute to the increase of the national resources and dissipate errors and discontent in agricultural industries, but also add to our knowledge of the cause of sterility, and, not the least, add to the well deserved standing of veterinary science. In reply to the question as to how we might increase veterinary authority and efficiency in this regard, we would unqualifiedly answer that, in order to reach this plane with security, a great

advance can be made in the teaching of veterinary students by the institution of a new and absolutely indispensable course, for inexperienced veterinarians, to be known as "Palpation Course of the Genital Organs of Cows" and earnestly endeavor to give them an extensive practical discipline along this line. Many a momentary deep regret and complaint would be spared to our younger, enthusiastic veterinarians in agricultural practice, and they would be led to say: "*Labor omnia vincit improbus.*"[1]

Cystic or Cysto-Fibrous Degeneration of the Ovaries, with Nymphomania, in other Animals than the Cow.

On page 194 we have recorded the occurrence of cystic degeneration in the ovaries of a goat and of a sow.

While nymphomania is not extremely rare in all domestic animals, it is preeminently common in the cow, not so much in a specific sense but rather in the closely housed and high bred, fed and milked dairy cow.

In economic importance, nymphomania in the mare assumes the place next to that of the affection in the dairy cow while, in other animals, it is not of great economic importance.

Nymphomania in the Mare.

Nymphomania in the mare is rare in some sections of the country, while in others it is quite common and possesses much economic importance, not so much because of the failure of the affected animal to breed, but because of its decreased value for work purposes, owing to the unusual development of disagreeable or dangerous vices.

The symptoms of nymphomania in the mare are, in many respects, analogous to those observed in the cow. There is a fundamental difference, however. The mania in the cow presents an obvious relationship to sexual excitement and is expressed chiefly by sexual signs, however erratic, but, in the mare, the sexual signs tend to assume secondary importance, while the primary place is occupied by maniacal symptoms not so readily connected with sexual excitement.

Nymphomania in the mare is most commonly met with in those

[1] See foot note on page 161.

animals which are kept closely confined and are not bred. It is more rarely observed in mares regularly worked and is well nigh unknown in those which are free, and is most commonly seen in young or middle-aged mares, rarely in aged. It is quite uncommon in mules, though in one instance, we observed the disease in so marked a degree as to render the otherwise valuable animal worthless.

The symptoms of nymphomania in the mare usually appear just prior to estrum or during that period. As in the cow, so in the mare, estrum may occur with comparative regularity, about every four weeks but, in some cases, is apparently more frequent, while the duration of the period may be so prolonged that the intervals of calm between the periods of sexual mania may become very brief.

In general, the first symptom of nymphomania, usually appearing a few days prior to estrum, consists of excitability and irritability of temper, though in some cases this is absent.

The patient is usually more or less vicious toward other horses and toward men. She will bite and kick at her mate or other horses when approached. If working with a mate she may constantly attempt to bite or kick it. Very frequently the patient will crowd against the pole of the wagon or other vehicle and perhaps lie down upon it in an effort to reach her mate and inflict injury. She manifests her viciousness by laying back her ears and switching her tail, while her eyes and physiognomy in general betoken evil disposition. The mere meeting of a strange animal of either sex upon the highway frequently arouses a maniacal storm; the mare balks, lies down upon the pole or thills, urinates and switches her tail; the vulva is rapidly opened and closed; the clitoris is erected; and the affected animal may attempt to grip the reins with the tail, may kick, rear or run away.

Toward persons her disposition is equally disagreeable and, indeed, often decidedly dangerous. Upon entering the stall to groom, harness, unharness or otherwise handle the animal, she is liable to kick, bite or trample upon the attendant without warning. In hitching or unhitching the animal, especially when working about her posterior parts, she is very liable to kick.

In the stable, even when no other animal is near, the patient may show her vice by kicking the sides of her stall, striking

and stamping with the feet. In one instance in our clinic, the mania was almost exclusively exhibited when the mare was alone in the stall. Watched from a distance, she would stamp her feet and kick the sides of the box stall in which she was confined. In her maniacal kicking she was utterly indifferent of the consequences to herself and would frequently and repeatedly kick one leg viciously with the other. Her eyes were wild and staring and her whole appearance and behavior one of violent insanity. If her owner or other person entered the stall she became calm, began eating or fondled the person with her nose and appeared in every way rational and docile. Turned in a paddock, she behaved normally. Hitched in the usual manner to a single wagon, she behaved perfectly. The duration of the mania and its intensity had increased for some months until the degree we have described had been reached and the attacks continued during 7–10 days. Ovariotomy was followed by complete and permanent disappearance of the mania.

The distinctively sexual symptoms noted consist chiefly of tumefaction of the vulva, injection of the vulvar mucosa, and increased secretion of mucus, with some mucous discharge from the vulva.

Urination is frequent, while the clitoris is erected and frequently protruded between the vulvar lips. The irritability of the vulva and vulvo-anal region is markedly increased and the animal frequently violently resents the handling of these parts. This is especially true, in many cases, of the tail, the animal resenting the raising of it in order to apply the crupper or remove it. While driving, should the patient either accidentally or intentionally get her tail over the reins, she grips them violently, kicks viciously, may turn abruptly and upset or break the vehicle, or run away.

In some cases the patient is perfectly docile and the only signs of disease consist of abnormally frequent urination with repeated opening and closing of the vulva and the projection of the clitoris, making her unfit for driving purposes simply from repulsiveness.

In most cases, however, the patient is unreliable or dangerous and cannot be depended upon in moments of emergency. During the periods of nymphomania she is very liable to be unsteady in

draft work and may at any moment balk and tax the patience of the driver very greatly.

Periodical at first, nymphomania or the vices such as kicking, balking and gripping of the reins by the tail, tend to become constant and permanent and the animal degenerates into an incurable rogue, falls into the possession of low dealers and finally finds her way into some inhuman hands, where she succumbs to brutal work.

FIG. 17. CYSTO-FIBROUS DEGENERATION OF OVARIES.
From insane mare.
C, C, C, Cysts. C, L, Corpus luteum. One-half size.

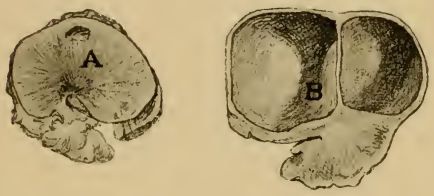

FIG. 18. CYSTIC DEGENERATION OF OVARIES.
From Nymphomaniac Mare.
A, Sclerotic Ovary. B, Cystic Ovary.

Examined macroscopically, the ovaries are usually large and contain one to several cysts, varying in size from ½–2 in. or more in diameter and containing a clear, faintly yellowish lymph. The cyst walls are thick and very firm and the density of the albuginea preserves to a large extent the even contour of the ovarial surface, so that it is only in case of quite large cysts that they project conspicuously beyond the general surface of the gland. In some cases, the ovarian tissue proper vanishes

almost completely under the pressure of large cysts, so firmly compressed within the enveloping tunica albuginea (see Figs. 17 and 18). In rare instances the cysts become enormous, reaching 4–8 inches and even more in diameter.

In other instances of nymphomania we have found, in extremely bad cases, small, atrophied, fibrous ovaries, very hard and dense, like fibro-cartilage.

The examination of the ovaries of the mare is to be made upon essentially the same basis as that already described for the cow. The examination is to be made upon the standing animal, due precautions being taken, according to circumstances, to avoid injuries to the veterinarian from kicks and to overcome any probable annoyance from movements of the animal. Usually a single stall, with the animal tied short in it, will suffice, but vicious animals should be secured in stocks, the twich applied and a forefoot held up or one hind foot raised by means of a sideline.

The hand and arm of the operator should be well cleansed and softened by warm water, and disinfected, and the rectum of the animal should be emptied of feces, usually by introducing a warm soda bicarbonate solution into the rectum. The finger nails of the operator should be trimmed close and the hand and arm thoroughly lubricated with warm oil, lard or liquid paraffin, and then gently introduced into the rectum. Usually little progress, if any, can be made while the hand is in the posterior or pelvic rectum, but it becomes necessary to push the hand gently forwards into the free portion of the rectum, which can then be carried to the right or left, up or down, and forwards or backwards. The mare often strains somewhat, which should always be accepted as a signal to the operator to cease his palpation until the expulsive effort ceases, but without withdrawing his hand. Care upon this point decreases the straining and does much to avoid laceration of the rectal mucosa, associated with hemorrhage.

With the palm of the hand directed downwards, the cervix uteri and uterine body, about the size of a man's wrist, may be traced forward to the point of bifurcation, where the cornua, almost as large as the body, are given off at approximately right angles. Tracing these to the right or left, the operator can recognize the ovaries at or near the anterior margin of the broad ligament, an inch or two beyond the obtuse end of the cornua.

The normal gland in the young or adult mare is elastic, smooth, firm, oblong and about 2½—3½ inches in its greatest diameter, by 1½—2 inches in its lesser diameter. The diagnosis of cystic or fibrous degeneration of the ovaries of the mare and the relationship between these diseases and sterility is not always clear. Nymphomania in the mare, is, unlike in the cow, most frequently observed in those animals not used for breeding purposes at all, rarely in those used in constant daily work, and chiefly in those more or less contantly stabled, irregularly worked and not at all bred.

How many of them would conceive if bred, we do not know, but we do know that many nymphomaniac mares breed and that the nymphomania usually disappears during the span of pregnancy, to recur with some degree of regularity after foaling. The condition of the ovaries in such cases is unknown.

It is highly essential therefore that, in examining a mare for sterility, a diagnosis should be made only after the most careful examination, not only of the ovaries but of all other generative organs as well. At the same time, we must have due regard for the clinical history of the case and the general condition and handling of the patient.

Treatment.

Since the ovisacs in the ovary of the mare normally rupture only in the hilus of the organ and the tunica albuginea is exceedingly thick and tough, as compared with that of the cow and other domestic animals, the rupture of cysts by rectal compression is practically excluded in all cases. The ovary is attached so far forwards that it cannot be drawn back and compressed per vaginam, as in the cow.

It is possible to puncture the cystic gland by means of a long trocar, while the ovary is grasped per rectum; or a vaginal incision for ovariotomy may be made, one hand introduced into the the peritoneal cavity and the organ directly grasped while, with the other hand, a long trocar is carefully inserted, and the cyst punctured.

When but one ovary is affected, unilateral ovariotomy may of course restore the breeding powers and, in properly selected cases, becomes desirable.

The question of overcoming sterility due to cysts or other ovarian disease, with a view to the restoration of the breeding powers in valuable brood mares, has been quite neglected and attention turned chiefly toward the amelioration or cure of the vice attending the malady, as symptoms, and thus restoring the work value of the animal. Since nymphomania in the mare is largely observed only in those not used or desired for breeding, this tendency in handling is natural and quite sufficient in this class of cases. It is only when involving animals desired for breeding purposes that we are specially concerned from an obstetric point of view. When our aim to restore fertility is frustrated by insurmountable obstacles, the duty of the veterinarian yet remains to preserve to the owner, as far as possible, any work value which the animal may possess when relieved of the nymphomania.

Three plans for the surgical relief or amelioration of nymphomania in the mare have been more or less advocated :

1. Clitoridectomy.

Because some regard the clitoris as the chief seat of irritation, from which the nymphomaniac symptoms are reflected, the removal of this organ has from time to time found advocates. In our experience it has not proven its efficiency, though we must confess that, owing to our skepticism of its value, we have not tested the operation sufficiently to warrant our condemning it.

We can not, however, admit that the clitoris is of sufficient importance as a center of sexual reflexes, to warrant the belief that its surgical removal will generally suffice to eliminate sexual mania unless first it be shown that it is in some way organically or functionally diseased. We freely admit however that clitoridectomy may, and does at times, overcome vice akin to nymphomania in some respects, but, in part, this may be attributable to the physical punishment of the animal under confinement. Nymphomania being a reflex nervous disorder, physical punishment may at times possibly exert a curative influence. Hollingworth[1] records a case in the mare where he obtained relief from nymphomania by clitoridectomy, the operation being performed under complete chloroform anaesthesia, in which case the cure

[1] Veterinary Magazine, Volume I.

could not be attributed to physical punishment so far as the operation proper was concerned and it seems questionable if it could be properly referred to the casting and confinement prior to the anaesthesia.

The relationship between the clitoris and sexual desire is by no means clear. While disease, functional disorder or irritation may arouse sexual desire, it is equally true that the excision of the organ does not abolish it nor interfere in the least with breeding, as we once witnessd, where some hundreds of sow pigs, from which this organ was removed by a travelling impostor who asserted that it destroyed sexual desire and fulfilled all requirements of castration, proceeded to copulate as usual and bred as freely as though they had not been operated upon.

As above stated, the nymphomania of the mare most frequently has its basis in cystic or cysto-fibrous degeneration of the ovaries, so far as we have been able to determine in this clinic, where we have performed ovariotomy in more than fifty nymphomaniac patients. In such cases, excision of the clitoris could apparently overcome the nymphomania only by curing the ovarial degeneration and it would be difficult to understand how such result could be expected.

We consequently believe that the alleviation of nymphomania by clitoridectomy occurs chiefly in those cases in which ovarial origin may be doubted and in which the disciplining of the patient through casting and securing and, if anaesthesia is not induced, the pain caused by the operation effect the alleged cure.

The operation is simple and free from any notable danger. The animal may be cast or secured on the operating table or in the stocks and the operation may be performed under general or local anesthesia or without either. The vulvar lips may be held apart with tenacula or retractors and the clitoris seized by means of a tenaculum or tenaculum forceps and, being well drawn out, excised with a scalpel at the point of attachment of its crura to the ischiatic arch. Quite as conveniently, a longitudinal incision may be made from below upwards through the floor of the vulva and the organ then excised, after proper dissection from surrounding tissues.

The hemorrhage is unimportant and may be controlled by

compression for a few minutes by means of forceps. The incision through the floor of the vulva may be sutured except a small area for drainage.

2. Caudal Myectomy.

In dealing with the symptoms of nymphomania in the mare, we related the very common and vicious habit of gripping the reins with the tail. Following the seizure of the reins, the nymphomaniac mare may lean heavily against the pole, kick viciously or, turning abruptly, break or upset the vehicle and run away. This vicous habit constitutes one of the most dangerous features of nymphomania in the mare, endangering alike property and the life of the driver or other persons and of the patient herself. Its amelioration or eradication, consequently, becomes important. The power of the animal to grip the reins may be overcome by myectomy, but this involves ordinarily no other effect upon the nymphomania.

As practiced in this clinic, the animal is confined in the stocks or upon the operating table and the tail secured, firmly stretched dorsalwards. Under proper antiseptic precautions and after the application of an elastic ligature at the base of the tail, two parallel incisions are made directly over the center of the two depressor coccygeus longus muscles, commencing close against the ligature and continuing for a distance of 6–8 inches, through the skin and caudal aponeurosis, laying the muscles bare. The muscles are dissected away from the surrounding parts and the entire exposed portion is excised, after which tampons of antiseptic cotton, approximately the size of the excised muscles, are laid in the cavities and, over these, an antiseptic bandage applied with sufficient firmness to control hemorrhage, after which the elastic ligature is removed.

Properly carried out, the operation leaves the patient with an efficient tail in all respects except the power to forcibly grip the reins. This power being inhibited, the reins may be easily freed by the driver. The vice is thus, in many cases, greatly ameliorated or wholly relieved, but the ovarian irritation presumably remains the same, and only the one important symptom, and those associated with it, is affected.

Amputation of the tail, with or without knicking, brings about the same result, with the disadvantage, or otherwise, of the loss

of the tail. Neither clitoridectomy, caudal myectomy nor amputation affects in any way the possibility of breeding.

3. Ovariotomy. Oöphorectomy.

When nymphomania referable to ovarian disease is present and can not otherwise be effectively overcome, castration is indicated.

In mares not desired for breeding purposes, the cure of ovarial nymphomania otherwise than by castration is all too liable to prove ephemeral and unreliable, so that castration in these cases at once presents itself as the most reliable and enduring remedy. The operation is comparatively simple and not highly dangerous.

It may be performed either in the standing or the recumbent position and with or without anaesthesia. In case of a valuable pedigreed mare desired for breeding purposes, with but one ovary diseased, the operation is to be limited to the affected gland.

In the standing position, without anaesthesia, the patient is secured in stocks, or otherwise, in a manner to prevent lying down, kicking or any extensive movements.

The vulva and vagina, as well as contiguous parts, are well washed and disinfected, avoiding always the introduction into the vagina of irritant antiseptics.

After the proper antiseptic precautions have been taken, the vagina should be partly filled with a sterilized, warm 1 % soda bicarbonate solution, which will cause the vagina to dilate or balloon. This condition having been brought about, the vaginal walls are tense and firm and the operative area is above the os uteri externum and standing perpendicular to the long axis of the vagina. Through this a stab wound is to be made, directly forward, large enough to admit one or more fingers into the peritoneal cavity and the opening thus made forcibly dilated by the fingers until the entire hand is passed through and the ovaries reached. The ecraseur is then carried in, the ovary caught in the loop of the chain and the gland promptly detached by ecrasement. This usually takes place, so far as we have been able to determine, without important hemorrhage. However, in one case, when the instrument was too sharp, fatal hemorrhage followed. Possibly there is usually a greater amount of hemorrhage than we ordinarily suspect, and it is well to take care that the instrument is sufficiently blunt, as indicated by the force re-

quired to crush off the gland, lest serious or fatal hemorrhage occur.

Under anæsthesia the animal is confined in lateral recumbency, preferably upon the operating table, the hinder parts being elevated, to cause the abdominal viscera to drop forward out of the way. Under anæsthesia the vagina does not balloon. The incision is made at the same point and in essentially the same manner. The recognition of the ovaries and their removal is the same as in the standing operation.

The patient is to be kept quiet for 6-8 days on a light, laxative diet. If the viciousness continues, the animal should be turned out and left without annoyance for several weeks; if docile, she may be put to work.

In some cases the viciousness may continue without visible abatement for a while and later wholly disappear. Too much should not, however, be expected from spaying. If a mare is fundamentally vicious, little good is to be anticipated from the operation, nor is a cure to be confidently expected if the operation has been delayed till the vice has become habitual instead of periodic.

Much depends too upon the driver and his method of handling the patient; gentleness, firmness and a display of good judgement are demanded. The work should be regular and moderate, the animal well fed and her general health well guarded.

Nymphomania and cysts in the ovaries of the smaller animals are not common. In the foregoing pages, Hess records instances in the sow and goat. We have observed nymphomania in a sow without determining the cause. We have also seen a nymphomaniac bitch, which was castrated in our clinic and in which both ovaries were the seat of enormous cysts, as shown in Fig. 19.

The diagnosis of cystic ovarian degeneration in the smaller animals can only be made by the subjective symptoms of nymphomania, to be verified by laparatomy and direct examination of the ovaries. The best treatment is castration, though, in the bitch and sow, it is indeed quite possible, in cases where the pedigree renders the patient highly valuable for breeding purposes, to crush or puncture the cysts and return the ovaries into the abdomen or, if only one gland is involved, it may be removed and the sound one retained, in order that the animal may breed.

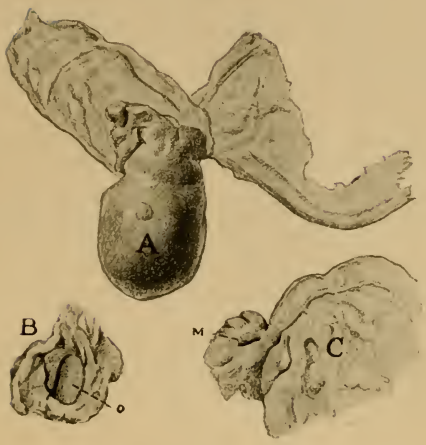

FIG. 19. NORMAL AND CYSTIC OVARIES OF BITCH.

A, Cystic ovary.

B, Normal ovary with the pavilion of the oviduct turned back to expose the ovary, o.

C, Normal ovary covered by the pavilion of the tube, showing the meatus, M, of the ovarian sac, by which it communicates with the peritoneal cavity.

One-half size.

7. SENILE ATROPHY OF THE OVARIES.

In aged females, senile ovarian atrophy occurs to mark the cessation of the power of breeding and the advent of the brief old age of our domestic animals. The advent of this period varies greatly with species and individuals. Fertility usually persists longest in animals regularly bred and well kept, while senile ovarian atrophy tends to occur earliest in those animals which are not bred and are badly kept or overworked.

The disease is not to be distinguished, by palpation or macroscopic appearances of the ovaries, from fibrous degeneration in adult animals, as already described, except by their very small size. It does not induce nymphomania, is not subject to remedy and definitely marks the end of the breeding powers of the animal.

8. Systemic and Painful Diseases.

Severe systemic affections and painful diseases, which depress the general vitality of the patient, tend constantly to prohibit ovulation and fertility. It is very rare that the evidences of ovulation and estrum occur during the existence of febrile disorders of any character. Chronic diseases—especially those of a systemic character, like rachitis, osteoporosis, and such severe bone diseases as are frequent in horses in many regions, and are expressed largely by the appearance of multiple spavins, ringbones, navicular disease, lumbar anchylosis, spontaneous fractures, etc.—tend constantly to induce sterility, due apparently to non-ovulation during the active course of the disease, which may continue for 2–3 years or more.

The remedy in these cases evidently lies in the direction of overcoming the constitutional malady itself, which is usually followed by a restoration of the normal reproductive powers.

II. DEFECTS AND DISEASES OF THE OVIDUCTS, UTERUS, VAGINA AND VULVA.

1. Arrests in Development of the Oviducts, and Uterus.

When dealing with arrests in the development of the ovaries, on page 155, we necessarily alluded to the concurrent arrests in the development of the genital tube. While arrests in the formation of the genital glands and of the oviducts, uterus and vagina are not necessarily parallel, they are quite frequently closely associated in the same individual. In Fig. 51 is shown the genitalia of a cow, in which the uterine body and the vagina are wanting and are replaced by two adherent, parallel cords representing the Müllerian ducts. In freemartins and hermaphrodites, arrests in development of the uterus and oviducts are common. In one instance occurring in our clinic, a filly was presented, with the history that she had an annoying mucous discharge from the vulva. Palpation revealed that that portion of the ducts of Müller which should have formed the uterus had instead developed the characters of a vagina. A slight constriction denoted the location of the cervical canal but, beyond this, the tube had all the characters of the vagina itself; its mucosa was identical with that of the vagina so far as the sense of touch revealed and the function of the tube was also vaginal in character, ballooning promptly upon palpation, wholly unlike the uterus.

While aberrations in the development of the oviducts and uterus are somewhat rare, the possible variations in such aberration are extreme and their character must be determined by palpation, either through the rectum or the vagina.

Such aberrations in development are rarely, if ever, subject to remedy, and their diagnosis and the determination of the character of the sterility, whether it be permanent or removable, is the chief question to be decided by the veterinarian.

2. Salpingitis and Occlusion of the Oviducts.

Inflammation of the oviducts, accompanied by suppuration, abscessation and occlusion, is somewhat rarely recognized in veter-

inary practice, partly, perhaps, because it is quite rare, probably largely owing to the fact that its occurrence usually passes unrecognized. The oviducts, when felt per rectum in the cow, are somewhat difficult to distinguish, as very small, dense, tortuous cords, extending from the apex of the uterine cornua, toward the ovary, in the anterior portion of the broad ligament. They are about $\frac{1}{16}$ of an inch in diameter.

In dealing with diseases of the ovaries on pages 177 and 193, reference has been made to recognized pyosalpinx, or abscess of the oviducts. Abscess of the ovaries, which we have mentioned on page 217, is presumably due to the passage of pyogenic bacteria from the uterine cornua, through the oviducts, to the ovaries, there to find lodgement and multiply. In thus traversing the ducts, a more or less pronounced salpingitis would tend to occur and this is verified by sufficient clinical and post mortem observations.

The causes of salpingitis, so far as determined, are largely, infectious granular vaginitis in the cow, and retained placenta, especially following contagious abortion in the cow, and other animals. In tuberculosis and some other affections, the oviducts may rarely become inflamed and enlarged so that, according to Zschokke, they sometimes attain the size of a lead pencil.

The symptoms have usually passed unobserved, except as related to sterility, the disease leading rarely to nymphomania. Its diagnosis can rest only upon palpation per rectum or vaginam, by which the ducts may be found enlarged, and their consistence altered. They may be either soft or hard, and may contain abscesses or contents of variable character.

The prognosis of salpingitis and pyosalpinx is always grave. The disease may abate and the organ recover, but the possibility is a remote one, since any extensive inflammation is likely to lead to adhesions and occlusion which determine permanent sterility. If but one tube is involved, it may be surgically removed and the patient rendered capable of breeding.

3. Metritis.

Metritis tends in all cases to induce sterility in all animals, sometimes temporary, frequently permanent. The malady occurs under a variety of forms, due to a multitude of causes and having

a varying significance for the fertility of the animal. The chief varities to be considered are :

a. **Acute metritis** occurring in all species of animals, following closely upon parturition or abortion and resulting from infection entering the uterus as a result of manipulations during parturition, or from retained, decomposing afterbirth or related causes. The malady is necessarily considered later among the "**Puerperal Infections**", to which the reader is referred.

b. **Chronic metritis, pyometra or myxometra.**—Chronic purulent metritis (pyometra) and muco-purulent metritis (myxometra), as related to ovarian disease, have already received consideration on page 222, and need not be repeated here.

These affections occasionally follow parturition, especially when accompanied by dystocia, or when parturition is succeeded by retention of the fetal membranes. This type, like acute metritis, is necessarily considered among "Puerperal Infections" and, accordingly, need not be repeated here.

c. **Chronic metritis, or pyometra,** also occurs in non-breeding females, so far as we know, wholly independent of ovarian disease and non-puerperal in character, as it may appear in an animal which has never bred or in one which has not recently bred. This type of cases is so like those in the preceding class in symptoms, prognosis and handling that they may be most profitably and concisely dealt with in the same chapter.

Closely allied to chronic metritis, also, is "**Uterine Abscess,**" which, following usually some puerperal infection, is naturally dealt with in that group.

All these forms of disease inevitably cause, during their course, sterility, which may be rendered permanent by the changes resulting in the organs involved. Salpingitis, pyosalpinx and occlusion of the oviducts are constantly threatened in the course of these maladies, while ulcerations and erosions of the uterine mucosa may lead to adhesions between the uterine walls and obliteration of the cavity of the cornua, uterine body or cervix. But such is not always true. The author recalls delivering a cow after ten days of dystocia, with a badly decomposed fetus, intense metritis and enormously thickened uterine walls. A few months later she conceived.

Since all these forms of disease have been, or will be, considered in other chapters, it suffices to mention them here as

important maladies in reference to sterility. The prognosis in these cases depends upon the promptness and efficiency of the handling, questions which are fully discussed in the chapters already mentioned.

4. Edema of the Uterine Walls.

In very rare instances, edema of the uterine walls has been recorded, the edematous enlargement being so great as to simulate pregnancy. Necessarily, it induces sterility and, so far as known, the condition is incurable.

5. Tumors of the Uterus, Vulva, Vagina and of the Broad Ligaments.

Tumors involving the uterus of the domestic animals are not at all common and play no very important role in the question of sterility. Zschokke claims that the most common tumors affecting the uterus of the cow are fibroma and lipoma.

Tumors of the vagina and vulva are more common than those of the uterus. Perhaps the most common place for the occurrence of benign tumors is on the line of demarcation between the vulva and vagina, that is, at the site of the hymen. They usually originate from the mucous membrane and, when located in the vagina and vulva, tend to assume the polypoid form and may vary in color according to their vascularity. The fatty tumors arise in the pelvic connective tissues and press upon the vagina in a manner to more or less narrow it.

Occasionally we meet with enlargements along the floor and sides of the vagina, due to a collection of secretions in Gärtner's canals. These present themselves as elongated, fluctuating tumors, which begin near the meatus urinarius and extend, in a divergent manner, obliquely forward and upward along the sides of the vagina. These retention cysts are easily diagnosed. When very large, they cause some narrowing of the vagina and may interfere with coition or parturition.

Tumors of the vulva and vagina which have pedicles are easily and quickly removed with the ecraseur. When the tumors are sessile, it is necessary to use the scalpel or scissors for their removal. These operations should be carried out under strict antiseptic precautions and, so far as possible, perforation of the peritoneal cavity should be avoided. If proper aseptic care has

been taken, perforation is important only because of possible prolapse of the intestines or other viscera. The prolapse may be prevented by appropriate sutures. Where the possibility is foreseen, the tumor, with a section of the vaginal wall, may be removed by ligature.

Retention cysts of the genital passage may be laid open freely with the scalpel, under strict asepsis.

Diseases of the broad ligaments are rare. Yet, they occur with sufficient frequency to merit attention. So far as we are aware, they occur chiefly in the cow.

Various writers refer to tubercular deposits in the broad ligament, which cause them to become thickened and, upon palpation, to give the ordinary characteristics of tubercular invasion. In addition, there are also symptoms of the disease in other parts of the body.

In one very interesting case of sterility, in a highly valuable pedigreed Holstein cow which we attended, it was found that the broad ligaments were the seat of eight or ten large abscesses with very dense capsules. The uterus and broad ligaments were adherent, over a large part of their surface, to the rectum and surrounding organs, and the ligament was invaded by multiple abscesses containing from two to five or six ounces of pus each. The contents of the abscesses were of a yellowish, granular character, which seemed strongly suggestive of actinomycosis. This impression was fully verified by microscopic examination. Although a careful search was made, no signs of actinomycosis were found elsewhere within the body. The case suggests that the infection probably occurred through the medium of copulation.

Tuberculosis of the uterus has been alleged to be a frequent cause of sterility, but we have few data in support of the presumption. Angst[1] records that, out of 34 sterile cows, 31 were affected with uterine tuberculosis!

Actinomycosis and tuberculosis of the uterine ligaments or walls, are usually not subject to remedy. Limited actinomycosis might possibly be relieved by the internal administration of potassium iodide.

[1] Deutsche Tierartzlichen Wochenschrift, 1898.

6. Occlusion of the Os Uteri.

Except during the time of estrum or at the period of birth, the os uteri externum is normally closed in all animals to such an extent that the folds of the mucous membrane of the cervix are firmly pressed together, so that some degree of force is required to pass any object of size through it. The degree of closure varies greatly in the different domestic animals, being most marked in the cow and the least so in the mare. In the cow, the cervical canal is long and tortuous and the cervix itself is thick and firm, apparently almost tendinous. The circular muscle fibres of the cervix of the cow and other ruminants are very numerous and powerful and maintain the closure of the canal in a very effective manner. In the cow, the mucous membrane is thrown into the numerous longitudinal folds common to the uteri of all animals, and, in addition, there are two or three transverse ridges of mucous membrane surrounding the canal in such a manner that it becomes exceedingly difficult to pass a sound through it, from the vagina, into the uterine cavity.

The physiologic dilation of the cervix during both estrum and parturition is not well understood, but seems to be due to a nervous reflex. We have already related, on page 32, that the vagina has an inherent power of dilating under sexual excitement. This is seen most marked in the mare and less so in the cow. Zschokke attributes this spontaneous dilation of the vagina of the cow to the contraction of the longitudinal muscle fibers, and to the action of the ischio-vaginal muscles upon those fasciæ which extend deeply into the vagina. He suggests that it is possible that this dilation of the vagina acts upon the mouth of the uterus and tends to widen it. As already stated, we consider that the reasons advanced by Zschokke are open to question, since the contraction of the longitudinal muscle fibers should tend rather to bring the walls together than to separate them. The explanation for the ballooning of the vagina requires further study, but we agree with Zschokke that it probably has an influence upon the dilation of the os uteri.

The closure of the cervical canal must be referred to the firm contraction of the circular muscles of the part. In the cow, the density of these muscles is so great, and their contraction so firm, that, except during the periods of estrum and parturition, it

is exceedingly difficult to insert even the little finger through the canal into the uterus. In a perfectly normal uterus of the cow, it usually requires half an hour to one hour of hard work to dilate the part sufficiently to insert an index finger. The cervix of the cow is so hard that it frequently leads the inexperienced veterinarian to diagnose sclerosis when it is perfectly normal and thus lead to an error in reference to the cause of sterility and an equal mistake in applying remedies for the sterility. Zschokke has searched in vain for cartilaginous tissue in the cervixes of cows, but has occasionally met with an excess of connective tissue, which has led, in his judgment, to some sclerosis. Even this, he admits, is very seldom. Zschokke, in his extensive experience, has never met with a case of atresia of the os except as a congenital affection, and even then only very rarely.

It is very evident that, if the mouth of the uterus is completely closed, neither the penis nor the semen can enter, because of the anatomical relations, which have been already discussed. It is, accordingly, an old custom in all countries to examine the cervix uteri in cases of sterility to determine if it is open or not.

The frequency of occlusion of the os uteri is a question which admits of much discussion and which is differently answered by different practitioners. In the judgement of some veterinarians, it constitutes the chief cause of sterility, while by others it is regarded as a very rare and more or less mythical condition. Hess passes over the question of occlusion of the os very lightly, while Zschokke considers it of much importance and of comparatively frequent occurrence. Bass deems it one of the great causes of sterility in the cow.

It is difficult to harmonize these conflicting views. It is constantly to be remembered that an os uteri is not closed, so far as conception is concerned, so long as the canal will admit of the passage of a small probe. There is no essential reason why the os uteri externum should be any wider than the canal of the oviducts, which barely admit the passage of a large horse hair. The anatomical character of the cervix of the cow renders it exceedingly difficult to determine if such a passage exists or not, until the os has been sufficiently dilated to permit the passage of a finger into the uterine cavity. According to Zschokke and others, the occlusion of the os, or a harmful stricture, has been met with in animals which have recently given birth to young

and has been followed by a vaginal discharge, presumably due to endometritis. In other cases, it occurs without any preceding disease.

We have indeed very little in our veterinary literature to thoroughly demonstrate the closure of the os uteri, as verified by post mortem examination, and the diagnosis has usually been based upon the difficulty of introducing a finger through the cervix into the uterine cavity. This, as we have already stated, is well-nigh impossible, at most times, in the normal uterus of the cow.

In the mare, closure of the os uteri is stated to occur, and doubtless does, but in our experience we have never seen such a case except in some disease of the uterine cavity itself, such as pyometra or uterine abscess, in which the cervix becomes sclerotic and in which, sometimes, as observed by us clinically, a complete closure of the canal results.

The diagnosis of closure of the os uteri is very difficult in the cow, still more so in the small domestic animals, but there is no difficulty ordinarily in the mare. If the uterus of the mare is normal, the index finger can readily be passed through it, even when she is not in estrum. During estrum, it is not at all rare to find the os of the mare so open and flaccid that the entire hand may readily be introduced through it.

In the cow, we should preferably examine the animal for suspected closure of the os uteri during the period of estrum, because the canal is naturally more dilated and dilatable at that time. The best method for examining the cervix is to grasp it per rectum with one hand, so as to fix and hold the cervix in a direct line, and then test the patency of the cervical canal with the index finger of the other hand or with a sound. One of the great difficulties in passing either the finger or the sound is the aforementioned transverse folds of mucous membrane, which tend to obstruct the passage and may lead to the conclusion that the canal is closed when, in fact, the sound or finger has simply been caught in one of these folds, and the cervical canal is wholly normal. Another serious difficulty is that, unless the cervix is fixed per rectum, as suggested, the pressure necessary to force the finger or sound through the canal causes the cervix to bend acutely, or even at right angles, and thus cause the finger or sound to be forced against the wall of the cervix,

which has now become perpendicular to the long axis of the finger or sound. In this way, we have known the operator to force his finger through the walls of the cervix into the peritoneal cavity while attempting to "open" a cervical canal which was not "closed", but perfectly normal.

The diagnosis of occlusion of the cervical canal, as already suggested, is all too frequently mythical and based upon unscientific grounds. The occurrence of the condition is freely admitted and verified by clinical and post mortem examinations, but the frequency of pathologic occlusion, of a degree to actually constitute a fertility destroying closure, is a debatable question of great significance.

When is the os uteri closed to a degree to interfere with or prevent fecundation? Few will answer it alike. If we knew better the exact relation of the organs during copulation, the answer might be more specific.

Some claim that, during copulation, the glans penis enters the os uteri. As proof, they cite uterine laceration or perforation alleged to have resulted from copulation, but can adduce from the pages of veterinary literature but one or two cases. The records are not wholly convincing in the one case we have found recorded. Even if it occurred, as alleged, the fact of serious or fatal injury would indicate rather that it was due to abnormal copulation.

It is fair to assume that manual exploration of the vagina in estrual animals induces conditions somewhat analogous to those obtaining during copulation and there is certainly little therein to suggest that the penis enters the cervical canal. The os uteri, while distinctly dilated as compared with the condition observed during the interval between estrual periods, is nevertheless closed too firmly to make the entrance of the penis into it comprehensible. It is to be further noted that, when the so-called "impregnators" are used in the mare and inserted in the os uteri externum immediately prior to service, the apparatus is not dislodged by copulation, as would inevitably occur should the penis enter, or even press hard against, the os.

In the cow, the canal is too small and tortuous to permit the penis of the bull to enter it, especially with the sudden and violent thrust made by that animal. The same holds true for other ruminants.

Others maintain that, during copulation, the meatus urinarius of the male penis is pressed against the os uteri externum of the female at the moment of ejaculation and that the semen is injected directly into the uterus through the cervical canal. Little evidence exists in favor of such assumption and much against it. In the mare, it is especially notable that large quantities of semen are expelled from the vulva immediately after the completion of copulation, which would signify that it had probably not passed beyond the vagina. If the vaginal cavity is examined immediately after copulation, large quantities of semen will be found in it, apparently the normal volume discharged at a single copulation. If this is largely expelled from the vagina immediately after ejaculation, it would scarcely appear that it was first thrown into the uterine cavity or cervical canal, but that it was discharged against the anterior wall of the vagina, especially the os uteri externum, and that only a very small proportion of the fecundating cells pass beyond the vagina to assume any important part in the process of fertilization. Some of the spermatozoa pass through the cervical canal, uterine and cornual cavities, reach the oviduct and meet the ovum or ova, where *one* male cell serves to fecundate each female cell or ovum, while the other spermatozoa perish. Most of the spermatozoa are expelled from the vagina immediately after copulation.

Occlusion of the os uteri, as a fundamental cause of sterility, consists of such complete atresia, or closure, of the cervical canal as to render the passage of the microscopic spematozoa improbable or impossible. In the oviduct with a canal admitting a large horsehair, the size of the channel is abundant for purposes of fecundation and, so far as we can determine, a like opening through the cervical canal fulfills all demands for impregnation.

According to this view, the smallest recognizable opening through the os uteri and cervical canal constitutes a reproductively *normal* condition and, ere we can diagnose occlusion of the os, we need to determine that the passage of microscopic spermatozoa, endowed with vigorous motile power and in their normal element, is impracticable. Hence, in our judgement, if the smallest sound, possessing adequate rigidity to render its insertion practicable, can be passed through the cervical canal without undue force, the diagnosis of occlusion of the os uteri is not warranted.

When closure of the cervical canal has been definitely diagnosed, it becomes evident that the most direct and only hopeful method of dealing with the consequent sterility is by its artificial dilation.

The manual dilation of the os uteri should be carried out under the strictest aseptic precautions in order to avoid an inflammation of the parts, which must be more or less injured during the process. In the cow, the dilation must be very gradual and its accomplishment requires much patience. As suggested above, it is best, where we wish to use force in penetrating the cervical canal, to first grasp the cervix uteri per rectum with one hand and then carry out the dilating operation with the other hand in the vagina. The operator should have the finger nails well trimmed and perfectly smooth, the hands clean, disinfected and well softened. The hand should be oiled or should be moistened with some unctuous substance, like a solution of sodium bicarbonate or a weak solution of salt at a temperature of about 100° F. The index finger should be pushed gently into the os with a rotary motion and advanced until resistance disappears and the finger tip enters the uterine cavity. After persisting in the effort for a considerable period of time, until the finger becomes tired and the animal considerably irritated, it may be best to desist for a while and renew the operation some hours later or upon the following day.

Zschokke condemns the use of wooden or metallic sounds in bringing about this dilation because he considers them dangerous. We hold, on the other hand, that they are quite as safe as the finger, providing, always, that the precaution is taken to first grasp and fix the cervix with one hand per rectum, in which case the progress of the sound may be constantly determined and the operator can know exactly if it is following the central line, that is, the cervical canal, and may determine when it has reached the uterine cavity.

We even regard a metallic sound as distinctly safer, easier to manipulate, and more effective than the finger, in dilating the os or diagnosing its patency, because it can be much smaller and more even than the finger. For the cow, this instrument should be of well tempered, plated steel, $\frac{3}{16}$ to $\frac{1}{4}$ inch in diameter at the point, 18 to 20 inches long and furnished with a handle con-

venient for manipulation. Some writers advise a curved point, but the canal it is to penetrate is direct and the instrument should be straight.

An interesting question in the dilation of the cervical canal is that in relation to the use of local anaesthetics, such as cocaine, stovaine and others. We find no records of the use of these drugs for this purpose. It would seem to us, however, that two very marked advantages might result. First, the use of these substances might diminish the resistance and straining, by obviating the pain incident to the process, and thus do away with one of the chief hindrances in the operation. In the second place, we have found that stovaine, especially, paralyzes motor nerves and it would appear to us that, if injected into the walls of the cervix, it might inhibit the muscular power and render the dilation of the canal easy, if not in itself accomplishing the desired end.

The smearing of the cervix of the uterus with belladonna and other similar substances, with a view to relaxing the parts, has not been followed by success, according to our observations.

Having already indicated our skepticism concerning the scientific basis for attributing a large percentage of instances of sterility to occlusion of the os uteri, it is essential to discuss freely the prognosis of dilation in the presence of this alleged cause. Numerous contributions appear here and there, in which excellent results are recorded from "opening" the uterus and it is a common practice among stallion grooms to "open" the os in mares which fail to conceive at the first or second service. It becomes an exceedingly difficult and delicate task to differentiate between fact and fancy, between science and mysticism.

Except we have first learned positively that a barrier to fecundation, not spontaneously removable, exists, we are not prepared to say that a given coition will or will not prove successful because preceding copulations, be they one or many and distributed over months or years, have failed. Without "opening", without mystical concoctions, without interference of any kind, we have observed the sudden and unexpected appearance of fertility after barrenness, in mares, from maturity up to the age of 10 or 12 years or more. In such cases, the reasons for the final conception and prior sterility remained equally impenetrable enigmas.

So, if a series of females which have failed to conceive are "opened", are drugged with this or that nostrum, have yeast injected into their vaginæ, have "impregnators" applied, or resort is had to artificial impregnation, some of them, possibly all, may conceive.

It is possible, though, we believe, highly improbable, that the forcible dilation of the cervical canal may indirectly favor fecundation. The discharge of viable ova into the oviducts is a reflex act. We know too little of the causes of the maturation and rupture of the ovisacs and the part played therein by reflexes from the other portions of the genital apparatus.

It is believed by many breeders, and apparently not without reason, that sexual excitation tends to hasten and even determine ovulation and hence some breeders practice forced service, at times, in order to hasten or insure estrum and ovulation. It is common experience and observation that the proximity of a male stimulates sexual appetite in the female, and we have good reason to assume that, with it, is associated the stimulation of ovulation. If this be true, we are not in a position to deny that the manual or instrumental dilation of the cervical canal may stimulate normal ovulation and hence indirectly favor conception.

We cannot, however, in the present state of our knowledge, place scientific reliance upon dilation of the os uteri as an effective remedy for sterility, except in isolated cases.

On the other hand, there is much in the ordinary "opening of the uterus" which is in violation of all surgical principles. Time and again we have watched the stallion groom, without any precautions whatever, proceed with his operation. Some dirty water in a filthy stable pail, to which is added some irritant laundry soap, is used as a lubricant for the dirty unwashed hands of the groom, while the long and rough finger nails, concealing abundant filth, receive no attention. The rough, dirty hand is forced through the vulva and vagina with scant regard for their delicacy, and is then rudely forced onwards through the cervical canal, tearing the tissues and inducing extensive hemorrhage so that the hand, when withdrawn, is covered with blood. The character of the uterine cervix of the cow renders such an operation less practicable and it is virtually impossible, within a reasonable time, to force the entire hand into the uterine cavity.

We have known, however, a veterinarian to force a finger through the cervical walls into the peritoneal cavity.

Sober consideration must convince anyone that such rough methods are not only antagonistic to the production of the desired result, but actually dangerous for the well-being of the patient and profoundly repulsive from a surgical standpoint.

A rudely dilated os uteri means hemorrhage into the cervical canal, with consequent blood coagula in the parts, which, if the animal is at once served, would seriously impede, or prevent, the passage of spermatoza through the canal. At the same time, the pain from the physical injuries will cause straining and tend to result in an unusually and injuriously complete expulsion of the semen.

If time is permitted to elapse after the operation before service is permitted, the injured parts become inflamed and swollen, and the closed os more tightly closed than before the operation. Infection almost inevitably contributes to the dangers to the life of the spermatozoa.

These conditions not alone tend to prohibit impregnation, but endanger the health of the genital passages, by planting infection in the injured tissues and, in our clinical experience, chronic pyometra has followed "opening" so closely in some cases as to point to the rude operation as the probable basic cause of the malady.

Others, especially veterinarians of excellent repute, instead of resorting to these rude and barbarous means of dilation, apply, the more scientific and far less dangerous expedient of introducing, into the cervical canal, sponge or kelp tents, which, through the absorption of fluids, swell up and gently dilate the canal. Admittedly they are far milder and safer. But they are only applicable in those cases where the canal is already permeable, as they cannot otherwise be inserted. As above suggested, when the canal is penetrable, the further dilation is, in our judgment, unnecessary, if not wholly unwarranted.

Nor is the danger from infection wholly obviated. Any foreign body, unless it be permanently aseptic or antiseptic, invites infection in the part and, when the dilating body is removed and the infection left behind, it remains as a menace to all spermatozoa which must pass through the infected tract on their way to conjugation with the ova.

On the whole, therefore, we consider that the manual or mechanical dilation of the cervix uteri should be strictly limited to those cases where the sterility is traceable to a definite obstruction in the canal, which it is possible to overcome by the operation.

Hypertrophy of the Os Uteri.—Aside from the closure of the os uteri, Zschokke, Hess and others have observed hypertrophy of the cervix as a hindrance to impregnation. In these cases, the os uteri externum projects far into the vagina, and is enlarged and firm. Zschokke has found this condition only in old cows which had repeatedly given birth. Hess believes that this condition may be transmitted to the offspring. The condition consists chiefly of a hypertrophy of the mucous membrane and the folds may reach ten times their normal size. Some veterinarians have recorded tuberculosis of the cervix uteri. Zschokke alludes also to the formation, about the os uteri externum in cows, of mucous membrane flaps as much as 6 cm. long, which, in his judgment, might act as a hindrance to the migration of spermatozoa through the cervical canal. In the mare this condition is very common in conjunction with general atonic conditions of the genital tract, which we consider below, where we shall deal with the problem of handling. The general handling of hypertrophy of the os uteri, or vaginal portion of the cervix uteri, must usually be coupled with an unfavorable prognosis. If the condition is static, if no active disease processes are present, and it is believed that parturition could be safely accomplished, artificial insemination may be successfully applied, if a small-caliber syringe nozzle can be introduced through the hypertrophied organ. If active disease processes are present, appropriate remedies should be applied for their cure. In general, however, the condition is beyond remedy.

7. Atony of the Genital Tract and Dilation of the Cervix Uteri.

In contrast to constriction or occlusion of the os uteri externum, we more commonly meet in the mare with an abnormal dilation of the passage. The os uteri is unusually wide open and flaccid and readily admits of the entrance of several fingers or of the entire hand.

There is present a general flaccidity of the genital tract, the mucosa are somewhat injected and there is an increased secretion of mucus. The malady occurs usually in adult or old brood mares, but we have observed it in fillies. As a rule it is observed in idle, highly-fed animals which have grown over-fat. The condition of the genital tract is simply the result of the general atonic state of the animal, caused by injudicious management.

Along with this condition, the mucous membrane about the os uteri externum becomes hypertrophied and developes extensive flaps of mucous membrane, which hang down over the os like curtains. These may mechanically interfere with insemination, as they act somewhat as valves and may possibly tend to deflect the spermatozoa from the cervical canal.

The handling of sterility due to these causes must be directed primarily to the removal of the causes themselves and secondarily to relief from the changes which have occurred in the genital canal.

First, the patient should be so handled as to restore the normal systemic tone. Idleness and obesity are to be supplanted by exercise, or by work of such a degree as to restore the general tonicity. This is not always easy of accomplishment in a harem of mares used wholly for breeding. In some manner, exercise should be enforced. When at pasture, the food supply should be reduced, by restricting the area or increasing the number of animals within the enclosure, to such a point that the mare must exert herself to a reasonable degree in order to secure the amount of food necessary to maintain good physical condition, and thus overcome the obesity and want of tone. A quiet mare, especially of the draft breeds, will not exercise unless compelled to do so in order to obtain food, water or shelter. The mere provision of a sufficient area, in which exercise may be taken, by no means assures exercise, except it is made necessary. If abundant food and water are close at hand, the animal will move far enough to procure these and generally stop, content with these.

Even greater care is essential in order to secure adequate exercise in winter. If abundant food and water are supplied at the stable, the animal is often too content to remain idly near the stall, even though a large enclosure is open to her, where vigorous exercise could be had.

If the food supply is limited, and an extensive field is open to the animal, in which some food can be procured only by more or less vigorous exertion, she will promptly take this exercise in order to provide the additional food, for which the system craves.

Best of all is work. Mares moderately, or even hard, worked are always among the most regular breeders. It is not rare for mares, which have long been sterile, to breed after being placed at steady work for a long enough time to bring them into good working condition, with a general vigorous tone.

Locally, something may be done to restore the genital tract to its normal tone. The congestion and atony may be largely alleviated by astringent douches, such as solutions of alum or tannin. Should there seem to be important infection, adequate disinfection should follow. Powdered tannin and iodoform may be introduced into the uterine cavity in gelatin capsules, and these crushed or opened so that their contents may at once escape.

The curtain-like flaps of mucous membrane may be snipped off with long scissors or removed by other convenient means. In all such cases the ovaries, oviducts and cornua should be carefully searched for abnormalities, and should any be found, appropriate measures applied.

8. Loss of Cotyledons.

It has been assumed by some that the loss of the cotyledons in ruminants serves to cause sterility, but Chauveau and others have experimentally removed all the cotyledons which could be recognized, without inducing sterility. New cotyledons were formed to maintain the functions of the uterus.

Clinically, the pathologic destruction of the cotyledons does not necessarily lead to sterility. In retained afterbirth, placentitis frequently follows; the cotyledons may be surgically removed in order to overcome the disease; or they may become necrotic and slough off and yet sterility not ensue. We have removed all recognizable cotyledons in order to overcome grave sepsis due to their necrosis, after which the patient bred promptly. The complete necrosis and sequestration of the cotyledons in retained placenta is not rare in cows. We have observed the sloughing off of, so far as we could recognize, all the cotyledons, the greatly enlarged structures lying in a mass in the uterine cavity, still attached to the secundines. Following their re-

moval and the disinfection of the uterine cavity, fertilization occurred in due season. Very frequently, when a retained fetus has undergone purulent decomposition and is later removed surgically, it is found that the cotyledons are all necrotic and, dropping off, are expelled along with, or following, the fetus. In due time the cow again conceives. The loss of the cotyledons does not lead to sterility; the septic metritis or other disease accompanying the retained placenta may cause sterility by inducing salpingitis followed by occlusion of the oviducts. Other anatomical changes may occur, rendering the patient sterile.

Our attention is to be directed to measures which may prevent the loss of the cotyledons, or, if they have sloughed away, to a restoration of the uterus to its normal health.

9. Vaginitis.

Though the normal secretions of the vagina are feebly alkaline, any disease which may affect this organ and induce purulent or other disease discharges tends to change the reaction of these, through bacterial influence, and render them acid, a condition which is inimical to the life of spermatozoa. It is held that, normally, the copulative tract of domestic animals contains more or less bacteria, the number and variety being quite abundant in the vulva, but decreasing both numerically and in variety as the os uteri is approached. Generally, also, it appears that the pathogenic power of bacteria diminishes as the os uteri is approached so that, in the anterior portions of the vagina, the bacteria present are largely saphrophytic. The bactericidal power of the vaginal walls gradually increases toward the anterior extremity, to become complete in the normal organ in the cervix uteri, beyond which the genital tract is normally free from bacteria. When, however, the copulative tract becomes invaded by pathogenic bacteria, their products, coming in contact with the spermatozoa, tend to destroy the latter and thus induce sterility by the destruction of the male cells before they have reached the uterine cavity.

It therefore becomes essential that, in cases of inflammatory disease of the vagina, the infection should first be controlled and eliminated before copulation is permitted. Not only should this be done from the standpoint of the fertilization of the ovum, but

also because of the danger of the transmission of disease to the male and, through him, to other females.

In purulent vaginitis, sterility is the rule, if not constant. Perhaps the disease causing the vaginitis itself also involves other organs and, independent of the vaginitis, induces sterility. So it is with the granular or nodular venereal disease of cows and other venereal infections. The handling of these has already received consideration on pages 73 to 107.

During the puerperal period, acute vaginitis may arise, causing sterility for the time, or, becoming chronic or leading to adhesions of the vaginal walls, the sterility may become more or less permanently fixed. The overcoming or avoiding of sterility as a result of this affection is considered under "*Puerperal Infections.*"

10. Persistent Hymen.

As already stated on page 32, the hymen is a membranous expansion, stretching across the genital canal between the vulva and vagina, and represents the remnant of tissues existing between the proctodeal pit and the posterior extremity of the embryonic gut. In domesticated animals, this membrane regularly atrophies and disappears wholly, or nearly so, before birth. Exceptionally, it remains until adult life. The persistence is most common in the mare, so far as recorded in veterinary literature. In a large proportion of cases, the remnants consist of one or more narrow bands stretching across the genital passage from above to below, not far from the median line. The lower end is attached to the vulvo-vaginal boundary just anterior to the meatus urinarius and, from that point, slopes upward and more or less backward to the roof of the vagina.

In other cases, the hymen persists to a much greater degree and, in one instance, we observed a broad sheet stretching from above to below and completely closing the left half of the vagina. In this mare the hand could be passed along the right side of the genital tract until it had reached the vagina and then, by causing this organ to balloon, the hymen could be felt as a broad membranous expanse about 7 or 8 inches in its perpendicular diameter and 5 or 6 inches horizontally, the entire membrane tensely stretched.

In another instance we observed a two-year-old filly with the

hymen persisting entirely across the inferior portion of the vagina and extending upward and backward toward the vaginal roof, but not reaching it. On attempting to breed the filly, it was found that the stallion could not copulate on account of some obstruction. As soon as the penis reached the region of the hymen, progress was stopped and the stallion dismounted. After several vain attempts at breeding, we were asked to examine the filly. We soon discovered that there was an opening through the hymen at the superior portion and consequently advised the stallion groom to see that the penis was pushed upward along the roof of the vagina, by the hand. By this means, copulation was successful and impregnation took place.

In other cases which have been recorded in the cow, the hymen has completely closed the genital passage and caused an accumulation of uterine discharges in the vagina. In all such cases, copulation is evidently impossible until the membrane is ruptured.

Bands of a similar character are also found, at times, representing the embryologic median walls of the fused Müllerian ducts, (see page 19) which have failed to atrophy and disappear completely, as is normal in the region of the vagina when the ducts fuse properly. They may persist so completely as to constitute essentially a double vagina.

In all cases where copulation is interrupted in such a manner as we have described, a careful search of the genital canal by the veterinarian is demanded. In making this examination one is to keep constantly in mind the embryologic development of the organs and look carefully for persistent hymen, which may constitute a transverse partition, as well as for bands representing the persistent median walls of the ducts of Müller, in the form of longitudinal septa. These conditions should always be clearly differentiated from any acquired disease or deformityof the parts.

They are to be handled on general surgical principles and as a rule offer but little difficulty in overcoming them. The narrow bands representing either of these embryologic structures rarely interfere with copulation and it is only when they are quite extensive that the process of coition is stopped. They may, as a rule, be destroyed by rupturing with the hand or by severing with a scalpel.

11. Adhesions of the Vaginal Walls. Atresia Vaginæ

We have already stated on page 95, while describing the venereal diseases of the cow, that adhesions sometimes occur between the vaginal walls, as a result of these affections. This seems to be especially true of the vesicular venereal disease in the cow. We have observed one case of adhesion of the vaginal walls in the mare, but were unable to procure a history of the case or otherwise determine its cause. In another instance in the mare, the vaginal adhesion resulted from vaginitis following puerperal infection.

In all cases of firm, extensive adhesions of the walls of the vagina, copulation becomes impossible and more or less serious injuries are liable to occur to the female, and possibly also to the male, from any attempts at coïtion. One mare which we observed was bred to a stallion during estrum and, on account of extensive vaginal adhesions, the vagina was somewhat lacerated and greatly irritated. The severe irritation caused violent straining, which brought about a prolapse of the floor of the vagina and, with it, the urinary bladder (vesico-vaginocele). This prolapse persisted for some time in spite of all efforts to overcome it. At first we attempted to overcome the prolapse by means of a rope truss. This failed and we resorted to vulvar sutures, but the straining was so violent that they were being torn out and were consequently removed, in order to avoid extensive lacerations. The straining was finally controlled by producing deep anaesthesia with chloral hydrate, for a period of four or five hours, during which time the local irritation subsided.

As a general rule, these adhesions of the vagina are beyond surgical aid. In handling cases of vaginitis, from whatever cause, highly irritant antiseptics, which might injure or destroy the external layers of the mucous membrane, should be carefully avoided, in order to anticipate such adhesions of the parts, which may permanently prevent breeding by making copulation impossible.

12. Vulvar Atresia.

In some cases of inflammation of the genital tract from venereal diseases, as well as from traumatic injuries or other diseases in the parts, the opening of the vulva may become so constricted

as to prevent the entrance of the penis. In one case which we observed in a mare, a foal became impacted in the passage during the night and remained until the following morning. The pressure upon the vulva was so great that gangrene of the vulvar lips ensued, resulting eventually in such a constriction of the vulvar opening that copulation was impossible.

We may rarely be able to overcome such strictures by surgical means, but as a rule they are not subject to remedy. The possibility of such stricture should always be borne in mind in dealing with inflammation of, or injuries to, these parts in female breeding animals.

13. Horizontal Position of the Vulvar Opening.*

When breeding females, especially cows and mares, become aged and their abdomens enlarged and pendulous, the pelvic organs drop forward and downward, and, dragging upon the anus and vulva, cause a more or less deep excavation in the perineal region. At the same time the posterior dorsal and lumbar portions of the spinal column become depressed, producing what might be termed senile lordosis, or "sway back." The lumbo-sacral articulation becomes involved in the change of position of the parts so that it becomes depressed along with the sacro-iliac articulation, which brings about a relative elevation of the ischiatic tuberosities and a more nearly horizontal position of the pelvis.

These changes in anatomical relations modify the direction of the vulvo-vaginal canal so that, instead of the vulvar opening being approximately perpendicular, as in the normal, it approaches closely to the horizontal. In copulating, the penis tends to approach the vulvar opening in a direction acutely oblique, or well nigh perpendicular, to the long axis of the vulvo-vaginal canal, thus rendering successful copulation uncertain, since the penis tends to glide forward and slightly upward over the vulva, against the anus, tail, or other parts.

We have already drawn attention on page 50 to the danger of physical injuries, against which we should guard, but it is also important to bear in mind that, whether such injury occur or

* Zschokke, die Unfruchtbarkeit des Rindes, page 134.

not, the abnormal position constantly invites sterility by causing a failure in coition.

The difficulty may be overcome in most cases, and copulation rendered safe, by means of standing the female with the posterior feet somewhat lower than the anterior and having the male stand upon ground approximately level with, or higher than, the ground upon which the anterior feet of the female rest. This position of the female tends to bring the vulvar opening somewhat nearer the perpendicular and consequently renders copulation more certain. In the mare, also, the penis of the stallion may be largely directed by the groom in a manner to avoid accident and render copulation more secure.

14. Rupture of the Perineum and Recto-Vaginal Fistula.

Rupture of the perineum or of the wall between the rectum and the vagina is not rare in the mare as a result of some portion of the foal, such as the head or a foot, pushing up into the rectum and appearing at the anus, while the other parts enter the vulva, when, unless prompt relief is given, a few violent expulsive efforts on the part of the mare forces the foal out and tears the perineum asunder. If the attendance is prompt, the misdirected head or foot may be pushed back into the vagina, after it has entered the rectum, and complete rupture of the perineum averted, but, as a result of the accident, a fistula generally persists, leading from the rectum into the vagina.

In either case, fecal matter drops from the rectum into the vagina and maintains a constant irritation of the mucosa of the vagina, with catarrhal discharge.

When the perineum is ruptured, the deformity of the part is such that copulation cannot usually be successfully performed, and, even if it can be, the presence of fecal matter in the vagina, with the consequent inflammation and catarrh, generally prevents fertilization.

Sterility due to this cause can only be removed, with any degree of certainty, by bringing about a recovery from the fistula or rupture. In some cases of this kind the sterility may be overcome by means of artificial impregnation. The more or less befouled vagina may be flushed out with a warm saline solution or even with weak antiseptics, after which semen, preferably

obtained from the vagina of a healthy mare immediately after copulation, is to be injected into the cervical canal or into the uterine cavity of the patient. The question of surgical treatment of these accidents is discussed under "Accidents of Parturition."

III Impediments to Copulation and Fecundation Referable to Nervous Disorders.

1 **Excitability and Timidity.** In young heifers, especially if the animal is very timid and is approached by a strange male, there is a tendency to avoid coition if possible, although the female is properly in estrum. In such instances the behavior of the male has much to do with this state and, so far as possible, he should be caused to approach the timid animal quietly.

A mare having a young foal at her side is sometimes much excited and resists the stallion because of the maternal instinct, by which she fears some injury to her young. It is usually desirable to keep the foal as near as possible to the mare's head, where she can see it and recognize its safety.

2 **Vaginismus.** In the cow there is occasionally observed a peculiar contraction of the vulva, when attempts at copulation are made, which is referable to a spasm of the sphincter muscles of that organ, due to hypersensitiveness. In this affection the vulva becomes so firmly closed that the penis of the male can not enter and, consequently, copulation can not occur. We have seen no records of this difficulty in the mare and have observed no cases where copulation failed because of it. In one case of nymphomania in a mare we found, upon inserting the arm for the purpose of spaying, that the sphincter of the vulva contracted so powerfully that it caused great pain by crushing our arm, and so injured it that it was lame for eight or ten hours after the operation had been completed. The condition might have interfered with copulation.

Vaginismus is probably most generally connected with ovarian disorder. Its cause is to be carefully determined by examination. If the malady is of ovarian origin, those glands must receive attention. If the condition appears to be wholly local, attempts may be made to overcome it by inducing fatigue in the animal, by the internal administration of narcotics or by the use of local anaesthetics applied to the vulva.

3. Violent Expulsive Efforts Following Coition. In the mare and the cow we occasionally observe very violent expulsive efforts immediately following copulation. It is apparently due, in some cases, to an irritability of the animal. If there has been some pre-existing disease of the part, which has caused a stricture of the coital canal, injury may follow the coition which produces pain and is naturally accompanied by straining. We observe the same results when the penis of the male is comparatively large and the copulation causes laceration or rupture of the vagina. It is, consequently, most common in those cases where the female is young or is of small size and the male is large, and especially where the penis is of very large size or of excessive length. In other animals the expulsive efforts are apparently due entirely to individual irritability. In such cases, immediately following coition, there is severe straining, which causes an immediate expulsion of a large part, or all, of the semen and may result, according to Zschokke* and others, in sterility.

In all such cases, the cause of the irritation should be discovered and removed. We have already suggested a plan for preventing injury from the penis of the stallion under, "The Dangers and Infections of Coition" on page 50. We have also pointed out the danger of permitting copulation when the vagina is inflamed. If the expulsive efforts are due to excessive irritability of the animal they may be overcome or ameliorated by causing her to move about constantly, or otherwise attracting her attention for some time after copulation.

IV. Extreme Variation in the Size of the Male and Female.

Under "The Dangers and Infections of Coition," on page 50, we have considered the question of the variation in the size of the male and female with reference to accidents. Closely allied to these accidents is the question of sterility due to this same lack of correspondence in size. In all cases where accidents are liable to occur because of this difference in size, sterility is likely to result for similar reasons. If the female is comparatively either too large or too small, sterility may ensue as a result of imperfect or incomplete copulation. The nature of the cause suggests the

* Zschokke, Die Unfruchtbarkeit des Rindes, page 137.

remedy. Artificial insemination, as described on page 278, may be indicated in some cases.

V. Infectious Diseases.

Infectious diseases, as a cause of sterility, have already received attention on pages 68 to 110. The venereal infections naturally tend to produce sterility, though in markedly varying degrees.

In addition to these, there are various infections which tend to cause the death of the fetus, and which we shall discuss in the chapter upon Abortion. While abortion is not identical with sterility, the results of it, by causing the death of the fetus prior to its expulsion, are essentially identical, from an economic standpoint, with a failure of fertilization itself.

NOSTRUMS AND PANACEÆ AGAINST STERILITY.

Few departments of veterinary practice offer so inviting a field for the plying of the sale of nostrums and the application of more or less mythical proceedings, as sterility. To the average layman, ovulation, fertilization and the development of the embryo are as a mysterious sealed book, which gives to the quack an open field for plying his method of chicanery. Sometimes the remedies are not devoid of merit in proper cases, but lose their value by being applied uniformly in *all* cases of sterility, regardless of the cause at work in a given case.

Veterinarians in America indirectly support this chicanery by failure to extend scientific aid. Science and charlatanism are incompatible and, whenever the veterinarians of breeding areas study and understand sterility and intelligently advise owners of sterile animals, quackery in this respect must cease. The veterinarian is helpless in combatting sterility until he first learns well the normal structure and functions of the genital system; he must first comprehend *fertility* ere he can understand *sterility*. Not only does he need have a theoretic knowledge of normal breeding, but he must have a clinical knowledge. He must be able, by manual exploration, to locate and recognize the various internal generative organs in our larger domestic animals and to determine by such examination whether they be normal or abnormal. This does not come by the reading of books nor by making post mortem examinations. The knowledge does not come to a man in an hour or a day. It is to be learned by a conscientious study upon the living animal and competency is attained only by long and faithful work.

When ability has been acquired, and the veterinarian can say that an ovarian abcess is present, and speak with authority upon the point, the intelligent owner will not resort to nostrums, nor cause the os uteri to be dilated. He will not try impregnators nor resort to artificial insemination. So, in each case, when the veterinarian is able to point out the difficulty with authority, the owner will desire the application of a remedy which will reasonably tend to remove the cause. As already stated, a previously sterile animal may suddenly and unexpectedly conceive.

Should an alleged remedy have been applied shortly before, it is probable that it will be credited with a cure, though the actual cause of the sterility may have been of such a character that the remedy applied could in no conceivable way have affected it.

In addition to many secret nostrums which are placed upon the market and vigorously advertised by their promoters, there are various remedies, which are not secret, but which have been lauded as sovereign against sterility, regardless of the underlying cause; or, possibly, we should say they are regarded as specifics against all cases of sterility, the causes of which are unknown to the parties concerned.

Dilation of the Os Uteri. We have already had occasion to refer to this procedure while considering "Occlusion of the Os Uteri." Dilation of the os uteri has a direct value, and is the only scientific method of handling an occlusion of the os uteri externum. This much granted, it has been seized upon by many as a universal remedy. We have also related that the cervical canal of the cow is so narrow, so tortuous, and its mucous membrane thrown into so many folds, that it is difficult to pass a finger or a sound through the canal. This difficulty is made greater by the vigorous contraction of the powerful circular muscles of the cervix.

So it is easy to say that the os uteri is closed, much easier for a careless veterinarian to make the statement than to prove its untruth by passing a sound through into the uterine cavity.

Of course some females, previously sterile, will breed after "opening" the os, which was not closed: so might the same animals have bred had their tails been split, or their horns bored.

Impregnators. A few years ago there was an an extensive interest shown in impregnators as a soverign remedy for sterility in mares. Some prominent American practitioners, deeply impressed with the idea, bent their energies to overcome sterility in this manner and devised and patented impregnators of various types. Generally they consisted of hollow tubes of soft rubber, 3 to 4 inches in length, having an opening of variable size, usually ½ to ¾ inch. The outside of the tube was constricted in its center, and the posterior end was armed with a broad flange to prevent its falling into the uterine cavity. This apparatus was inserted in the os uteri externum just before the stallion mounted. The theory of use was that the "impregna-

tor" held the canal open and that, during ejaculation, the semen was thrown directly into the uterine cavity, the urethal opening of the penis coming into direct apposition to the open tube.

Evidently the os uteri was open, as, otherwise, the "impregnator" could not have been inserted. The advocates of its use have not shown why semen passed through a rubber tube should have its virility increased. But mares, which had been sterile previously, conceived at the first service, and statements to that effect, by owners of mares, were freely used by makers of "impregnators" to show their infallibility. What influence, if any, was exerted by the "impregnator," is not wholly clear, but generally it may be regarded as a harmless diversion, which ordinarily will not prevent conception. In rare cases, they may be of actual value.

Incidentally, experience with "impregnators" teaches that, contrary to the views of some, the penis of the stallion does not enter the cervical canal of the mare during normal copulation. If it did, the "impregnator" would inevitably be displaced into the uterine cavity.

Injections of Yeast Solution into the Vagina. Another method of handling sterility in cows, which acquired, for a time, a favorable reputation, was the injection into the vagina of a solution of yeast or the introduction, by other means, of yeast into the vaginal cavity. Cows previously sterile, in some cases, promptly conceived and these cases were naturally reported. Those which did not conceive after the treatment were generally not mentioned.

There may be conditions of the vagina, chronic infections of the mucosa, or other disease, which the application of yeast may overcome, but this has not been determined. It is inconceivable, in our present state of knowledge, that yeast introduced into the vagina could overcome cystic degeneration, sclerosis or abscess of the ovaries, or, indeed, many of the conditions named in the preceding pages as causes of sterility.

Aphrodisiacs. Yohimbin Spiegel. For many years numerous drugs have been credited with the power of arousing the sexual appetite and, through this agency, the sexual powers. Among these drugs are: cantharides, turpentine and the balsams and resins and, more recently, a new drug, yohimbin, has been

introduced to overcome sterility. In large doses, these drugs induce more or less irritation of the urino-genital tract and stimulation of the sexual desire.

To what extent aphrodisiacs stimulate ovulation and spermatogenesis has not been determined. It is possible that indirectly, through irritation of the genital-tract, they stimulate the ripening and discharge of ova and spermatozoa but, from all data at hand, they merely arouse the sexual appetite without increasing the sexual powers. In the minds of some, vigorous sexual desire signifies exalted breeding powers, but this is a false assumption. In nymphomania, for example, the sexual appetite is intense and the breeding power almost nil. Sexual appetite, without normal ovulation in the female and the formation of normal spermatozoa in the male, has no value for breeding purposes, but is rather a harm, frequently leading the owner astray and diminishing the value of the patient for other purposes.

Yohimbin has recently acquired a high repute, in some quarters, as a remedy against sterility, both in human and in veterinary practice. It has been commended chiefly for arousing the sexual appetite, when absent in either sex. Its efficacy is in vigorous controversy and the cost of the drug is at present prohibitive except in unusually valuable animals.

Holterbach (Berlin Tierarztliche Wochenschrift, No. 9, 1908), in an exhaustive article, champions the use of the drug.

He used the drug in 37 cases of absence of sexual desire: 22 cows, 9 bitches, 3 bulls and 3 sows. In his observation, the drug has a greater affinity for the female than for the male genitalia. A five year old Simmerthal cow calved normally in June, 1906, but estrum did not follow. All other drugs, including cantharides, proved useless. In August, 1907, 14 months after calving, 16 tablets of yohimbin chlorid, each containing 0.1 gram of the alkaloid, were prescribed, one tablet to be given three times daily in the drinking water. On the third day there was excitement, bellowing, uneasy stepping about, frequent urination and decreased milk flow. On the fourth day there was a muco-sanguineous discharge from the vulva (menstruation?) and on the fifth day the owner noted expulsive efforts resembling labor pains. The external genitals were

swollen and hyperaemic, but no estrum was present. The uterus was large. The ovaries were enlarged, but not cystic. Six weeks later, the cow, showing violent estrum, was bred and the owner "believed" her in calf.

Another cow, nine months post partum, without estrum, and having cystic ovaries, was treated in the same way, developed estrum 10 weeks later, was bred and the owner "believed" her to be pregnant.

Frubinger (D. M. W. No. 7, 1907) condemns the drug as worthless and attributes the alleged cures in man to suggestion.

Müller (Arch. Internat. Phar. et de Therap. Vol. XVII, p. 81) considers it an erratic aphrodisiac, acting differently on different individuals. Daels, quoted by Holterbach, experimentally caused menstruation in a bitch already in estrum, but bitches usually menstruate at this time anyhow. In another, not in estrum, but date of probable normal estrum not named, menstruation occurred in four days. A third bitch showed a mucous discharge. Later, bloody feces were voided and the animal died from the toxic effects of the drug. Autopsy showed enlarged, congested genital canals, prominent ripe ova, etc.

In experiments with young bitches, less than nine months old, the drug, in fatal toxic doses, failed to cause reactions in the genital organs.

So far as we have been able to determine, the drug has not induced estrum in any case where estrum may not have occured without it, nor impregnation where such a result was not perfectly possible without the drug.

The alleged estrum induced was of doubtful character. Swelling of the vulva occurs without estrum. A bloody discharge from the vulva may not be menstruation. The bloody feces following the administration of the drug might be called menstruation with equal right.

Further authentic data are essential to a reliable conclusion. Until these are at hand, the administration of the drug should be regarded as a very expensive experiment of exceedingly doubtful value. It has a possible value in cases where sterility exists as a consequence of the absence of sexual desire without organic disease of the genital glands.

ARTIFICIAL IMPREGNATION.

Undoubtedly efficient in some cases, artificial insemination has been advocated as a widely applicable remedy for sterility, apparently upon the theory that sterility is usually based upon mechanical impediment.

Artificial insemination is an easy and successful operation in fertile mares and other females with readily penetrable os uteri. It is difficult of application in the cow because of the narrow, tortuous, obstructed cervical canal. It is a valuable remedy in cases due to physical impediments to natural insemination, in so far as obstacles are surmountable by this means. It is inconceivable, in the present state of our knowledge, how the operation can otherwise exert a favorable influence upon sterility, unless we admit that in some cases, owing to nervous causes, insemination without copulation, by avoiding the nerve-reflexes of that act, may favor fertilization. This has not been shown.

Some exaggerated statements have been made regarding its efficiency. It has been asserted that 50 %, 60 %, or more, of mares, taken in large numbers, regardless of the presence, nearness or remoteness of estrum, will be fertilized by this process. Upon its face, the contention is absurd. There is a belief, to which some embryologists have lent weight, that spermatozoa will live for days and weeks in the genital tube awaiting the appearance of an ovum. We have found no convincing data, however, to indicate that, in a fertile animal, coming regularly in estrum and artificially inseminated shortly after a normal estrual period, the spermatozoa have remained in the genital canal until the next ovulation and induced fertilization. If the mares are fertile and the artificial insemination is carefully made at the proper time in relation to ovulation, there is no reason to doubt that 60 % or 100 % may be fertilized.

In occlusion of the cervical canal, in deformities and defects of the os uteri, which may inhibit or render uncertain the passage of the spermatozoa into the uterine cavity, artificial insemination constitutes a rational and valuable remedy. In some diseases of the vagina and of the vaginal portion of the uterus, artificial insemination offers possibilities which should not be ignored. In recto-vaginal fistula and in rupture of the perineum, where

copulation is rendered difficult or uncertain, the operation is indicated. The limitations of artificial impregnation as a remedy against sterility should be fully recognized, and the value of the process should not be discredited by its application in improper cases.

It has been urged, and with some reason, in cases of deformity of the penis in stallions, by which the semen is ejaculated in some other direction than forwards, that the fertility of the male may be greatly heightened by artificial insemination added to the imperfect copulation.

There is a commercial feature, in connection with artificial insemination, which interests the breeder rather than the veterinarian and has no relation to sterility. Throughout nature there is a superabundance of male fecundating cells. In a normal ejaculation of a healthy adult male, there are sufficient spermatozoa to fecundate innumerable females. It has, consequently, been proposed to extend the procreative power of a valuable breeding male by artificial insemination—by collecting some of the semen from the vagina of the female just served and transferring it, under proper precautions, to the vaginæ of other females, to cause one copulation to answer for several or many fertilizations.

The operation of artificial insemination is simple. It may be practiced as an adjunct to copulation. In such case, the male is permitted to serve the female, and promptly thereafter the operator inserts his hand into the vagina, picks up some of the semen and introduces it into the cervical canal. This may be done with the aid of a short spoon, in which the semen may be picked up and inserted through the os. A syringe, of almost any type, may be used to pick up the semen and then inject it into the uterus. The operator may simply use his hand. Even one finger immersed in the seminal fluid and pushed into the cervical canal would, ordinarily, carry sufficient spermatozoa to accomplish the purpose. This plan of insemination is applicable in those cases where some physical hindrance to natural insemination exists, of a character surmountable by the artificial method.

A second method of artificial insemination is the transfer of the semen from the vagina of a female, with which the male has recently copulated, to another female. If the two females are

in close proximity, the operation is readily carried out by means of any of the impregnation syringes, or otherwise. It is essential merely that the transfer be made promptly and without serious damage to the seminal fluid.

By this method, females incapable of copulation may be impregnated, such as those suffering from ruptured perineum or other obstructions in the vagina or vulva. It may also be resorted to in order to avoid the dangers of copulation between animals in which there is too gross a variation in size, either the male or the female being too large to safely copulate with the desired mate.

The chief essentials in artificial insemination are cleanliness (asepsis), reasonable promptness, the protection of the semen against extremes of temperature and its secure lodgment in the uterus or cervical canal.

The hands, vessels and apparatus are to be made clean—aseptically clean—and every precaution taken against the transfer of dangerous infection. The possibilities of transferring infectious diseases by this means should not be underestimated.

The duration of the vitality of the spermatozoa has not been fully determined. They can be kept alive in a warm saline solution for days, but it is doubtful if their fertilizing power can be maintained, with practical certainty, for a long period of time. The transfer should consequently, in the interests of efficiency, be made as promptly as possible. While, experimentally, artificial fertilization may be induced after carrying the semen a long distance and keeping it many hours, the intervening time subjects it to many unfavorable circumstances. If to be carried, it may be placed in a rubber bag or wide mouthed bottle, the vessel being immersed in water at a temperature of about 100° F. and maintained at about this temperature until the semen has been used.

We have already suggested in a preceding chapter that fertilization of the egg, under normal conditions, occurs in the oviduct, immediately after the rupture of the ovisac and the discharge of the egg into the tube. The observations upon this point have been carried out largely upon the rabbit as a representative of mammalia and it is assumed that the phenomena occurring in this animal are largely typical of the entire mammalian group. In the observations upon fertilization in the rabbit, copulation has generally ensued immediately after the doe has given birth to young and from 8-12 hours prior to the rupture of the Graafian follicles. Under these conditions, when the ovisacs rupture, the spermatozoa have already passed through the uterus and the oviduct and have reached the ampulla of the tube, so they may at once meet the egg when it is discharged and fertilization immediately follow. The spermatozoa may even have reached the ovum while yet in the ruptured ovisac, before its discharge into the Fallopian tube as shown in Fig. 20.

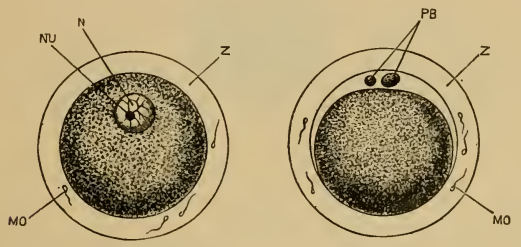

FIG. 20. A fully formed ovum of the Rabbit shortly before its discharge from the ovary. Marshall after Bischoff.

FIG. 21. Ovum of Rabbit from the upper end of the oviduct after extrusion of the two polar bodies. Marshall after Bischoff.

MO, Spermatozoon. N, nucleus or germinal vesicle. NU, Nucleolus or germinal spot. PB, Polar bodies. Z, zona radiata.

This rule is probably true in our larger domestic animals, but it is possible that copulation may sometimes be delayed until after the rupture of the ovisac and the discharge of the ovum into the tube so that, before it meets with the spermatozoa, it

may have travelled some distance along the oviduct toward the uterus.

In the typical fertilization of the ovum in the rabbit, where the spermatozoa have already reached the anterior end of the oviduct when the Graafian follicle ruptures, the ovum undergoes segmentation or division during its passage toward the uterus. According to Van Beneden, the segmentation of the ovum begins 10 or 12 hours after fertilization or 18-24 hours after copulation and continues for the next two days or until about the end of the third day, at which time the ovum reaches the uterus and its segmentation has been completed. At this time it is about the same size as the original ovum or possibly somewhat smaller, but has acquired, during its passage through the oviduct, a layer of albumen on its exterior, which increases the total size very considerably.

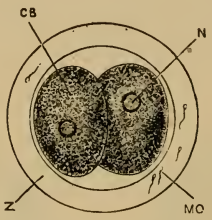

FIG. 22. A rabit's ovum from the middle of the length of the oviduct, about 22 hours after copulation, showing division of the ovum into two cells. × 200. Marshall after Bischoff.

CB, Blastomere, or segmentation cell, MO, Spermatozoon imbedded in the zona radiata. N, Nucleus. Z, Zona radiata.

The length of the time required for the passage of the ovum from the ovary to the uterus has not been determined for most animals, but, reasoning from other data in embryology, it would appear possible that, in the larger animals, it may require a longer period of time for travelling through the tube than in small ones like the rabbit. If we are to judge of the time required for the passage of the ovum through the oviduct by the appearance of estrum and menstruation, we would be led to assume that, in the cow, it is quite as rapid as in the rabbit. Some

authors estimate that in woman the period is probably five to eight days, but we are aware of no definite data upon which to base this assumption.

About 10-12 hours after the fertilization of the egg of the rabbit, the ovum undergoes cleavage, by which there arise two spherical cells, which are essentially alike in all respects except that some observers believe that the one is slightly smaller than the other. See Fig. 22.

Each of these two cells, after a brief pause of a few hours, divides again into two cells, constituting a mass of 4 ovoid cells, which again subdivide to constitute a group of 8 cells, those derived from the larger of the two first cells being now more clearly larger than the others, the larger ones grouped together centrally, while the smaller rest upon them as a cap. Later the segmentation of the small cells proceeds somewhat more rapidly than that of the larger and they tend to grow around and enclose the latter. According to Marshall, when the ovum of the rabbit

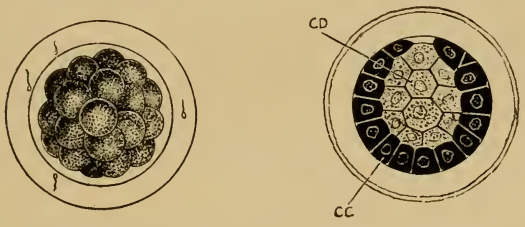

FIG. 23. A rabit's ovum from the lower end of the oviduct, about the middle of the third day; showing the morula stage, shortly before the completion of segmentation. ×200. Marshall after Bishoff.

FIG. 24. A rabbit's ovum seventy hours after copulation, taken from the lower end of the oviduct just before entering the uterus and showing the condition at the close of segmentation. × 200. Marshall after Van-Beneden.

has reached the 70th hour after fertilization, its segmentation has been completed and it passes from the oviduct into the uterus. At this time it is a spherical mass consisting of an exterior layer of small, nearly spherical, transparent cells, enclosing almost completely the group of larger, more granular cells; it has reached what is known as the morula or mulberry stage. See Figs. 23 and 24.

At this stage the external layer, consisting of the smaller cells, and the internal mass of larger ones are firmly attached to each other at one point only. The segmented ovum is still surrounded by the vitelline membrane, the zona radiata and the layer of albumen which it had acquired during its progress through the oviduct.

Within a few hours after entering the uterus the ovum has become greatly enlarged, owing to the accumulation of a fluid between the external layer of small cells and the mass of larger inner cells, except at the point of attachment between the two, so that the inner mass occupies a comparatively small area at the superior pole of the ovum. This stage in the development of the ovum is known as the *blastodermic vesicle*. The vesicle consists of an outer wall of flattened, polygonal cells, which have been formed from the outer cells of the previous stages, to which is attached, at one of its poles, the small mass of large cells. Separating the two layers of cells, except at the polar point of attachment, is a relatively large quantity of fluid, which greatly distends and increases the size of the vesicle. The mass of inner cells is flattened out in the form of a disk, consisting of several layers of somewhat spherical cells at the center, which is known as the embryonal or germinal area, while, at the pheriphery, they are but one or two layers in thickness. As the vesicle increases rapidly in size the vitelline membrane disappears, while the zona radiata and the albuminous layer become greatly attenuated by being stretched out.

During this stage of development, which continues in the rabbit to about the seventh day, the ovum lies free within the uterine cavity and, in case of multiparous animals, the ova, which enter the uterus almost simultaneously, tend to distribute themselves at more or less uniform distances apart throughout the organ and assume the positions which they are to retain throughout their period of intra-uterine development, the location of each being early indicated by a bulging of the uterine walls.

Germinal Layers.

Toward the close of the developement of the blastoderm, important changes take place, by which there are established three distinct germinal layers, each of which is destined to take a spe-

cial part in the formation of certain tissues of the embryo. These changes affect chiefly the embryonal area or that point in the blastoderm at which the various layers are united, and the internal cells are massed.

The exact method of the formation of the germinal layers is not wholly free from controversy. In the embryonal area, which is a circular or discoid patch, three layers of cells may be recognized : an upper or external layer of pavement cells, the epiblast ; a middle layer of larger, cuboidal cells, the mesoblast ; and a lower stratum of pavement cells, the hypoblast.

At the margin of the embryonal area, the walls of the blastodermic vesicle consist of two layers of cells representing the external and internal germinal layers, while, passing slightly beyond this, the remainder of the blastodermic vesicle, constituting about ¾ of its total surface, consists of a single layer of cells, the epiblast.

According to Rauber and Kölliker, the uppermost layer of the blastodermic vesicle, the primitive epiblast, disappears from the embryonal area, to be succeeded by a new epiblast arising from the mesoblast so that, according to these, the entire embryonal area is ultimately derived from the inner hypoblast, which, in the morula, consisted of the larger, granular, slowly multiplying mass of cells.

Late in the blastodermic stage, the embryonal area becomes pyriform, its greater diameter corresponding to the long axis of the blastodermic vesicle, which has now assumed the eliptical form. The broader end of the embryonal area may be designated the anterior, or head, end and the narrower the posterior, or tail, end.

The Primitive Streak. The Primitive Groove

As the blastodermic vesicle approaches the completion of its development, there appears the primitive streak, consisting of an axial thickening of the epiblast, at the posterior, or tail, end of the embryonal area. This thickening extends longitudinally and finally equals about two-thirds of the length of the area and has a faint longitudinal depression known as the *primitive groove*. A cross-section of the primitive streak shows it to consist of a multiplication of the deeper cells of the epiblast on the median

line. From the deeper layers of this thickened, dense, primitive streak, the cells grow out in lateral plates between the epiblast and hypoblast, to constitute the permanent mesoblast. See Fig. 25.

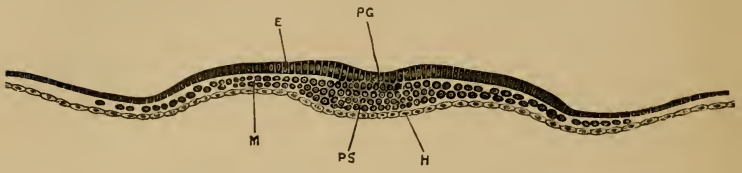

FIG. 25. A transverse section across the hinder part of the embryonal area of a rabbit embryo at the end of the seventh day, the section passing through the primitive streak. × 80 Marshall after Kölliker.

E, Epiblast. H, Hypoblast. M, Mesoblast.
PG, Primitive groove. PS, Primitive streak.

FORMATION OF THE EMBRYO

The embryo is formed in the embryonal, or germinal, area. A longitudinal depression known as the neural groove is formed immediately in front of the primitive streak, the long axes of the two structures being parallel. The neural groove is bordered on the sides by the neural folds, which grow upward from the epiblast and then approach each other to become united into a tube, in which, eventually, the central nervous system is formed and soon shows, in its anterior or head-end, the brain vesicles.

By an infolding of the walls of the blastodermic vesicle about the margins of the embryonic area, the latter becomes constricted off from the rest of the vesicle, which then constitutes the vitelline, or yolk sack. The yolk sack of the mammalian embryo is small and of little consequence, as it contains no appreciable amount of nutriment for the embryo, but simply a quantity of a presumably inert fluid. After this constriction forms, dividing the embryo from the yolk sac, the dorsal surface of the embryo grows much more rapidly than the ventral, which causes it to bend ventralwards very rapidly, so that the head-end is soon at right angles to the remainder of the embryo. The head-end of the embryo, by becoming flexed, is bent downward

into the yolk sac and pushes the walls of the latter before it. The different parts of the brain soon become recognizable and the nose, eyes and ears are also quite apparent, while, upon the sides of the head and neck, the visceral arches and clefts are seen.

The Cœlom or Body Cavity

On the eighth or ninth day after fertilization in small animals, perhaps somewhat later in the larger ones, the cœlom, or body cavity, is formed as a cleft or rearrangement of the cells of the mesoblast, by which an extensive cavity is formed, radiating outwards from the region of the notocord, to pass beyond the embryo itself and extend outward in the walls of the blastoderm to near the margin of the mesoblastic area. This change serves to divide the mesoblast into two layers, the external of which is closely adherent to the epiblast, the two constituting the somatapleur, while the inner mesoblastic layer and the endoblast, with which it is intimately related, constitute the splanchnopleur.

From the epiblast arise finally the epidermis, the hair, nails, hoof, horns, etc., and the cerebro-spinal nervous system. From the mesoblast arise the muscles, bones, connective and other skeletal tissues and the deeper layers of the skin.

The mesoblast of the splanchnopleur gives origin to the heart and the muscular portions of the digestive, respiratory and urinogenital organs and, in a general way, to the pale, or unstriped, muscle fibers, while the somatopleuric mesoblast forms the striped, or voluntary, muscles. The endoblast of the splanchnopleur forms the epithelium of the digestive and respiratory tracts. The origin of the various tissues from the three embryonic layers is of great interest in the study of medicine and surgery and numerous functions can only be understood by recalling the embryonic origin of certain tissues in the adult. A wound of the epithelium can be repaired by epithelial tissues only. Cells originating from the mesoblast have not the power to repair the epiblastic injury.

Ere the blastoderm can proceed far in its development, new provision must be made for its nutrition, which, in mammalia, must be derived from the mother through an intimate relation between her uterine mucosa and special organs of the fetus, the fetal envelops, especially the placenta.

At a very early period, this nutritive relationship between the mother and the fertilized ovum is established by two outgrowths: one of the extra-embryonal somatopleur, to constitute the amnion; the other from the splanchnopleur, to constitute the allantois, both of which we shall describe later.

The Nervous System

We have already intimated that the *neural groove* of the blastoderm marks the beginning, location and direction of the future cerebro-spinal nervous system. Consisting of thickened epiblast, the neural folds increase in prominence, while the groove between them deepens and the summits of the folds approach each other as segments of an arch, to finally meet and fuse above the groove, converting it into a closed tube which, lined with ciliated epiblastic cells and filled with fluid, is to persist throughout the life of the animal as the central canal in the spinal cord and as the ventricles of the brain, while, from the deeper epiblastic cells in the walls of the tube, are to develop the nerve cells and fibers of the cerebro-spinal axis. Under normal conditions, the neural groove grows rapidly in length and depth and, in the rabbit, its lips have met and fused to constitute a complete tube by the end of the ninth day. At this time one can distinguish the spinal cord, the fore-brain, the mid-brain and the hind-brain.

The cerebro-spinal nervous system of mammalian animals constitutes the central organ, about which the other portions of the embryo develop in more or less complete harmony. Any interruption in the normal development of the cerebro-spinal axis interrupts or vitiates the proper growth of other parts of the body. Should the neural groove become branched and double at its anterior end, there forms in the embryo two heads instead of one, constituting a double-headed monster or bicephalus; (See Fig. 35) or the fission may extend more posteriorly to constitute double neck or chest. Should the posterior end of the neural groove undergo division into two parts, we have a monster in which the posterior parts of the body are double, while the anterior may remain single and normal. Should two neural grooves form side by side and in intimate contact with each other, there may result a double monster, of two more or less separate bodies as in Figs. 126 and 127. Finally, the division between the two neural grooves may be complete and two

embryos form which are wholly separate, but have common envelops and umbilic cords. In the cow not rarely we find one of the two embryos so aberrant in form as to constitute a well nigh shapeless mass like Figs. 26 and 27, known as *amorphus*, *acardia*, or a "mole."

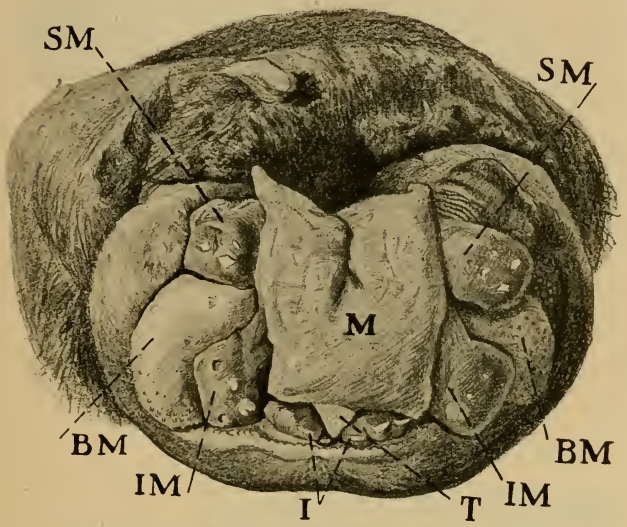

FIG. 26. "MOLE," OR ACARDIA. FROM COW.
M, Muzzle. SM, SM, Superior maxilla, showing white denticles.
IM, IM, Inferior maxilla showing denticular masses (grinders).
BM, Buccal mucosa showing papilla.
T, Tongue. I, Incisors.
One-half size.

The fusion of the lips of the neural canal may become interrupted at various points and the canal may remain open even to the time of birth, to constitute spinal bifida. An instance of this occurring in the dorsal region (dorsal spinal bifida) is shown in Fig. 28, in which the superior wall of the spinal canal is wanting from the dorsal region, backward. A similar persistence of the neural groove may occur at any point in its entire length, producing cervical, dorsal, lumbar or sacral spinal bifida, according to location.

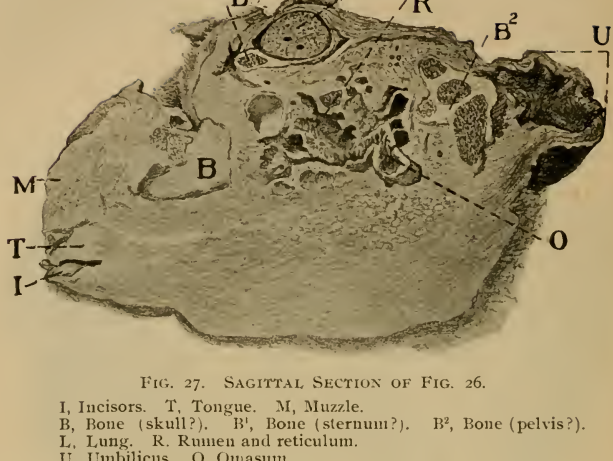

FIG. 27. SAGITTAL SECTION OF FIG. 26.

I, Incisors. T, Tongue. M, Muzzle.
B, Bone (skull?). B¹, Bone (sternum?). B², Bone (pelvis?).
L, Lung. R. Rumen and reticulum.
U, Umbilicus. O, Omasum.
One-half size.

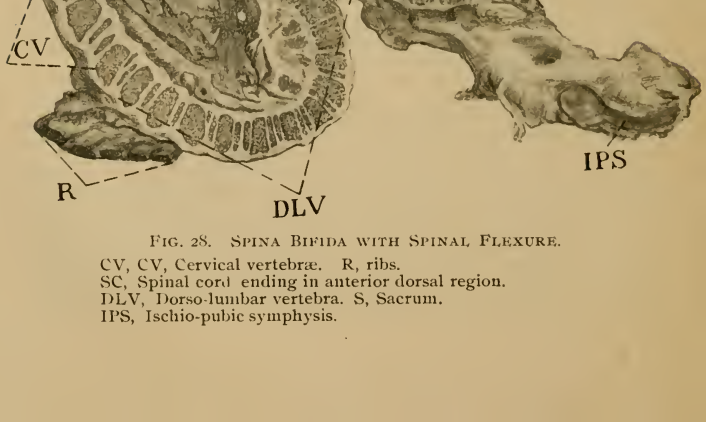

FIG. 28. SPINA BIFIDA WITH SPINAL FLEXURE.

CV, CV, Cervical vertebræ. R, ribs.
SC, Spinal cord ending in anterior dorsal region.
DLV, Dorso-lumbar vertebra. S, Sacrum.
IPS, Ischio-pubic symphysis.

The Brain.

The brain commences to form and is recognizable before the neural canal has been completed. It consists at first chiefly of a series of vesicles which are known as the fore-brain, mid-brain, and hind-brain. The anterior cerebral vesicle, or fore-brain, gives rise very early in its development to the optic vesicles, as lateral outgrowths, which are ultimately converted into the essential parts of the eye.

Normally, there are two of these outgrowths, which, under aberration in development, may fuse or grow out as single projections on the median line, to constitute the one-eyed monster,

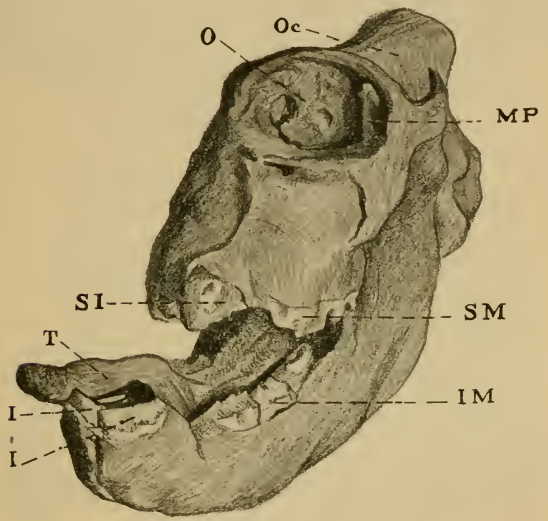

Fig. 29. Skull of Cyclops. Foal.

Oc, Occiput. O, Single orbital cavity.
MP, Coronoid process of inferior maxilla.
SM, Superior grinders.
SI, Superior incisors fused into a single organ.
IM, Inferior grinders. T, Tongue.
II, Inferior incisors.

or cyclops. In case of this fusion of the optic vesicles, the development of a single vesicle on the median line, there is a tendency towards the inhibition of the development of the olfactory vesicles.

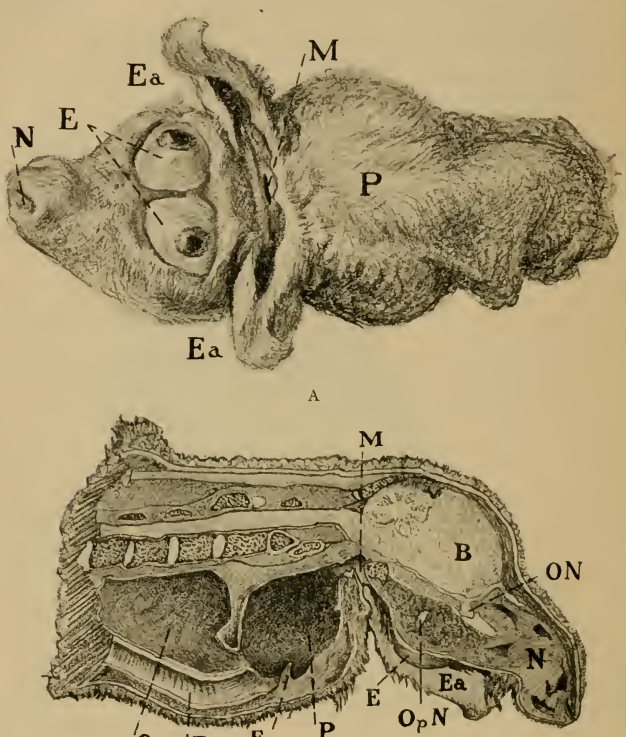

FIG. 30. CYCLOPS. LAMB.

A, Head and neck, seen from below. B, Sagittal section.
M, Mouth. Ea, Ear.
N, Nostril. P, Dilated pharynx. ON, Olfactory nerve.
OpN, Optic nerve. Ep, Epiglottis. O, Œsophagus.

The cerebral hemispheres are developed first as a median prolongation at the anterior end of the fore-brain, which later becomes divided into the two hemispheres by its anterior wall growing back into it from the front. These two hemispheres appear first as large vesicles with very thin walls and these cavities persist throughout life as the lateral ventricles of the brain, which communicate, through the foramina of Munro, with the third ventricle. See Figs. 41 and 60.

FIG. 31. HYDROCEPHALUS. CALF. (After photograph).

In some cases the fluid in these cerebral hemispheres becomes enormously increased, to constitute the fetal disease of hydrocephalus as indicated in Fig. 31. In other instances the cerebral

hemispheres grow rapidly and the walls of the skull fail to close over them, so that they protrude, to constitute *hernia cerebri*, as shown in Fig. 32.

From these cerebral hemispheres, there grow out early in their development the olfactory vesicles, which are later to develop into the olfactory lobes, from which the olfactory nerves pass to the nose. These sometimes fail to appear if the optic vesicles are represented by a single vesicle, to constitute a cyclopean monstrosity as shown in Figs. 29 and 30.

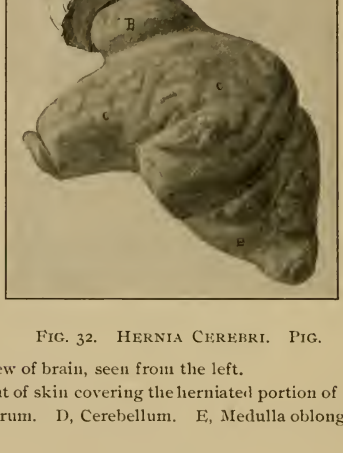

FIG. 32. HERNIA CEREBRI. PIG.

Lateral view of brain, seen from the left.
A, Segment of skin covering the herniated portion of the brain, B.
CC, Cerebrum. D, Cerebellum. E, Medulla oblongata.

THE SPINAL CORD.

As already suggested, the spinal cord develops from the posterior portion of the neural groove. The neural folds grow upward and their borders approach each other, to finally fuse at their margins, leaving a cavity within, which constitutes the central cavity of the spinal cord, and persists throughout the life of the animal. The neural canal is lined by columnar, ciliated epithelium which persists throughout life, to constitute the epithelium of the central canal. The deeper layers of epithe-

lium about the spinal canal go to form the skeletal frame-work and the nerve cells grow out into these deeper parts from the columnar epithelium which lines the cavity. These nerve cells, or neuroblasts, are at first spheroidal in form and show upon their surface one to several prolongations, which are later to constitute the polar elongations, or axis cylinders, of the nerves.

The spinal nerves develop first by the formation of the spinal ganglia, which appear in the neural folds at a very early period, and from the inner sides of which there grow out nerve fibers into the spinal cord, to constitute the superior, or dorsal, roots of the spinal nerves. They become the centripetal, or sensory, roots of the nerves. The ventral, or motor, nerves arise very early as small outgrowths from the lower part of the sides of the spinal cord, in the position they occupy during adult life. These ventral roots grow outward to meet the dorsal roots just beyond the ganglia and fuse with them, after which they again divide into dorsal and ventral twigs, which are mixed nerves.

DEVELOPMENT OF THE ORGANS OF SPECIAL SENSE

A The Olfactory Organs.

The Nose.

The olfactory organs appear early in embryonic life as thickened patches of epiblast upon the antero-inferior part of the head, which patches soon sink inwards to constitute the olfactory pits, into the bottom of which the nerves of smell grow out from the olfactory bulbs of the brain.

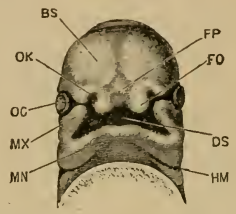

Fig. 33. The under surface of the head of a human embryo, lettered by Professor His, Hn, and estimated as about twenty-nine days old. × 7½. From Marshall after His.

BS, Cerebral hemisphere. DS, Stomatodeum. FO, Processus globularis, or lateral portion of fronto-nasal process. HM, hyo-mandibular cleft. MN, Mandibular arch. MX, Maxillary arch. OC, Eye. OK, Olfactory pit.

The olfactory pits are at first incomplete, their lower borders being deeply notched, and communicate with the stomatodeum, somewhat as an extension of that cavity. The olfactory pits and the stomatodeum are connected by a narrow isthmus, bordered inwardly by the *processus globulares* of the fronto-nasal process and externally by the maxillary processes of the maxillary arch. Soon the maxillary processes approach and fuse with the processus globulares anteriorly, to complete the circumference of the olfactory pits and, by separating them from the mouth, to constitute the nostrils. For a short distance anteriorly, as far as to the incisive foramen of the adult, the processus globulares send projections inwards to constitute the anterior portion of the palate, while, behind the foramen, the maxillary processes send out shelf-like projections, which meet on the median line to

constitute the posterior portion of the palate and, from their fusing borders, send projections upward to eventually reach and fuse with the lower surface of the fronto-nasal process, to constitute the nasal septum, dividing the nasal chamber into two distinct cavities. The nasal passages are at first very short but, as the

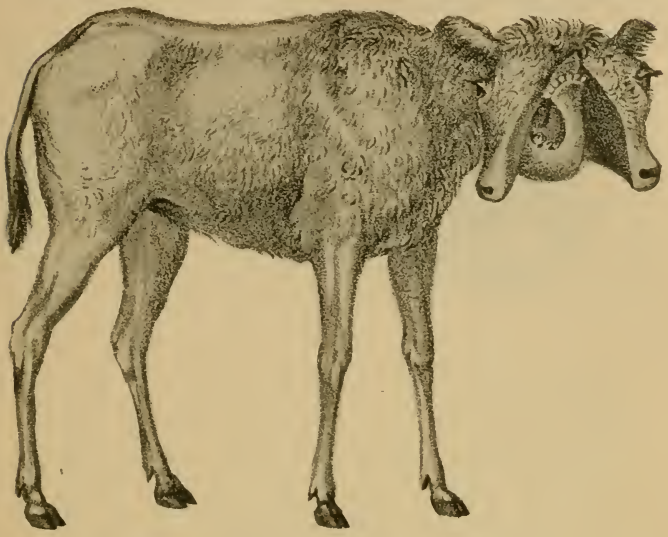

FIG. 34. SCHISTOCEPHALUS BIFIDUS. (Gurlt).

nose elongates, the palatine processes from the maxillary arch grow backward and, fusing on the median line, completely separate the oral and nasal cavities so that the latter finally open posteriorly, through the posterior nares, into the pharynx.

The upper lip is formed by a fusion of the fronto-nasal processes with the maxillary arch. Aberrations in the development of the anterior nares and upper lip are not rare, especially in bovidæ, where, in some instances, the processus globulares fail to fuse with the maxillary processes, constituting hair lip (Schistocephalus fissilabrus). In other instances as in Fig, 34, fission on the median line through the fronto-nasal process occurs, so that the maxilla is divided, with the mandible curved up-

ward between the two lateral halves, to constitute schistocephalus bifidus.

In dealing with diseases of the septum nasi, its origin should always be recalled and it should be remembered that, in some forms of disease, fluids may collect or new tissues may develop between the two laminæ, from which the septum takes its origin.

FIG. 35. CLEFT PALATE. FOAL. (From photograph).

In some cases these margins fail to fuse and result in a cleft palate, as shown in Fig. 35. In other instances the fusion extends too far backward and, passing across the pharynx, completely separates the nasal chamber from the mouth and pharynx, constituting atresia of the posterior nares, by which arrest in development the animal is unable to breathe through the nostrils and must respire entirely through the mouth. With the greatly elongated soft palate of the horse, which renders oral breathing extremely difficult, the animal can not live if both posterior nares are closed, while, if the atresia affects but one nostril, the animal can breathe readily when not severely exerted, but, if put to hard work, shows extreme dyspnoea as a result of the restricted breathing room.

THE EYE.

The eyes originate partly from the optic vesicles of the brain and partly from the optic pits in the epiblast upon the sides of the head.

The optic nerve develops from the optic vesicles, which appear as lateral outgrowths of the fore-brain early during em-

bryonic life, varying apparently in species from 10-20 days after fertilization. The optic vesicles appear first as tubular outgrowths from the forebrain, but the distal end of each soon becomes enlarged, while the connecting stalk remains a narrow tube. Later, the enlarged distal end becomes invaginated within itself to constitute the optic cup, which is later to form the retina and within which the vitreous body develops. The lens develops somewhat later, first appearing as a pit in the epiblast upon the side of the head. This pit gradually sinks deeper and its mouth narrows, until it finally closes to constitute the vesicle of the lens.

The vesicle sinks into the optic cup and the margins of the latter come in close contact with it except at one point on the ventral surface, where there is a distinct groove, the *choroidal fissure*. Within the vesicle the *lens* becomes elaborated from the enclosed epiblastic cells.

The *vitreous body* is derived from an ingrowth of mesoblast, which enters the optic cup through the choroidal fissure.

As the lens becomes invaginated and separated from the external epiblast, a layer of mesoblast extends across between the vesicle and the external epiblast, constituting the *cornea*, the tissues of which become transparent. The choroid and sclerotic coats develop from the mesoblastic tissues surrounding the optic cup; the iris is formed by a forward growth of the margins of the optic cup; and the anterior chamber appears somewhat later as an excavation between the cornea and lens. The eyelids are the last structures to form in connection with the eye and consist of folds of the skin from above and below. These extend over the eyeball to finally meet and become fused together, without adhering to the surface of the cornea, so that they create a closed sac, the lacrymal sac, between their internal surfaces and the cornea. In the rabbit and carnivora, the eyelids remain closed for a short time after birth, while, in ruminants and solipeds, the eyelids open somewhat prior to birth.

The membrana nictatans, or third eyelid, is formed from a fold of skin in a similar manner to the two ordinary eyelids and exists in all domestic mammals.

The lacrymal duct is formed in the groove existing between the external nasal process and the maxillary arch.

In the domestic animals, we occasionally meet with aberrations in the development of the eye. Sometimes the eyelids have be-

come so intimately fused that they fail to open at the proper time, a condition which is not usually subject to remedy. In other cases, the cornea fails to undergo the normal transformation into a transparent body, but remains opaque. In yet other instances, there is seen growing from the neighborhood of the lacrymal duct long hairs, which irritate the eye but which are, at times, subject to surgical removal. In still other instances, there is a contraction of the inner, or mucous, layer of the eyelid or a comparative overgrowth of the external skin, by which means the eyelids are inverted, producing entropium.

The Ear.

The first traces of the ears consist of open pits opposite to the hind-brain at an early period in the life of the mammalian embryo, usually at about ten to fifteen days. These pits sink in deeply until they come in close contact with the hind-brain and early acquire a communication with the auditory nerves. The mouths of the pits soon close and the invaginated portion becomes separated from the external epiblast, to constitute the auditory vesicles, in which the essential parts of the ear, the semicircular canals, vestibule, cochlea, etc., are developed.

The Eustachian tube is formed from the hyomandibular pouch, which extends out from the pharynx as a diverticulum. At one time it pushes out against the epiblast and is separated from the exterior by a very thin membrane consisting of epiblast externally, in immediate contact with the inner layer of hypoblast, with no mesoblast between. Later, a layer of mesoblast grows in between the epiblast and hypoblast and the three constitute the tympanic membrane. This pouch does not normally reach the surface at any time during fetal life, but occasionally opens abnormally in various mammalian animals, to constitute gill-slit fistula, which rarely persists at the time of birth in a manner analogous to the open gills of fishes and other similar animals. In the solid ungulates, there is a large infundibulum formed in connection with the Eustachian tube, which is known as the guttural pouch, or air sac. The slit-like communication of this guttural pouch with the pharynx is sometimes abnormal in the new-born foal, which causes air to become impacted in it (tympany of the guttural pouch), which may so press upon the larynx as to strangle the young animal.

The formation of the external ear, or pinna, has not been so well studied in domestic animals as in man. The conchal cartilage arises from the mandibular and hyoid arches, which bound on either side the hyomandibular cleft. As shown in Fig. 36 in the human ear, the concha consists of a series of tubercles with deep fissures extending between them. We have no data to show that the early stages of development of the concha in our domestic animals are precisely parallel, but they are presumably

FIG. 36. The left ear of a human embryo, lettered by Professor His, Br. 2, and estimated as thirty-five days old. From Marshall, after His. × 20.

1, tuberculum tragicum. 2, tuberculum anterius helicis. 3, tuberculum intermedium helicis. 3 and 3c, cauda helicis. 4, tuberculum anthelicis. 5, tuberculum antitragicum. 6, tuberculum lobulare.

essentially so. By observing Fig. 36, it will be seen that between 1 and 2 there is a deep fissure which, in the ear of the horse, is apparently marked by an important ridge inside the concha. It is interesting, in connection with this fissure, to observe that foals are frequently born with a deep invagination of the epiblast at this point, causing a long, narrow fistula which extends downwards from about the middle of the internal border of the concha to near its base, and from which there exudes a viscid mucus. In other cases, this invagination extends more deeply and penetrates the squamous temporal bone and, in the development of the osseous tissues, the invagination is interrupted and a closed sac formed at the distal end, in which, ordinarily, one or more teeth are formed (ear teeth) which resemble more or less closely the molars of the horse and may grow to almost any size, projecting far above the external surface or growing inward, causing an inward bulging of the skull into the cranial cavity. (See Figs. 37A and B.) Various authors

ascribe these formations to outgrowths from the buccal mucous membrane. A glance at the figure, prepared from a clinical case, indicates otherwise, and that it arises from the epiblast of the conchal region in a manner parallel to the formation of the teeth within the mouth from the stomatodeal epiblast.

FIG. 37 A.

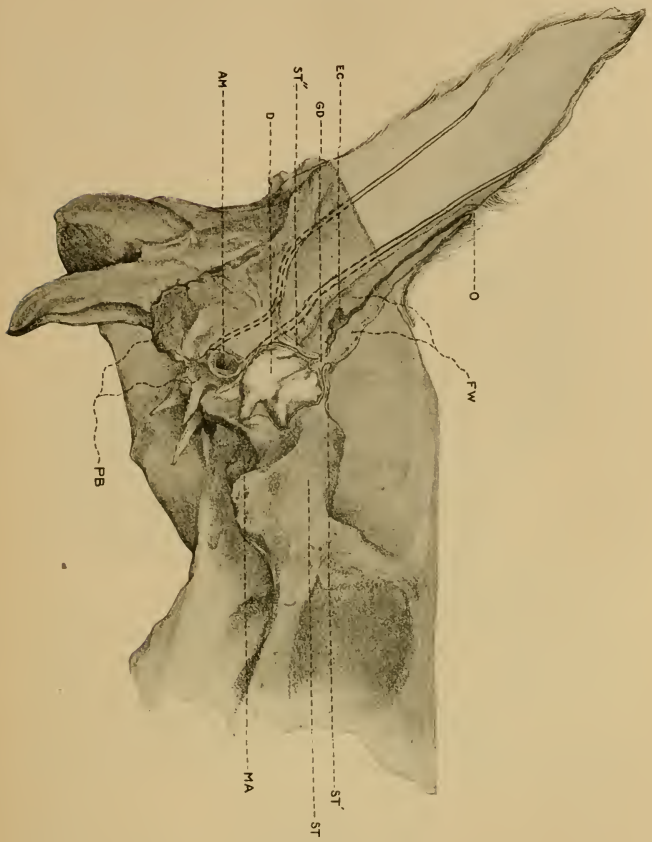

FIG. 37 B.

FIG. 37. DERMOID CYST OR "EAR TOOTH" IN FOAL.
Indicating the method of the formation, from invagination of the epiderm. O, Orifice of invaginated area. FW, Fibrous wall of invaginated canal. EC, Epiblastic cavity. D, Tooth. ST, Squamous temporal bone. ST', ST'', Incarcerating outgrowths of squamous bone tending to isolate EC from D. GD, Persistent fibrous cord connecting EC with the capsule of D; the epiblastic canal in this cord has been obliterated. PB, Petrous temporal or ear bone, which constitutes a separate bone in the horse. AM, Anditory meatus. MA, Maxillo-mandibular articulation.

FORMATION OF THE DIGESTIVE APPARATUS.

The alimentary canal of the embryo at first consists of that portion of the blastoderm which is included within the embryo in the process of infolding and finally becomes constricted off from the yolk sac by the gradual folding inward of the embryonal area at its margins. For a time the alimentary tract continues to communicate with the extra-embryonal portion of the blastoderm, or yolk sac, by means of the yolk-stalk or vitelline duct. In some species of animals, this tube remains open until a comparatively late period in embryonic life and traces of it may be found in some of them in the umbilical cord at the time of birth, but it does not normally retain its relation with the intestines.

The intestinal tract, during the early life of the embryo, is divided into three sections, known respectively as the fore-, mid-, and hind-gut; the first comprising that portion anterior to the communication with the yolk-sac, the second, the middle portion of the area occupied by the yolk-stalk and the third portion, or hind-gut, that which projects from the yolk-stalk posteriorly. In the fore-gut there early appear two dilations, the pharynx and the stomach. The gut is at first closed both anteriorly and posteriorly and the communications with the exterior become established later. The anterior end opens first.

There appears, in that region of the embryo which is later to constitute the mouth, a depression known as the stomatodeal pit, by which the epiblast sinks inward in the direction of the pharynx until finally the two cavities are separated merely by a thin layer of epiblast and one of hypoblast, the intervening mesoblastic tissues having been absorbed. Eventually, the thin membrane gives way and the mouth communicates with the anterior end of the fore-gut, or pharynx.

The pharynx shows a marked dilation in comparison with the other parts of the digestive tube. In sagittal section, the internal surface shows the prominent visceral arches, between which extend the visceral pouches. Among these visceral pouches, the hyomandibular and first branchial are the most prominent and have, on the outer surface, corresponding visceral grooves, which do not normally open upon the exterior, but the hyomandibular groove becomes very thin and ultimately forms the tympanum,

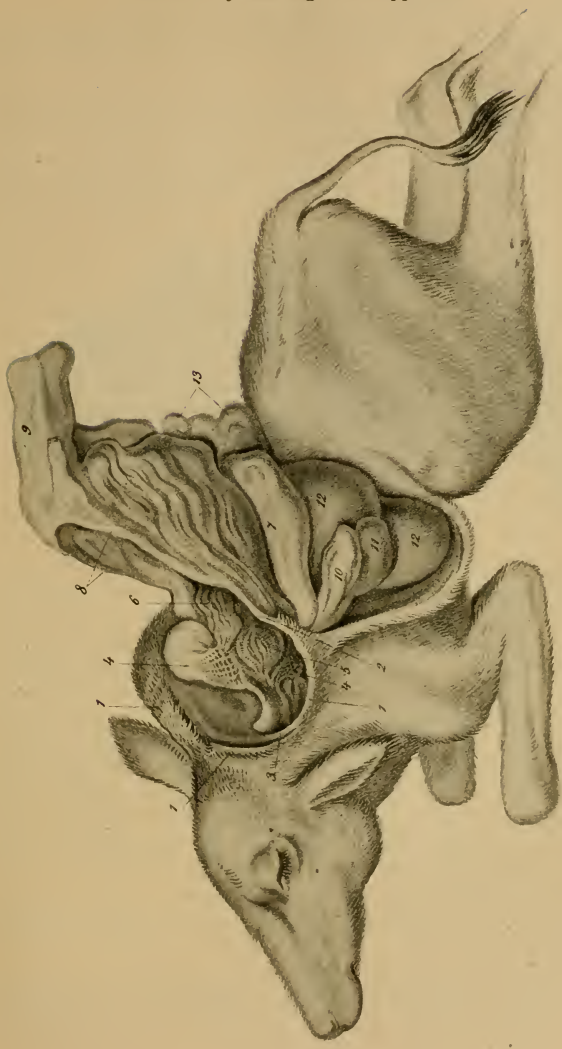

FIG. 38. SCHISTOCORMUS FISSIDORSUALIS SUBECOSTATUS. (Gurlt).

or eardrum. Rarely the hyomandibular gill-slit opens completely upon the exterior to constitute gill-slit fistula of the new born.

The embryonic line of demarcation between the stomatodeum and fore-gut is not perfectly known in the adult, but is in the immediate vicinity of the soft palate, the buccal mucosa and the teeth being derived from the stomatodeal epiblast, the tongue growing forward from the hypoblast of the floor of the fore-gut.

Later in the life of the embryo, varying according to species, there appears, opposite the posterior end of the hind-gut, a distinct depression in the epiblast, the proctodeal pit. The invagination of this pit is of a similar character to that of the stomatodeum and soon extends sufficiently toward the hind-gut that only a thin membrane remains between them, consisting externally of a layer of epiblast and internally of hypoblast. Normally, this pit soon opens into the hind-gut and the alimentary canal now communicates with the exterior, both anteriorly and posteriorly.

Various aberrations in the development of these parts occur. The most common is an arrest in the development of the hind-gut, by which a portion of it is wanting and it consequently does not become connected with the proctodeal pit and does not open exteriorly. In such cases, the young animal is born devoid of a rectum. In other cases, the membrane between the proctodeal pit and the hind-gut fails to disappear and the young animal is born without an anus, as shown in Fig. 42. In still other instances, as recorded by Gurlt, the intestine ceases at the vitelline stalk, passing out through the umbilicus, where it ends blindly.

A highly interesting aberration involving the digestive tract, and spinal column, is that recorded by Gurlt and illustrated in Fig. 38, which he designates as *Schistocormus fissi-dorsualis subecostatus* and describes as a cleft in the dorsal wall of the body, beneath the spinal column on the left side, through which the stomachs and other abdominal viscera prolapse.

Gurlt remarks that the aberration is very rare, he having known of three instances, one in the calf, two in lambs—all in ruminants.

We have observed a single case, resembling that of Gurlt in many respects but showing important differences. Figs. 39 and 40 delineate briefly its character. In this instance, the omasum,

M, and the spleen, S, are protruding from a crater-like opening in the head, through the occiput. The rumen and reticulum are wanting in the specimen, fragmentary shreds indicating that they had been torn away accidentally or eaten away by some animal before the specimen came into our hands. In this case, the prolapse of the alimentary tract is not lateral, but dorsal, immediately upon the median line, obliterating for a distance the cerebro-spinal axis.

FIG. 39. SCHISTOCORMUS FISSIDORSUALIS.

Showing crater-like opening in the occipital region.

Since the notochord becomes established prior to the formation of the gut, it would seem improbable that the prolapse would occur through that organ, but rather that it would pass in front of it, and this is apparently what has occurred. A study of Fig. 41, *IN* and *PT*, shows that, just anterior to the end of the notochord, there is an infundibulum growing down from the thalamencephalon, or midbrain, while, just opposite, growing upward from the posterior border of the stomatodeum, is the pituitary pouch, which later becomes the pituitary body, the two infundibuli coming into immediate contact with each other. The fore gut has pushed forward and upward, to escape through this area of low resistance, upon the back of the head. The fore-gut escaping, no neck has developed, and the sternum, *ST*, extends forward beneath the pharynx, *P*, and the basi-occipital bone, *BS*. The illustration from Gurlt likewise indicates a virtual absence of neck, though less pronounced.

At first the alimentary canal is of the same length as the body and forms immediately beneath the notochord, but later it in-

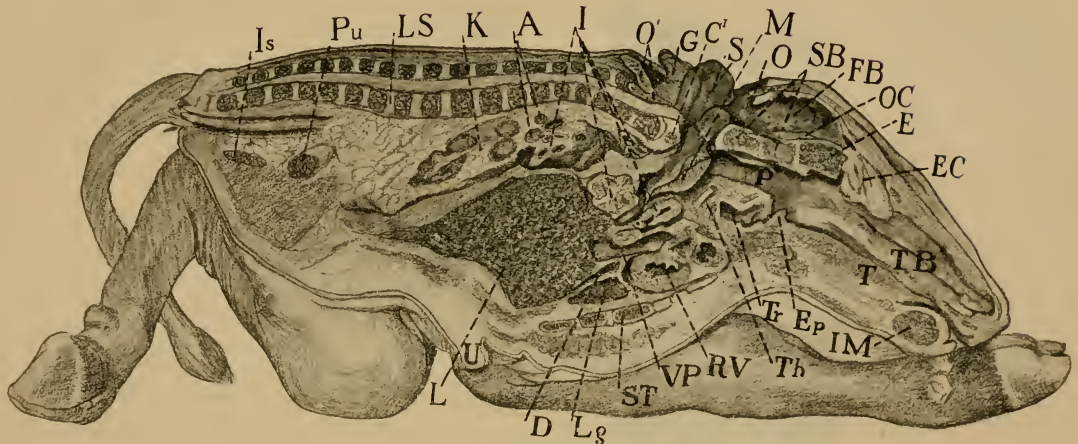

FIG. 40. SAGITTAL SECTION OF FIG. 39.

T, Tongue.
IM, Inferior maxilla.
TB, Trubinated bones.
E, Ethmoid bone.
EC, Ethmoid cells.
FB, Fore brain.
OC, Optic commissure.
SB, Sphenoid bone.

S, Spleen.
G, Gastro-splenic omentum.
M, Third stomach.
C', 1st rib.
O, Ant. end of occiput.
O', Post. end of occiput.
Ep, Epiglottis.
Line crosses thyroid gland.

P, Pharynx.
Tr, Trachea.
St, Sternum,
RV, Right ventricle.
VP, Portal vein.
I, Intestine.
K, Kidney.
A, Adrenal gland.

L, Liver.
Th, Thymus.
Lg, Lungs.
U, Umbilicus.
Pu, Pubis.
Is, Ischium.
LS, Lumbo-sacral Articulation.
D, Diaphragm.

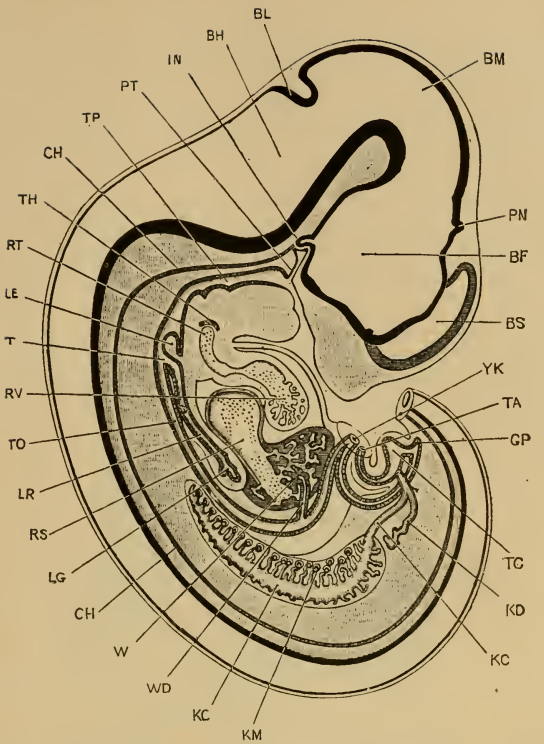

FIG. 41. A median longitudinal, or sagittal section through a rabbit embryo, at the end of the twelfth day. The section is a strictly median one except in two respects, the cerebral hemisphere of the left side has been introduced in order to render the figure more complete ; and the Wolffian body and ureter of the right side. The terminal portion of the tail has been removed.

BF, Cavity of fore-brain or thalamencephalon.
BH, Cavity of hind brain, or fourth ventricle. BL, Cerebellum.
BM, Cavity of mid-brain. BS, Cavity of cerebral hemisphere, or lateral ventricle. CH, Notochord. GP, Post-anal gut.
IN, Finger-like process of infundibulum. KC, Wolffian duct.
KD, Ureter. KM, Wolffian body. LE, Epiglottis.
LG, Lung. LR, Trachea. PN, Pineal body. PT, Pituitary body.
RS, Sinus venosus. RT, Truncus arteriosus.
RV, Ventricle of heart. T, Glottis. TA, Stalk of allantois, cut short.
TC, Cloaca. TA, Thyroïd body. TO, Œsophagus. TP, Pharynx.
W, Liver. WD, Bile duct. YK, Yolk stalk, cut short.

(Marshall).

creases in length far more rapidly than the body and drops away from the dorsal portion of the body cavity to float freely, confined in position only by the mesentery, which it has derived from the superior wall of the abdomen and carried with it in its descent.

At first the posterior gut of the embryo represents jointly the intestine and the genito-urinary passages and constitutes a single dilated chamber, or cloaca, but later there grows back, from the angle between the stalk of the allantois and the gut, a partition which serves to separate the digestive tube from the genito-urinary tract. This partition is sometimes incomplete, especially in the female when the proctodeal opening fails in the upper portion and causes a closed anus, when the feces from the intestine drop into the vagina, to be expelled through the vulva, as indicated in Fig. 42.

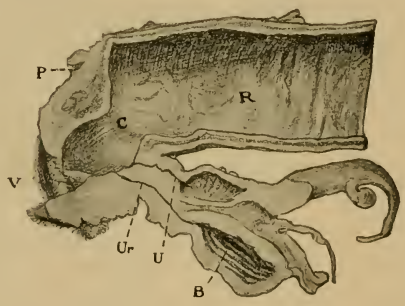

FIG. 42. ATRESIA ANI. LAMB.

R, Rectum. P, Closed proctodeal pit. C, Cloaca.
Ur, Urethra. U, Uterus. B, Bladder. V, Vagina.

THE LUNGS.

The lungs are formed as an outgrowth from the floor of the pharynx in the region of the first to third branchial arches and begin as a longitudinal groove, which soon develops into a blind pouch. This evagination extends backward beneath the pharynx and at its distal end soon splits into right and left halves, to constitute the two lobes of the lungs. The growth continues back-

ward beneath the oesophagus and above the heart and the distal ends of the two lobes become enlarged and commence dividing into small lobes. The lobes elongate greatly and give rise to buds which end in somewhat enlarged ampullæ, which continue to subdivide in this manner, the terminal infundibuli constituting the air cells, while the tubes leading from them are the bronchioles, the larger ones are the bronchii, the original tube leading from the floor of the pharynx becomes the trachea, and the slit which first appeared in the bottom of the pharynx forms the glottis.

The Teeth.

The teeth appear very early in the life of the embryo and originate from the epiblast of the stomatodeum in the form of a longitudinal invagination of thickened epithelium along the border of the jaw, which eventually sinks down into the substance of the jaw as a continuous ridge, known as the common enamel germ. Later, the ridges become enlarged at intervals, to constitute the individual enamel organs, while the portions between

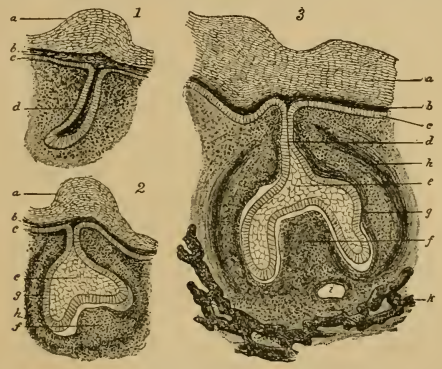

Fig. 43. Three successive stages in the development of a tooth-germ of a pig embryo (after Frey and Thiersch): a, b, c, layers of thickened oral epithelium, showing dental groove on surface in 3; e, enamel organ; f, dental papilla; g, h, internal and external layers of follicle wall; i, blood-vessel; k, maxilla; d, epithelial ingrowth, the end of which expands into the enamel sac. (Heisler).

these enlargements tend to atrophy and finally to completely disappear.

Each enamel organ soon consists of a flask-like vesicle of epiblast with a narrow neck, which is still continuous with the epithelium of the mouth by a cord-like constriction, while the distal end, or fundus, of the flask is enlarged and spherical. Beneath this enamel organ, there soon forms, from the mesoblastic connective tissue, the dental papilla, which pushes up into the sac, causing an invagination of its base. The enamel sac now invests the top of the papilla as a cap and soon takes on the form of the future tooth. The enamel organ is then in the form of a flattened sac, the distal end invaginated, so that the two walls are brought into close proximity. See Fig. 43.

Upon the external surface of the dental papillæ, odontoblasts arise, from which the dentine of the tooth is formed. The enamel prisms are formed from the epithelium of that part of the walls of the enamel sac which lie in immediate contact with the dental papilla, while the superficial wall, i. e. that portion continuous with the neck-like mass of epithelial cells still maintaining connection with the mouth cavity, disappears without taking any recognized part in the formation of the enamel tissue. The dentine, forming from the odontoblasts upon the apex and sides of the papilla, soon invests these portions in the hard ivory substance, while the base and center of the dental papilla continue as the tooth pulp. The base is at first wide open, but, as the tooth develops, it gradually contracts and finally, in some teeth, there grow out projections or septa of dentine, to constitute the roots or fangs, which divide this cavity into two or more distinct openings, according to the individual tooth or species, and, through these apertures, the blood vessels and nerves pass to the pulp of the tooth. See Fig. 44.

As the enamel organ sinks down into the jaw, there occurs a condensation of the surrounding mesoblastic connective tissue to constitute a capsule, the tooth follicle, which closely invests the enamel organ and papilla. When the bony tissue of the jaw forms, the follicle serves as periosteum for the tooth and alveolus, while, from its inner layers, the external tooth tissue, the cement, is developed. The origin of the dental tissues is then: 1, the enamel from the invaginated epiblastic cells; 2, the papilla, vessels, nerves and dentinal tubules from the mesoblastic

connective tissue, and, 3, the cementum and dental and alveolar periosteum from the mesoblastic dental follicle.

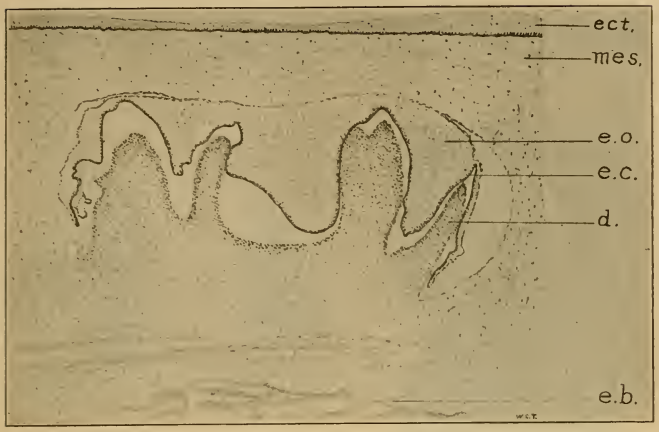

FIG. 44. Sagittal section through an inferior grinder of an equine embryo, 4 inches long. ect, ectoderm of mouth cavity; mes, mesoderm; eo, enamel organ; ec, enamel cells; d, dentine; eb, embryonic bone.

The enamel cap is at most points detached from the dentine papillæ. The section through the tooth follicle is so made that the plicæ of the enamel cap have split each of the dentine papillæ so that there are four instead of two.

When the bony jaws form later, the teeth are at first in continuous grooves, but transverse osseous partitions later extend between the tooth germs and finally constitute separate compartments, or alveoli, for each. The permanent teeth are developed as outgrowths from the enamel organs of the temporary set in those cases where they are preceded by such; in the others they are formed the same as the temporary teeth from a backward growth of the common enamel germ.

The teeth of domestic animals, and especially of the horse, are subject to many aberrations in development. The mesoblastic connective tissue follicle, under disturbances, may undergo serious aberration during its developmental stages. There may be a

large amount of fluid formed within the follicle, which may cause the destruction of the tooth germ and may become enormously increased, to the extent of one, two or more pints of fluid and, when in the upper jaw, may cause serious distress to the animal by projecting into the sinuses and interfering with respiration.

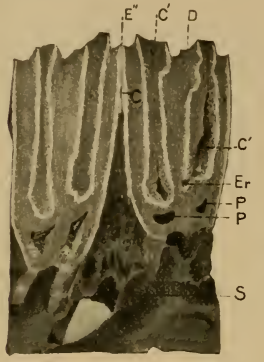

FIG. 45.

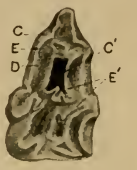

FIG. 46 A.

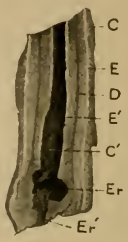

FIG. 46 B.

FIG. 45. Sagittal section of superior molars of adult horse showing on the left, normal development, on the right, arrested development of the cement area.

FIG. 46. A, Crown, and B, Longitudinal cross section of a superior grinder of adult horse showing absence of cement in central infundibulum and erosion of the enamel and dentinal plates.

C, External cement. C′, Central cement area.

E, External enamel layer. E′, Central enamel. E″, External enamel at point of contact between adjacent molars. The adjacent enamel laminæ project above the surrounding tissues, have no cement between them and are so arranged as to prevent the impaction of food particles between.

D, Dentine. Er, Erosion area. Er′, Erosion canal penetrating the tooth fang.

P, Pulp cavity. S, Superior maxillary bone.

These aberrations we know as follicular cysts. In other cases, the walls of the follicle form an abnormal amount of cement, which causes a very great accumulation of this substance, to constitute what we know as a cement tumor, or cementoma.

Sometimes there is a distension of the follicle with fluid, accompanied by a growth of cement upon its inner surface, giving rise to what we know as compound follicular cysts.

At other times the walls of the tooth follicle become greatly thickened by an abnormal growth of connective tissue, to constitute what is known as a fibrous odontome.

Finally, in the horse, and to a less extent in other animals, where there are deep invaginations from the sides or upon the crown of the enamel organ into the dental papilla, there is normally formed in the grinders a sufficient amount of cement to completely close the spaces between the infolded layers of enamel. In some instances this formation of cement is incomplete and an opening is left through the central portion of this substance, from the grinding surface of the tooth down to the bottom of the infundibulum, in close contact with the enamel. Through this cleft, food particles pass and, becoming lodged in the deepest part, undergo bacterial decomposition, which causes a solution of the enamel and dentine and, finally, a perforation of the pulp cavity, leading to a purulent inflammation of the tooth pulp and a destruction of the life of the organ, with many complications of a highly important character. See *C'* Figs. 45 and 46.

The enamel organ is subject to aberrations in its development by which a tumor is formed, which may prevent the eruption of the tooth and lead to what is known as a multilocular cyst.

FIG. 47. Cross section of molar of adult horse.
C, External cement. C', Central cement. E, External enamel. E', Central enamel. P, Pulp cavity surrounded by dentine.

The dental papilla may undergo two important forms of fetal aberration or arrest in development. First, there may be an excessive development of the dentinal substance to constitute an

ivory tumor, or radicular odontome. Occasionally such tumors in the horse reach a weight of five pounds or more.

There is frequently an arrest in the development of dentine at the wearing surface of the tooth. In the grinder of the horse, where the enamel dips down into the body of the tooth, it serves to bring two lamellæ of dentinal substance into close contact.

FIG. 48. A and B. Table surface and section of inferior molar of adult horse, showing non-fusion of dentinal lamellæ, followed by infection and purulent pulpitis.

C, External cement. C′, Central cement. E, External enamel. E′, Central enamel. P, Pulp cavity surrounded by dentine.

In the complex grinder of the horse, the papilla or radicle of the tooth, *d*, Fig. 44, splits up into several sharp elevations which push their way up into the enamel organ. The dentine forms from the ondontoblasts upon the exterior of these projections, and the soft tissues, or tooth pulp, occupy the interior of these elevations so that at their apexes the inner, or pulp, surfaces of the dentinal plates come in immediate contact. Normally the opposing faces of these two plates should fuse at the grinding surface and hermetically seal the pulp cavity as

shown between *C* and *C'* in Fig. 46 B, and at *D* in Figs. 45 and 46 A, before the time when the tooth comes into wear, and the dentinal summit is worn away. In some cases, as shown in Fig. 48, this fusion fails to occur and results in an opening into the pulp cavity, with food particles passing through between the laminæ into the pulp, causing a purulent inflammation of it, with destruction of the tooth and other important complications. Thus, in the early stages of embryonic life, aberrations in the formation of the tooth germs serve in a variety of ways to induce defects in these organs which lead to their early disease and destruction, accompanied by an endless variety of complications of more or less serious importance for the well-being of the animal.

The mammalian tooth, the hardest tissue in the body, is normally a product of epiblastic growth from the stomatodeum, which has become invaginated into the bones of the maxilla and mandible, but tooth tissues are not confined to these parts. We have already related on page 301 that tooth tissue, histologically and anatomically, is also formed in the squamous portion of the temporal bone of the equine embryo, but here the conditions closely simulate those obtaining in the oral cavity itself, that is, epiblastic cells are invaginated into the deeper layers of mesoblast. From the mesoblastic bone, the squamous temporal is formed, while the incarcerated epiblast, as in the jaws, develops into enamel tissue.

From these considerations one might be led to state that the invagination of epiblast into embryonic tissues which are later to form bone leads to the development of teeth and that this condition is essential to their origin. This, however, is not wholly true. Somewhat rarely in horses, and yet more infrequently in other animals, we meet with dental substances in the ovaries and testicles, and here the condition of the invagination of epiblast into mesoblast, with the incarceration of the former in mesoblastic tissue which is to ossify, does not occur. Possibly, here, the epiblast becomes invaginated through the *gubernaculum testis* or the corresponding ligament of the ovary into the mesoblastic genital gland, or it may reach the genital gland through the Wolffian duct, which, according to some embryologists, arises by a longitudinal invagination of the epiblast, and, while the tissues of the

gland do not ossify, the very dense tunica albuginea affords a degree of compression of a somewhat analogous character.

We may then state that, so far as we know, teeth are always liable to result whenever limited sacs of epiblast become invaginated into mesoblast, and become incarcerated and separated from the general epiblastic layer, while the surrounding mesoblast is converted into bone or is bound down by firm layers of unyielding connective or other dense tissues.

The Liver.

The liver of the embryo appears about the end of the second week as an outgrowth from the inferior wall of the intestine just beyond the dilation which marks the future stomach. The formation of the liver resembles in many respects that of the lungs, the outgrowth becoming enlarged at its distal end, while the proximal portion becomes narrowed to constitute the bile duct. The liver is the most conspicuous of all the glands in the embryo and, at the time of birth, constitutes the largest and heaviest portion of the internal viscera. In volume and weight, it is equal to the entire intestinal tract, with the lungs and heart added.

The Pancreas.

The pancreas arises at about the same time as the liver, as an infundibulum from the anterior wall of the duodenum, and is lodged in the tissue of the mesentery between the intestine and dorsal wall. The gland quickly divides up into lobules, from which the acini and ducts are formed.

THE CIRCULATORY SYSTEM.

During the second week in the life of the embryo, the heart is recognizable as two symmetrical and distinct halves, which consist at this time of two straight tubes, lying along the head-end of the embryo between the yolk-sac and the neural folds and connected at their posterior ends with the vitelline vessels. These two tubes soon unite to form a single one, which becomes twisted upon itself and forms a prominent swelling on the ventral surface of the embryo in the region of the pharynx. It is twisted in an S-shaped loop and is free in its middle portion, while the ends are attached anteriorly and posteriorly to the ventral surface of the fore-gut. The posterior, or dorsal, portion of the heart represents the future auricles and is separated by a somewhat marked constriction from the ventral portion, which is to become the ventricles. The anterior end of the loop is somewhat enlarged to constitute the *truncus arteriosus*, which is attached to the fore-gut in the vicinity of the mandibular arches.

The heart increases rapidly in size and, within a week from the first traces of its formation, the constriction between the auricular and ventricular portions has become very narrow, the auricles have assumed their ear-like form, and the ventricular portion lies transversely across the body, shaped somewhat like the adult stomach.

The Sinus Venosus.

The blood is returned to the heart by three symmetrical pairs of veins: the Cuvierian vein from the body of the embryo, the vitelline vein from the yolk-sac, and the allantoic vein from the placenta. These three pairs unite to constitute the sinus venosus, lying transversely across the body and opening into the auricular portion of the heart. The *sinus venosus* ultimately becomes a part of the auricle and disappears as a separate structure.

The auricular chamber becomes imperfectly divided into the two auricles, at an early date, by outgrowths from the walls, which finally separate the two chambers. The septum between the two auricles does not become complete during fetal life, but closes normally at the time of birth; abnormally, it may persist

after birth, giving rise to the affection known as persistent foramen ovale, or cyanosis of the newborn, by which the blood remains mixed, as in the serpent, giving a bluish color to the skin and mucous membranes, usually ending in the early death of the young animal.

The constriction between the auricular and ventricular portions gradually develops to form the septum between these cavities and, from these also, the auriculo-ventricular valves are formed.

The ventricular cavity becomes divided into two somewhat unequal halves toward the close of the first month. There also forms in the *truncus arteriosus*, ta, Fig. 49, a median partition, which, growing backwards, divides the vessel into two parts, which are to represent in the future the common aorta and the pulmonary artery. The septum between the two ventricles is for a time incomplete and both the aorta and pulmonary artery are connected with the right ventricle only, so that the left cavity communicates with the arteries only through the opening in the ventricular septum.

The Arteries.

A series of aortic arches, see between va and da, Fig. 49, arise early in the third week of embryonic life from the anterior extremity of the truncus arteriosus, one for each of the visceral arches, the more anterior appearing first. At first there are two wholly separate aortæ, which run parallel to each other throughout the length of the body just beneath the notochord, but they soon become fused posteriorly to constitute the dorsal aorta, from which is given off the vitelline arteries to the vitelline sac. Further back it divides into the two allantoic arteries, which carry the blood to the allantois. The aortic arches pass from the floor of the pharynx up through the visceral arches on either side and open into the aorta. They are soon complete, five, or, according to some authors, six pairs, being present, one for each branchial arch, and all connected above with the dorsal aorta.

The attachment of the truncus arteriosus begins to shift backward along the floor of the mouth and divides into two branches, the anterior of which maintains connection with the mandibular and hyoidean aortic arches, while the posterior is connected with the three, or four, remaining vessels.

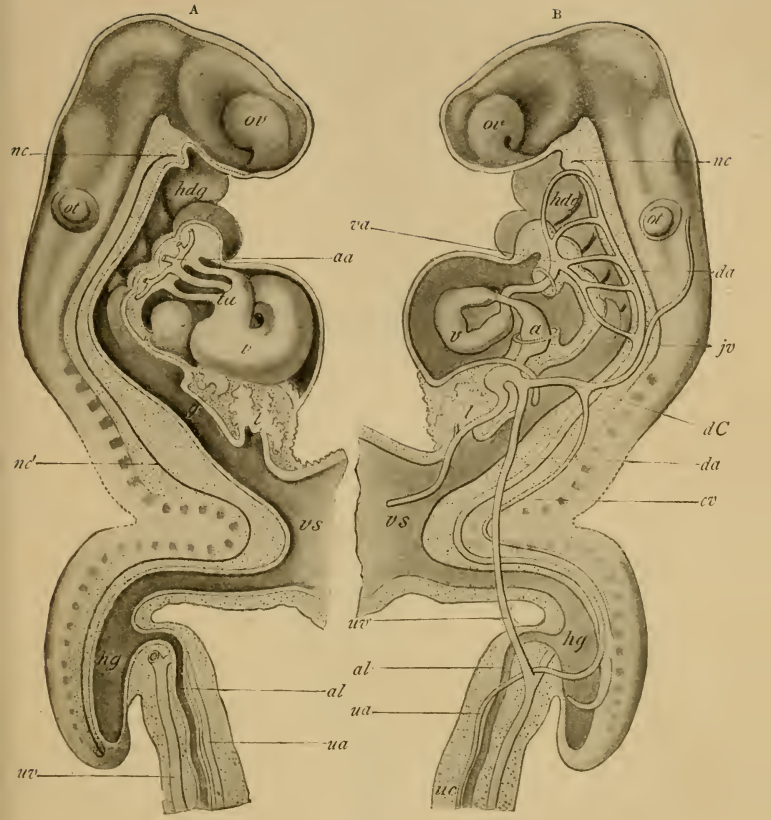

FIG. 49. Reconstruction of human embryo of about 17 days (His): ov, optic vesicle, ot, otic vesicle; nc, nc′, notochord; hdg, head gut; vs, vitelline sac; l, liver; v, ta, primitive ventricle and truncus arteriosus; va and da, ventral and dorsal aortæ; aa, aortic arches; jv, primitive juglar vein; cv, cardinal vein; dC, duct of Cuvier; uv,ua, umbilical vein and artery; al, allantois; uc, umbilical cord. (Heisler).

The aortæ continue forward beyond the aortic arches and run alongside the brain, to constitute the internal carotid arteries.

Changes now begin to appear, looking toward the foundation of the adult plan of circulation. The middle portions of the aortic arches in the mandibular and hyoidean arches disappear; the connection between the truncus arteriosus and the aortæ, through these arches, ceases to exist and the proximal ends of these vessels remain as the external carotid arteries.

The third aortic arch remains and retains its connection with the anterior portion of the aorta and its proximal end or stem constitutes the common carotid artery. The connection between the portion of the aorta posterior to the junction with the third aortic arch and anterior to the fourth disappears, thus separating the carotid system from the aortic vessels.

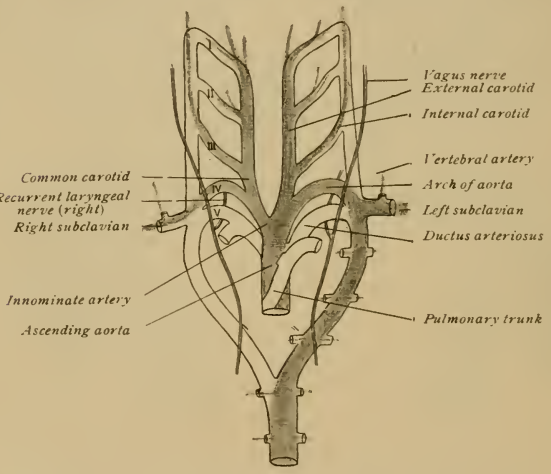

FIG. 50. Diagram illustrating the fate of the aortic arches. (Modified from Heisler.)

The left fourth aortic arch persists, to eventually become the aorta, while the fifth, or, according to those authors who recognize six aortic arches, the sixth, arch ultimately becomes the pulmonary artery. See Figs. 49 and 50.

At approximately the fifth or sixth week of embryonic life, the heart leaves the region of the pharynx and passes backward, while the neck becomes elongated and the head extended forward, which causes a great lengthening of the common carotid artery.

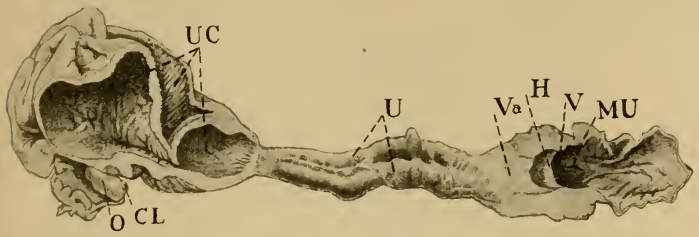

FIG. 51. ARRESTED DEVELOPMENT OF THE UTERUS AND VAGINA. COW.

O, Ovary. CL, Corpus luteum. UC, Uterine cornua.
U, Cordiform Mullerian ducts representing the uterus.
Va, Vagina. H, Hymen. V, Vulva. MU, Meatus urinarius.

During the formation of the cranial nerves, the inferior laryngeal divisions of the pneumogastric nerves cross behind the fourth, or permanent, aortic arches between the aorta and truncus arteriosus, to reach their destination in the muscles of the larynx. As the heart recedes toward the chest and the head grows forward, the laryngeal nerves are necessarily caught and dragged along with the aortæ into the chest cavity, thus bringing about their recurrent course.

While the heart is moving backward, the right aortic, or systemic, arch becomes smaller and finally disappears. As a result, the right laryngeal nerve is released from the dragging of the aorta but still passes around the right subclavian artery, while the persistence of the left arch, with its increased size, to become the common aorta continues the dragging upon the left recurrent nerve, which, throughout the life of the animal, must pass into the chest, around the aorta, and retrace its way back to the larynx. This essential difference in the course of the two inferior laryngeal nerves is by some presumed to have a fundamental relation to the fact that, in the affection of "roaring" in horses, it is regularly the left nerve which becomes degenerated,

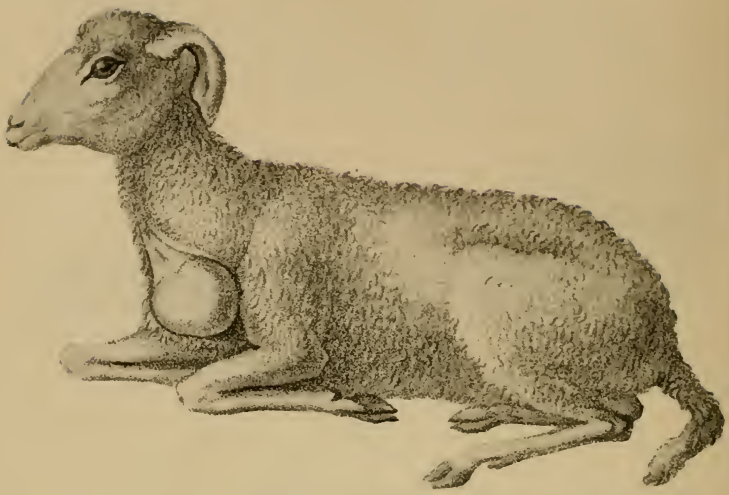

FIG. 52. FISSICOLLIS. CERVICAL ECTOPIA CORDIS.
(Gurlt.)

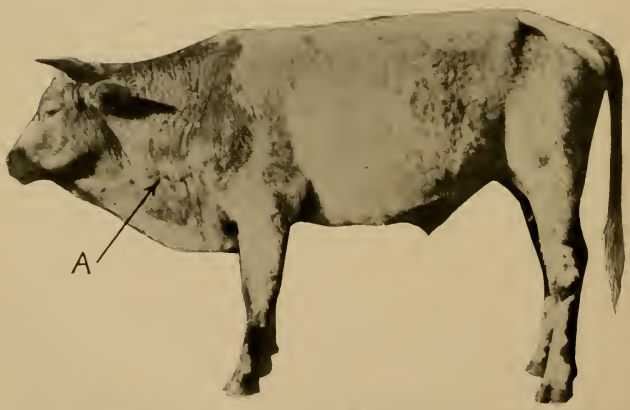

FIG. 53. CERVICAL ECTOPIA CORDIS IN AN ADULT STEER. A, Ectopic heart.
(Kansas City Veterinary College.)

though the essential relation of this to the disease is unknown, nor is there any explanation why the recurrent character of the nerve should cause disease in the horse and not in other animals.

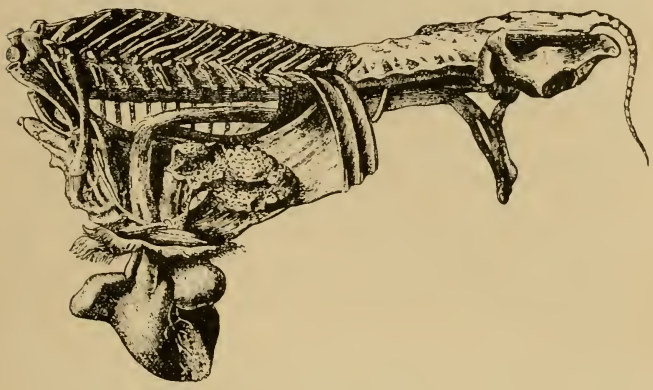

FIG. 54. ECTOPIA CORDIS; SCHISTOCORMUS FISSISTERNALIS. After Hering.

It should be noted here also that the heart sometimes becomes arrested in its movement backward and remains in the cervical or pharyngeal region. It thus occurs, especially in bovidæ, that the young may be born with the heart just beneath the pharynx or at any point between this and the first rib, as shown in Figs. 52 and 53, thus graphically reminding one of the normal shifting of the location of the heart from its first position along the floor of the pharynx, in the embryo, toward the posterior portion of the body, to become lodged within the chest cavity.

In other cases, the aberration in the location of the heart may occur in connection with a fissure of the sternum, through which the heart becomes herniated, as in Fig. 54.

The fifth aortic arch gives off a branch, before joining the aorta, to go to the lungs and constitute the pulmonary artery. In the right vessel, the arch disappears between the pulmonary artery and the aorta, while, in the left, it continues up to the close of fetal life, as the *ductus arteriosus*, which, up to the time of birth, maintains the indirect communication between the right ventricle and the posterior aorta, and persists throughout life as a fibrous cord, the *ligamentum arteriosum*.

The Veins.

When the mammalian embryo is about three weeks old, there are three pairs of veins : the Cuvierian, the vitelline and the allantoic. The first of these return the blood from the embryo itself and are formed by the union of the cardinal veins. The vitelline veins are formed in the walls of the yolk-sac and carry blood from it along the vitelline stalk to the heart, while the third pair return blood from the placenta along the stalk of the allantois.

The vitelline veins of mammals are naturally small, since the vitellus, or yolk, contains essentially no nutriment and, hence, affords small opportunity for any important functions in these veins, so long as they merely carry blood from the yolk-sac to the heart. They are situated in the mesoblast of the splanchnopleure, enter the embryo at the umbilicus and, passing forward along the sides of the alimentary canal, empty into the sinus venosus.

In growing out from the intestine, the liver surrounds the vitelline veins before they empty into the sinus venosus. Here the veins break up into a series of capillaries, converging later to form the efferent hepatic vessels. In this way, the capillary system of the liver is formed and we have a vein dividing up into capillaries in the same way as arteries usually do, and converging again to form a second venous trunk. At about the same period that the vitelline veins are breaking up to constitute the functional circulation of the liver, they become connected with each other just before their entrance into that gland, by three communicating branches, two of which pass beneath the duodenum and one over it, and thus form venous rings surrounding the intestine. From the anterior ring, there arise veins which carry the blood into the liver. The right and left vitelline veins soon unite to form a single trunk, which, a little later, is joined by veins returning blood from the intestine, after which it is known as the hepatic portal vein.

The veins which previously established the communication between the right and left vitelline veins disappear in part in such a way that the remaining portions, which constitute later the direct trunk, are twisted about the duodenum in a manner similar to that seen in adult life.

The allantoic veins are at first paired, but they undergo a variable extent of fusion in the different species of animals; in our domestic animals they are usually united into a single vein within the body of the fetus at an early date, while externally, in the umbilical cord, they usually remain separate. These veins, arising from the placenta, pass along the sides of the allantoic stalk, or urachus, and eventually reach the sinus venosus and empty into that cavity. Later, they lose their connection with the sinus venosus, the right vein becomes smaller and finally disappears, while the left increases much in volume and gives off some vessels as it nears the liver, which enter it directly, while the main portion of the vessel joins the hepatic portal vein prior to its entrance into that gland.

At a slightly later date, when both vitelline and allantoic vessels have ceased to empty into the *sinus venosus*, all the blood from these two vessels must pass through the capillaries of the liver before it can reach the heart. At this period, a communication, the ductus venosus, is established between the right hepatic and portal veins, by which the blood may pass from the vitelline and allantoic vessels across to the hepatic vein, without passing through the capillaries of the liver. This *ductus venosus* grows rapidly and affords a commodious and direct path, through which the blood may pass at once from the placenta to the heart, without going through the liver. It becomes obliterated in the foal some time prior to birth so that, in this animal, all blood from the allantois must pass through the liver.

The posterior vena cava does not acquire much size until the hind limbs begin to form and the iliac veins unite to constitute its principal branches. It enters into the *ductus venosus* near its termination in the hepatic vein.

The anterior and posterior cardinal veins unite to form the Cuvierian veins. The anterior cardinal vein persists in some of our adult domestic animals, such as the cow, as the external jugular vein. The posterior cardinal vein disappears in its middle and the posterior end becomes the internal iliac vein, while the anterior portion of the right posterior cardinal vein persists as the vena azygos.

The anterior vena cava represents the right anterior Cuvierian vein, while the left vein disappears completely, with the possible exception of the coronary sinus of the heart.

The Fetal Circulation.

In the earlier stages of the fetal circulation, all the blood returned to the heart, whether from the embryo, the placenta or the vitelline sac, is emptied into the sinus venosus, from which it passes into the cavity of the common auricle. In this way a complete mixture of the blood from all sources necessarily occurs. This mixed blood is then forced out by the auricle, through the truncus arteriosus, toward the head of the fetus.

The sinus venosus later becomes a part of the auricle and into it empty the Cuvierian veins and the posterior vena cava. The septum between the two auricles is gradually formed, but there remains the foramen ovale, through which the blood can pass with more or less freedom. The posterior vena cava opens very near to the foramen ovale and a small valve at this point tends to cause the blood to flow from the posterior vena cava to the left auricle, by way of the foramen. In this way, considerable admixture of blood from the three different vessels still ensues. Later, as the left Cuvierian vein disappears, the blood from the head and anterior limbs is all returned through the right vein, or anterior vena cava, so that there are now only two vessels, both of which empty into the right auricle. At this period, the blood which enters the auricle from the anterior vena cava, coming from the head and both fore-limbs, is entirely venous in character, while that from the posterior vena cava is chiefly arterial, or red, blood coming from the placenta, with a small portion of venous blood added from the posterior limbs and other parts of the body.

By an elaboration of the valve in the foramen ovale and a valvular fold at the opening of the posterior vena cava, the blood from this vein is finally all carried directly across the right auricle into the left auricular chamber.

The right auricle now receives blood from the anterior and posterior vena cavæ and a small amount from the coronary sinus. The blood comes respectively from the head and fore-limbs, from the hinder part of the body, the placenta, the intestine and the liver and from the walls of the heart itself. The blood entering the heart through the posterior vena cava deserves special consideration. The right allantoic vein disappears early in fetal life, while the left persists and enters the body

through the umbilicus, to pass forward to the posterior border of the liver, where it unites with the hepatic portal vein, so that the combined vessel now carries blood from the intestine, from the vitelline veins of the earlier period and from the placenta.

For a period of time, generally extending to the date of birth, the blood may pass either through the capillary system of the liver or, entering the ductus venosus, may pass directly to the posterior vena cava without going through that gland.

The blood which is carried to the heart by the posterior vena cava is largely arterial in character, that is, it has given up its carbon dioxide and other waste material in the placenta and has derived, from the blood of the mother, oxygen and nutritive materials, which these veins carry to the heart. Into this posterior vena cava, there also enters the blood which has been to some degree favorably modified by passing through the kidneys and the liver, in which glands certain deleterious substances have been removed. The blood from the posterior vena cava consequently presents a marked contrast to that from the anterior vessel, which returns only the blood sent through the arteries to the head, neck and anterior limbs after it has performed its nutritive office to those parts and, consequently, comes back charged with waste materials, without having received in its course any additional nutrient matter or having undergone any purification in passing through the tissues or organs. The blood brought by the anterior vena cava passes into the right auricle and thence into the right ventricle, from which it is driven along the pulmonary artery. Since the lungs are not yet functioning, only a small portion of it enters these organs and virtually all of it passes through the ductus arteriosus to the dorsal, or posterior, aorta. Connecting with the latter at an acute angle, the blood is directed backward toward the posterior part of the body, whence it largely passes to the placenta, through the umbilical arteries, where it is relieved of its waste matters and, in exchange, receives oxygen and nutrient material. On the return of this arterial blood from the placental capillaries, along the umbilic veins, with its small admixture of venous blood along with that which has been somewhat modified by passing through the kidneys and liver, it re-enters the right auricle, to at once pass over into the left auricle and thence into

the left ventricle. From this latter cavity, it is driven along the common aorta until it reaches the carotid and subclavian arteries, through which it is carried almost wholly to the head and anterior limbs.

While the aorta is freely open from the heart along the posterior aorta toward the posterior portions of the body, it seems that very little of the blood from the left ventricle passes backward. This is largely because the blood from the right ventricle, which, at this period, is as strong as the left, has already filled that portion of the posterior aorta posterior to the juncture of the ductus arteriosus with that vessel. Consequently, the blood pressure in the two portions of the vessel is approximately equal, so that there is as great a tendency for the blood from the right ventricle to pass forward from the ductus arteriosus as for that from the left to pass backward from the opening of the ductus arteriosus when propelled through the common aorta.

In some cases, it has been found that the aorta has become obliterated during embryonic life at a point just anterior to its juncture with the ductus arteriosus and posterior to the fourth aortic arch, so that all the blood to the posterior end of the fetus must pass through this vessel. This condition of independent anterior and posterior circulations has not interfered with the development of the fetus, but, at the time of birth, the circulation is at once blocked to all the posterior portions of the body, so that the new-born young must promptly perish.

The plan of the fetal circulation is in a measure the reverse of that after birth, the purified or red blood coming from the placenta along the posterior systemic veins to the right auricle, thence passing largely to the head, neck and anterior limbs through the right ventricle, ductus arteriosus, carotid and subclavian arteries. This would suggest that the head received purer blood of higher nutritive value and that, consequently, the head end of the fetus should develop most rapidly. In the earlier stages of fetal life, this apparently holds true but later, in the larger herbivora at least, the development of each of the two ends of the body becomes approximately equal. Throughout fetal life, the blood of the entire body is of a mixed character, the red blood of the umbilic veins becoming mixed with venous blood before reaching the heart.

Prior to birth, the vitelline vessels have disappeared except in so far as they have persisted as portions of other vessels within the body. As soon as birth takes place and the umbilical cord is ruptured or the placenta detached from the uterus, the allantoic circulation must abruptly cease, while the pulmonary circulation must be promptly established because the respiratory functions have been shifted from the placenta to the lungs.

As soon as the animal begins to breathe, the lungs must at once commence to function and, while, prior to birth, no blood of any note has passed through the pulmonary arteries and capillaries, they must now promptly become active. In order that the blood from the right ventricle shall pass through the pulmonary arteries to the lungs, instead of through the ductus arteriosus into the aorta, it is essential that the latter becomes promptly obliterated.

The rupture of the umbilical cord finally interrupts the placental circulation and renders useless all those vessels within the fetal body whose sole office was dependent upon the fetal circulation. To this end, the intra-fetal portion of the umbilical vein, with the ductus venosus, needs to close and disappear. Vestiges of the umbilical vein persist, but its channel becomes occluded within a very few days after birth, unless interrupted by disease processes. The allantoic, or umbilical, arteries must likewise undergo a partial degeneration and complete loss of function. When ruptured in the natural way, they usually part just outside the abdomen, though some writers (Carsten-Harms) allege that these arteries occasionally rupture within the abdominal cavity, especially in the cow. This is not wholly clear and is somewhat difficult of proof. In the foal, where it is generally admitted that they divide outside the abdominal cavity, the torn ends promptly retract within the body and, dragging with them the connective tissue surrounding their walls, normally retreat from the surface in such a manner as to preclude the possibility of hemorrhage and to greatly diminish any danger from infection in these vessels. (See Fig. 56.) A little later their ruptured ends retract to the vicinity of the anterior portion, or fundus, of the urinary bladder, from whence they may be traced throughout life as connective tissue cords, passing from this point to the internal iliac arteries to constitute the round ligaments of the bladder of the adult.

THE DEVELOPMENT OF THE URINO-GENITAL SYSTEM.

The urinary and genital systems are closely allied in their origin and are both preceded by the Wolffian bodies and ducts, which for a time perform the excretory office of the kidneys and finally take prominent parts in the origin of both the urinary and genital organs.

The Wolffian Ducts and Wolffian Bodies.

The Wolffian ducts are claimed by some embryologists to originate, as a pair of longitudinal grooves, in the epiblast on the lateral surface of the body, at about the level of the notochord or somewhat below. The invaginations of epiblast continue to sink inward into the mesoblast of the somatopleure until they attain the inner surface of the body cavity, in contact with the peritoneum. Other investigators, and apparently the majority, hold that the Wolffian ducts are wholly of mesoblastic origin, though at first lying immediately against the epiblast, as solid rods, which later become excavated in their center to constitute their cavity. For a time the Wolffian ducts end blindly behind, but later they open into the cloaca.

The Wolffian bodies are first recognizable, during the third week of the embryo, as longitudinal thickenings in the dorsal surface of the body cavity, there being one of these ridges on either side of the mesentery. They develop rapidly and become greatly elongated so that they soon reach from the posterior portion of the cervical region back to the end of the lumbar region.

The essential tissues of the Wolffian bodies appear to develop, independently of the Wolffian ducts, from the mesoblast, in the form of rods and cells. The rods coil somewhat upon themselves and become excavated to constitute tubes and, growing toward the Wolffian duct, empty into it at one end, while the other end becomes dilated, and then invaginated, to constitute the Malphigian bodies, or glomeruli. Into these glomeruli, branches of the aorta penetrate to furnish the functional blood supply. The veins from these glands empty into the posterior cardinal veins.

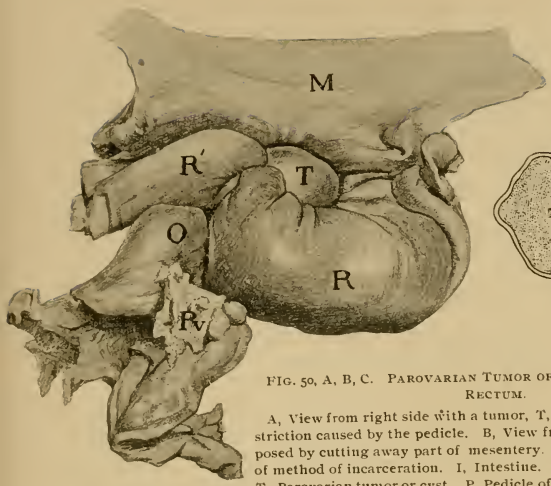

FIG. 55 A.

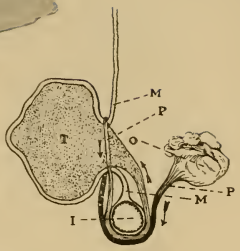

FIG. 55 C.

FIG. 50, A, B, C. PAROVARIAN TUMOR OF MARE, INCARCERATING RECTUM.

A, View from right side with a tumor, T, almost hidden by the constriction caused by the pedicle. B, View from left side, the tumor exposed by cutting away part of mesentery. C, Schematic illustration of method of incarceration. I, Intestine. M, Mesentery, O, Ovary. T, Parovarian tumor or cyst. P, Pedicle of tumor. R, Rectum.

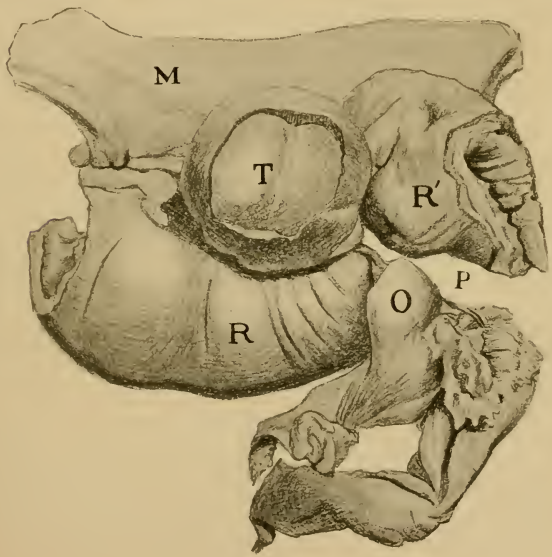

FIG. 55 B.

Later the Wolffian bodies commence to degenerate and atrophy and finally the essential tissues of the organs almost wholly disappear and the Wolffian bodies, with their ducts, become concerned in the origin of accessory portions of the reproductive apparatus.

In the female, the Wolffian bodies play no important part in the formation of the ovaries, but they send some outgrowths into these glands, which persist for a time without playing any essential part. Some remnants of the Wolffian bodies persist, however, as the parovarium, or organ of Rosenmueller, and from these vestigial portions of the Wolffian body the large pedunculated cystic tumors, occasionally seen in the mare, appear to arise. In rare cases these pedunculated par-ovarian tumors become looped about the rectum, inducing fatal incarceration, as shown in Fig. 55.

In the female, some traces of the Wolffian duct may remain at its anterior end. In its posterior portion we do not observe remains of this duct in most animals, but, in the cow, they usually persist as Gaertner's canals, which sometimes become blocked at their mouths to constitute retention cysts. These present themselves as elongated sacs, arising close to the meatus urinarius on either side and extending upward and forward along the walls of the vagina. When they become very greatly distended, they serve to interfere with copulation and, if very large, possibly with parturition.

The Wolffian bodies largely disappear in the male but take a somewhat prominent part in the formation of the testicles and thus in part persist throughout life. Tubules grow out from the Wolffian tubules in the anterior part of the Wolffian bodies and finally enter the substance of the testicle to constitute the vasa efferentia, which eventually become connected with the seminal tubes. The coni vasculosi are derived from the anterior Wolffian tubules and the Wolffian duct is finally converted into the epididymis and vas deferens.

The Kidneys, Ureters and Bladder.

Before the disappearance of the Wolffian body, there appears toward the posterior end of the Wolffian duct an outgrowth or diverticulum, which is later to constitute the ureter and which, passing backward toward the cloaca, finally acquires an independent opening a little way behind that of the Wolffian duct.

At the anterior end, this infundibulum grows forward beneath the Wolffian body and dilates to form a sac which is to constitute the pelvis of the kidney, while, from its walls, a number of branching tubules grow out to constitute the uninary tubules and, at their ends, they enlarge to constitute the glomeruli of the kidney.

At the point of communication between the ureter and the allantois the latter tube becomes dilated to constitute the urinary bladder. Behind, the allantois is constricted to constitute the urethra, while, in front, the narrowed portion which passes out through the umbilicus is known as the urachus. During the life of the fetus, the urine chiefly passes through the urachus, which opening normally closes at the time of birth.

The Reproductive Organs.

The development of the reproductive organs of the female has already been described on page 11, to which the reader is referred. They undergo many aberrations in their development, due to arrests, some of which have already been noted on page 247. Fig. 51 on page 323 illustrates an interesting form of arrested development of the uterus and vagina, in which these organs are represented by enlarged, solid cords.

The Male Reproductive Organs.

The Testicles.

The testes form, like the ovaries, in the genital ridges and in the earliest stages the mode of origin or development can not be differentiated in the two sexes. Later the differentiation occurs through the development of some parts of the undifferentiated genital gland and the atrophy of others. The Wolffian bodies and ducts play an important part in the development of the excretory apparatus of the testicles. In the indifferent gland the mesoblastic cells become grouped in cords containing small cells, along with the larger and more numerous primitive sexual cells. These sexual cords are formed from the roundish masses of cells, separated from each other by connective tissue sheaths. They eventually become elongated and hollowed out to constitute the seminiferous tubules.

From the Wolffian bodies, cell cords grow out and fuse with the semeniferous tubules to constitute the vasa recta and rete

testes and the latter, by further growth, form the head of the epididymis. The upper, or anterior, end of the Wolffian duct is modified to constitute the body and tail of the epididymis, while the posterior portions form the vas deferens, seminal vesicle and ejaculatory duct.

Early in fetal life, the developing testicle shifts its location from its primary lumbar position toward its final normal resting place, in most animals in the scrotum. Formed in the peritoneum of the body wall in the sub-lumbar region, the gland is outside or behind the parietal peritoneum and, as it shifts its position and descends into the cavity of the abdomen toward the internal abdominal ring, it necessarily carries with it a peritoneal covering and remains attached to its point of origin by a double peritoneal fold, mesentery or mesorchon, between which its vessels and nerves pass.

In the formation of the Wolffian body, there arises, in connection with it, the inguinal ligament, which passes from the fundus of the scrotum through the inguinal ring up to the Wolffian body. When this atrophies and disappears, the cord persists and maintains a connection with the testicle, as the *gubernaculum testis*, or with the ovary, as the *round ligament*. The gubernaculum testis consists of connective tissue and unstriped muscle fibers, surrounded by peritoneal coverings. Since the testicle, the gubernaculum testis, and the vas deferens, originating from the Wolffian duct, form outside of or behind the peritoneum, as the organ descends each of the three structures must drag with it a double peritoneal fold, so that finally there appear three peritoneal folds, as shown in Figs. 56 and 57 : one for the testicle and its artery, A ; one for the vas deferens, V, and a third for the gubernaculum testis, G, G′, and G″, all of which are continuous.

As the organ continues to descend toward the inguinal ring, the peritoneum of the abdominal floor, which stretches across the ring, evaginates through it as the *processus vaginalis* at P. in Figs. 56 and 57, into which pouch the epididymis, E, descends, followed later by the gland, T. The testis having formed on the median side of the Wolffian duct, which later forms the epididymis, the two structures maintain this original relation throughout and, when the testicle comes to rest in the scrotum,

the epididymis lies upon its external face, above the gland. The relation as to elevation between the testicle and epididymis becomes reversed. In the abdomen, processus vaginalis and inguinal canal, the epididymis is *beneath* the testicle and precedes it in the descent but, when the testicle finally reaches the bottom of the scrotum, it performs a partial revolution forwards on its long axis, which reverses the relation and brings the epididymis

FIG. 56. Genito-urinary system of a foal, 24 hrs. old, to illustrate descent of testicles and behavior of ruptured umbilic arteries.

The central portion of the abdominal floor has been partly excised and laid back. Seen from below.

T, Testicle. A, Artery of testicle. G, Gubernaculum testis. V, Vas deferens. B, Bladder. UA, Ruptured ends of umbilic arteries retracted within abdomen. P, Processus vaginalis UV, Umbilic artery.

above the testicle in the horse. In ruminants, this reversal of relation does not occur, as the long diameter remains perpendicular. The processus vaginalis remains normally open throughout life in the domestic animals, but in the adult it is so narrow that abdominal viscera may not escape through it.

When the testicle has descended into the scrotum, it is attached posteriorly at the bottom to the fundus of the sac by the gubernaculum and upwards along the posterior wall of the scrotum and inguinal canal by the frenum, consisting of the peritoneal duplicature between V and G in Fig. 57 ; above, the gland is connected by means of the testicular or spermatic cord, consisting of the vas deferens, arteries, veins and lymphatics covered by peritoneum. In the foal, pig, and more rarely in other species, at the time of birth, we frequently meet with a hernia (congenital scrotal hernia) of intestines or omentum through an abnormally large processus vaginalis, alongside the spermatic cord.

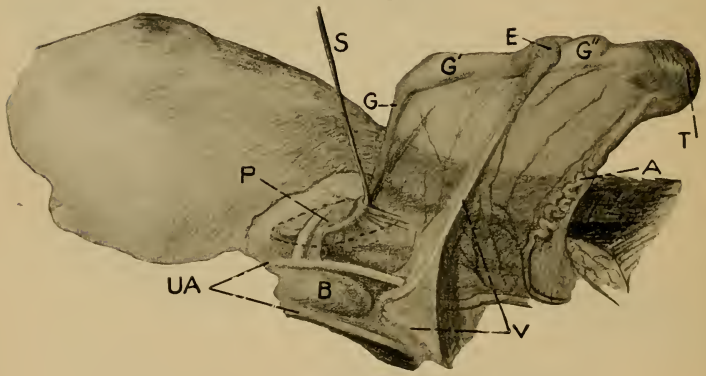

FIG. 57. RIGHT INGUINAL REGION OF FOAL, 24 HRS. OLD

Illustrating descent of testicle, viewed from below, the testicle lifted upwards to reveal attachments.

P, Processus vaginalis, surrounded by a dotted line and containing a curved sound, S. G, Gubernaculum testis emerging from the internal inguinal ring and reaching to the larger portion, G′, which extends to the epididymis, E, and is succeeded by the final or third section of the gubernaculum, G″, reaching from E to the testicle, T.

A, Artery of testicle. V, Vas deferens. B, Bladder. UA, Umbilic arteries.

In some instances, the epididymis, E, Fig. 57, descends into the scrotal sac, while the gland remains in the abdomen or incarcerated in the internal ring. Far more frequently, both gland and epididymis are retained within the peritoneal cavity to constitute cryptorchidy. The successful castration of cryptorchid animals depends fundamentally upon a practical knowledge of the track and mode of descent of the testicle, and of itsattachments, through the medium of the gubernaculum testis, vas deferens and testicular artery.

The Wolffian ducts open early, at their posterior ends, into the terminal portion of the allantoic stalk, which is later to constitute the urethra, which, in the male, elongates backward to extend to the distal end of the penis. The penis of the male and clitoris of the female arise alike as outgrowths from the ischial arch ; in the female it stops short in its growth as a non-essential erectile organ, without acquiring any relationship with the urethra, while, in the male, it becomes greatly elongated and, curving downwards and then forwards, passes between the thighs to end in a special sheath and prepuce. The urethra extends throughout its entire length to open at the extremity of the glans penis.

Arrests or aberrations in development of the penis occur, consisting usually of an abbreviation in its length, suggesting a graduation in extent between a normal penis and clitoris. Sometimes the defective penis is directed more or less backwards, leading to a backward direction of the urinary stream. In other instances, the formation of the urethra is aberrant and it opens at the ischial arch or lower down along the penis, to constitute hypospadius or epispadius.

Defects in the development of the penis and clitoris are largely associated with aberrations in the essential genital organs themselves, partaking more or less of hermaphroditism or bi-sexual character. Hermaphroditism varies greatly in character and extent and tends largely to follow certain types for each species of animals. In the horse, it is not rare to meet with an animal having a well developed vulva, vagina and uterus, the vulva and vagina functioning, the latter ballooning under manual exploration, as in a normal mare. No ovaries are present but, instead, typical cryptorchid testicles producing the ordinary

Fig. 58. Pseudo-hermaphroditism of Horse, showing Rudimentary Penis.

cryptorchid sexual reflex, a male voice, form and behavior. Such a case was readily castrated by us through the ample vagina in the same manner as spaying a mare. (Fig. 58). The elongated clitoris, which projected 2 or 3 inches beyond the vulva, was amputated. The udder was well developed. In other cases in the horse, we have observed well developed mammæ with testicles resting just above and to the outer side of them, an abbreviated penis and no vulva. Between these types various gradations appear. In a boar, as shown in Fig. 14, we found a male gland (testicle) on one side and a female, (ovary) on the other.

The Limbs.

In a rabbit embryo of about the tenth day, the mesoblastic cells on either side of the notochord become grouped into cuboidal masses, divided from each other by transverse lines, which are known as *somites* or *primitive segments*. The first pair appears in the cervical region prior to the closure of the neural tube and additional somites appear, extending forward toward the head end and backward toward the tail. From these somites

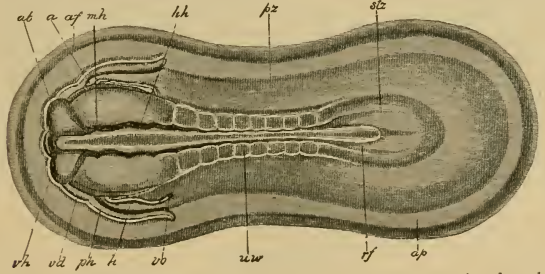

Fig. 59. Rabbit embryo of the ninth day; seen from the dorsal side (after Kölliker.) ×21.

stz, Stem zone. pz, Parietal zone. In the stem zone 8 pairs of somites appear on either side of the chorda dorsalis and neural tube.

ap. Area pellucida. rf, Medullary groove. vh, Fore-brain.
ab, Eye vesicle. mh, Mid-brain. hb, Hind-brain.
uw, Primitive segment. h, Heart.
ph, Pericardial portion of body cavity.
vd, Margin of entrance to foregut. af, Amniotic fold.
vo, Vena omphalo-mesenterica. (Heisler).

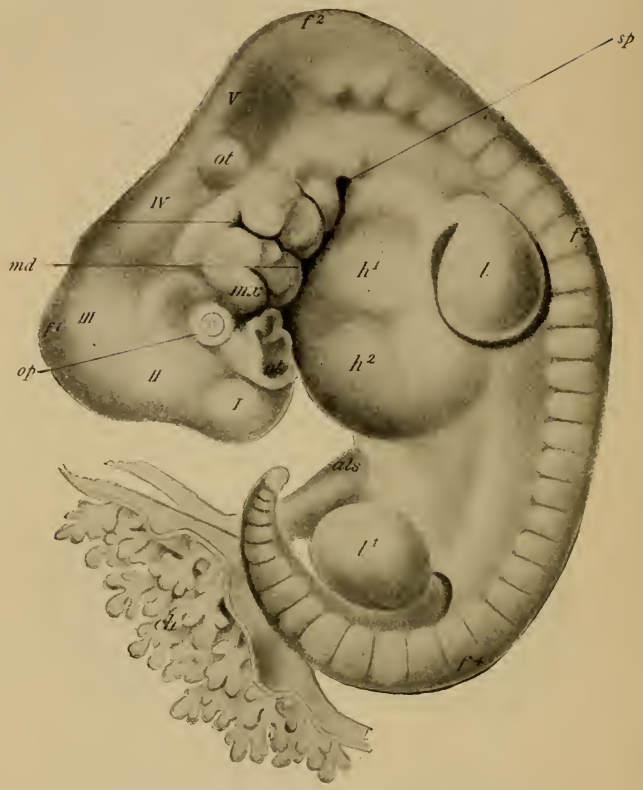

FIG. 60. HUMAN EMBRYO OF ABOUT 28 DAYS. SHOWING LIMB BUDS. (His).

I to V, Brain vesicles. f^1, f^2, f^3, f^4, Cephalic, cervical, dorsal and lumbar flexures. op, Eye. ot, Otic vesicle. ol, Olfactory pit. mx, md, Maxillary and mandibular processes of first visceral arch. sp, Sinus precervicalis. h^1,h^2, Heart. l, l^1, Limbs. als, Allantoic stalk. ch, Villous chorion. (Heisler.)

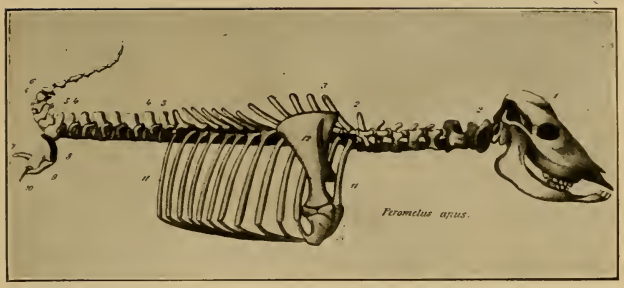

FIG. 61. PEROMELUS APUS. (Gurlt).

FIG. 62. PEROMELUS ACHIRUS, FOAL.

later arise the vertebral column, the skeletal muscles, tendons and ligaments and the corium, or deeper layer of the skin.

The formation of the limbs begins as small buds, or outgrowths, arising from the mesoblastic somites soon after the third week in the human embryo, earlier in the rabbit and probably in most of our domestic mammals. The limb-buds each represent several mesoblastic somites, as indicated by the fact that the nerves passing to each limb are formed by the union of branches from sev-

eral intervertebral nerves, each vertebra representing a somite. The buds lengthen to constitute the limbs, the bones arising from the connective tissue, while the muscles develop from the muscle plates of the mesoblast. The segments of the limbs are brought about by transverse grooves where the joints are later to form and the digitations begin as longitudinal grooves, which deepen into clefts.

Various aberrations in the development of the limbs occur in our domestic animals. Merely the buds may appear and, within them, rudimentary bones representing the scapula and pelvis or, more or less also, the humerus and femur, but the other parts may fail of development. Any one, or all, of the limbs may be wanting. Fig. 61 represents the skeleton of a bovine fetus without limbs (Peromelus Apus), while Fig. 62 represents a foal, in which the two anterior limbs are wanting (Peromelus Achirus.) In such cases the defect is apparently due to an arrest in the development of the limb-buds during the first month of pregnancy. Between this absence of limbs and their normal development occurs every gradation of arrest in the development of limbs, as peromelus micromelus or dwarf limbs. Rarely a limb may undergo amputation during its early stages of development by becoming involved in a loop of the umbilical cord.

A more common aberration in the limbs and feet is abnormal fission, by which the entire limb or its digitations become multiplied. Most commonly, only the digits are involved, resulting in one or more extra digits, as shown in Figs. 63 and 64.

Sometimes a greater part of the limb is involved in the abnormal fission. Rarely normal fission fails in those animals naturally provided with two or more digits or, after their more or less complete fission, fusion occurs between them and the animal is born with less toes than normal.

Rarely, in the development of the limbs, a tendency is shown toward the addition of an element not normally present in the genus but regularly occurring in some other genera, as is illustrated in well developed clavicles in the pig, as shown in Fig. 65.

FIG. 63. MEGALOMELUS PERISSODACTYLUS. PIG.

FIG. 64.
MEGALOMELUS PERISSODACTYLUS. FOAL.

FIG. 65. HUMERI OF PIG, WITH CLAVICLE-LIKE OUTGROWTHS.

FIG. 66 A

FIG. 66. A, Foal with bent anterior metacarpal bones, showing extreme dorsal flexion of metacarpo-phalangeal articulations.
B, Bent metacarpi from A.

FIG. 66 B.

The limbs are furthermore subject to a variety of contractures, sometimes involving a misdirection of the limb due to deformity of the articulations, at other times to a bend in the bone itself, as shown in Fig. 66 A and B.

THE FETAL MEMBRANES AND THE PLACENTA.

The maintenance of the intra-uterine existence of the fetus, and its development to a degree which will enable it to maintain a more or less independent existence at the time of birth, requires that effective means be established for the exchange of nutritive and waste materials between the mother and her young, not alone for the basic purposes of nutrition and excretion, but also that the embryo may be moored or fixed at a given point in the maternal organ, where its position can be maintained throughout the duration of pregnancy in such a manner as to best protect and insure its life and normal growth. To this end there are formed three structures from the blastodermic vesicle, which undergo changes to finally constitute the fetal membranes and placenta.

1. The Vitelline, or Yolk Sac.

When the embryo commences to develop, the embryonic area folds inward at its borders, leading to a constriction between this area and that part of the blastodermic vesicle which lies beyond, and they finally become separated except by a narrow neck, the vitelline duct, while, beyond, there exists the comparatively large vitelline or yolk sac. This vitelline, or yolk, sac plays but a minor part in the development of the embryo and tends to more or less completely disappear, according to species, while in some it persists as an embryonal vestige to the time of birth. In the mare, the yolk sac is very inconspicuous early in fetal life and disappears almost completely at a very early stage. In Fig. 74 this general plan is suggested at the twenty-eight day of pregnancy, while in Fig. 75 it is indicated that, at five months, it has well nigh disappeared.

In the sheep, as shown in Fig. 76, it assumes a wholly different form and undergoes great elongation. In other of our domestic animals there are variations in the form which this sac assumes, but, in each alike, it is of apparently little importance except during the very earliest stages of embryonic life.

2. The Amnion.

The amnion commences to form as soon as segmentation has been completed and the ovum has passed through the oviduct and reached the uterus. This occurs at about the 13th or 14th

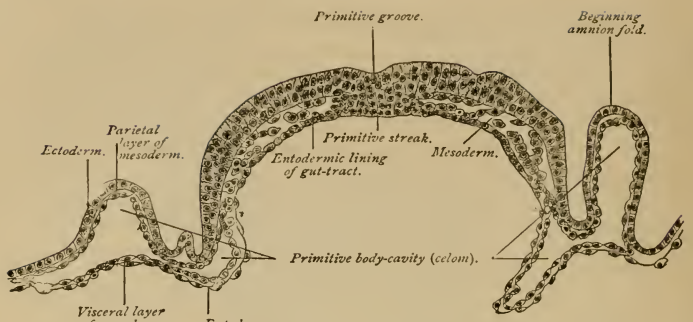

FIG. 67. Transverse section of the embryonic area of a fourteen-and-a-half-day ovum of sheep. (Heisler, after Bonnet).

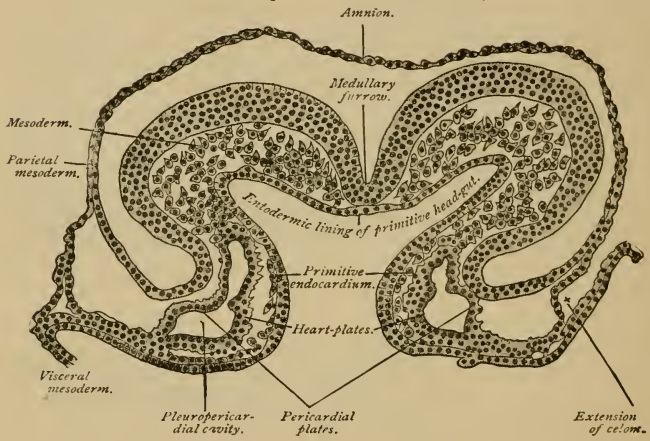

FIG. 68. Transverse section of a sixteen-and-a-half-day sheep-embryo. (Heisler, after Bonnet).

day of gestation in the embryo of the sheep and is soon complete. The date of its appearance in other domestic animals is approximately the same.

The amnion arises from the extra-fetal portion of the somatopleure, which folds upward around the margin of the embryonic area beneath the zona pellucida, or prochorion. It forms a double

membrane which, by continuing to grow upward and converge, finally meets above the dorsal surface of the embryo and fuses. By the fusion there is formed a double sac which envelops the fetus completely except at its point of origin at the ventral surface, where it takes part in the formation of the umbilicus. The inner of these two membranes constitutes the true amnion, while the external one forms the external or false amnion which, fusing with or replacing the prochorion, forms the primitive chorion and later, when the allantois grows out, blends with it to contribute to the formation of the permanent, or allantois-chorion. This outer, or

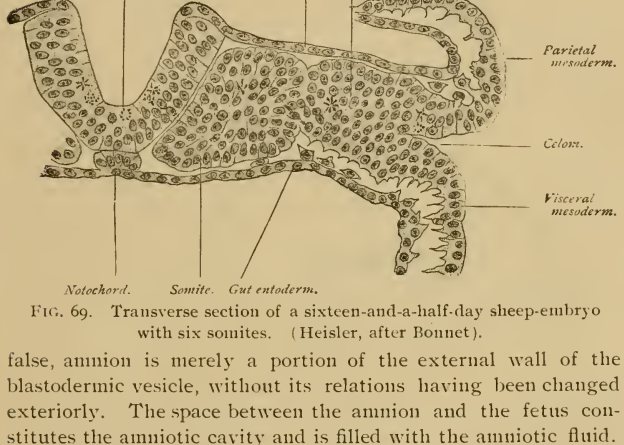

FIG. 69. Transverse section of a sixteen-and-a-half-day sheep-embryo with six somites. (Heisler, after Bonnet).

false, amnion is merely a portion of the external wall of the blastodermic vesicle, without its relations having been changed exteriorly. The space between the amnion and the fetus constitutes the amniotic cavity and is filled with the amniotic fluid.

As the amniotic cavity becomes filled with fluid and enlarges, it closely invests the vitelline stalk and the allantoic cord in its passage through this cavity. The amount of liquor amnii varies greatly in different animals and at different periods of pregnancy, but it is generally most abundant at about the middle of gestation. In the cow and mare the amount of amniotic liquid varies from 5–6 liters, while, in the sheep, according to St. Cyr and Violet, it varies between 100 and 500 grammes. In woman, the amount is said to be about 1½ liters.

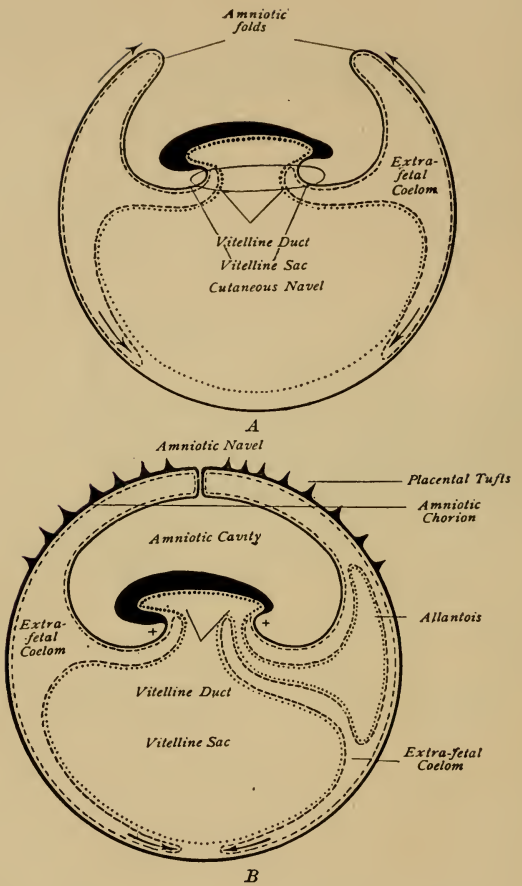

FIG. 70. Schematic longitudinal section of fetal annexes of mammalia. At the points indicated by + the skin is continuous with the amnion. (Bonnet).

An increase of this fluid constitutes what is known as dropsy of the amnion, which accumulation, in the cow, may sometimes reach the enormous amount of 20 or more gallons and prove so burdensome as to prevent the patient from arising when down, because of the great weight of the accumulated fluid. (See Dropsy of the Amnion.)

In some cases, especially in the embryo of the cow, the amnion apparently becomes contracted during the early stages of its formation and causes an eversion of the somatopleuric portion of the embryo, resulting in the condition which we know as *fissura ventralis* or *schistosomus reflexus*. In this deviation, no body cavity is formed and the internal viscera, derived from the splanchnopleure, lie free within the chorion. In other words, the constriction and infolding of the splanchnopleure to constitute the intestine proceeds. The constriction which should externally mark the division between the fetal and vitelline portions of the somatopleure, to constitute the umbilicus, fails to develop; the amnion contracts; the spinal axis of the embryo bends ventralwards, in a way passes out through the non-constricted umbilic area and the embryo, so to speak, turns inside-out. The spinal axis of the fetus becomes sharply doubled dorsally and the somatopleuric portions lie as a partially everted sac with its peritoneal surface presenting externally. This abnormality constantly causes serious difficulties at the time of parturition and frequently taxes the resources of the obstetrist to overcome them. This will be more fully considered when dealing with dystocia. See Figs. 71 and 72.

Other interesting defects in the development of the amnion occur, one of the most frequent being adhesion of this membrane to the epiblast of the fetus, largely upon the head, by which, at the time of birth, the fusion between the skin of the fetus and its membranes offers an important or serious obstacle to its expulsion.

The liquor amnii contains albumin, sugar, urea and other elements of urine and, in many cases, especially in the foal, also some masses of meconium. The avenue by which each of the fluid substances reaches the amniotic cavity has not been fully shown. Some hold that the fluid transudes into the cavity from the amnion itself, coming indirectly of course from the blood of

FIG. 71. SCHISTCORMUS REFLEXUS. (Gurlt.)

FIG. 72. Schistocormus reflexus, after partial embryotomy to overcome dystokia.
E, Left ear, above which is seen the radial portion of the left carpus.
F, Right anterior foot. R, Ribs. S, Sternum.
PL, Lacerated area where posterior limbs have been torn away.

the mother. It is obvious that the meconium observed in the amniotic fluid of the foal has been expelled from the intestine through the anus and that, the anterior end of the alimentary tract opening also into this cavity, any discharge of secretions or debris from the mouth or nostrils falls at once into the amniotic cavity. It is also clear that urine may be readily and freely expelled into this cavity and that the urinary salts found in the amniotic fluid are derived from the fetal kidneys and discharged into the amniotic sac through the urethra.

The amnion consists, on the embryonic side, of a thin layer of epiblast, while, on the outer side, it is formed from the somatopleuric mesoblast. The external surface of the amnion is in contact throughout more or less of its extent, varying according to species, with the inner wall of the allantois.

The Allantois.

The allantois arises as an evagination from the hind gut just posterior to the vitelline duct and grows outward and backward between the two amniotic layers, and, in the mare and carnivora, finally envelops the amniotic sac completely, so that, in these animals, there occur two complete envelopes to the fetus, each of which is eventually filled with fluid. (See Figs. 74, 75.)

Tracing the allantois from its origin in the hind gut, there is a slight constriction which is to constitute the urethra, followed by a dilation from which the urinary bladder is to develop, then an elongated, narrow tube, the urachus, which extends from the fundus of the urinary bladder out through the umbilicus and along in the umbilical cord across the amniotic cavity.

In structure, the inner layer of the allantois is of hypoblast derived from the inner layer of the hind gut, while the external layer consists of mesoblast, in which the allantoic vessels are formed to constitute the vascular layer.

In all our domestic animals, the allantois constitutes a great sac, which is filled with a liquid, the allantoic fluid, which consists largely of the secretions from the kidneys, augmented perhaps by transudation from the blood vessels of the walls of the sac itself. The allantoic fluid contains albumin, grape sugar

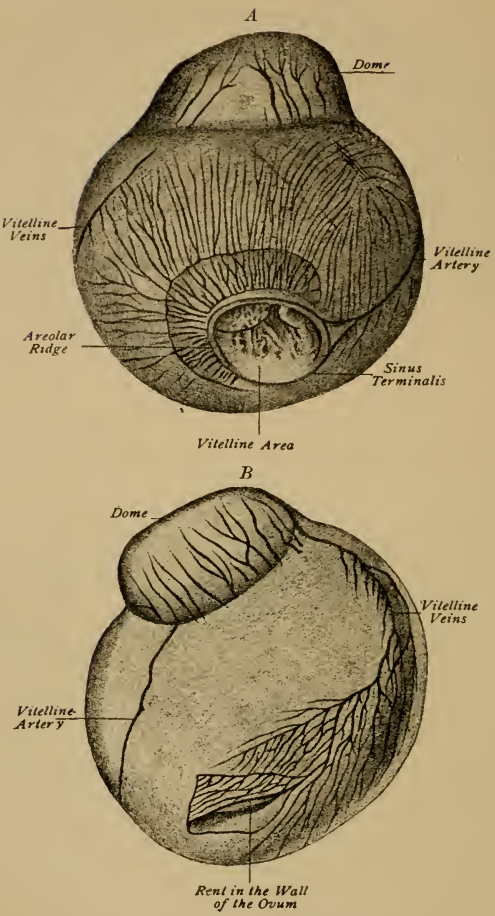

FIG. 73. A, Embryo of the horse in its membranes. 4.2 cm. in its greatest diameter. Twenty-eight days after fecundation. B, The same seen from the other side. (Bonnet).

and urea and is, consequently, similar in character to the amniotic fluid, except that no meconium can reach this cavity since only the urinary tract communicates with it.

In the fetus the urinary secretions may pass either backward through the urethra into the amniotic cavity or forward through the urachus into the allantoic cavity and, consequently, through this tract the two cavities communicate throughout intra-uterine existence. In the human embryo there is virtually no allantoic sac except for a very brief time early in pregnancy, the walls of the allantois soon coming in immediate contact.

Collectively, these membranes, with the addition of the vestigial remains of the vitelline sac, constitute the fetal membranes, or after-birth.

The Chorion.

The external or vascular layer of the allantois, with the external or false amnion, constitutes the permanent or allantoic chorion. In the brief interval elapsing between the formation of the amnion and the allantois, the external or false amnion performs temporarily the functions of the placenta by throwing out placental tufts which acquire intimate attachments with the mucosa of the uterus, maintain the attachment and fixation of the embryonic mass in its position and provide an avenue for nutrition and excretion. Later, when the vascular layer of the allantois spreads over the inner surface of the false amnion and fuses with it, the allantoic tufts push out into the existing amniotic structures, acquire intimate relations with the uterine mucosa and lead finally to the displacement or effacement of the amniotic chorion.

The form, extent and relations of the allantois in different animals present the greatest variability. In the mare, as indicated in Figs. 74 and 75, the allantois grows completely around the amnion and constitutes a complete double envelop, except for the area occupied by the vestigial yolk sac. It thus completely separates the amnion from the false amnion or amniotic chorion, its sac being filled with the allantoic fluid. Its internal surface is lined with endoblast from the enteric canal, while its exterior layer is of splanchnopleuric mesoblast. A study of Fig. 75 shows that the somatopleuric mesoblast, or outer layer of the true amnion, is in contact with the splanchnopleuric mesoblast of

the allantois : these, though separable, adhere somewhat intimately, the two together constituting the sac usually designated as the amnion. Similarly, the external wall of the allantois presses against the mesoblastic layer of the amniotic chorion or false amnion, fuses with it and constitutes the allantois-chorion.

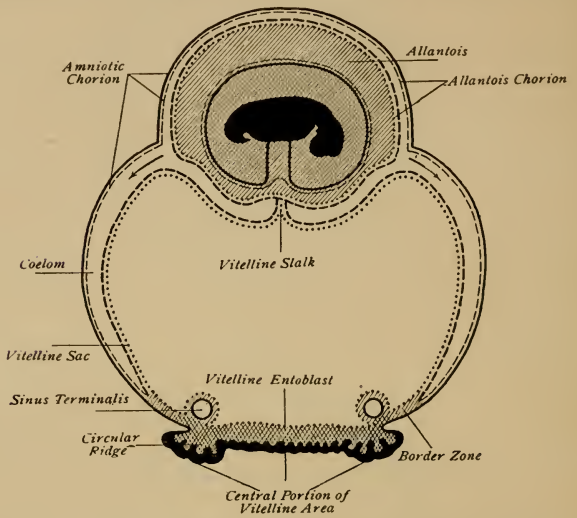

FIG. 74. Schematic illustration of fetal annexes of the embryo of the horse, 28 days after fecundation, as in Fig. 73. Perpendicular section through the embryo and its envelops.
The embryo in black. — Ectoblast. . . . . Vitelline layer.
– – – Parietal mesoblast. — — — Visceral mesoblast. (Bonnet).

In ruminants and swine, unlike the globular or spheroidal blastoderm of the horse as shown in Figs. 73 and 74, it becomes very greatly elongated, as shown in Figs. 76 and 77, longer even than the uterine cavity, necessitating its folding upon itself. This elongated sac does not persist, but soon atrophies and almost wholly vanishes long before birth. The formation of the allantois follows more or less the plan of the blastoderm and its yolk sac and in these animals becomes much elongated. In swine the apices of the allantoic sac are destitute of placental

tufts, as shown in Fig. 77. In ruminants, Fig. 80, the allantoic sac becomes much elongated, while its apex, along with the amniotic chorion, finally undergoes necrosis, as shown on the right of the figure, or the apex of the amniotic chorion alone becomes necrotic without the allantois having penetrated it, as shown at the left.

In case of single pregnancy, the allantoic sac of the ruminant occupies both cornua. The arrangement of the allantois in ruminants differs greatly from that of the horse. The allantoic sac does not completely surround the fetus but, lying along its ventral side, greatly elongated, only partially encloses the amnion.

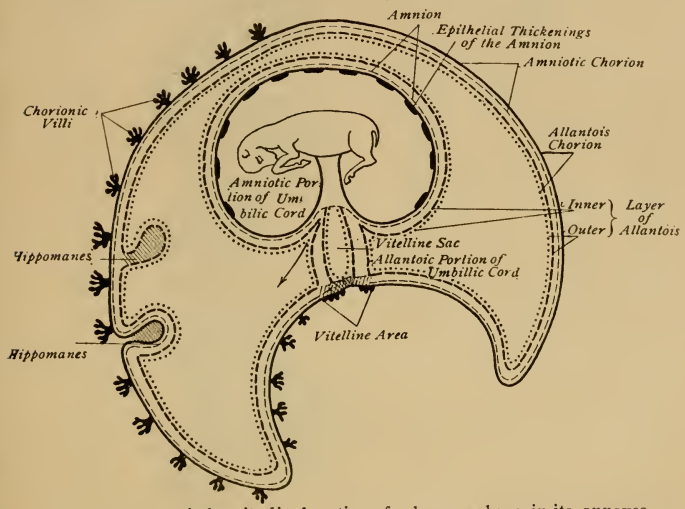

FIG. 75. Schematic longitudinal section of a horse embryo in its annexes, at about 5 mos. gestation. Reduced to about ⅛. (Bonnet).

This applies, however, only to the inner or hypoblastic layer of the allantois, which constitutes the immediate wall of the sac. The vascular, or mesoblastic, layer extends completely around the fetus and its amnion but, over that portion of the amnion where the allantoic sac does not extend, the amnion, vascular layer of the allantois and amniotic chorion are unseparated by

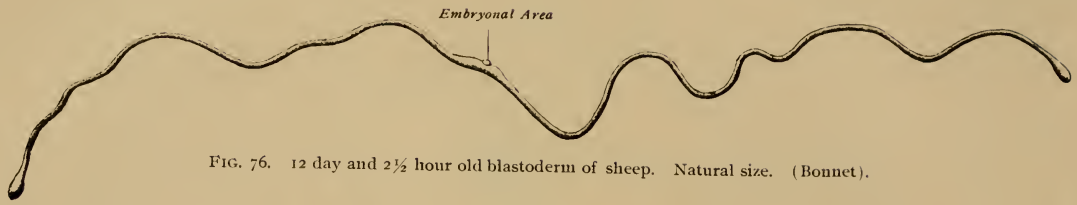

FIG. 76. 12 day and 2½ hour old blastoderm of sheep. Natural size. (Bonnet).

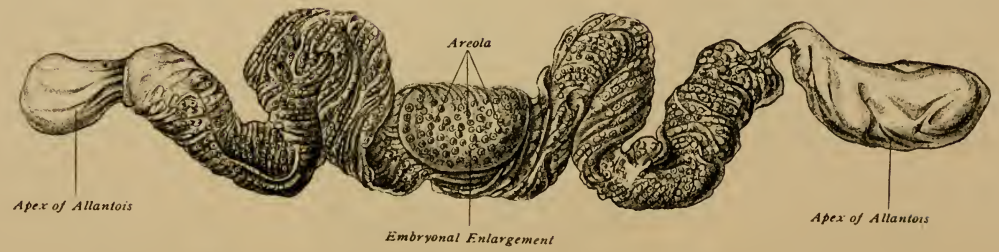

FIG. 77. Swine embryo and its membranes. 48 cm. long. Reduced to about ½ size. (Bonnet).

any intervening fetal fluids. Mesoblast being everywhere contiguous to mesoblast, the amnion becomes adherent to the chorion over a large area, to such a degree as to make their separation difficult.

This difference in the character and extent of the allantois establishes a marked difference in the phenomena of parturition. In the mare, where the allantois constitutes a complete enveloping sac filled with fluid, the fetus tends to be born enclosed within the amniotic sac, including the adherent inner or amniotic layer of the allantois, while, in ruminants, the extensive area of the amnion not covered by the allantoic sac causes the amnion to remain adherent to the chorion and the fetus to be born naked.

The Placenta.

By the term placenta we understand those portions of the fetal membranes or annexes which serve to bring about an intimate contact between the circulatory system of the mother and that of the fetus. The development of the mammalian embryo can proceed independently for but a brief period since, having virtually no nutrient reserve in the vitellus, its growth must depend upon nutritive substances obtained from without, from the uterus of the mother. When the morula reaches the uterine cavity at the eighth to tenth day, the zona pellucida throws out tufts, the primordial chorion, which enter into somewhat intimate relations with the uterine mucosa, but this zone soon becomes attenuated, and disappears as the blastoderm rapidly enlarges within it. This primitive chorion, or prochorion, must be replaced by a more permanent and efficient structure for the nutrition of the fetus.

Soon there grow out, from the surface of the epiblast, tufts or villi which extend into the mucosa of the uterus through which there is an exchange of nutritive material and waste products between the mother and fetus. When the amnion develops, the external or false amnion is but a continuation of the somatopleuric wall of the yolk sac, which completely invests the embryo. Over the entire surface of this embryonic sac, villi grow out to establish relations between the embryo and mother and constitute the amniotic chorion or placenta. These structures, like the preceding, are primitive and temporary in character and soon become lost as unimportant parts of the more permanent structure to follow, or they atrophy and disappear.

When the vascular layer of the allantois develops, it grows out and fuses with the amniotic chorion, which largely disappears or becomes lost as a separate membrane, while the blood vessels from the allantois grow out through it to constitute new tufts, which soon attain an intimate relation with the blood vessels of the uterus.

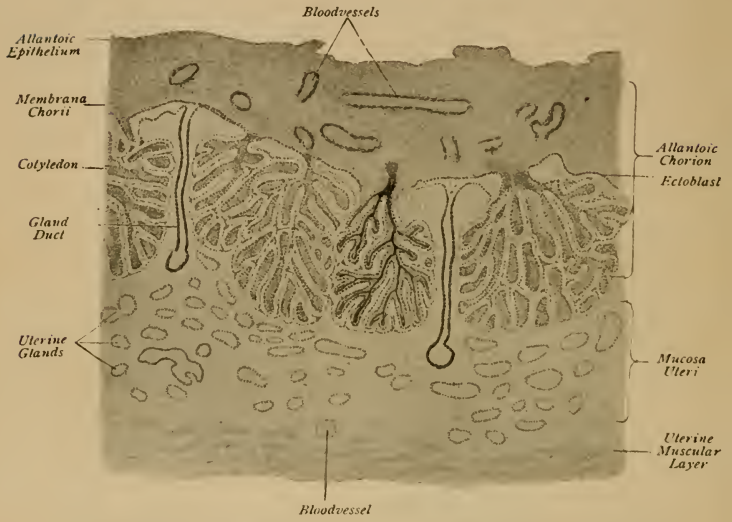

FIG. 78. Section through the chorion and uterine mucosa of the horse, at 9½ months. Enlarged about .45–1. (Bonnet).

The blood vessels of the fetus and those of the mother do not become continuous, but are constantly separated by three layers of tissue, the endothelial layers of both the maternal and fetal capillaries and an intervening layer of connective tissue. The capillaries of the allantois become greatly branched and grow out as villi which, sinking into the mucous membrane of the uterus, come into immediate contact with corresponding capillary loops from the uterine vessels and become closely adherent with each other with extremely thin walls, through which there is a free

exchange of nutritive and waste products, but not of cellular elements.

The separation of the fetal from the maternal circulation is so complete that most micro-organisms of disease do not ordinarily pass through and, consequently, where the mother is affected with a contagious disease, the fetus does not ordinarily contract it through the medium of the blood. For example, in tuberculosis the fetus is almost never infected during its intra-uterine existence, but is born free from the malady, however badly the mother has been affected during the period of pregnancy.

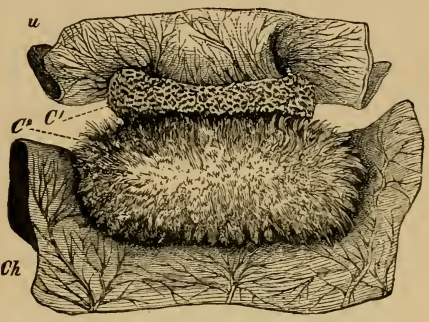

FIG. 79. Cotyledons of a cow, according to Colin.

u, Uterus. Ch, Chorion. C¹, Maternal, C², fetal portion of cotyledon. Fetal and maternal portions are partly separated from each other. (Bonnet.)

The area, or areas, in the mucosa of the uterus at which elaborate changes take place for the attachment and nutrition of the fetus, is known as the maternal placenta and the corresponding portion or portions of the chorion which sends capillary tufts into the placental area of the uterus, constitute the fetal placenta.

Among our domestic animals, there are great variations between these placentæ. In some species, the relations existing between the fetal villi and the capillaries of the uterus are so intimate that, when the fetal placenta is removed, a portion of the mucous membrane of the uterus is carried with it, while, in other animals, the placental villi of the fetus separate from the maternal tufts and leave them intact. From this difference in

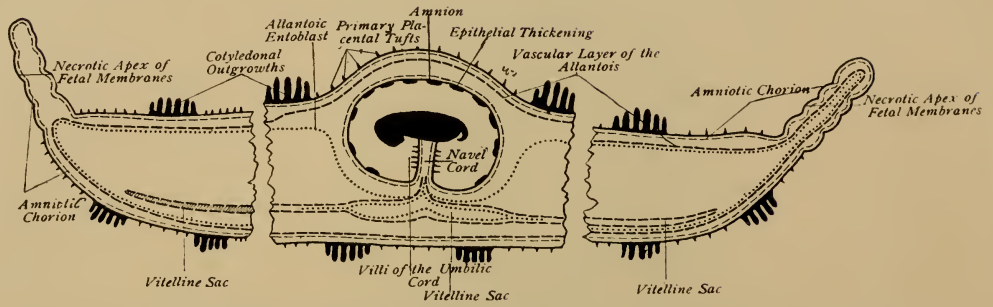

FIG. 80. Schematic sagittal section through the fetal annexes of ruminants. The parts between the two end portions and the central piece are represented as having been excised. (Bonnet).

the mode of the separation or dehiscence of the fetal membranes, we divide mammalia into two groups, known as the deciduata, in which the maternal mucosa is torn away with the fetal membranes, and the indeciduata, in which the separation between the fetal membranes and uterus occurs between the villi of the chorion and the maternal vessels.

By some authors, the term placenta is limited to those structures in which the villi of the chorion are concentrated at certain points upon its surface. These animals are designated as placental. In other animals, the villi are scattered over the entire surface of the chorion and these are designated as diffuse placental or aplacental.

Among our domesticated animals, in the indeciduate group, we have, of the aplacental or diffuse placental type, the horse (Fig. 75) swine and camel, and of the placental group we have the ruminants, except the camel.

In the deciduous group are the elephant, carnivora, rodentia and monkeys.

In man and the anthropoid apes there is a very complex deciduous placenta, of a discoid type, with a decidua reflexa.

Our most common and useful animals belong to the indeciduate group, in which are found the ruminants and equidæ, while in the deciduate group we have only the dog, cat and rabbit.

The form and extent of the placenta in the different species of animals varies greatly. In equidæ and swine the placentæ or chorionic villæ are diffused over the entire surface of the chorion, as small elongated tufts, which we know as diffuse placentæ. In ruminants the villi are restricted to comparatively small areas of about 80 to 100 or more in number, which are known as placentules or cotyledons. Between these cotyledons the chorion is free from the uterus. In the non-gravid uterus of the ruminant, there exist numerous elevations upon the surface of the mucosa, which constitute the rudimentary cotyledons. When impregnation takes place the cotyledons become highly vascular and their mucous membrane undergoes marked development, while, from the chorion, there grow out, at points corresponding to these eminences, numerous branched villi which ultimately sink deeply into the mucosa of the cotyledons or placentules. This condition gives rise to what we know as multiple placenta. (See Fig. 79.)

In carnivora, the placentæ are zonular, the chorionic villi are restricted to a zone encircling the embryonic sac and the anterior and posterior poles of the chorion are devoid of villi.

The Umbilical Cord.

The umbilical cord serves chiefly as a bond of communication between the embryo and the placenta. It is formed by the allantoic stalk, surrounded by the amnion, and includes the vestige or remnant of the vitelline duct. In the mare and carnivora it may be divided into the amniotic and allantoic portions. The amniotic portion, or the umbilical cord proper, extends from the umbilicus of the embryo, through the amniotic cavity, to open into the cavity of the allantois. The allantoic section of the umbilic cord extends across the allantoic sac, from the amnion to the allantois-chorion. Cross-section of the umbilical cord in the amniotic portion reveals the following structures: the amnion, serving as a thin, dense, investing membrane; the two umbilical arteries, the pair of umbilical veins, sometimes fused to constitute a single vessel; the urachus and the vestiges of the vitelline duct. Around these vessels, filling out the amniotic sheath and investing the urachus and vessels within to constitute a more or less even cord, is a gelatinous substance, the Whartonian gelatin, embedded in a network of delicate connective tissue.

The allantoic portion of the umbilic cord consists essentially of the mass of umbilic vessels, which have now become more or less branched. Partially surrounded by, and adherent to, these vessels may exist more or less evident remnants of the vitelline duct and sac, prominent in the very early stages of fetal life, rapidly disappearing more or less completely at a later date. The urachus ends in a funnel-shaped dilation just beyond the amniotic sac, to become continuous with the allantoic sac.

During the earlier stages of gestation there normally projects into the umbilical cord one or more loops of intestine and, in some cases, portions of the liver or of other viscera. The protruding intestinal loop escapes through the umbilic ring of the somatopleure, beside the allantoic stalk, inside the skin and amniotic sheath. The protrusion through the umbilicus apparently occurs because the abdominal cavity has not developed

with sufficient rapidity to accomodate the rapidly growing visceral mass and, consequently, a portion of it is crowded out through the umbilical opening alongside the vessels and remains outside of the abdominal cavity until the contraction of the umbilicus gradually forces the intestines back into the now more capacious abdomen where they permanently remain. In numerous cases the umbilic ring does not normally contract, the ring remains open, the intestinal loop fails to return within the abdominal cavity and the fetus is born with umbilic hernia.

The vessels of the umbilic cord are disposed spirally from left to right, a condition sometimes suspected to be due to a revolution of the fetus upon its short axis but apparently more properly referable to a fundamental plan in development uninfluenced by fetal movements. The spiral arrangement of the cord adds to its compactness and strength and to the maintenance of the vessels in regular order.

The length of the umbilic cord varies widely with species and individuals. In the mare the length ranges from 35 to 40 inches, the amniotic portion representing about one third of the total length. It is sufficiently long that, when a foal is normally born and the dam is in the recumbent position, the cord remains intact and may even persist after the mare has risen to her feet, but ruptures when she turns her head to the foal, to lick it, or starts to move away from it. Sometimes the foal, by its struggles, ruptures the cord by its own efforts. In other cases, the cord remains intact and the chorion is completely expelled, still attached to the living foal, and its rupture takes place after the foal rises to its feet.

The point of normal rupture of the navel cord of the foal is about 1½ to 2 inches from the umbilicus, at a well marked constriction. This delimits the cord proper from what may be called the *umbilic base*, or cutaneous navel, a hairless, cylindrical, firm segment 1 to 1½ inches long. At the termination of this portion a softer and more fragile cord begins with a somewhat constricted neck and, within this latter at a point ½ inch or more from the base, the rupture of the cord generally occurs. (See Fig. 90 B.)

The navel cord of the cow consists of an amniotic portion only and is less than ½ the length observed in the mare, ranging be-

tween 11 and 16 inches or ¼ to ⅓ the length of the fetus, a difference which regularly leads to its rupture during the expulsion of the fetus and only rarely permits the birth of the calf with the cord intact. Hence, in the cow and other ruminants, not only is the fetus born naked, as already related, but during its expulsion the rupture of the cord usually frees it completely from all fetal annexes.

In the pig, the umbilic cord is wholly amniotic and very long, equal to the entire length of the fetus, while, in carnivora, the cord is short and very resistant, so that eventually it is usually bitten in two by the mother.

In relation to diseases of the new-born, it should be noted in reference to the various structures of the umbilical cord that, when it is permitted to rupture naturally, the umbilical arteries quickly retract within the abdominal cavity and draw along with them, in an inverted manner, the loose connective tissue surrounding them. It has been claimed by some, apparently on insufficient grounds, that, in the cow, etc., the arteries rupture within the abdomen. This retraction of the arteries accomplishes two important purposes: it draws their wounded ends away from the exterior, preventing the entrance of infection into them, and the inverted connective tissue which is drawn back with them, offers an impassable barrier to hemorrhage. The retraction of these arteries also causes a thickening of their walls, as their length decreases, and thus serves to narrow and virtually obliterate their cavity. (See Fig. 56.)

The umbilical vein remains open for a time and serves as an avenue for infection. This fact is highly important in relation to the well-being of the young, since, through this portal, serious infection frequently occurs to constitute the disease known as navel infection or omphalo-phlebitis. The urachus, too, may remain open (pervious urachus) or become re-opened a few days after birth through the agency of infection, much as arteries reopen to constitute secondary hemorrhage from infected wounds.

The Whartonian gelatine, if retained in the cord by means of a ligature, serves the dangerous purpose of a culture medium for bacteria. When the cord is normally ruptured, the Whartonian gelatine quickly oozes from the broken surface, the stump of the cord soon dessicates, the wound occasioned by the rupture becomes hermetically sealed and, from that moment on, infection is excluded.

TERATOLOGY.

Teratology is the science of monstrosities, or aberrations in the development of the embryo. The subject is too extensive for any definite consideration in a treatise upon obstetrics. The extent of deviation from the normal may be of every gradation. There may be merely a perceptible deviation from the normal, which we usually designate a defect, or arrest, in development. Or the deviation from the normal may be so extreme as to result in an almost shapeless mass, such as the acardia, or "mole", illustrated on page 289, or a double monster such as is illustrated in Figs. 126 and 127. Such deviations are known as monsters and, as a general rule, the departure from the normal is such that it prevents the animal from living after birth or compromises the existence of the mother in the act of birth, so that such abnormal individuals are rarely born alive or, should this occur, their defects in structure are such as to nearly always cause their early death. In the lesser deviations from the normal, we sometimes fail to observe the defect at the time of birth and it is only when it has caused disease that we are led to note the fundamental defect in development. Such is well illustrated by the defects of the teeth, which are mentioned on page 314.

In the preceding chapter, under the head of Embryology, we have mentioned numerous forms of monstrosities and defects in development in order to draw a contrast between the normal embryological development and the abnormal, or teratologic, development. We have also aimed, in that chapter, to point out the causes of these deviations, so far as they are well known, and to forge a connecting link between teratology and disease. Neither have we attempted to give an extended account of embryology, but have aimed to aid the veterinary student, as far as possible, to get the logical connection between embryology and the subjects of obstetrics and surgery. The veterinary obstetrist needs know, so far as possible, the embryologic foundation of certain defects, and of diseases arising from these in our domestic animals, because intelligent handling of these must be based upon such an understanding.

We shall have further occasion to refer to some forms of aberration in development when dealing with the subject of dystokia, since some of them lead to very great difficulty in parturition and tax to the utmost the resources of the obstetrist. We shall again

have occasion to mention some of these aberrations in development when dealing with the defects of the new born animal.

While the subject of teratology is one of very great scientific interest and serves largely to emphasize the facts of embryology and the regularity with which the development of the embryo ordinarily proceeds, we must content ourselves, in this treatise, with a bare mention of the subject. Teratology was first placed upon a scientific basis by Gurlt (Lehrbuch der pathologischen Anatomie, 1831) and later the science was expanded by Saint Hilaire and others.

Experimentally, teratology has also received a considerable amount of attention and it has been found that the chick embryo and others which are readily available for manipulation may be caused to undergo a great variety of aberrations during the early stages in development, by mechanical disturbances. The conclusion has been reached, from these experiments, that accidents of a somewhat similar character, occurring during the very early stages of embryonic development in our higher animals lead also to aberrations in development.

It is worthy of remark that those arrests in the development which have occurred early in the life history of a given embryo show a marked tendency to recur in the offspring of the defective organism, when it lives to the breeding age. This may readily occur in the milder forms of aberration in development, but it is only rarely that the more serious cases, which we generally speak of as monstrosities, are capable of breeding, or even of surviving to the adult period. In the lesser aberrations in development, such as arrests in the closure of the umbilic or inguinal rings, resulting in hernia, the defect is extremely liable to become fixed and to be reproduced with disastrous frequency in the offspring of such an animal.

Among the laity, the occurrence of monstrosities arouses more or less mysticism and they are frequently attributed to some psychic influence upon the pregnant mother, usually at some late period in gestation, when the defect has already long been fixed in the fetus, having occurred at a very much earlier date. On the other hand, it is highly probable that teratology itself has had an important influence upon mythology and may have played an important part in such myths as the Cyclops, the Janus and others, which myths find accurate representatives among the monstrosities in man and in animals.

PREGNANCY, OR GESTATION.

By the term gestation we comprehend that period of time during which the young is undergoing development in the uterus of the mother, a period extending from the time of the fertilization of the ovum until the birth of the fetus.

The modifications which necessarily take place during this period are of a very profound character, and exert an important influence upon the life and nutritive powers of the mother.

The volume of the uterus becomes very greatly increased. The walls of the non-gravid organ are contracted and firm and its cavity is insignificant, the mucous membrane of the walls being in contact. As soon as impregnation occurs, the uterus must become very greatly increased in volume in order to accommodate the fetus and its membranes. Even prior to impregnation, during estrum, the uterus has undergone some degree of enlargement and intensified function preparatory to the fertilization and nutrition of the ovum. Consequently, impregnation in a way continues and accelerates this increase in volume until it reaches its maximum at the time of parturition.

The first notable change in the uterus, which has already been anticipated during estrum, is the greatly increased vascularity of the organ, both of the walls and the mucosa. The mucous membrane becomes especially vascular, as is shown by its deeper color and its great increase in thickness, as well as by a softening of the membrane.

The increased function in the mucosa is not equally apparent in all parts, but is most pronounced in those regions where the attachment of the fetal placenta is to occur. Thus, in the ruminant, the principal increase in activity and growth of the mucosa is at those points which are to constitute the cotyledons of the gravid horn, while, in the mare, it is more evenly distributed over the entire organ. In the bitch and cat, it is largely concentrated in that part which is to enter into relations with the placental zone of the fetus.

In multiparous animals, like the bitch, cat and sow, the uterine cornua become enlarged and bulged at the points where the impregnated ova have lodged and become attached to de-

velop into embryos. This arrangement results in a nodular form suggesting the general appearance of a rosemary, the nodes in the elongated organ being usually quite equally distributed throughout the entire length of the tube. In the uniparous animal, in which the fetus, as a rule, is lodged partly in the cornu and partly in the body of the uterus, the gravid cornu and body increase far more rapidly in size and undergo greater changes in structure than the non-gravid or vacant cornu.

The blood vessels of the uterus undergo very rapid growth during pregnancy. The non-gravid uterus is firmly contracted and shows no great vascularity, so that operations upon it may not be accompanied by great hemorrhage. When pregnancy occurs, the arteries and veins very rapidly enlarge and increase to many times their former volume, so that any injury or wound of these vessels tends to cause more or less serious hemorrhage.

The density of the non-gravid organ, serves to differentiate it from the intestines and other abdominal viscera, because of its firmness upon palpation. During pregnancy this density decreases very greatly and the organ soon comes to resemble, to the sense of touch, the intestines. This is very markedly the case in the pregnant bitch, in which this change in the density of the organ causes it, so far as the sense of touch reveals, to so closely resemble the intestine as to occasionally embarrass an operator when spaying a bitch which is unexpectedly pregnant. This decrease in the density of the organ is attributed partly to the thickening and softening of the highly active mucous membrane, partly to the enormous increase in the number and volume of the arteries and veins and partly to a relative decrease in the thickness of the walls of the organ, owing to its very rapid distension, in which process the growth in comparative thickness fails to keep pace with the increased area. In the non-gravid uterus, there is present in the contracted organ a reserve of tissue, which must later undergo very rapid development. The non-gravid cornu is usually 50 to 100% thicker than the gravid cornu.

The glands in the uterine mucosa become rapidly elaborated ; the utricular glands become enlarged, they increase in length and width and their secretions become augmented. In the ruminant

the uterine cotyledons develop rapidly and it has been shown that new ones appear. Rainard could distinguish but 30 to 40 cotyledons in the uteri of heifers or lambs, while, after parturition, he found 100 or more. It has further been shown by the experiments of Colin and others that, if the cotyledons have been artificially removed from a cow, new ones form during the period of pregnancy. In the mucous membrane of the uterus, there also form crypts, at an early period in pregnancy, into which the villi of the fetal chorion grow and become attached. These crypts are the counterpart of the villi of the chorion and vary in their form and complexity according to the species of the animal. They are lined with a thin layer of epithelium, immediately beneath which are the uterine capillaries, in a rich net-work. In the mare these crypts are distributed over the entire uterine surface, in harmony with the distribution of the villi of the chorion, while in the cow they are limited to the cotyledons and constitute essentially the mass of these organs during pregnancy. In those animals having zonular placentæ, they are confined to the placental zone.

Between the mouths of these crypts, utricular glands open upon the surface of the mucous membrane and pour out their secretions, the uterine milk. (See Fig. 78.)

Investigations have shown that during pregnancy the muscle fibers of the uterus become increased in size and multiplied in numbers, so that the increased volume of the organ is not wholly dependent upon increased function in some of the muscle cells, but partly upon a multiplication of the muscle fibers. The lymphatics and nerves also increase in extent and volume during pregnancy.

The broad ligaments of the uterus become increased in their length and thickness and their muscle fibers in volume. Fleming asserts that the muscle fibers are increased in order to give them sufficient strength to sustain the weight of the greatly enlarged uterus and its contents. This cannot be correct, because the gravid uterus lies upon the floor of the abdomen and does not swing in the ligaments. The increase in the extent and strength of the broad ligaments should be attributed rather to the necessity for their maintaining their relations with the uterus in its changed position and for preventing their rupture during

movements of the organ. In themselves, the ligaments would not suffice to sustain the weight of the gravid uterus, but they perform an important office in tending to keep the uterus in its normal direction along the abdominal floor. It should be constantly borne in mind, however, that the parietal attachments of the broad ligaments do not change during pregnancy and neither advance nor retreat. It is also to be noted that the gravid uterus grows forward constantly and advances beyond the anterior attachment of the broad ligaments to the abdominal walls, and that it is because of this that torsion of the uterus can occur.

The sensibility of the uterus is increased, presumably because of a heightened development of the nerves of the organ. Upon opening the bodies of pregnant animals under anaesthesia, or immediately after death, the uterine walls undergo very marked contractions, which closely resemble the peristalsis of the intestines. These uterine contractions, or peristalsis, are especially marked in the pregnant bitch or cat, where there are alternate constrictions and dilations due to alternating contraction and relaxation of the circular fibers, while the part taken by the longitudinal muscle fibers is shown by an alternating increase and decrease in the length of the uterus.

The sympathy between these uterine contractions and the other parts of the genital apparatus is shown in a variety of ways. It has been generally believed that copulation, in case of the pregnant female, tends to produce sympathetic contraction of the uterus, with an expulsion of its contents, or abortion. In manipulations of the pregnant uterus, we constantly consider that we should be very gentle and careful lest we induce contractions which will end in the death and expulsion of the fetus. Hess has asserted, moreover, that artificial abortion is readily and uniformly induced by the dislodgement of the yellow bodies from the ovaries by manual compression per rectum. It is a common experience that the removal of the ovaries, or castration, of the pregnant female tends constantly to induce abortion. This contractility of the uterus during pregnancy probably has an important relation to its functional activity and the nutrition of the fetus, and tends to maintain the fetuses in their proper position and direction by correcting any chance displacement caused by any sudden movements of the body.

These contractions are important for the development of the power in the uterine walls which finally assumes a very necessary function at the time of parturition, because it is largely through these that the os uteri is dilated and the fetus is expelled. It is notable that it is in the multipara, where the uterus is long and tubular, that the uterine contractions play the greatest part in the expulsion of the fetuses, while, in the unipara, like the mare and cow, the principal expulsive powers at the time of parturition reside in the abdominal walls and the uterus performs a less conspicuous part in the act of birth.

After the expulsion of the young from the uterus, it is again highly important that there should be a vigorous contractile power in the organ, in order that it may expel, at an early period, the fetal membranes and such portions of the uterine epithelium as are cast off. It is needful that the walls should contract vigorously in order to check the amount of blood passing to the organ and to close all capillaries in the uterine mucosa which have been opened during the process of separation between the fetal membranes and the uterus. It is also important that the uterine cavity shall be promptly closed and the epithelium of its walls brought in contact. This contraction, too, indirectly exerts a disinfecting, or bactericidial, power and serves to prevent the entrance of infection or overcome any infection which may have gained entrance into the cavity during or immediately after the expulsion of the fetus.

THE FORM OF THE PREGNANT UTERUS.

The gravid uterus undergoes important changes in its form, since it must adapt itself to the form, volume and position of the fetus or fetuses and especially to the membranes which surround them. In the multiparous animals, we have already stated that the fetuses are distributed somewhat equidistant from each other throughout the length of the cornua and that, at the points where they develop, the organ becomes enlarged, while between them it is constricted so that it gives the organ a nodular appearance. In animals, like the mare and cow, which usually produce but one young at a time the uterus assumes a somewhat oblong or globular form. In uniparous animals the fetus is usually contained in the uterine body and one horn, so that the principal changes take place in those parts and leave the non-gravid cornu but slightly increased in size or changed in form, so that it appears as a mere appendage upon the side of the enlarged cavity which contains the fetus. In the multiparous animal, whether there be several fetuses or only one, the development of the young occurs in the cornu or cornua and the so-called uterine body regularly remains empty and serves merely as a passage for the fetus from the point of its development, when the time for parturition arrives. In rare cases in multiparous animals, not infrequently in the mare, a fetus may develop more or less equally in the two cornua, bicornual pregnancy, and, at the time of parturition, offer serious or fatal obstacles to birth. (See Transverse or Bicornual Pregnancy.) Usually, in multiparous animals, the number of fetuses is approximately equal in the two horns.

The cervix of the uterus undergoes well-marked changes during the latter part of pregnancy. During pregnancy the os uteri is firmly closed by the constriction of the circular muscle fibers of the cervix and the occlusion is further secured by means of an albuminous clot, which is quite thick and firm. The cervix is at first quite firmly contracted, so that it is exceedingly difficult to force a passage through it into the uterus of the cow, while, in the mare, as in the non-pregnant state, it is very easily dilated and one or more fingers or the entire hand may be inserted.

As parturition approaches, the os uteri normally becomes somewhat dilated. The walls of the cervix become softer and

more distensible and the longitudinal folds of mucous membrane begin to disappear. Finally, when labor begins, the os, under normal conditions, dilates until it becomes completely effaced and is of the same dimensions as the vagina and uterus, so that the two cavities now become continuous, with no distinct line of demarcation between the two portions. After parturition has occurred, the os and cervix normally resume their previous condition very promptly, so that within a few days these parts are approximately the same as before impregnation.

The situation of the uterus is modified by the changes taking place in its volume. At the same time, its growth must alter in some degree the situation of other floating viscera. The gravid uterus possesses the highest specific gravity among the floating organs of the abdominal cavity and, as a consequence, in our quadrupedal animals it soon descends to and rests upon the abdominal floor. Its position upon the abdominal floor is slightly modified in some cases by neighboring organs, when they are sufficiently voluminous and possess a high specific gravity, like the rumen of ruminants and the great colon of solipeds. As a result, in the mare the pelvic flexure of the colon is displaced somewhat to the right and the uterus passes along beneath it to the left of the median line. In ruminants, on the other hand, the uterus becomes slightly displaced to the right by the enormous rumen. In the multiparous animals, none of which have any very voluminous floating viscera, the gravid uterus becomes the most important abdominal organ and takes first place along the median line, displacing the other viscera to either side or upward.

These changes come about somewhat slowly. At first the gravid uterus rests partly in the pelvis and well suspended by the broad ligaments in the sublumbar region, but, as soon as the fetus has acquired any great volume, it at once bears the uterus downward and forward onto the abdominal floor and finally pushes its way along this, as on an inclined plane, until it reaches the diaphragm, where the most anterior extremity of the gravid uterus lies in close relation with the stomach, liver and diaphragm.

During this change in the position of the uterus, the os uteri is for a time dragged forward so that it is farther from the vulva than in the non-pregnant animal, but later, in unipara, when the

fetus has come to rest against the diaphragm and has acquired a longitudinal diameter which equals or exceeds that of the abdominal cavity of the mother, the more posteriorly situated end of the fetus, with its membranes, pushes up into the pelvis to the os uteri. The os uteri may itself be pushed back toward the vulva, and in some cases, when parturition is near, especially in the cow and ewe, the os uteri becomes displaced backward to such a degree that it may even appear between the lips of the vulva when the animal is lying down. This prolapse of the vagina and cervix in pregnant ruminants sometimes requires the attendance of the obstetrist. See Ante-partum Prolapse of the Vagina.

On the other hand, in some animals with exceedingly pendulous abdomens, or in that pathologic condition where rupture of the abdominal floor has occurred so that the fetus passes through the muscular floor of the abdomen to rest against the skin, the uterus is dragged abnormally downward and forward so that the vulva and anus are drawn inward and present a concavity.

In multiparous animals the uterus lies folded upon itself very much the same as the intestine. Fleming states that, in the pig, each cornu of the uterus lies above the corresponding line of mammæ. This, however, is impossible, since, when there are 6 or 7 fetuses in one cornu, their combined length is at least double that from the pubis to the diaphragm. Consequently, they cannot be arranged in a straight line, but the cornu must be thrown into folds to accommodate the disposition of the fetuses contained within it.

The direction of the uterus in our domestic animals is very simple. Its weight and the horizontal position of the body tend constantly to keep it in an antero-posterior direction, in a general line with the long axis of the body, modified only in those cases of multiparous animals, in which the cornua are too long to lie in a direct line, and in the larger herbivora, in which the uterus may be slightly displaced to the right or left by great viscera.

In those animals like the cow and mare, in which the abdomen may be very pendulous, there may be a somewhat marked deviation of the uterus downward, which would cause the os uteri to present somewhat upward, but this is not of such a

character as to be termed abnormal and forms no particular impediment to labor. In other cases, the uterus becomes displaced on account of the ruptured prepubian tendon (which see) or it may become rotated upon its long axis, inducing torsion of the uterus, which we shall consider later.

The influence of the gravid uterus upon neighboring organs is comparatively unimportant except in a purely mechanical way. It does not interfere materially with any of the abdominal viscera. When the fetus attains considerable size and rests against the diaphragm, it may mechanically impede respiration to a slight degree.

The influence of the gravid uterus upon the circulation of the region has been claimed by some writers to be quite important. Fleming states that, in the cow and mare, the gravid uterus exerts an unfavorable compression upon the blood vessels of the hind limbs, vulva and rectum and causes engorgement of the veins and lymphatics in these parts. In this way he accounts for the edema of these parts so often observed in the later stages of gestation in the mare. He thinks, also, that this edema is referable to some extent, in the mare and cow, to pressure upon the saphena and mammary veins. It would be exceedingly difficult to demonstrate this hypothesis upon anatomical grounds. In woman, in her upright position, with the head of the fetus normally resting against the pelvic inlet and the entire weight of the fetus bearing upon these parts, it would seem reasonable to expect some interference with the return of blood from the inferior extremity of the mother, and this is clinically true. However, in our domestic animals in their quadrupedal position this cannot well follow. In dropsy of the amnion in the cow (which see), there is such a great collection of amniotic or allantoic fluid that the patient is borne down by the immense weight and cannot rise to her feet. Still, in these cases, dropsy of the limbs is never seen, but they are on the contrary very clean and free from any edema whatever. Both from an anatomical and a clinical standpoint, the allegation that compression by the gravid uterus causes edema of the posterior limbs and abdominal floor is questionable ; the edema should probably be referred to other than mechanical influences.

The changes in volume, weight and position of the gravid uterus, while they bring about some alterations in the position

of other viscera, do not interfere materially with their functions. The modifications in position necessitated by the growth of the uterus come about gradually, so that the other organs readily adapt themselves to the change, without inconvenience.

The increased weight of the body contents, which has become greater in pregnancy, necessarily hampers somewhat the movements of the mother, so that she is slower and less agile. It may be also that there are psychic reasons which cause her to move more slowly and carefully, lest there should be danger of injury to herself or her fetus.

Very early in pregnancy, important psychic changes occur. In the mare, especially, it is noted that there is greater docility and that the animal seems somewhat more sluggish. Both the mare and the cow, toward the latter part of pregnancy, show some arousing of the maternal instinct and are more ready to defend themselves in event of danger. This is especially noted in the cow upon the approach of carnivorous animals, which, in the natural state, constitute her enemies.

In domestic animals we do not observe those disturbances in the digestive and nervous systems which are seen at the commencement of pregnancy in woman. As a general rule, the pregnant female is more quiet and contented than the non-pregnant and, during the first half of pregnancy, takes on flesh rapidly upon a comparatively light diet, but later in gestation shows a tendency to lose flesh, because of the great drain upon the maternal system due to the rapid growth of the fetus. This tendency to fatten during the early stages of pregnancy is used by stock-feeders to hasten the fattening process of animals intended for slaughter. The animals are habitually bred at a favorable time and then sold upon the market before they have reached the middle stage of gestation.

Fleming states that the pressure exerted by the uterus upon the vagina and the neck of the bladder causes the animal to urinate more frequently, but this is not noticeable clinically. Probably this thought is suggested by the clinical fact observed in pregnant woman, in whom, owing to her position and that of the fetus, there is direct mechanical compression of the urinary bladder. The volume of blood in the body of the pregnant female is said to be positively increased, but its corpuscles and solid constituents relatively decreased.

THE POSITION OF THE FETUS IN THE UTERUS.

The position of the fetus or fetuses in the uterine cavity is largely determined by the form and direction of the cavity itself and the form and specific gravity of the fetus. Since these factors are reasonably constant in each species, it follows that the position of the young in the uterine cavity is also quite uniform.

It is not always easy to determine precisely the position of the fetus in the uterus, by post-mortem examination, because of the fact that the fetus and uterus probably change their position somewhat according to that of the maternal body. We have already stated above that the gravid uterus possesses the highest specific gravity of any of the abdominal viscera. The fetus also offers the highest specific gravity among the uterine contents and, this being true, it follows that the position of the fetus should always be stable, independent of its umbilic attachments.

In the development of the embryo, the head-end grows much more rapidly during the first stages of embryonic life than the posterior portions. The circulation of the fetus is so distributed that more arterial blood reaches the anterior than the posterior end of the embryo, especially during the early stages of fetal life. The brain grows very rapidly and the dorsal surface of the body outgrows the ventral, so that the embryo is soon arciform. The great development of the head-end of the embryo, as compared to the posterior, causes the anterior portion to possess greater weight, which would constantly tend to cause the embryo, if suspended, to rest with its head-end lower than the posterior part of the body. The arciform character of the fetus continues throughout intra-uterine life and, from the beginning, affects the stability of the position of the fetus.

The fact that the uterine cavity of each of our domestic animals is more or less tubular in form renders it essential that the long axis of the fetus should correspond to the long axis of the uterine cavity, so that regularly the fetus is found resting in this position. Exceptions to this rule occur in the uterus of the mare and, more

rarely, in other animals in which a single fetus develops more or less equally in each of the two cornua, but even in this instance the rule is followed in a measure by the fetus being placed longitudinally in the combined cavities of the two cornua. This compels the fetus to assume a transverse position in relation to the long axis of the body of the mother and of the body of the uterus. The question of the development of the fetus in the two horns is discussed under "Bi-cornual Pregnancy."

The question of the presentation of the anterior or posterior end of the fetus toward the os uteri is largely determined, so far as we know, by the inclination of the uterus and comparative specific gravity of the head and tail ends of the fetus. Early in embryonic life, as we have already related, the fetus floats free in the amniotic sac and may turn upon its short axis, so that either the head or tail may present toward the os uteri. In the mare and carnivora there is further facility afforded for the fetus to turn upon its short axis, by the complete allantoic sac. This entirely surrounds the amniotic sac, so that the fetus with its amnion may turn within the allantois. Turning upon the short axis must necessarily cease as soon as the long axis of the fetus exceeds the transverse axis of the uterine cavity. The fetus then becomes fixed, so far as its antero-posterior diameter is concerned, for the remainder of its intra-uterine life.

In the uniparous and biparous animals, the bases of the uterine cornua slope more or less backward and downward from their anterior attachments toward the os uteri and maintain this position until the weight of the fetus and its membranes, with that of the contained fluids, bears the organ down to the abdominal floor. During this period, prior to the descent of the uterus upon the abdominal floor, the head-end of the fetus is much the heavier and consequently tends to become directed toward the os uteri. A further influence in reference to the position of the fetus is the question of the form of the uterine tube itself. This tube is not uniform in its transverse diameter, but is tapering and becomes smaller as the oviducts are approached, so that again the tendency would be for the larger end of fetus to occupy the larger end of the cornu, which would cause the head-end to present toward the os uteri.

In multiparous animals, in which the uterus lies upon the

abdominal floor at a very early period in pregnancy, the question of the inclination of the uterus can have less influence upon the direction in which the head-end shall present than in the unipara, and so we find that they present somewhat indifferently though the tendency for the head-end of the fetus to present toward the vulva is still well marked.

Late in gestation, the hinder parts of the fetus become more developed, so that in the larger herbivora these parts equal or exceed in bulk and weight the anterior portions of the body. By this time the uterus is lying upon the abdominal floor and the posterior part of the fetus occupies the lowest point of the abdomen in the neighborhood of the diaphragm. In addition to this, the fetus has acquired a longitudinal diameter which is in excess of the transverse diameter of the uterine cavity, and the relationship between the long axis of the fetus and that of the uterine cavity becomes fixed and permanent.

We thus find that, in the vast majority of cases in our larger domestic animals, the fetuses regularly present anteriorly at the time of birth. In multiparous animals, the fetuses present somewhat indifferently, usually anteriorly, frequently posteriorly.

The relationship between the transverse axis of the fetus and that of the maternal body is largely determined by the form of the fetus itself and of the surface upon which it rests. We have already learned that the fetus early assumes the form of an arc and that this form is maintained throughout its intra-uterine life. The fetus bends ventralwards and its form inhibits any marked dorsal flexion. During the early stages of gestation, the uterus is suspended by its ligaments in the abdominal cavity and its cornua in the mare are more or less curved downward at their middle portion. In ruminants the gravid cornu or cornua retain for a time their non-gravid spiral form, curving downwards, backwards and then upwards. An arciform fetus would normally assume the most stable position, which would be with its convex or dorsal surface applied to the convex side of the uterus and its concave or ventral surface toward the concave uterine surface.

At this stage the natural position of the fetus in the mare is with its dorsum downward and its ventral surface upward. In the ruminant, so long as the uterus remains in its non-gravid position, the ventral surface of the fetus would normally present down-

wards, if in the base of the cornu, to correspond with the concave side of the uterus.

As the weight of the fetus increases and bears the uterus downward to the abdominal floor, the position of the arciform fetus becomes unstable because it tends to come to rest, lying upon its convex dorsal surface, upon the essentially plane abdominal floor. Its position would be equally unstable should it settle against the abdominal floor upon its ventral or concave border, as might occur in the ruminant. Either of these positions is so unstable that the fetus tends to revolve upon its long axis and finally come to rest in a more or less lateral recumbent position. Hence, during the later stages of pregnancy, the fetus is generally found lying somewhat upon its side along the abdominal floor, where it may be readily felt, through the flank, in our larger animals.

In ruminants, the downward, forward, and finally backward, curvature of the uterine cornua leads to instability of the fetal position and, as the fetus acquires weight and descends to the abdominal floor, it must assume a stable attitude and, instead of resting upon its ventral surface with its concave border downwards, must turn upon its side and come to rest upon the abdominal floor. In so doing, the gravid cornu tends to revolve slightly upon its long axis.

The attitude of the fetus is largely determined by its form and the available space for its accomodation. In the cow and mare, the abdominal cavity is not sufficiently long to accommodate the fetus in an extended position and it must consequently be doubled up in a way to occupy a minimum amount of space anteroposteriorly. This condition is most completely fulfilled by the head and neck bending ventralwards so that the chin comes in contact with the sternum ; the anterior limbs flexed at the elbow and carpus so that the anterior feet rest with their ventral surfaces against the chest, the carpus being in contact with the sides of the head, and the posterior limbs, flexed at the stifle and tarsus, folded beneath the body in approximately the same position as is observed in sternal recumbency of the adult animal.

In the multiparous animals, the fetuses rest in a more direct line, there being much less curvature in the long axis, especially toward the termination of pregnancy. The limbs, being shorter

and less conspicuous than in the larger animals, are more frequently extended and the neck, being very short, is not curved.

When parturition approaches and the fetus of the uniparous animal has well-nigh outgrown the available room in the abdominal cavity, the presenting end of the fetus pushes up to, or into, the pelvic cavity and is readily felt by manual exploration per vaginam or per rectum. In the cow, the fetus having a comparatively short neck, the head is frequently extended a few days before parturition, pushes up into the pelvic cavity and, extending over the top of the vagina by pushing the superior wall of the uterus backward, it appears to the inexperienced veterinarian to be outside the uterus, although in reality the position is not rare and not abnormal. Along with the head, there may present also, in these cases, two anterior feet, extended. We have not observed this attitude of the fetus in the mare, although it may occur.

At the termination of pregnancy, the fetus changes its position and, when it begins to move toward the pelvic inlet, as a result of labor pains, it normally revolves slightly upon its long axis and, changing from lateral recumbency, presents with its dorsum toward the lumbar vertebræ of the mother and its ventral surface toward her pelvic floor. This is essential in relation to the resistance offered to the passage of the fetus through the pelvic canal. Whenever it presents otherwise than with the dorsal surface corresponding to the spinal column of the mother, it causes great or insuperable difficulty in expulsion and calls for a version of the fetus upon its long axis before delivery can readily occur. This difficulty arises from the fact to which we have already alluded, that the fetus maintains the form of an arc, the ventral surface being concave. The direction of the roof of the passage through the pelvis is also somewhat arciform, with its concavity downwards, so that the arciform fetus can readily pass only in the one position and a very great obstacle is offered to its passage when its dorsum is directed downward or to the right or left, its arciform body becoming impacted against some portion of the maternal passage.

SIGNS OF PREGNANCY.

It is of great importance in many cases to determine the existence or non-existence of pregnancy. In the examination of mares in case of sale, it becomes highly important that the veterinarian should be able to determine definitely if the animal be pregnant or not. If desired for breeding purposes, the greatest proof that can be established of the breeding power of a female animal is the fact that she is pregnant. When a mare is being purchased wholly for work it is important to determine in advance if she is pregnant or not, since the condition of pregnancy may interfere seriously with her usefulness. In the cow also it frequently becomes desirable to determine for the owner or prospective buyer whether pregnancy exists or not. In cows which are used for dairy or breeding purposes, it is essential that they be capable of breeding and it is frequently a very important question to the owner to decide whether a cow shall be retained for breeding or dairy purposes or whether she shall be sold to the butcher as sterile, and this can only be determined either by an intelligent investigation by the veterinarian or by awaiting the time for parturition to occur, which latter method may occasion a very considerable loss to the owner because of the delay.

In all animals, it is important that we should be able to differentiate between pregnancy and certain diseases, which may more or less closely simulate that condition.

There are many signs of pregnancy which have more or less value, but the vast majority of them are somewhat erratic and liable to mislead. It not infrequently occurs that an animal is regarded as pregnant for a long period of time and presents the general appearance of that condition, but finally fails to bring forth young, while in other cases, which may be even more deceptive, there are but slight external appearances of pregnancy and the owner is surprised when parturition unexpectedly occurs.

The veterinarian should consequently be able to speak positively regarding the question of pregnancy in a domestic animal and, doing so, he needs to know and consider all symptoms or signs which have any relation to the question.

The diagnosis of pregnancy during its earlier stages is exceedingly difficult and, during the very earliest period, is impossible. The symptoms of pregnancy may be divided into three principal groups: the subjective or physiologic signs; the objective signs; and the positive or direct signs, which are observed by examination of the parts in a way to definitely determine the presence of the fetus itself.

Physiologic or Subjective Signs.

Some of the physiologic, and psychic, manifestations of pregnancy are quite well marked, but tend in some cases to become deceptive. The physiologic symptom upon which the greatest reliance is placed is the cessation of estrum. As a general rule, fertilization stops the appearances of estrum very promptly and permanently throughout gestation. Estrum may not cease immediately upon fertilization, but continue to the close of the normal estrual period during which the impregnation has taken place. Perhaps in this case we should rather say that the estrum continues until ovulation and fertilization have occurred. In discussing the relationship between estrum and ovulation, we ventured to suggest that in some animals, if not in all, but especially in the cow, ovulation does not occur until near the close of the estrual period. Consequently fertilization does not take place until such time, and until then we cannot expect a cessation of estrum. In other words, copulation, even though it be eventually fruitful, does not mark the period of fertilization. However, it is generally noted that, if copulation occurs early during estrum and fertilization follows, the estrual period seems to be cut short.

Not only do the symptoms of estrum usually disappear to not recur until after parturition has taken place, causing the female to persistently refuse copulation, but it is said by some observers that males themselves in many cases decline to copulate with females which are pregnant. This is not uniformly true by any means. Both in the mare and cow there are frequent cases in which the pregnant animal shows all the signs of estrum and in which prompt and repeated copulation occurs in an apparently natural way. This is especially true in nymphomaniac cows, which frequently show all the signs of estrum, at the regular in-

tervals, after fertilization has occurred, and will continue to copulate regularly for two, three or more estrual periods, in spite of the existence of pregnancy. In a case which we personally observed, the cow was bred for three successive estrual periods, to a bull of one breed the first time, and to one of another breed during the last two periods, and finally gave birth to a calf at the proper time from the first breeding, which showed the characteristics of the breed of the first bull. Similar observations are made in all our domestic animals, though not so frequently as in the cow.

It is quite generally believed that copulation in an advanced state of pregnancy is liable to induce abortion and numerous cases have been cited to apparently demonstrate the fact. In one case which we observed, the cow showed signs of estrum at about the close of the eighth month of pregnancy and was bred. On the following day abortion took place. The conclusion was that the copulation had caused the abortion. This may or may not have been true. The abortion may have been due to the same causes as the estrum, or we might say that possibly the abortion, or rather the death of the fetus preparatory to its expulsion, had induced the signs of estrum and led to copulation with the male.

While the cessation of estrum is an important indication of pregnancy, it is evidently not final nor wholly reliable ; a non-pregnant animal may cease to show signs of estrum, as we have already related when discussing sterility, while a pregnant one may show signs of estrum at any time during gestation and copulate freely with the male.

In our domestic animals there is usually noted, as a consequence of impregnation, a more tranquil disposition of the female, as a result of which she tends to take on fat during the earlier stages of gestation and, as we have already remarked, this tendency is made use of in preparing animals for slaughter.

Toward the close of pregnancy, animals apparently become lazy and are not capable of performing certain kinds of movements which require agility, such as running and jumping, with the same ease as those which are not pregnant. But these changes are not well marked and the mare which is kept regularly at work suffers but little inconvenience so long as the labor

is of a moderate character, that is, if the load to be drawn or carried, or the pace which is to be maintained, is not extreme.

Physical or Objective Signs.

The most important physical signs of pregnancy are those indicated by a change in the volume and form of the abdomen and mammæ, accompanied by the secretion of milk, to which may also be added, according to some investigators, a change in the composition of the urine.

The development of the fetus with its membranes and the contained fluids, along with the increase in the volume of the uterus itself, necessarily leads to a corresponding increase in the volume of the abdomen. This increase naturally occurs chiefly during the later stages of pregnancy, although it begins very early in gestation. During these earlier months the apparent increase in the volume of the abdomen must be due to an increased volume of fat or of intestinal contents, since the actual increase in the size of the gravid uterus is not sufficiently conspicuous to bring about any visible changes. Later, this change in volume becomes more marked and there ensues also some degree of change in form, which serves to distinguish the enlargement of pregnancy from other abdominal enlargement.

The pregnant uterus, having a very high specific gravity, drops directly upon the abdominal floor and bears it down, which causes the abdomen to enlarge chiefly in the lower part, while the upper portion apparently sinks somewhat.

While this symptom is important as an indication of pregnancy, it is not reliable. The enlargement is frequently not prominent, so that in some cases, especially in mares, there may be so little increase in the size of the abdomen as to wholly deceive the owner until near the time of parturition.

On the other hand, various diseased conditions may give rise to an enlargement of the abdomen which may closely simulate pregnancy, such as dropsy or tumors of the ovaries, uterine tumors, hydrometra or pyometra, ascites, and dropsy of the kidney (hydronephrosis) and other abdominal organs. Even in health, some females, especially the large herbivora, acquire a very voluminous abdomen from feeding heavily on hay or grass, and the condition at times so closely simulates pregnancy

as to lead to error. The enlargement of the abdomen, as a sign of pregnancy, becomes valuable, therefore, only in connection with other signs and should not be depended upon alone.

The enlargement of the mammæ normally begins quite early during pregnancy in primipara, while, in animals which have produced young several times, these organs do not ordinarily show signs of enlargement until toward the close of gestation. In the cow or goat which is used for dairying purposes, the milk flow may be perpetual and, when the milking of the animal has been continued throughout gestation, there is no notable enlargement of the udder. In poor milkers there is usually a tendency for the flow of milk to decrease soon after impregnation and in many cases it is impossible to keep the cow milking up to the time of parturition or even to mid-term. In other cases, however, the animal continues to secrete milk throughout gestation, and toward the time of parturition, when the mammæ would ordinarily enlarge as a result of pregnancy, there is increased secretion of milk.

The enlargement of the mammæ is not, however, a trustworthy sign of pregnancy. In some animals the glands fail to enlarge to any appreciable degree and, after parturition, fail to furnish milk for the nutrition of the young. This is especially observed in old mares, which have been bred for the first time. On the other hand, the mammæ become enlarged in the absence of impregnation. Fleming states that the milk glands may be aroused to activity in the young animal, when but a few days old, owing to suction upon the teats, as is habitually observed in young calves when a number of them are kept together, in which case they form the habit of sucking each other repeatedly. While this rarely excites the glands to function, it is claimed that it does at times. In other cases it is repeatedly noted that animals which are in estrum show functional activity of the milk glands. The bitch, while in estrum, very frequently shows enlargement and some functional activity of the mammæ. We have observed a mare mule which, though presumably incapable of impregnation, constantly soiled her hind legs badly while in estrum, owing to a profuse flow of milk from the greatly enlarged udder.

It has been claimed that toward the close of gestation there

are alterations in the composition of the urine of the pregnant animal, consisting chiefly in a decrease in the salts of lime, but the data upon this point are not sufficient to warrant any definite conclusion.

Some have proposed to weigh animals suspected of being pregnant, but the weight of animals varies so greatly, as a result of the character of food, work or health, that no deductions can safely be drawn in this way.

Finally, when parturition is near, there is an increased vascularity of the mucous membrane of the vulvar opening.

In the cow, a further sign of pregnancy, applying only near the close of gestation, is that of sinking of the hips owing to relaxation of the broad sacro-sciatic ligaments of the pelvis. As already noted similar signs are regularly observed in sterility especially when due to diseased ovaries.

None of the foregoing signs of pregnancy are wholly reliable. While they generally answer the purposes of the breeder, there are frequent exceptions which may lead to more or less serious error. Any one of the foregoing symptoms of pregnancy may be induced by other causes and any one of them may be absent nearly or quite to the time of parturition.

Positive or Direct Signs.

We can only determine the existence of pregnancy positively by observing the presence of the fetus in the uterus by some unequivocal means. To this end we have definite means: 1, by vaginal, rectal or abdominal manipulations or by ballottement; 2, by auscultation of the fetal heart-beat; 3, by observing the movements of the living fetus.

The determination of the presence of the fetus in the uterus by manual exploration is more or less available in all our domestic animals when gestation is well advanced. In our larger herbivora it is not easy to feel the fetus through the abdominal walls, because of their tension and firmness, but in the small animals, like the bitch and cat, the fetuses may be somewhat easily felt through the thin abdominal walls.

In the larger animals, if the fetus is well back and a portion of it projects into the pelvis, it may readily be touched and recognized through the vagina. This method, however, is not so

available as that per rectum and is quite inapplicable, as a rule, until very near the close of pregnancy.

In the mare and cow, rectal exploration affords conclusive evidence of the presence of a fetus. If the rectum is properly emptied and the oiled hand is introduced to the full length of the arm, it is generally possible to reach the fetus as it lies within the uterus and, by careful palpation, to distinguish its parts. Usually in the course of this palpation, after the mid-term of pregnancy, the fetus reacts to the touch and moves somewhat, revealing not only its presence, but also the fact that it is living.

In some cases, however, when the fetus has acquired considerable volume and the abdomen of the mother is quite capacious and pendulous, the fetus drops so far away forward that it may be almost out of the examiner's reach. In such cases the examiner will find the enlarged tightly stretched vagina passing over the brim of the pelvis and disappearing forward into the abdominal cavity. This is in marked contrast to the normal non-gravid uterus, which can be readily distinguished and picked up by the hand per rectum. When the uterus has thus disappeared out of reach forward, the ovaries have also been dragged with it and cannot be touched. This absence of the uterus from its normal non-gravid position and the presence of the enlarged and stretched vagina extending forward, is at least conclusive evidence that the uterus has been borne forward by a load of some character, which we would at once assume to be a fetus. Further manipulation will reveal the presence of the fetus, some part of it lying within reach.

In making the examination per vagina or per rectum, great care should be taken to provoke as little excitement of the animal or irritation of the uterus as is possible. It is needless to suggest that the examination per vaginam should be made under antiseptic precautions and in a manner which would not cause straining. The examination should be made through the walls of the vagina at the sides of the *cervix uteri* and not through the *os uteri*, as this would inevitably jeopardize the life of the fetus.

Ballottement may be carried out in two ways. Some claim that ballottement can be practiced in small animals, the same as in human obstetrics, per vaginam : but it would seem that the re-

sults are not satisfactory because, in our multiparous animals, the fetuses lie in the cornua and, even though we place the animal in a vertical position, the young cannot readily drop into the pelvic cavity in a manner to permit of ballottement.

In the larger domestic animals, ballottement through the abdominal walls is usually quite satisfactory, after some experience has been acquired. The animal is examined in the standing position. The veterinarian stands upon the right side of the cow, or upon either side of the mare, though preferably upon the left, and places the palm of his hand against the abdominal wall in the lower flank region just above and anterior to the udder. By a sudden push upward there should be recognized a hard body which recedes from the hand as though floating in a liquid and, a moment later, falls back again and strikes the examiner's hand. The exact point for this manipulation must be determined for each individual case and it may be necessary to search the surrounding area for some distance before coming in contact with the fetus and thus recognizing its presence. This constitutes one of the most reliable and available methods for the diagnosis of pregnancy. There are no other normal abdominal contents which can thus be pushed away from the abdominal wall with a bound and then fall back again with an evident impact upon the point from which they departed. Naturally, this method is only applicable after the fetus has acquired considerable volume ; hence, it is not available for purposes of diagnosis until the beginning of the last half, or third, of pregnancy.

The determination of pregnancy by auscultation of the fetal heart-beat is recognized as positive in its results. It is only available when the fetal heart has acquired such dimensions and force as to render its sounds audible. It not only demonstrates fully the presence of a fetus, but also gives the important information that the fetus is alive.

The heart-beat of the young consists of regular sounds which are not rythmic with the beat of the maternal heart ; they are much more rapid and have a different character, the sound having less volume and being somewhat clearer—perhaps we should say having a higher pitch. Lafosse claims to be able to diagnose pregnancy in the cow at six months by the heart sounds, but admits that the results are not uniform in all cases, or rather,

that in some the heart-beat cannot be perceived, but that, when present, it is thoroughly reliable. As a general rule, the rate of the heart-beat is about twice that of the mother. The heart-beat is detected best in the standing animal along the floor of the abdomen or low down in the flank, though the exact point for best hearing it must be determined separately for each case. In our experience we have found it very easy in most cases to detect the heart-beat in the mare, cow and ewe, either directly or with the aid of the stethoscope.

Under some conditions, when the intestines are very active, their sounds may mask or obliterate those of the heart, rendering the examination very difficult and possibly destroying its efficiency.

The movements of the fetus constitute clear evidence of pregnancy and of the fact that it is alive. We have no reliable and safe methods for inducing movements of the young and, consequently, this evidence of motion is procurable only by chance or at considerable risk. Fleming remarks that some ignorant persons pour water into the ears of the pregnant animal, in order to cause it to make violent efforts to get rid of the fluid, and claim that, if the animal is pregnant, it will only shake the head and ears. Others give a drink of cold water to an animal which is warm and very thirsty and thus induce movements of the fetus, owing to the shock from the close proximity of the cold water when it enters the stomach or rumen, to the fetus. This is a dangerous procedure, liable at all times to cause abortion.

The only safe method of determining pregnancy by the presence of fetal movements is by long and repeated observations, until the fetus makes more or less distinct movements, in a voluntary way, which can be seen through the abdominal walls. These occur in most, if not all, pregnant animals, but are most readily observable in the mare and cow, where the size and strength of the fetus suffice to bring about very vigorous movements. They are noted chiefly at the same point in the abdomen as that designated for ballottement, that is, in the lower flank region.

In all these methods for diagnosing pregnancy, it will be observed that none of them are applicable or reliable in the earlier stages, so that at this period reliance must be placed upon the

two preceding classes of symptoms rather than upon direct investigation. Among these direct methods, that most early available is the manipulation per rectum, which can be made to succeed as early as a fetus has acquired sufficient size to be felt floating within the uterus. In this case, upon examination per rectum, the uterus is found markedly enlarged and softened and more or less fluctuating or sugillating. Floating somewhere within the liquid, usually lying at the bottom on account of its high specific gravity, is the fetus, which is perfectly movable and some of the parts of which may be recognized.

The differentiation of pregnancy from various diseases of the uterus or abdominal organs sometimes causes difficulty.

The uterus itself is subject to a variety of diseases which cause its enlargement and thereby simulate the pregnant condition. In very rare cases there has been observed, especially in the cow, a dropsical condition of the uterine walls, which causes the organ to become enormously enlarged and leads sometimes to the supposition that the animal is pregnant. In such cases, our only positive means for differentiation is the determination of the presence or absence of the fetus itself within the uterine cavity, by one or several of the methods which we have already described. Such a uterus will not respond to ballottement, there can be no fetal heart-beat and no fetus can be touched by rectal exploration.

Extensive abscess of the uterus, or pyometra, might be mistaken for pregnancy. In the case of pyometra, there is usually some abnormality of the cervix uteri and a more or less constant discharge from the vulva, while the uterus itself is very flaccid and the two horns are usually distended alike, no fetus being recognizable in either. In abscess of the uterus, the organ is large and more or less spherical and its walls are hard and tensely stretched, while an examination through the vagina shows that the os uteri is obstructed or effaced.

Uterine tumors may be mistaken for a fetus, but should be distinguishable by the fact that they do not move in the uterus, but only with the uterus or its walls; that is, the tumor may be pushed back and forth only to the same degree as the uterus itself moves with it, while the fetus may move freely within the cavity of the organ, except in cases of mummification.

Tumors of the ovaries, whether cystic or solid, rarely attain sufficient size to be mistaken for pregnancy, though in one case we observed in a sow an ovarian tumor weighing 28 pounds. These tumors are to be differentiated from pregnancy, or at least from normal uterine pregnancy, by the fact that the uterus itself is normal, empty and in its proper location, except as it may be displaced by the weight of the tumor.

Hydronephrosis, or cystic kidney, is occasionally observed in our domestic animals, usually in the sow, and may simulate pregnancy to the extent of causing a very great increase in the size of the abdomen. In one case which we observed in a sow which would normally weigh about 300 pounds, there was a cyst of the kidney which occupied almost the entire abdominal cavity and caused a very great enlargement of it. The weight of the cyst finally became so great that the animal could not rise when down. The cyst contained about 80 pounds of fluid. In an animal of this size, it is not easy, for a time, to differentiate between this condition and pregnancy. In the cystic kidney, however, the cyst augments continually and more or less rapidly, giving the body a general fullness, which is not at all confined to the lower flank region, as in pregnancy. The abdomen becomes very tense and, moreover, there is likely to be increased thirst, along with some depression and greater difficulty in moving than if the animal were pregnant. Moreover, there is usually some history of the date of breeding and the enlargement of the abdomen soon shows a want of harmony between it and the period of possible impregnation. If the normal duration of pregnancy has been exceeded and the distension is very great, these facts become highly diagnostic; or, if great distension of the abdomen occurs prior to the time at which pregnancy should normally cause enlargement, it becomes obvious that this is due to some other cause.

Ascites, or dropsy of the abdomen, may also become confused with pregnancy, especially in the bitch, where it is comparatively common. Here again our differentiation would depend largely upon the same considerations as in cystic kidney, between which two conditions there is little difference in the symptoms in the living animal.

In either hydronephrosis or ascites, along with general symptoms of those maladies, the trocar may be used as an aid in diagnosis.

The Duration of Pregnancy.

The duration of pregnancy varies greatly according to the species of animal, in the individuals of the same species and even in the same individual during different pregnancies. In our domestic animals we find the extremes of variations in normal duration in the rabbit, where the young are carried for 28 to 30 days, and in the elephant, where the duration is 1¾ years, or about 21 months. The duration of pregnancy is not definite in the individuals of any species and the limits in variation increase somewhat according to the increase in the average duration. In those animals having a short period of gestation, like the rabbit, the variation is very slight, scarcely exceeding two days, while in the mare, with an average duration of a trifle more than 11 months, the variability is increased to two or three months. The variations in the duration of normal pregnancy in the mare are more than twice the normal duration of pregnancy in the rabbit.

The duration of pregnancy bears a somewhat inconstant ratio to the size of the animal and, as a general rule, the larger the animal, the greater the duration of pregnancy. This law, however, is not wholly applicable and in some cases would seem to be well-nigh overthrown. In a given species where there are great variations in size, as in the dog, there is no variation in the duration of pregnancy because of size, so that the great Mastiff, weighing more than 100 pounds, has no greater gestation period than the Toy Terrier weighing 2 or 3 pounds. In some cases, also, species which are somewhat closely allied have very uniform periods of pregnancy, which do not accord with the differences in size. Thus, the duration of gestation in the dog is only a trifle greater (about 12%) than in the cat. In those species which cross to produce hybrids, such as the horse and ass, the duration of pregnancy is naturally nearly the same.

The duration of pregnancy is also somewhat dependent upon the state of development in which the young are, born. Thus, in the carnivora we find a duration of 8 or 9 weeks, while in

sheep and swine, which are but little larger in many instances, the duration is more than double. However, in these latter instances, when the young are born they are far more developed than the former.

It has been claimed that breed exerts some influence upon the duration of pregnancy and Wilhelms has asserted that the Hungarian cow goes some 10 days longer than the Dutch cow. Fleming is of the opinion that thoroughbred mares have a longer duration of pregnancy than those of the common breeds.

Statistics apparently show, also, that a male fetus is carried a trifle longer than a female in those animals where generally but a single young is born at a time, but if any difference exists it is quite unimportant obstetrically.

It may be that some of the variation in the duration of pregnancy can be accounted for by the time during estrum at which copulation takes place or the time elapsing between copulation and fertilization. This can scarcely apply to any great extent in such an animal as the cow, in which the estrual period is ordinarily less than 24 hours, while the variation in the duration of pregnancy is very great, and in which fertilization does not follow forced coition at or subsequent to the close of estrum. It has not been determined how long a time is required for fertilization to take place after impregnation, but it may generally be assumed that the ovulation occurs soon after copulation and that fertilization follows promptly.

According to Bonnet, the ova of the ewe, sow and bitch have undergone segmentation and passed through the oviducts to the uterus eight to ten days after coition, which would intimate that the fertilization had occurred within a few hours after ovulation and impregnation, and segmentation had promptly begun. Thus, the time elapsing between coition and fertilization must be inconsequential, as related to the span of gestation.

The chief cause of variation in the span of gestation does not rest upon these considerations. To some extent it may be explained by the fact that the fetus may be expelled in a state of relative immaturity, almost a premature birth ; it may reach that average stage of development which we would designate as normal, or it may remain more or less quiescent in the uterus for a period after the attainment of this normal degree of intra-

uterine development. It is reasonable also to conclude that the rate of development of the young will vary according to the individual character of the mother and may be dependent, in a degree, upon her state of nutrition.

Duration of Pregnancy in the Mare. As a general rule, the duration of pregnancy in the mare is about 12 lunar, or a trifle over 11 calendar months, or about 330 to 340 days. Bonnet gives 11½ to 12 lunar months (322–336 days) as the normal. Dietrichs, among 500 observations, found that 80% of mares foaled between 331 and 350 days. Count Lehndorff, in his text-book on horse breeding, gives a table of more than 8,300 records, in which the average duration of pregnancy was 11 months and 3 days. Statistics show that, in various studs, the male foals were carried from ½ to 6 or 8 days longer than the female. There are great variations of opinion by different writers in reference to the normal duration of pregnancy. Some consider normal a birth which occurs anywhere from 300 days, or 10 calendar months, to 365 or more days and some even extend the limit to 394 or even to 420 days, as in a case given by Baumeister and Rueff.

Saint-Cyr concludes that the normal duration of gestation in the mare is 340 to 350 days, between which time most foals are born. Some may be born alive and continue to live, from the 300th day onward, while it is not rare for foals to be born up to nearly 365 days. Rarely normal gestation may be prolonged to 400 days or over 13 months. It would seem, therefore, that there may be a variation, in the period of gestation in the mare, of about 100 days, or more than three months, and that we apparently have no means for determining in advance at what time a mare will foal, except that, in a general way, we may expect the vast majority of births to take place between 11 and 11½ calendar months. It has been alleged that breed has a certain degree of influence upon the span of pregnancy and statistics of Count Lehndorff seem to indicate that, in different studs, there are more or less marked differences in the duration.

A former client, engaged in breeding pedigreed French draft horses, found that, in 55 mares, the average duration of pregnancy was 336 days. Among the 13 pregnancies in one year, the average was 333 days, the longest being 364 days, a

mare foal, and the shortest 318 days, a horse foal. The shortest duration recorded by him was 298 days, the foal being a mare.

Duration of Pregnancy in the Ass.

Carsten-Harms gives the duration of pregnancy in the she-ass as 348 to 377 days, which is in excess of the average duration in the mare, but the observations which have been made are not sufficient in number to render them very reliable. Various writers claim that the period of gestation of mule foals is greater than with horse foals.

The Cow. The duration of gestation in the cow is usually 270 to 280 days, with a very wide variation. In 1062 cases quoted by Fleming, 15 were pregnant less than 241 days, 52 from 241 to 270 days, 119 from 271 to 280 days, 544 from 271 to 300 days, 230 from 282 to 290 days, 70 from 290 to 300 days, and 32 beyond 301 days. Fleming gives the average duration at about 283 days, while Colin makes the average 280 to 285 days.

The Sheep and Goat. The duration of pregnancy in the sheep and goat is about 5 months, with variations of some 12 days. Some observers have found that the duration of gestation was longer in female than in male lambs and there is an impression, which is apparently supported by statistics, that twins are born somewhat earlier than single fetuses, but the difference, if any exists, is very slight.

The Sow. The duration of pregnancy in the sow is a trifle short of four calendar months, or about 115 to 120 days, the variation not being very great, although some authors give, as extremes, about 104 to 127 days, with most births occurring between 115 and 125 days.

Carnivora. The bitch is pregnant from 58 to 65 days, but usually about 9 weeks or 63 days, while the duration of pregnancy in the cat is 3 or 4 days less, or about 8 weeks, with a variation of 3 or 4 days.

Wild Animals.

In wild ruminants, the duration of pregnancy varies from 34 or 35 to 40 weeks. Harms notes the peculiar fact that in the deer there is a period of 40 weeks between impregnation and the birth of the young, but that this time does not represent the period of development of the fetus as we understand it in most

animals. The ovum of the deer undergoes segmentation and then lies in the uterus for four months in an essentially dormant state. About December the distinctive embryonic development begins and birth follows in May or June, or about five months later. If this time of five months, during which the active development of the fetus has taken place, is compared with the duration of gestation in the sheep, the two periods of gestation become virtually identical. It is suggested that this delay in the development of the young is a provision by which it may be born at a favorable season of the year.

The Number of Fetuses.

In the domestic animals we find great variation in the number of fetuses ordinarily brought forth at a given birth, and we recognize, as a rule, two or three classes of animals in reference to these numbers: the uniparous animals, chiefly the mare and cow, which ordinarily give birth to but a single young at a time; the biparous, or twin-bearing, animals, among which we find chiefly the goat and the larger breeds of sheep; and the multiparous animals, among which we include the carnivora and the sow.

Twin Pregnancy.

In all animals, however, there are occasional departures from the rule. Thus, in unipara, we occasionally find twins and sometimes, in our multipara, only one or two young are born at a time.

Among our uniparous domestic animals, twins are most rare in the mare, although every veterinarian of experience in a horse-breeding district has observed such cases. Among cows, twins are not at all rare.

The causes of twin pregnancy may vary. Fundamentally, the number of fetuses must depend upon the number of ova which have been discharged into the uterus during a given estrual period. In some cases, two or more eggs are formed in one Graafian follicle and, when discharged and fertilized, may each develop into a fetus, but one yellow body remaining in the ovary to indicate their origin.

Usually twins proceed from the simultaneous rupture of two ripe ovisacs, with the discharge and subsequent fertilization of one ovum from each.

In other cases, twin pregnancy may be caused by complete division of the ovum or blastoderm to form two separate embryos, in which instance they become identical twins, being of like sex and enclosed in a common chorion each having a separate amnion.

Twin pregnancy in the mare nearly always results in abortion at about the eighth to tenth month and in a large proportion of cases it is found, when the two fetuses are expelled, that one is much more developed than the other, indicating that the least developed one has been dead in the uterus for a considerable period of time, without having undergone decomposition. In the mare, this twin abortion occurs in probably 90% of the cases and, among those which are born alive, it not infrequently occurs that one of the pair is liliputian in size.

Rueff records one case of twin gestation in the mare in each 250 cases and this seems to be somewhat near to the average. While we have personally observed several instances where both twins have been born alive, they are usually more or less imperfect and tend to perish soon after birth. In other cases, however, we have seen them quite normal and vigorous, very much alike in size and form and partaking of that striking likeness common in the twins of other animals and of man. Triplets and quadruplets have also been recorded very rarely in the mare. As in twins, abortion usually brings the pregnancy to a premature close or, if born alive, the foals are generally weak and tend to perish. Saint-Cyr cites one case in which a mare, from a single stallion service, aborted two fetuses in one chorion and, some months later, gave birth to a living and vigorous foal.

The most interesting cases of twin pregnancy recorded are those of a series quoted by Saint-Cyr, in which the twins were due to successive copulations. The mare, having been put first to a stallion and then to a male ass, brought forth a foal and a mule at the same time. In these cases the two copulations were not very widely separated, usually during the same day or, in one case, after an interval of 15 days, probably one prolonged estrum.

In the cow, twin and triplet pregnancies are not so uncommon and the tendency to twin abortion, which is seen in the mare,

is absent. They tend to carry the twin fetuses to the regular period as though but one were present, though, as already noted, it is claimed that the duration of twin pregnancy is normally a trifle less than that of single pregnancy.

In some cases there is an hereditary tendency to the production of twins in a given strain or family and certain individual cows produce twins year after year. Fleming quotes one case in which a cow, during an interval of seven years, produced 25 calves, or an average of more than three per annum, having given birth to a single calf the first time and thereafter producing anywhere from two to six calves at a birth. In the one instance of six young, all died prematurely. One of the most notable cases of excessive numbers is that given in the Magazine of Gurlt and Hertwig, Vol. 23, page 125. A cow which had given birth to one vigorous calf was butchered, and fifteen fetuses were found in the uterus. Other instances of from three to six or more calves at a birth are recorded, scattered throughout veterinary literature, and are of little interest, except from the standpoint of curiosity, unless we should remark that, when a cow is attended during parturition, a search of the uterus should always be made, after the removal of one fetus, to determine the presence or absence of additional young.

In the ewe, twins are very common and, in some of the large mutton breeds, twin pregnancy becomes the rule and single births the exception, aside from yearling ewes. In some well-fed bands of ewes, we have seen an average of two lambs per ewe for the entire number. In one case of 26 Cotswold ewes we observed 52 lambs, there having been a sufficient number of triplets to bring the average up to two lambs per ewe.

In the smaller breeds of sheep, like the Merino, twins are less frequent.

In the goat, the general rule is twins or triplets.

We have already noted, page 156, the frequent occurrence in the cow of what is known as freemartins, or of twin pregnancy, in which one of the pair of twins has become arrested in its sexual development and remains to some extent hermaphroditic, or neutral, in character.

The Diagnosis of Multiple Pregnancy in uniparous animals is seldom called for except in cases of difficult labor. Even

then, as a rule, it is not suspected except in those cases where the difficult labor is produced by simultaneous presentation of parts of the two fetuses. Sometimes a twin pregnancy may be suspected on account of the very great size of the abdomen, and it might be diagnosed by an exploration per rectum, though not with great certainty. When two young present simultaneously at the pelvic inlet and cause dystokia, the condition can usually be readily diagnosed by tracing the presenting parts, limbs or head, to the separate bodies of the fetuses. The only difficulty occurring, as a rule, is when a single fetus undergoes that deformity which we know as campylorrhachis or schistocormus reflexus, Figs. 71 and 72, in which case the spine of the fetus is abruptly bent upon itself, so that the head and all four feet present simultaneously at the pelvic inlet, thus closely simulating twins. This abnormality is to be differentiated from twins by the fact that, when one portion is repelled or advanced, the other part moves in harmony with it, which is not true of cases of twin pregnancy, where the one fetus can be repelled while the other advances.

Position of Fetuses in Multiple Pregnancy. In animals which are normally uniparous, as the mare and cow, it is interesting to study the position of fetuses in case of twins or triplets. In general it may be stated that, where twins occur as a result of the simultaneous rupture of two ovisacs and the fertilization of the eggs, they develop two complete sets of membranes, each fetus having its own amnion and chorion. In those cases where twin pregnancy is due to the fission of a single ovum, the two embryos are developed in the same chorion, but each has its own amnion.

When the two fetuses each have separate membranes, it is possible for one of them to be expelled at one time and the other to remain in the uterus for a considerable period afterward and finally be born alive. In this way we find recorded, in our literature, occasional instances where an animal has aborted one fetus at a comparatively early period in gestation and later, after the normal duration of pregnancy, has given birth to a living twin. We find quite commonly, in the mare, that one of a pair of twins perishes and remains in the uterus for a considerable time, while the other continues to live and develop. Finally they are aborted,

or the one is born alive, and there is observed a great variation in the degree of development of the two, which sometimes leads to the belief that they represent impregnations at widely sep-separated times.

When death of one fetus occurs early, it may undergo mummification and remain in the uterus as an inert body. In our museum, there are, in the uterus of a cow, twin mummified fetuses which had perished at about the 7th month of gestation.

In the cow and ewe, each of the twin fetuses very largely occupies one uterine cornu and usually presents with the head toward the os uteri, but it is not rare to find them presenting alternately, that is, one anteriorly and the other posteriorly.

It is interesting to note also that occasionally, in twin pregnancies, one twin is more or less enclosed within the body of the other. This presumably results from fission of an ovum, by which two embryos result from a single egg and, being unequal in size and remaining intimately connected, the one grows around and includes the other, until finally its inclusion is more or less complete.

THE HYGIENE OF PREGNANT ANIMALS.

Little can be said, in reference to the hygiene of a pregnant female, which would not equally apply to the same species of animal in an unimpregnated state. It has been held by many that the pregnant female requires different care from others, but there is no scientific reason why this should be so, nor have we any clinical experience supporting such a contention.

There is but one view-point from which we may claim that special care is essential for the well-being of the pregnant female and the young within her uterus. The weight of the fetus tends to render the animal somewhat less capable of performing certain kinds of labor or movements and the attachments of the fetus with the uterus are such that any very violent movements may cause some disturbance of these. It consequently follows that, in animals in an advanced state of pregnancy, more care should be used in reference to violent exertions. This is seen to some extent in all animals, but more especially in our larger herbivora, where the single, very large fetus may cause some disturbance of the placental attachments should any sudden movement of the mother occur. In a general way, however, we would not care to submit a non-pregnant animal to such abuse as might lead to injury of the pregnant female.

The well-being of the pregnant female is best conserved by the same diet which would maintain the non-pregnant animal in the best state of health and, in relation to exercise, the same conditions hold true. Those pregnant females which are allowed their freedom and, consequently, get normal exercise without any serious disturbance are those which most regularly pass through the pregnant state without serious inconvenience and danger. Next to these we find the safest pregnancy in the mare to be that accompanied by regular daily labor of a gentle character.

Any violent movements in any pregnant female are, of course, to be obviated as far as practicable. It is important that the pregnant mare which is worked should not be roughly jostled by the pole of a vehicle, because such blows may serve to directly injure the fetus or disturb its placental attachments and thus imperil its life. Abortion following, the life of the mother may

also be in danger. Any form of violence which might bring about a sudden and severe impact upon the abdominal walls should be avoided.

Mares used for draft work should be carefully guarded against violent pulling, because this tends constantly to increase the intra-abdominal pressure and thereby to greatly interfere with the circulation in the uterus and to disturb the placental attachments of the fetus. Abortion, following very severe pulling, is not rare. We observe precisely the same danger at times when the animal is free in the pasture and becomes accidently mired in deep mud.

Pregnant animals which are used for labor may continue at quiet work to the end of pregnancy, but, if the labor is of a somewhat strenuous character, it is best to omit it at an earlier period. A brood mare put to gentle farm work or other labor of a similar character may be continued at it without disadvantage and, in many cases, rather with advantage, up to the time of parturition. It is not at all rare in agricultural communities to have mares stop in the plow and give birth to a foal without any accident and in a very prompt and successful way. We have personally observed cases where the mare has dropped in the harness and has scarcely permitted time for being unharnessed before the foal was expelled. Yet, no harm has come from it. We have seen the same occurrence in mares which have been used for driving purposes and where parturition came on so suddenly that it was impossible to return the mare to the stable and she has foaled upon the roadside. We have never observed any untoward effect to either the mother or fetus from such an occurrence.

Anything which is liable to cause the gravid uterus to be violently thrown about in the abdominal cavity has a constant tendency to bring about injury to the placenta or displacements of the uterus which may prove more or less serious. It is not safe to drive a mare, well advanced in pregnancy, at a rapid pace, because of the unavoidable displacements of the uterus with its heavy contents. Consequently, rapid trotting, galloping and jumping should be avoided as far as practicable. When pregnant animals are free in the pasture they usually guard against these excesses and move with care, at a comparatively

slow pace, and thus avoid the dangers which may be thrust upon them by injudicious handling while at work.

Much the same results are noted in pregnant animals which are shipped in railway cars. The shipment itself is not essentially dangerous under proper conditions, but the unsteady movements of the car and the fright of the animal cause it to be thrown about more or less violently. If these violences can be avoided, the dangers from railway travel are reduced to a minimum and rendered comparatively unimportant.

The dangers which we have enumerated are of such a character that we would generally wish to avoid them in the non-pregnant, as well as in the pregnant, animal. The chief difference is that the risk is somewhat greater for the pregnant animal than for the non-pregnant, largely because it involves the lives of both the mother and the young, each dependent upon the other.

Some writers suggest that the pregnant female should not be allowed near the male, but there is no clinical evidence in support of such a contention. It is quite true that in exceptional cases a pregnant female will show signs of estrum and copulate with the male, but it has not been shown that this is extremely serious. Instances have been observed where abortion has quickly followed copulation, though it has not yet been determined whether the coition caused the abortion or the death of the fetus caused the appearance of estrum and hence the coition. At best, it may be said that injury from this coition during pregnancy is very rare. It is to be remembered, however, that pregnant females will only rarely copulate, and it is a notable fact that those which do so are almost wholly stabled animals and very rarely those which are running at large. In this class of stabled animals, if they show estrum it is usually accepted as conclusive evidence of non-pregnancy, and the animal is bred, incurring all the risks possible were the male habitually free with the female.

Abortion is probably more rare among those animals where the male and female are allowed to consort throughout the year than in any other class. Upon the ranges, where the bulls consort with cows throughout the year, accidental abortion is not known to be any more common, nor even so likely to occur as in stabled cows, and the same is true in cases where stallions are allowed to consort with mares throughout the year. In our smaller domes-

tic animals, males habitually consort with pregnant females throughout their pregnancy, and yet abortion is far more rare in these than in the larger animals. The clinical evidence, therefore, would indicate that it is not harmful to pregnant animals to permit the male to consort with them regularly.

Admittedly, however, it is dangerous to allow a male to be abruptly turned loose among pregnant females, where he may greatly annoy them and possibly cause serious injury. On the contrary, when a male is permitted to regularly consort with the pregnant females he does not annoy them nor in any way endanger the well-being of the fetus in the uterus.

The quality of food to be recommended for a pregnant animal does not differ essentially from that for any other. There are foods which are not safe for the non-pregnant animal and are equally unsafe for the pregnant female. Pregnant herbivorous animals are most healthful if allowed to graze in pastures, under the most normal conditions possible. It is not highly essential that they should be protected from inclement weather any more than if they were not pregnant. Rain, snow, cold or heat is no more prejudicial to the well-being of a pregnant animal than to that of the non-pregnant.

Some writers have insisted that certain forms of food, notably those which have been attacked by rust, fungi or molds, are especially dangerous for pregnant animals. This, however, has not been demonstrated clinically. It is quite true that abortion is more common at times among animals which are fed upon a very poor quality of food, but, if we observe other non-pregnant animals which are compelled to subsist upon the same diet, we find that they suffer in a similar way in all respects save the one question of the well-being of the fetus. Both pregnant and non-pregnant animals become emaciated and weak or show other constitutional disturbances as a result of being compelled to live upon such food and occasionally abortion is merely an additional symptom of the injudicious feeding. Special emphasis has been placed at times upon foods which are affected with smut or ergot and they are blamed for producing wide-spread abortion. As a general rule, however, the presence of smut or ergot upon fodder is seized upon merely as an excuse for the presence of abortion, which may generally be properly attributed to other causes.

If contagious abortion breaks out in a harem of mares which are running upon corn stalks during the autumn or early winter, after the corn has been gathered, it is not difficult for the owner or veterinarian to find stalks of corn affected by smut and, believing that this causes abortion, to make it serve as a scapegoat for the infectious disease which is destroying the foal crop. At another season of the year, if the mares are grazing upon bluegrass and abortion breaks out, the searcher after ergot may find a few traces upon the grass and thereby explain the presence of the contagious disease. If the mares are grazing upon red clover, which admittedly has a tendency to induce tympany and other serious diseases in case of overfeeding, the character of the food is again drawn upon to explain the presence of the disease.

In general it should then be stated that the food should be of a good quality, just as it should be for a non-pregnant animal, and that in amount it should correspond very closely with the volume allowed to ordinary animals.

In reference to water for pregnant females, there is again no essential danger which does not equally apply to the non-pregnant animal. Fleming holds that pregnant animals should not be allowed to drink very cold water, which is not clinically true. We have habitually observed animals drinking cold water at will and have never observed any ill effects from it. Throughout the western parts of the United States, and even in the Mississippi Valley, pregnant animals habitually have cold water during the winter season. Upon the Great Plains of the United States, pregnant animals very largely use snow instead of water and it does them no harm ; when they do drink water from a stream it is generally barely above the freezing point. Throughout the Mississippi Valley it is not at all rare in the winter season to be obliged daily to break or cut the ice which covers the water which pregnant animals are to drink.

Nevertheless, there is some force to the remark in reference to the allowance of very cold water ; if an animal is allowed to become extremely thirsty and has been made very warm by fatiguing labor and is then allowed to drink an inordinate amount of ice-cold water, it may have a very deleterious influence upon the fetus, since, when the water reaches the stomach or rumen, it comes in close contact with the young animal and causes a very severe shock. But even this injudicious allowance of water

would be improper in case of a non-pregnant animal, and in reality we have no clear clinical evidence that a draft of such cold water causes abortion. In those pregnant animals which are much out of doors during cold weather and which go to water at will, there seems to be no danger whatever from drinking the cold water, because it is taken very slowly, as a rule, so that the shock is not so great. It is common to note that these animals, after drinking of ice-cold water, shiver somewhat in the cold, but this does not seem to have any special danger for the life of the fetus.

Some writers also speak very unfavorably of allowing pregnant animals to eat frozen food, or herbage which is covered with frost. This notion also seems to be quite erroneous. Upon the western plains the animals which are left out during the entire winter, whether pregnant or not, must habitually paw or dig the snow from the scanty herbage in order to procure food and consequently eat with the grass a considerable amount of snow, which may be at a temperature of as much as—40° or—50° F. Yet, pregnant animals do not suffer from this cause. In the Mississippi Valley, during the earlier periods in the settlement of the country, almost all pregnant animals were fed out of doors in the winter time and the food had to be taken from the ground, which was largely covered with snow and frequently at quite a low temperature. Yet, these pregnant animals almost never aborted under any conditions whatever. We must admit, however, as we have done in reference to the drinking of cold water, that some foods may be so damaged by cold as to make them undigestable and injurious, alike for pregnant and non-pregnant animals. Succulent foods, like roots, clover or green vegetables, which are normally killed by a moderately low temperature, may be so frozen as to be quite injurious. Naturally, they should not be allowed to pregnant animals, nor to those which are non-pregnant.

The housing of pregnant animals should not differ in any material respect from that of the non-pregnant. The same rules as to light, air, ventilation and the amount of cubic space per animal applies alike to all, whether pregnant or not. A stall that is good for a non-pregnant animal is sufficient for a pregnant one. It is of course desirable that the stalls for pregnant animals should

not slope very greatly, either backward or forward. The same rule applies also to the non-pregnant animal, although pregnancy intensifies the backward pressure of the abdominal viscera, in case the stall slopes very greatly, and may thus thus tend to cause prolapse of the vagina.

When the time for parturition draws near, it is generally advisable that cows and mares which have been kept in single stalls or stanchions should be removed from these and given some degree of liberty of movement at the time of labor. Most writers advise that the mare should be given a roomy box-stall, under the belief that she can better foal in such a place. This may be generally true, although accidents have occurred because of the very fact that the animal was loose in a box-stall. In such a stall the mare sometimes lies down with her buttocks immediately against the side wall and there is not room for the expulsion of the foal. Instead, the foal is jammed against the side of the stall, its expulsion delayed and its life endangered. In other cases the mare turns somewhat violently and the head of the protruding fetus is seriously injured by being pressed against the wall. The box-stall in which a mare is to foal should, therefore, be ample in size and give every possible opportunity for labor to progress without danger of accident from contact with the side walls. Some breeders arrange a special stall for foaling mares. A false wall is added, beginning at the base, three or four feet inwards from the main wall, and sloping upward and outward at an angle of 45°, joining the main wall at the height of three or four feet. This slanting wall prevents the foaling mare from becoming cast and the protruding foal from being jammed against the walls.

Later, when considering the question of abortion, we shall deal with the handling of animals which have aborted or threaten to abort in a stable or herd of other pregnant females.

The pregnant animal, like any other, should be allowed to lead a tranquil existence, free from cruel handling and from great fear. If pregnant animals, especially in the advanced stages, are chased by other animals, such as ewes being annoyed by dogs, it is naturally prejudicial to the life of the fetus. It has been suggested by some that pregnant animals of different species should not be allowed in the same field or pasture, but this is only partially correct and depends rather upon the character of the indi-

vidual animals than the question of difference in species. We have habitually seen pregnant mares, cows, sheep and pigs in the same enclosure, without any special danger to either from the presence of the other.

It needs to be noted that at the time of parturition it is unsafe to permit hogs in the enclosure where parturition is occurring, since, being omnivorous, they may devour the new-born young, and, should the parturient animal be exhausted or otherwise unable to defend herself, she too may succumb to the rapacity of the hogs. This is especially true in cases of dystocia and still more when prolapse of the uterus occurs. Fleming relates a case of prolapse of the uterus in a cow in which hogs devoured the prolapsed organ but amputated it so well that the animal recovered.

On the other hand, it is a well known fact that some animals take it upon themselves to annoy others, and even compromise their lives, whenever opportunity offers. This is especially true of mules, which sometimes have so meddlesome a disposition that they constantly harry any animal which cannot resist them, simply as a pastime; to a less degree, the same applies to colts. Again, we sometimes observe that a pregnant mare or cow is exceedingly irritable toward her companions and consequently it is sometimes unwise to permit a particularly ill-natured pregnant mare to consort with other pregnant mares, because of the injuries which she may inflict upon them by kicking or other violence.

Surgical operations and medication sometimes offer dangers to the pregnant animal and should consequently be undertaken intelligently. Serious surgical operations which are not urgent should be delayed until after parturition, especially if they involve the confinement of the pregnant animal. But this caution should not carry us too far. Serious operations, with rigid confinement, pain, fear, chloroform anaesthesia, loss of blood, subsequent infection and fever, are repeatedly performed upon pregnant animals without untoward results. While suggesting caution, pregnancy should not be regarded as a bar to major operations upon pregnant animals. Much will depend, in these cases, upon the temperament of the individual animal. In one instance we dishorned a timid Jersey heifer, which was in an advanced stage of pregnancy, and abortion promptly followed in a manner which

suggested that it was due to the fright and pain of the surgical operation or possibly to a considerable hemorrhage which followed the removal of the horns.

Any drug which causes more or less serious poisoning of the mother may naturally imperil the life of the fetus. Chief among the drugs which have a bad repute in this respect are aloes and other drastic purgatives. Whether these act by passing through the placenta and gaining access to the fetus itself and injuring it, or by causing contractions of the uterus in harmony with the peristalsis of the intestines, we do not know. Usually, however, other purgatives, such as bland oils and moderate doses of eserine and arecoline, may be given without inducing abortion and with the same safety as if the animal were not pregnant.

Consequently, in dealing with pregnant animals, we should constantly bear in mind the possibilities of abortion or other injury to the fetus, and not cause unnecessary interference which may imperil the life of the fetus. From a politic standpoint, the owner of the animal should always be advised of the possible danger to the fetus from medication or surgical operation and in all cases the casting and other manipulations connected with disease or operation should be as gently and judiciously carried out as is possible.

ANOMALIES IN FECUNDATION AND GESTATION.

Superfecundation.

Superfecundation is the fertilization of two or more ova, one after another, during one estrual period. When two or more ova are discharged during a given estrual period, one or more of them is fertilized as the result of one copulation, another ovum as the result of a subsequent copulation. If the two or more copulations are made by the same male, the evidence of superfecundation is wanting. When two or more males of different types, breeds or species copulate with the female and each fertilizes certain ova, the evidence of superfecundation becomes marked. The phenomenon may occur in any female in which two or more ova are discharged during a given estrum. If all the ova are simultaneously discharged, superfecundation is less probable, except the copulations follow each other shortly.

Superfecundation is most common in the bitch, in which there is a prolonged estrum, probably successive ovulations, and very commonly repeated copulations with dogs of various breeds. As a result, it is not rare to find the young of a given litter showing unmistakable evidences of varying male parentage, some of the young being evidently of one breed, others of another.

In such biparous animals as the sheep and goat, such results are always possible, but the opportunity for copulation by males of different breeds is not usually offered.

In the mare, in which twins are rare, there are records of a few cases in which a mule and horse foal have been born as twins, the result of closely succeeding copulations of a stallion and an ass. The two services may be separated by several days, not exceeding the duration of the estrual period. Lanzillotti-Buosanti records a case where an interval of eight days elapsed between the service by the stallion and the ass.

Superfetation.

Superfetation differs from superfecundation in that fecundation occurs in an animal already pregnant, due to copulations during two separate estrual periods. The phenomenon depends

upon two conditions. First, the female must depart from the physiologic rule that pregnancy inhibits ovulation and estrum.

How frequently this rule is violated, we do not precisely know. In the cow, especially the closely confined dairy cow, estrum during pregnancy is by no means rare. Regular estrum may appear for two, three or more periods after fecundation, copulation occur and, finally, a calf may be normally born from the first copulation. We do not know, however, that ovulation occurs in these cases. Perhaps it does. But superfetation rarely, if ever, follows.

A second essential condition is an open passage from the os uteri externum, through one of the oviducts, to the pavillion of the tube, so that the spermatozoa and ovum may meet. In unipara, this passage tends to become occluded early by the presence of a fetus in the uterine body and the adhesion of the fetal membranes to the entire circumference of the tube. In bicornual uteri, in which the fetuses are usually limited, in their location, to the cornua, and the uterine body is vacant, the fetuses of the primary fertilization may be confined to one of the cornua, an open avenue through the entire length of the other cornu exist and a second fecundation at a more or less remote period occur. De Bruin (Geburtshilfe b. d. Kleineren Haustieren) quoting Kroon, relates that a goat was bred September 14, 1897, estrum and copulation reccurring on November 5th, or 52 days later. On February 13, 1898, 152 days after the first breeding, and at the completion of the normal duration of pregnancy, she expelled two living and one dead, fully developed young. On the following day, when the membranes were expelled, there were discovered three more fetuses, perfectly formed, but not fully developed. These Kroon regarded as certainly the result of the second copulation.

Tapken, also quoted by De Bruin, observed superfetation in sows. In one instance the sow was bred on February 22, 1890, and again 17 days later. On June 21, 120 days from first breeding, she gave birth to 7 live pigs and, 14 days later, to 9 live and 3 dead pigs.

The Wandering of Genital Cells.

Schmaltz (Carsten-Harms) claims that the spermatozoa may pass through one of the oviducts, into the peritoneal cavity,

and cross over to the opposite ovary. It has also been experimentally shown that, in rare cases, an ovum which has escaped from one ovary, but failed to enter the corresponding oviduct, may pass across to the other ovary and enter its Fallopian tube. An egg which has emanated from one ovary may become fertilized, pass through the corresponding oviduct and cornu to the uterine body and thence upward into the opposite cornu, to become attached and develop into an embryo. The evidence of such occurrence is found in the fact that a fetus sometimes develops in one uterine cornu, while the yellow body from which the ovum evidently emanated is located in the opposite ovary.

Polyspermia.

It is believed by some authors that an ovum may be overfertilized, that is, instead of one spermatozoon penetrating an ovum, two or more gain admission to it, in which case the development may be abnormal and lead to the formation of some of the double or triple monstrosities.

Extra-Uterine Pregnancy.

Extra-uterine pregnancy is the existence, for a greater or less period of time, of a living ovum outside the uterine cavity, within the abdomen. The precise nature of most cases of alleged extra-uterine pregnancy in animals has not been definitely ascertained and, before arriving at any final conclusion as to their nature, the subject needs much investigation. Not infrequently fetuses are found outside the uterus in the abdominal cavities of animals, but it has not been clearly shown how they attained this position. Many records are given of the finding of such fetuses in the peritoneal cavity, but their anatomical relations are not recorded.

Several forms of extra-uterine pregnancy occur :

1. Ovarian pregnancy has been recorded and verified. In these cases it appears that the ovisac ruptures, but the ovum does not escape from it and spermatozoa, passing up through the oviduct and pavilion of the tube, reach the ovum and bring about its fertilization. The ovum may then undergo a development analogous to that observed in the uterus, either enclosed within the ovary or attached to it by the fetal membranes. The records of ovarian pregnancy are exceedingly rare, and as a rule

there are no symptoms which would lead to a diagnosis of the condition during the life of the mother. Ovarian pregnancy is liable at any time to cause the sudden death of the mother, owing to a rupture of the ovary when the fetus has developed within it or a violent detachment of the placenta, by either of which accidents fatal hemorrhage is highly probable.

2. Tubal pregnancy is apparently the most common cause of extra-uterine gestation and, in all probability, accounts for the majority of cases of this character. Tubal gestation is more readily understood than other forms. Any defect in the tube, which might cause the arrest of the ovum during its passage through it, would naturally result in the attachment and development of the embryo at that point. In multiparous animals, if one of the earliest ova should become arrested during its descent,

FIG. 81. Extra-uterine pregnancy. Swine. Showing 2 fetuses closely adherent to each other and intimately invested by membranes.

all those on the ovarian side of it would alike become halted in their migration. Consequently, a series of tubal embryos might be formed, which apparently occurs sometimes in domestic

animals, especially in the sow, and leads eventually to the existence of a group of two or more extra-uterine fetuses, as shown in Fig. 81.

The cause of the arrest in the migration of the ovum may be a folding in the tube or disease or injury of the mucous membrane. The tendency of tubal pregnancy in animals is for the development to go forward, in a quasi-normal manner, up to that period when the volume of the fetus and its membranes becomes so great that the tube is no longer capable of accommodating them. Then the thin walls of the tube rupture and the fetus or fetuses, with part or all the membranes, pass out into the peritoneal cavity. This rupture and the detachment of the fetal membranes may cause fatal hemorrhage. If fatal hemorrhage does not follow, and the fetal membranes have not been wholly detached from the maternal placenta in the oviduct, the fetus may become attached to or imbedded in the peritoneal surface, and continue to develop. If its placental attachments in the oviduct have become wholly separated, the fetus necessarily perishes at once and may undergo partial dessication and remain in the peritoneal cavity without injury or inconvenience to the mother throughout her normal span of life.

In other instances of tubal pregnancy, the developing fetus escapes through the pavilion of the tube and thus gains the peritoneal cavity. It may retain its attachment, through its membranes, with the tube, become adherent to the peritoneal walls and continue until the normal duration of pregnancy has been completed and the usual size of the fetus is reached, when it perishes and probably partially dessicates.

We do not ordinarily discover tubal pregnancy during the life of the mother, but only upon post-mortem examination, usually when the animal is slaughtered for food.

3. Rupture of the gravid uterus may occur at almost any stage of pregnancy, and the possibility of such an accident increases as the close of the normal period of pregnancy approaches. Rupture of the uniparous uterus most readily occurs in its body or the gravid cornu, and the adjacent fetus tends to at once drop through the rent into the peritoneal cavity. In the biparous uterus, the rupture may occur at such a point as to interfere with but one twin, unless the twins have a common chorion,

when each must be affected similarly. In a multiparous uterus, the rupture may occur at any part of the gravid organ and one, two or more adjacent fetuses escape through the opening.

The accident usually causes fatal shock or hemorrhage of the mother. Otherwise, the fetus may at once perish, infection of its body and membranes, through the os uteri, follow, leading quickly to fatal sepsis of the mother, or abscessation may follow, the adherent surrounding tissues constituting the abscess wall and the decomposing fetus and membranes, the abscess contents. The abscess may rupture externally through the abdominal walls or internally into the intestinal tract.

Escaping these immediate dangers, should the chorion remain partially attached to the placenta, the fetus may continue to live up to the normal period of birth or it may perish immediately, but, the os uteri remaining sealed or infection otherwise avoided, the fetus remains as an inert body for an indefinite period, to constitute a variety of extra-uterine pregnancy.

4. It is claimed by some writers that a primary abdominal impregnation may take place—that is, an ovum may drop into the peritoneal cavity and there become impregnated by a spermatozoön, which has traversed the uterus, cornu and oviduct and escaped, through the pavilion, into the peritoneal cavity. The embryo becomes attached to the peritoneal surface and develops in a more or less normal way. No unquestioned case of primary abdominal pregnancy has yet been seen. The possibility of such an occurrence has not been disproven. The cases thus far cited to prove the actual occurrence have all been faulty in some particular, which serves to throw a doubt upon the correctness of the alleged occurrence.

The course of abdominal pregnancy in animals, so far as has been observed and recorded, is that the fetus or fetuses acquire a more or less rigid attachment to the abdominal walls or some of the viscera, and the fetal membranes closely invest the fetal body in such a way as to compress it into the smallest possible space. In the cases ordinarily observed, the fetus or fetuses are closely enveloped in firm membranes without any intervening liquids, so that the covering, which may be regarded as the amnion, is in direct contact with the hair of the fetus and cannot readily be stripped away from it. This is well shown in Fig. 81.

The fetus usually seems to have been normal originally, but

to have later undergone a process of dessication and in this state remains as an inert body for an indefinite period of time. We have few records of how long a fetus may thus remain as an inert body in our domestic animals, because, as a rule, it is only discovered upon slaughter and the time at which it developed has not been determined. In woman, where the observations have been more accurate, there are cases recorded where an abdominal fetus has remained inert and without inconvenience to the mother during a period of more than 50 years.

The degree of dessication in extra-uterine pregnancy is not equal to that observed in intra-uterine mummification, as a comparison of Figs. 81 and 86 well show. Extra-uterine fetuses are comparatively plump, usually normal in size and development and are closely invested by tough, adherent membranes. Intra-uterine mummified fetuses are free from membranous attachments, greatly shrivelled, discolored and gnarled.

There are few cases, indeed, in which extra-uterine pregnancy has caused any known disease or discomfort in animals. Fleming cites a number of cases in which the fetus has undergone putrid decomposition, with the formation of an abscess, which has ruptured into the intestines or other viscera or, more frequently, externally through the abdominal wall. He classes these cases as extra-uterine pregnancy, but submits no evidence to show that the fetus was not in the uterus until it decomposed and finally escaped therefrom as a part of the contents of an abscess within the uterine cavity. We shall refer further to this subject under the heads of "Torsion of the Uterus," "Atresia of the Os Uteri," and "Putrid Decomposition of the Fetus."

The diagnosis of extra-uterine pregnancy is difficult in the living animal. In carnivora, the fetus may possibly be recognized, and its location outside the uterus determined, by extra-abdominal manipulation. However, this is difficult, as we cannot readily trace the non-gravid uterus by this means. Even though we can feel a fetus through the abdominal walls, we can not be sure that it is not in the uterus. It may be attached firmly to the abdominal floor, which would constitute presumptive evidence that it is extra-uterine, but the proof is not final, since one of the uterine cornua, with a fetus included, may be firmly adherent to the abdominal wall and thus nullify the diagnosis. In our larger domestic animals, an exploration of the

uterus may show that it contains no fetus and if, through its walls or those of the rectum, a fetus can be recognized it becomes clear that we are dealing with extra-uterine pregnancy, or at least with an extra-uterine fetus.

Fleming (Text-Book of Veterinary Obstetrics, 1st Edition, p. 159) quotes S. Della-Rovere as having attended a case of extra-uterine pregnancy in a cow, in which he removed a living calf through an incision in the wall of the vagina. The citation by Fleming fails wholly, however, to show that the fetus was not in the uterus. No record is made as to the condition of the uterus itself and it is almost certain from Fleming's quotation that it was not extra-uterine pregnancy at all.

It is not at all rare to meet with cases of uterine pregnancy which closely simulate extra-uterine gestation. We have already suggested, on page 383, while considering the position of the fetus during gestation, that in some cases in the cow the fetus pushes its way up into the pelvis alongside the vagina and can be clearly felt there. This position is apparently normal and has no danger, seemingly, for the life of either mother or fetus. A still more puzzling condition is the bi-cornual or transverse pregnancy of the mare, in which the fetus lies beneath the vaginal floor in a transverse position, in such a way as to lead the inexperienced to believe that extra-uterine pregnancy exists.

In order to definitely recognize and verify extra-uterine pregnancy in the living animal, the following factors are essential: first, we must recognize the presence of a fetus; second, we must establish the fact that it is not in the uterus, and we can do this, in case of a uniparous animal, only by determining clearly that the uterine cavity is vacant. The emptiness of the uterus must be verified either by inserting the fingers or hand into the uterine cavity itself, or by an ample and authentic examination of the uterus per rectum. Otherwise, we can clearly determine extra-uterine pregnancy only by a post-mortem examination.

The treatment of extra-uterine gestation is rarely necessary. If diagnosed, and it seems to threaten the life or health of an animal, the removal of the fetus may be considered. In animals which are used for meat purposes, the patient should be sent to the butcher at the earliest convenience, providing the meat has not been injured by decomposition of the fetus or other disease induced by its presence. In carnivora, the fetus may be removed by laparotomy.

DISEASES OF THE PREGNANT ANIMAL.

Special diseases of pregnant animals are comparatively rare. Most pregnant animals are kept in a reasonably natural state and, consequently, do not suffer greatly as a result of gestation. Quite naturally pregnancy confers no immunity against the ordinary diseases of animals. Nevertheless, we find more or less serious diseases during gestation, which are referable to the pregnant state and which require our attention. The tendency to disease of pregnant animals is in harmony with the environment, the degree of domestication and the care given the animal. Those animals which are most closely confined and housed are most subject to diseases during the pregnant state; but this is also in harmony with the prevalence of the diseases of non-pregnant animals.

The influence of gestation upon the course of the ordinary diseases of animals is not well marked and apparently makes very little difference, except that, when a pregnant animal becomes so seriously diseased that its life is threatened, the fetus tends, in many cases, to perish and become expelled prior to the death of the mother. Hence, any serious disease of the pregnant female may acquire additional gravity because of the possibility of abortion, which would complicate the malady. It must be admitted that the fetus constitutes a heavy burden upon the maternal system and, when serious disease arises, this demand upon the nutritive supply of the mother for the maintenance of the life of the fetus may constitute a factor in reference to the prognosis of the malady. Advanced pregnancy may greatly modify the prognosis of fractures, strains and other more or less disabling injuries, the extra weight of the gravid uterus adding to the difficulty of getting up and down and interfering with locomotion in a manner which may jeopardize the life of the mother or the young.

All those infectious diseases which are frequently accompanied by abortion, such as contagious pleuro-pneumonia of cattle, sheep-pox, contagious cellulitis or pink eye, hog cholera, and foot and mouth disease, are constantly more dangerous for the pregnant female than for other animals, because of the danger which they possess for the life of the fetus, and the extra hazard to the mother through its death and expulsion.

Fleming claims that the pregnant animal suffers especially from numerous affections which are seen less frequently in the non-pregnant, and, according to his view, should be in some cases referred to the pregnant condition. Among these he mentions the cramps of the muscles of the hind limbs, which simulate closely, he says, dislocation of the patella in non-pregnant animals, though he does not point out the difference between the two affections. Since the actual character of the so-called upward dislocation of the patella in the horse is in controversy, it is not necessary for us to discuss the question of the differential diagnosis, but merely to state that the occurrence of this cramp is not extremely rare in the mare and that it may readily be overcome, as in the so-called dislocation, by causing the animal to move the affected limb and then looking after the exercise and general care of the patient.

Other veterinary writers also refer to *pica*, or morbid appetite in pregnant animals, although no evidence is adduced that this is any more common in the pregnant than in the non-pregnant state, or that gestation has anything whatever to do with its occurrence. It requires no special notice in reference to handling, but should be dealt with as in the non-pregnant animal.

The same may be said of the question of constipation in pregnant domesticated animals. The annoyance from this trouble in pregnant women is well known, but it does not apparently hold true in animals to any marked degree. It usually depends chiefly upon too close housing and injudicious feeding and should be corrected simply by removing the causes and giving the animal proper attention.

Fleming further refers, among the diseases of pregnancy, to edema of the feet and limbs of the mare, which he compares to that observed in woman. It is a well known fact that edema of the feet and limbs is a common malady in the horse, without any reference whatever to pregnancy, and it is only natural that in the pregnant state, while the animal is more quiet than usual, such an edema may become emphasized. Beginning, as is usual, in the lower parts of the limbs or feet, it reveals itself as an infiltration of the connective tissue beneath the skin, which is painless and tends to pit under pressure. The degree of this edema may vary and it may gradually extend upward toward the body.

It has little real significance, so far as the well being of the mare or foal is concerned, and tends to disappear shortly after parturition. It may be largely avoided, during the period of pregnancy, by careful attention to the diet and the allowance of regular exercise. It is usually not seen in those mares which are kept at moderate work regularly, run at pasture, or are otherwise kept constantly out of doors where they may take natural exercise. This condition should not be confounded with rupture of the prepubian tendon or the infiltration of the abdominal floor leading thereto.

Osteomalacie.

Osteomalacie is described by numerous European writers as a common disease of pregnant animals. It does not differ, apparently, from the osteomalacie of non-pregnant animals but is believed to be more common and severe in the pregnant animal. Its chief interest to the obstetrist is the greater susceptibility to the malady. In some instances, epizootics of osteomalacie have been recorded in pregnant cows and other pregnant animals.

St. Cyr attributes the malady to three chief causes: 1. Deficient quantity and quality of food. 2. The parturient state. 3. Prolonged lactation.

The first, in conjunction with bad housing, is generally invoked to explain the occurrence of osteomalacie in non-pregnant, as well as in pregnant animals. The second reason assigned, the pregnant state, is generally recognized as a cause of osteomalacie. The third cause is presumed to act merely by lowering the vitality of the animal, and thereby increasing its susceptibility.

The beginning of the malady is obscure. The pregnant cow moves carefully, maintains the recumbent position more than usual, and exhibits rheumatic symptoms. The appetite remains good and fever is absent.

Then follow fractures of a more or less spontaneous character; a slight misstep, a slip or even an effort to rise, serves as a sufficient cause. The pelvis suffers most frequently and, in many cases, is comminuted. Other bones—scapula, sternum and long bones—are less commonly broken.

M. Germain reports the symptoms in the goat as consisting primarily of paraplegia, followed by swelling of the jaws and loosening of the teeth in the alveoli, with difficult mastication.

In solipeds, fracture of the vertebral column is not rare.

The diagnosis of the malady is not easy, as there occur no very definite symptoms, except those of general ill-health, until perhaps a fracture occurs and this too often is referred to accident. When a fracture occurs in a pregnant animal, without sufficient known accident, the fact may well arouse suspicion of osteomalacie.

The prognosis, once the disease is well established, is very grave. When the malady becomes enzootic and, as a consequence, its nature is recognized early, much may be accomplished by improved hygiene conditions, especially by a liberal supply of nutritious food of proper quality. With these improvements, further benefit may be derived from the administration of nux vomica and iodide of potash. Some recommend phosphoric acid or calcium phosphate, internally.

Dropsy of the Amnion and Allantois.

Hydrops Amnii. Hydrallantois.

When describing the amnion and allantois we alluded to the fact that there is regularly present an amount of fluid within each of these sacs, which may vary in different individuals of the same species, the quantity in the mare and cow being usually about 5 to 6 l. of amniotic, and 6 to 15 l. of allantoic fluid. When it materially exceeds this amount we have the condition known as dropsy of the amnion. This affection occurs in various domesticated animals. It has been observed chiefly in the cow and next in the mare, though Saint-Cyr records one case in the goat, and Merrick has observed it in the ewe and bitch.

Generally the exact nature of the disease has not been fully determined and, in the majority of cases which we meet clinically, we do not determine whether the fluid is chiefly or wholly within the amnion or the allantois. In woman, where the allantois is devoid of a cavity from an early date, the dropsy naturally occurs in the amnion. Because of this fact, veterinarians refer generally to the malady as *hydrops amnii*, regardless of the fact that the collection may be in either or both sacs. In our domestic animals, where the allantoic cavity is quite as extensive as, or larger than the amnion, the fluid may be collected in either membrane or may pass from the one sac into the other through the urethra,

bladder and urachus. According to Kammermann, the greater amount of the fluid is generally in the allantois, but may be found in the amnion. In those cases which are attended during the life of the animal and in which the fetus is extracted, we naturally obliterate the evidence as to the location of the fluid, because it is all evacuated and the membranes are largely destroyed.

The increase in the amount of fluid varies greatly in different cases. Harms records an accumulation of 8 l. in the goat, while Lindenburg and Georgi record 120 and 150 l. in the cow. In the mare, the amount may reach 100–160 l., according to Kammermann and Georgi. These records, of course, indicate some of the more severe cases and, between these and the normal, there is every possible gradation. While we have observed several instances in the cow, we have not accurately measured the amount of fluid in any case, but our estimates are in accord with the foregoing.

The symptoms in the cow vary greatly according to the severity of the malady and, in many instances, they do not attract much attention until the disease has acquired an extreme degree. There appear some of the general symptoms of ill-health, as indicated by a rough and staring coat. The eyes are sunken and there are present the general appearances of dullness, weakness and anemia. The pulse is weak and frequent and the heart-beat more or less tumultuous. The respiration is labored. The movements of the animal are more or less difficult. The cow, in many cases, emits a grunt during expiration. The appetite finally becomes somewhat decreased and the bowels may be slightly constipated, though there is usually nothing very evident in this respect. Rumination may be decreased or suspended. The urine is decreased in quantity.

According to the acuteness of the malady, thirst is increased, since evidently the increased amount of fluid in the amnion or allantois must be derived from the liquids which the animal consumes. It consequently occurs that, in severe cases, there is usually very great thirst.

The abdomen becomes abnormally enlarged, the abdominal walls exceedingly tense and percussion gives a dull sound. If the animal is caused to move suddenly or the part is given a

sudden thrust or blow with the hand, there may sometimes be recognized a splashing sound.

Examination per rectum reveals the uterus abnormally distended with fluid, constituting a vast, tense, immovable sac, pushing the other viscera aside and filling, more or less completely, the entire abdominal cavity. The enlarged state of the abdomen frequently leads the owner to suspect twin pregnancy or a fetus of abnormally large size. Since the fetus is of higher specific gravity than the surrounding liquid, it may lie so low down along the floor of the abdomen that it cannot be readily felt per rectum in the uterus. The fetus, however, may be felt by abdominal ballottement. It may also be determined, by the presence or absence of fetal movements, whether the fetus is still living.

The os uteri is generally found quite rigidly closed and in the cow it is only with difficulty that the hand can be passed through it. This does not differ materially from the normal condition of the cervix uteri in the cow.

The great weight of the accumulated fluid and the debilitated state of the animal cause it to lie down a great deal. When the amount of fluid becomes very great, it is frequently necessary to aid the cow in regaining her feet, and finally, as the disease advances, the patient becomes wholly unable to get up, even with assistance.

The diagnosis of the disease must depend largely upon the distension of the abdomen, the dullness upon percussion and the exploration per rectum. It must be differentiated from dropsy of the abdomen, or ascites, and from dropsy of the kidney, or hydronephrosis. The latter is exceedingly rare except in the pig.

Ascites is quite rare in our domestic animals, except in the bitch. When the fluid is intra-uterine, it may be differentiated from that in the peritoneal cavity by rectal exploration.

The causes of dropsy of the fetal membranes are not well determined. Generally the disease seems to depend largely upon insufficient nourishment or improper diet. Kammermann records that, in one year, following a wet summer and consequently damaged fodder, the number of cases of dropsy of the amnion or allantois was unusually large. Our observations have been somewhat parallel to this and we have noted, in certain stables of

cows, a large percentage of the animals affected with this malady in a given year, when the food had been somewhat damaged, and consequently afforded insufficient nourishment.

A very interesting fact in connection with hydrops of the amnion and allantois was observed by us among a herd of Shorthorn cows, with which an American buffalo or bison was allowed to consort, and a number of which became impregnated by him. Almost without exception, during one year, all the cows which were in calf by the buffalo perished from hydrops amnii, while the other cows upon the farm, of which there were 100 or more, did not suffer from the malady. Similar observations have been recorded by others.

The cadaver of an animal which has died from this disease is emaciated and anemic. In some cases the abdominal muscles may have become ruptured, because of the great weight which they have been called upon to bear, in addition to the weakened state of the muscles as a result of the dropsy. The uterus is greatly distended, pale and thin-walled. Kammermann has recorded a rupture of this organ, Garreau found the membranes destroyed, Harms observed them ruptured, and Schutt found plastic clots floating in the fluid. Harms records that the fetuses are, as a rule, feebly developed and may also be dropsical. The liver and kidneys show appearances of parenchymatous infiltration. The post-mortem appearances have not been well studied. Though most of the animals die, they have generally been handled before death, the fetal membranes torn and the liquid contents expelled or removed, so that the evidences of the actual conditions present during life have been largely obliterated prior to the death of the animal.

The course of the disease is variable. Most animals live until near the date for the normal close of pregnancy, but they do not as a rule give birth to young without aid. In the cow, a large proportion of the animals go down and are unable to stand before the veterinarian is called and may perish before the time for parturition arrives. When gestation continues for the normal time, there is an absence of power on the part of the mother to bring about the expulsion of the uterine contents. The long continued, great distension of the uterus has destroyed the contractile powers of its walls. The abdominal walls also

lose their power of contraction and cannot effectively aid in the dilation of the os uteri and the expulsion of the fetus and fluids. Possibly the debility of the uterus was the cause of the disease. When the time for parturition arrives, the patient shows some uneasiness and possibly some very slight evidences of labor pains, not of a vigorous character.

The prognosis of dropsy of the amnion is very grave for both the mother and the fetus. In mild cases, it may be favorable for the mother and a living fetus may be born. In the severe cases, the fetus is generally too feeble to live after birth. The mother, also, is usually so weak and her uterus so flaccid and open to infection that she is very liable to perish. Almost uniformly, hydrops amnii is followed by retention of the fetal membranes, which gives rise to serious complications.

The gravity of the condition is often very deceptive to the owner and the inexperienced veterinarian. The patient is free from pain and fever, looks bright and cheerful and may retain a fair appetite.

In mild cases, spontaneous birth may occur, but as a general rule assistance must be given in order to bring about the expulsion of the uterine contents. In the very severe cases the animals show complete loss of appetite, become unable to rise, and soon succumb to the general weakness and decubitis. These symptoms are intensified by the interference of respiration caused by the pressure of the fluid upon the diaphragm. When the abdominal muscles give way and the uterus descends against the skin until it nearly reaches the ground, or rupture of the uterus occurs, as observed by Kammermann, death quickly follows.

If the dropsy is slight, and the mother does not seem to suffer great inconvenience from it, the case may be allowed to go without interference until the normal period of parturition has been reached. At this time the patient should be closely watched and early assistance given in order that birth may take place without too great difficulty or danger. Such mild cases are rarely, if ever, diagnosed.

Whenever the disease is well defined, so that the mother has difficulty in getting up when down and is evidently suffering seriously from the malady, complete evacuation of the uterine cavity should at once be brought about. The os uteri should be

forcibly and carefully dilated until the hand can be passed into the uterine cavity, when the membranes should be ruptured and the excessive fluids allowed to escape or siphoned out. The presenting parts of the fetus should be secured by cords and, by gradual traction, the further dilation of the os uteri accomplished and the fetus extracted. This requires much patience and time, but in our judgment should be persisted in until the operation is completed and the entire contents of the uterus, except the placenta, have been removed.

In our experience, when we have dilated the os uteri somewhat and ruptured the membranes, allowing the fluid to escape, and then awaited normal labor, we have been disappointed. The labor pains have not appeared, the weakened uterus has undergone infection, the fetus has quickly perished, become emphysematous, its extraction has been made highly difficult, and the mother has perished as a result. We believe, therefore, that the delivery should be completed as soon as possible after it has been begun, and that no interval should be allowed to occur between the dilation of the os uteri, the rupture of the fetal membranes, and the extraction of the fetus. The effort should be continuous from the beginning to the end.

It should be observed that, in inserting the hand into the uterus of the cow, in this disease, before the fetus has been extracted, there is a peculiar condition of the organ, which tends to confuse the inexperienced operator. In normal pregnancy the body of the uterus becomes enlarged and the median partition between the two cornua recedes from the cervix. In hydrops amnii in the cow, the inter-cornual partition does not recede from the cervix, so that, as soon as the hand enters the uterus, it comes in contact with this perpendicular partition between the two cornua, in a very unexpected place, in close proximity to the cervix. This fact should be recognized and injury to this structure avoided.

Harms suggests that, in some cases, the os uteri has retreated so far into the abdominal cavity that it cannot well be reached to be dilated and that, in such, the animal should be turned upon its back in order to bring it well within reach. This position also favors the expulsion of the remaining waters. Harms also suggests that animals which have suffered from hydramnii should not again be used for breeding purposes, although in-

stances have been recorded where such cows have successfully bred.

In order to overcome the extreme weakness after the extraction of the fetus, it is well that stimulants and tonics should be administered for a few days. Full doses of strychnia, hypodermically, or strong coffee or other stimulants, as a drench, are indicated. It is highly essential that the uterus should be closely watched and involution favored in every way, in order to guard against infection. The animal should be given good, clean quarters, with abundant bedding, good and abundant food, and every possible hygienic care, until fully convalescent.

Dropsy of the Uterus. Hydrometra.

Edema of the gravid uterus is extremely rare in domestic animals and we find but one case recorded, which occurred in the cow. In this instance, cited by Harms, a cow far advanced in pregnancy showed symptoms of abdominal pain and died within an hour. Post-mortem examination revealed a great infiltration of the walls of the uterus, so that they had attained a thickness of 8 to 10 cm. Upon incision, the infiltrated fluid escaped.

Dropsy of the Uterine Cavity. Ascitic Hydrometra.

An accumulation of fluid between the chorion and uterine walls is exceedingly rare and the few cases which are related are not perfectly clear, but suggest that in some of them the writer may have been dealing with hydramnios or hydrallantois. It appears, however, that such a condition does rarely occur.

Schutt (Gurlt und Hertwig, Vol. 9, Page 199) relates a case in which the animal was very feeble and recumbent much of the time, but could get up with help. She groaned and was restless; respiration was somewhat labored; her coat was rough and her appetite poor. The abdomen was greatly enlarged. The motions of the fetus could be distingished and it could also be felt by ballottement. Finally the animal could not get up, and perished.

Post-mortem examination revealed a greatly distended uterus with normal walls, fetus and membranes, but between the chorion and uterus there were 30 quarts of clear, odorless fluid.

Werner (Berliner Tierarztliche Wochenschrift, 1890, No. 52) records a case in which, though the abdomen was increased in

size, no motions of the fetus could be determined either by internal or external exploration. Five days after the first examination, there was found in the gutter of the stall a watery fluid, estimated at about 5 or 6 large pailfuls. The fetus, about the size of a child's head, was removed in the fetal membranes. The uterus was washed with a creolin solution and a tonic was administered, under which the cow recovered when she was bred again, against the advice of Werner. The dropsy of the uterus returned, and the cow was sold, so that the observation of the case was interrupted. (Harms, Tierarztliche Geburtshilfe.)

Paraplegia.

In the cow, and rarely in other ruminants, there occurs during pregnancy a form of paralysis of the hind limbs, the nature of which has not been fully determined. Presumably it depends upon a variety of causes. The cause may at times be some injury or accident to the limbs or spine or to the muscles acting upon these. There appears, however, to be some more important cause in a large majority of cases. During one winter, in the vicinity of Ithaca, N. Y., there was wide-spread complaint from paraplegia in pregnant cows. It appeared in numerous dairies scattered over a large area and involved, in some herds, as many as 10% to 15% of the cows.

In these cases, the disease appeared more or less suddenly and the animal would be found lying down unable to rise. Perhaps at first she would be able to stand, upon being assisted to her feet. This condition might continue for days or weeks, until finally she would go down and be unable to rise, even with assistance. The disease generally appeared two or more weeks prior to the average end of gestation and continued until after parturition, unless the animal were previously destroyed or succumbed to the affection or to some intercurrent complication. The animal was bright, lay upon the sternum with the head erect and appeared at first quite normal. The temperature was normal, the muzzle moist, the pulse and respirations unchanged. The bowels were normal or possibly suffered some degree of torpidity, as would be naturally expected in an animal in the recumbent position. The appetite was good. The fetus was alive and apparently normal.

The occurrence of this malady could not be traced to any definite cause. The cows which were affected were in the stable, since the disease occurred during the latter half of the winter. As the food upon which they subsisted varied in the different dairies, nothing definite as to cause could be determined in this way. The grain upon which the animals were fed was mostly imported from the western states and consisted largely of bran, corn meal and brewer's grains or sprouts. The hay was grown locally by the farmers, and had been generally damaged during the haying season because of wet weather, so that most of it was of an inferior quality and more or less discolored and mouldy, but it was not pre-eminently bad. The cows were not in good condition. They were not extremely emaciated and had not been starved so far as quantity of food was concerned, but had been fed somewhat liberally. Yet they were thin in flesh and seemed to be weak and wanting in vigor. This condition applied alike to the pregnant and non-pregnant animals. The damaged hay seemed the most probable cause of the disease.

Saint-Cyr records similar occurrences. Though he thinks it would be improper to speak of them as epizootic, yet they occurred quite frequently during certain years and in given herds.

The disease usually persists, should the animal survive, until parturition, after which it generally disappears. The tendency for it to disappear after parturition seems to be largely due to the decreased load which the animal has to bear because of the expulsion of the fetus and its annexes and the decreased drain upon the maternal system when freed from the nutritive demands of the fetus. In the diagnosis of paraplegia we must carefully distinguish it from other maladies causing similar symptoms. We have already stated that paraplegia may be due to some accident, such as a strain or other injury to the limbs or spine. The possibility or probability of such injury should be excluded as far as possible.

We have already related that osteomalacie may induce symptoms of paraplegia. It is not readily diagnosed clinically from the affection under consideration. They are much alike in causes so far as known. If a fracture or lameness occurs without warrant it may be very suggestive of osteomalacie.

We should carefully differentiate paraplegia from dropsy of the amnion, in which the collection of the fetal fluids may be

so great that the animal is unable to rise when down simply because of the enormous weight.

Paraplegia is also to be distinguished from parturient paresis, or "milk fever," which in rare cases appears during pregnancy, instead of after. The differentiation between the two is not very easy, since in a mild form of parturient paresis the animal may look bright. Parturient paresis, however, occurs chiefly, in those rare cases in which it is seen during pregnancy, only a few days prior to the end of gestation, and is usually accompanied by a sub-normal temperature, as in the ordinary paresis after calving. This will be more fully dealt with under "Parturient Paresis." Parturient paresis occurs solely in vigorous, well fed cows, while paraplegia not due to accident is seen in improperly nourished, anaemic cows.

There may be difficulty in differentiating between overfeeding and paraplegia. It is a well known fact that, in the cow, paraplegia is a common symptom of serious disorder and that we have more or less complete paraplegia, paralysis and coma following overeating and the decomposition of food in the rumen. The history of the overfeeding should of itself usually serve to distinguish between the two maladies. However, the treatment is largely alike.

The prognosis is variable. Paraplegia due to the various accidents enumerated is curable in so far as the causes and effects are removable.

In the enzoötic outbreaks of paraplegia observed by us, the results have not proven satisfactory. The forced decubitis was not readily removed during pregnancy and the long wait until the advent of parturition led too often to fatal results. Our mortality has been high, perhaps largely because our patients were too distant and our handling, consequently, wanting in proper oversight.

Parturition, by removing the mechanical weight of the fetus and its annexes, perhaps at times including some degree of hydrops of the amnion and allantois, exerts a favorable influence upon the course of the disease. Parturition also favors recovery by relieving the mother from the nutritive demands of the fetus. The earlier parturition occurs after the advent of the disease, the more favorable the outlook for the patient.

The treatment of paraplegia of pregnancy should be directed toward the securing of the best possible environment for the patient and providing abundant nutritious food. The animal should be given a comfortable, well bedded dry stall where it can not slip when attempting to rise.

In all cases, an intelligent effort is to be made to relieve the patient of superfluous weight. Bulky innutritious food should be withdrawn and the alimentary tract relieved from any existing overload. This may be partly accomplished by means of laxative foods, such as roots and bran with an extra allowance of salt. But in decubitis there is a constant tendency to digestive torpidity, which should be combatted. Strychnine given hypodermically in doses of one half to one grain, repeated three times a day, answers splendidly for an average-sized cow. Not only does it overcome the intestinal torpidity, but at the same time affords a most effective tonic. It may, with great advantage, be combined with moderate doses of eserine or arecoline until the alimentary tract has been satisfactorily unloaded. This is preferable to alkaline purgatives and oils, being safer to administer, more prompt and efficient in action and probably less dangerous to the life of the fetus.

Enemas, advised by Fleming and others, are of little use in ruminants, the principal point for our attack being the gastric apparatus, with 100 or more feet of intestine intervening.

Our attitude toward the existing pregnancy is to be carefully considered. Whatever the cause of the paraplegia, the presence of the fetus, fetal fluids and membranes intensifies the malady by the mechanical weight. The nutritive demands of the fetus upon the mother add to the gravity of the case, especially when we recall the fact that the digestive and nutritive powers of the animal are much depressed by the recumbency.

Shall we hasten parturition? Our answer should be based upon a thorough consideration of all the surroundings. If it appears safe to await normal parturition, this should be done. If the case is progressing unsatisfactorily and much time must yet elapse before parturition is to be regularly expected, premature birth should be induced. In some cases this has yielded us good results where, otherwise, a fatal termination appeared to be the only prospect.

The premature evacuation of the uterus having been determined upon, the obstetrist, under all due aseptic precautions, is to carefully and gradually dilate the cervical canal, rupture the fetal membranes, cause the fetal fluids to escape, secure the fetus, arrange the presenting parts in the proper position, and, exerting sufficient traction upon the presenting parts, gradually cause the needed dilation of the cervical canal and complete the extraction of the fetus. The process should not be hastened, but as gently accomplished as is possible. In our experience, the operation in the cow requires for its proper performance three to five hours.

When begun, the delivery should be completed without any intermission of effort. Should the cervix be dilated and the membranes ruptured, in the weakened condition of the uterus, infection of the membranes, death and decomposition of the fetus, metritis and sepsis of the mother are extremely liable to follow.

The fetus removed, the uterine cavity, or rather the cavity of the fetal membranes, should be flushed out with tepid water in order to remove blood coagula and fetal fluids. A small amount of carbolic acid or other antiseptic may be added to the uterine douche.

The fetal membranes are to be allowed to remain in the uterus for 18 to 24 hours, when they are to be mechanically removed, if practicable, followed by antiseptic douching of the uterine cavity. If the membranes are inseparable except by lacerating the maternal placenta, their removal should be further delayed and their putrefaction prevented or ameliorated by the frequent introduction into the uterus of large volumes of tepid water, to which a little carbolic acid has been added. The introduction of the tepid fluid not only keeps the organ cleansed but also favors its involution and the expulsion of the retained membranes.

Amaurosis.

Fleming quotes Riss (Recueil de Med. Veterinaire, 1831), who observed two cases of amaurosis in pregnant mares, which appeared late in gestation and disappeared promptly after parturition. We have observed one instance of amaurosis appearing in a mare late in gestation, but the disease remained permanent after parturition. In case the disease was proba-

bly a result of periodic opthalmia and had but remote, if any, relation to pregnancy.

* * * *

St. Cyr and other authors refer to the rare occurrence during pregnancy, of eclampsia (especially in bitches), parturient paresis and mammitis. They have little special significance and will be considered later, when dealing with those maladies, occurring post-partum.

Rupture of the Prepubian Tendon.

Edema of the Abdominal Floor.

Writers on veterinary surgery and obstetrics generally include rupture of the prepubian tendon among the ventral herniæ, without directing special attention to this characteristic and very serious lesion with its premonitory symptoms.

The eventual lesion consists of a transverse rupture of the prepubian tendon, immediately in front of the pubis, between the two abdominal rings. Both of these rings are usually involved and, when the rupture becomes complete, obliterated, all tissues between the two openings being torn asunder.

The disease or accident is practically confined to the mare ; we have seen one instance in the cow, and have found no record of its occurrence in other animals.

So far as known, the rupture takes place only in advanced pregnancy, rarely prior to the close of the tenth, usually during or after the completion of the eleventh month.

The causes, so far as determined, are :

1. The increased strain upon the abdominal floor caused by the presence of the gravid uterus, which represents at the close of pregnancy probably 30 to 40 per cent of the total weight of the abdominal contents.

2. Degenerative changes in the tissues of the abdominal floor, including the prepubian tendon, closely associated with profuse edema of this region.

3. Very rarely there is a definite history of violence. In one instance observed by the author, a mare, becoming mired in deep mud with her hind-feet, over-exerted herself in gaining the bank of the stream, thus pulling the hind limbs forcibly backwards, and with them the pubis, causing its chief anterior stay, the

prepubian tendon, to give way. No edema or other evidence of disease preceded the accident.

Almost always there can be no reasonable presumption of accident, the rupture being what we may designate as spontaneous and usually comparatively gradual, frequently being preceded for days or weeks by premonitory warnings.

The disease may be more common in draft mares than in those of lighter breed, but, as our experience has been largely with the former class, the grounds for comparison are not conclusive. We have observed the lesion most frequently in idle mares which were well fed.

The first symptom noticed is an extensive edema of the abdominal floor, beginning just in front of the mammary gland and extending thence forward and backward until it reaches from the anterior pectorial region to the perineum, covering the entire floor of the body for a depth of 2 to 4 inches. The edema presents the usual clinical characters, except that it is possibly somewhat firmer than generally seen and somewhat more inclined to be painful to the touch.

The exact relationship of the edema to the rupture of the tendon is undetermined, our observation leading us to believe that the former is an expression of serious degenerative changes which are taking place in the deeper parts. The edema apparently involves the tendon itself from the first and diminishes its resisting powers by forcing the fibers apart, as well as weakening them directly.

The movements of the patient soon become restricted to such locomotion as is essential, and this is marked by care and deliberation. The restriction of movement may be partly due to the mechanical impediment of the edema, but it appears rather to result from pain and a premonition of injury.

This restriction of motion generally precedes the rupture of the tendon and is increased as the rupture extends.

Should the tendon remain intact until relieved of its excessive load through parturition, the edema quickly disappears and the parts become normal, but in many cases the tendon gives way before the foal is born. The mare then succumbs or, recovering, is ruined in value. The foal generally perishes.

When the tendon begins to part between the two abdominal rings, characteristic symptoms arise which serve to distinguish

it from other lesions. The spinal column of the horse forms an arch from the first dorsal vertebra to the sacrum. This arch is chiefly maintained by the linea alba, originating from the sternum in front and ending behind on the pubis, as the prepubian tendon, thus acting as a powerful tie. If the prepubian tendon parts at the abdominal rings, the arch of the spine can be no longer completely maintained and the back drops downwards, as is shown at C in Fig. 82, producing lordosis, or "sway back," while the pubis becomes displaced backwards. This causes the external ilial tuberosity to descend and the ischial tuberosity to become displaced upwards, decreasing the slant of the hip, as we have intimated at B in Fig. 82, in contrast to the normal slant at A.

The rupture of the tissues between the abdominal rings obliterates these and relaxes the fixation of the mammæ in them. The abdominal tunic also becomes ruptured on the same level, the skin becomes greatly stretched, the milk glands are displaced downwards and forwards, as indicated by the position of the teat at T in Figs. 82, 83, 84 and 85, and the glands become less conspicuous because of the compression from the stretching of their capsule derived from the ruptured abdominal tunic.

In Figs. 82–84, the displacement is comparatively mild. In some cases it is much greater, as shown in Fig. 85, from St. Cyr. No other form of rupture could cause such displacement of the mammary gland, as it is firmly fixed to the abdominal ring so long as that remains intact.

The umbilicus is also necessarily displaced forwards and downwards, as shown at U in Figs. 83 and 84. The rupture having involved the entire prepubian tendon, and the abdominal tunic having given way, the rent may extend on either side outwardly from the external side of the abdominal ring until it includes the entire abdominal floor. Through this great rent, the gravid uterus and other viscera drop down upon the skin and skin muscles and, pushing the abdominal tunic and musculo-tendinous portions of the abdominal floor forwards, bear the skin and skin muscle downward until the hernial sac may reach the tarsus or even lower. Early in the progress of the lesion, firm upward pressure with the hand, in the premammary region, discloses a tense hernial touch without a distinct boundary. As the rupture progresses, the hernial touch becomes more pronounced.

The downward displacement of the abdominal viscera, with

the backward displacement of the pubis, causes the flanks to sink in and greatly reduces the transverse diameter of the body at this point.

The skin and skin muscle tend, by their elasticity, to check or stop the progress of the rupture, in which they are aided somewhat by the resistance of the uterine ligaments and the mesentery, which aid in supporting the visceral weight when the organs have become displaced downwards. In some cases in our practice, the skin and its muscle did not suffice to stay the progress of the rupture, but gave way, causing eventration and necessitating immediate destruction of the patient.

FIG. 82. RUPTURE OF THE PREPUBIAN TENDON IN THE PREGNANT MARE.

A, Acquired slant of hip. B, Estimated normal slant of hip. C, Estimated normal spinal line. T, Teat displaced downwards and forwards.

In those very rare instances where violence has played an essential part in causing the rupture, there need be no premonitory edema. The symptoms appear very suddenly: the tumor is large, the pain intense, the expression anxious, the body bedewed with cold sweat, the respiration hurried, the pulse

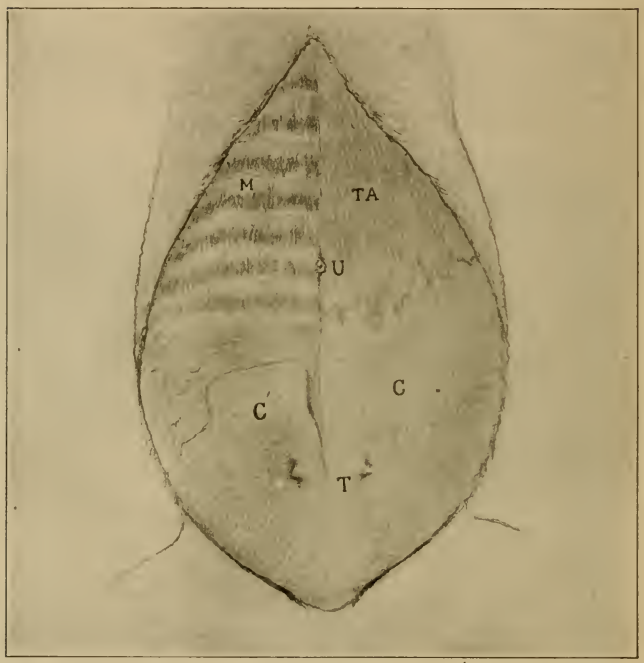

FIG. 83. RUPTURE OF THE PRE-PUBIAN TENDON IN THE PREGNANT MARE. Dissected abdominal floor of Fig. 82.

TA, Abdominal tunic, showing ruptured margin displaced forwards.
M, Transversalis muscle, the abdominal tunic removed, showing posteriorly the ragged margin at point of rupture.
CC′, Sclerotic connective or cicatricial tissue constituting, with the skin, the posterior portion of the floor of the hernial sac.
T, Teats displaced forwards. U, Umbilicus.

rapid and weak and the patient tends to quickly collapse from shock or hemorrhage.

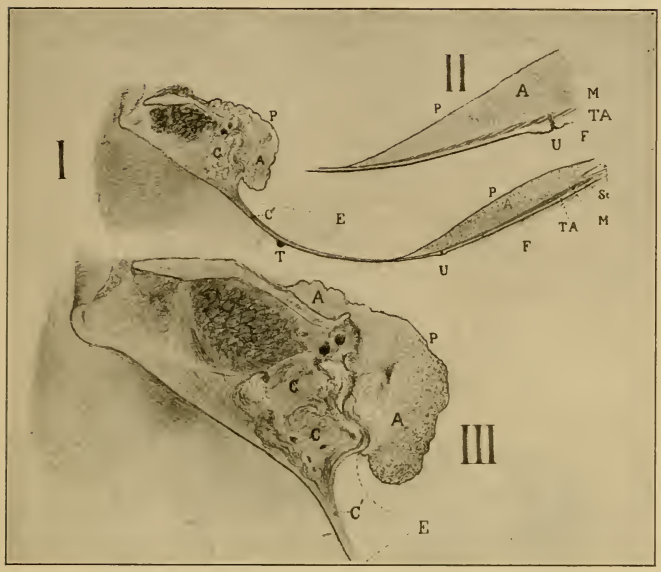

FIG. 84. RUPTURE OF THE PREPUBIAN TENDON IN THE PREGNANT MARE. Sagittal or median section of abdominal floor, from Fig. 82.

I, Section extending through pelvis and sternum.
II, Detail of anterior portion.
III, Detail of posterior portion.

P,P, Peritoneum. E, Extent of rupture in the abdominal floor.
A,A, Sub-peritoneal fat, occupying entire area except that comprised in E, where peritoneum is absent as a result of the rupture.
C, Curled connective tissue, the pelvic remnants of the pre-pubian tendon, posterior to the point of rupture.
C′, Cicatrical tissue occupying the space between the ruptured ends of the pre-pubian tendon, devoid of peritoneum and adipose tissue.
T, Displaced teat. U, Umbilicus displaced forwards.
F, Skin and skin muscle. TA, Abdominal tunic.
M, Transversalis muscle. St, Sternum.

The character and extent of the lesions, with the reparative efforts in a surviving case, are well shown in Figs. 83 and 84, in which it is seen that the peritoneum, prepubian tendon and abdominal tunic have all parted just anterior to the pubis and passed forward about half way to the sternum, dragging with them, for a part of the way, the teats. Posterior to these and occupying the area previously filled by them, is an extensive expansion of dense connective tissues, C, which has assumed the functions of the ruptured parts.

In Fig. 84 it is shown that the subperitoneal fat, A, does not invade the ruptured area, E, but seems to depend for its formation upon the presence of the peritoneum.

The prognosis of complete rupture of the prepubian tendon is very grave, since most mares, along with their foals, perish before the conclusion of the pregnancy during which the rupture occurs.

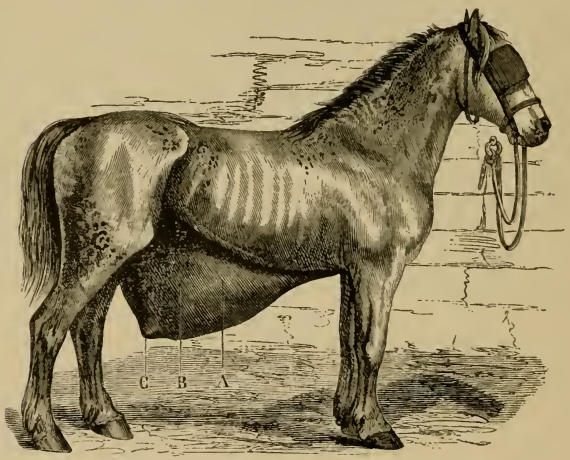

FIG. 85. RUPTURE OF PRE-PUBIAN TENDON. MARE.

A, B, Hernial sac. C, Teat displaced downward and forward. (St. Cyr.)

If the parturition, following the pregnancy during which the accident occurred, is safely passed, the animal may thereafter

breed without danger or difficulty, but is so unsightly that her value for this purpose is seriously diminished. She may do ordinary slow work, but here the unsightliness becomes still more serious and few persons are willing to use such an animal.

The foal in the uterus at the time of the rupture usually perishes, but, if the mare survive, succeeding foals may be born with the same safety as though the lesion did not exist.

When a threatened or beginning rupture is promptly recognized, and appropriate measures for prevention or relief applied, the prognosis is highly favorable.

The advice of Fleming, that extensive edema of the abdominal floor in pregnant mares is unimportant and may be safely ignored and that the disease will quickly disappear after parturition with little or no attention, has led, when followed, to serious disaster in our hands.

Edema in advanced pregnancy in the mare is a serious condition, which calls for prompt and energetic handling. It should always be regarded as a precursor of rupture of the prepubian tendon. If left without attention, many of the mares will succumb from rupture; if proper attention is rendered the danger will be almost wholly averted.

Treatment. In the handling of threatened rupture of the prepubian tendon, mechanical support of the greatly overloaded and weakened abdominal floor should receive our first consideration. Whenever extensive edema occurs along the floor of the abdomen in a mare far advanced in pregnancy, unless the condition is clearly referable to unimportant causes, we urgently advise the immediate application of an abdominal bandage of canvass or other strong material. The bandage should be constructed with 8 or 10 strong buckles and billets and fitted to the oval form of the abdomen by means of a gore placed in the center of the canvas. We do not at all times have the required time for properly constructing the bandage, and, in order to avert immediately threatening disaster, an emergency, many-tailed bandage should be quickly applied. In order to adapt this to the oval form of the abdomen, the tails should be crossed so that the most posterior of one group of tails shall be tied to one of the most anterior of the other end, and the remaining tails united upon a similar plan. The spine and the point where the ends of the bandages are tied should be amply padded to avoid pressure-necrosis of the

skin from the buckles or knots, and should be carefully readjusted daily or as often as conditions may dictate.

In applying the emergency bandage to cases where the tendon has already parted or its rupture seems very imminent, it is important to get it quite tight. In order to facilitate this, it is best to tie a solid loop in each upper tail, that is, in each tail of the bandage which passes over the back, through which each lower tail may run as through a pulley. The bandage cannot be properly tightened at the first effort. One after another of the tails is to be tightened as well as convenient at the first tying. As soon as all are fastened, go back to the first ones and tie them over again and continue the process until the desired support is secured, and the great weight of the viscera lifted from the abdominal floor and largely transferred to the spine through the bandage.

The decrease in the weight of the abdominal viscera is also of very great importance. We should lessen the weight of the digestive viscera by withdrawing all bulky food and replacing it with limited quantities of concentrated aliment. We might hurry the unloading of the intestinal tract by the aid of small doses of eserine sulphate, or arecoline, such as half-grain doses every half hour, until the desired effect has been induced.

If the tendon has parted, the induction of premature labor should receive careful consideration.

As a rule, the foal perishes unless aid is given. Even under close watching, the uterine contractions go on unobserved and cause the death of the foal through separation of the placenta before adequate expulsive force is brought into play. Most of the expulsive power is destroyed when the abdominal floor gives way, leaving the uterus alone to expel the fetus. It therefore seems desirable to anticipate this danger to the fetus by bringing about artificial delivery not later than the completion of the eleventh month, in a way to best safeguard the life of the fetus. The premature delivery is best effected by carefully dilating the os uteri with the hand; grasping and, if necessary, cording the fetal parts presenting, and applying moderate traction to compensate for the lost expulsive power of the abdominal muscles. It is to be remembered that it is best to have the patient in lateral recumbency during delivery, since this raises the fetus approximately to a level with the pelvic inlet. When the mare is in the

standing position the fetus drops down below the pelvis, through the immense rupture, and rests upon inert parts.

If premature delivery is not decided upon, the mare should be closely watched and prompt aid should be given at the first signs of labor.

After delivery, the bandage may be removed at once and the case dismissed if the tendon has not ruptured; if it has ruptured, the bandage should be readjusted and retained until such time as the ruptured tissues have healed and the weakened abdominal floor has been reenforced by the new formation of connective tissue, as indicated at C, in Fig. 84.

The mare may be retained until the foal is ready to wean, and then destroyed; she may be kept permanently as a brood mare, with reasonable assurance that thereafter she will foal unaided; or she may be used at moderate work without discomfort.

In the very severe cases, where the skin and skin muscles are giving way so that eventration is imminent, or where accompanied by shock and serious internal hemorrhages, the mare should be promptly destroyed, after performing Cæsarian section if it is desired to save the foal.

Hernia of the Uterus or Hysterocele.

As Hernia of the Uterus, we describe a condition of varying significance, due to any cause, except rupture of the prepubian tendon which we have already described in the preceding chapter, by which a portion or all of the gravid uterus escapes through the muscular walls of the abdomen. This accident or condition may occur in any of the domestic animals and at any point of the abdominal floor. Any ventral hernia may become occupied by a portion of the gravid uterus in any of those animals where the non-gravid organ is of sufficient length to drop into the opening so that impregnation may occur in the herniated organ. The hernia may also occur later, when the gravid organ is borne down by the weight of its contents. If the hernial ring is sufficiently large to allow the escape of a fetus or fetuses through it, the gravid uterus drops into the hernial sac. The causes are the same as those of other herniæ, and have no special relation to obstetrics except that the fetus passes through the hernial ring, becomes developed within the hernial sac and offers obstacles to birth.

The hernia may be due to traumatism, or to a congenital defect in the abdominal wall, either at the umbilicus or the inguinal ring. Sometimes, in the development of the fetus, the umbilical ring remains so large that the abdominal viscera permanently protrude through it, against the skin. Such an animal, when grown, if permitted to become pregnant, and the hernial ring is very large, is liable to uterine hernia and the fetus or fetuses may develop in the hernial sac. Herniæ of such dimensions are rare in our larger domestic animals, but umbilic herniæ are occasionally met with, in the mare, of such size that, were she allowed to go without treatment and be bred, a uterine hernia would inevitably result.

In some animals, especially in the bitch and sow, the ovary and uterine cornua pass from their ordinary position through the inguinal ring and reach the location of the testicle in the adult male, in the perineal region. As a consequence, in case of pregnancy, the young may develop in this herniated portion of the uterus, outside the abdominal cavity.

The diagnosis of uterine hernia is comparatively easy. The fetus or fetuses are so superficially situated that they may be recognized by palpation. Sometimes the tumor is not reducible because the fetus has become larger than the hernial ring and consequently cannot be returned into the abdomen by pressure.

The significance of these herniæ will vary greatly according to conditions. If occurring as the result of a recent accident, when no hernial ring or sac has become established, the hernia tends to enlarge rapidly because of the presence in it of the gravid uterus and other viscera. In any hernia with a well established ring and sac, into which the gravid uterus enters, the tendency is for the sac to continue to grow, but for the ring to remain undisturbed. They have little risk generally for the life of the mother until parturition comes on, when they may become a serious menace to the lives of both mother and fetus. If the fetus should be of too great size to readily pass through the hernial ring or if there be an extensive hernia of recent date which has destroyed the expulsive powers of the abdominal walls, active obstetric interference may be demanded in order to save the lives of parent and offspring.

It is inadvisable, as a rule, to attempt to breed animals which have herniæ of such a character that it is probable that a fetus or

fetuses may find lodgement therein. When a ventral hernia occurs during pregnancy, the parts should be immediately and carefully supported by a wide bandage so as to prevent the extension of the newly-formed rupture. Females having congenital hernia at the umbilicus or inguinal ring should not be bred for zootechnic reasons, as well as because of the probability of obstetric difficulty.

When such animals have been bred, however, and the question of the preservation of the life of the mother or fetus arises, we may bring about artificial abortion in behalf of the life of the mother or may resort to hysterotomy with a view to saving the life of the fetus and perchance of the mother also.

Rupture of the Gravid Uterus.

Rupture of the gravid uterus is not common in domestic animals, though doubtless it occurs more frequently than recognized. It may occur from a great variety of causes, may be of any degree and accompanied or followed by various symptoms.

On page 58 we have already alluded to the record of the rupture of the non-gravid uterine cornu of a cow during coition. On page 260 we have noted a case where a veterinarian, through error, ruptured the uterus in attempting to dilate the cervical canal in a case of sterility. On page 424 we have mentioned the possibility of uterine rupture in dropsy of the amnion.

On page 417 we have alluded to those cases of rupture of the gravid uterus in which the fetus has escaped more or less completely from the uterine body without causing fatal lesions, the fetus and its membranes not undergoing decomposition but remaining indefinitely as an inert body to constitute a form of extra-uterine pregnancy.

In a subsequent chapter, "Torsion of the Uterus," we shall have occasion to speak of a transverse rupture of the uterus or vagina as a consequence of the revolving of the gravid organ upon its long axis to such an extent as to cause its tissues to part, leading to various complications of a very grave character.

Rupture of the gravid uterus may occur as a result of emphysema of the fetus, which will be considered later.

When dealing with the subject of dystocia we shall have occasion to discuss the not infrequent uterine ruptures due sometimes to mal-position of the fetus, far more frequently to errors

on the part of incompetent persons while attempting to overcome difficult labor.

When labor has been completed, ruptures of the uterus may still occur through incompetent handling of retained placenta or as a consequence of prolapse of the uterus.

Since these various ruptures are sufficiently considered in their proper places, it is desirable that we should here confine ourselves to the comparatively rare instances of rupture of the gravid uterus not included in the other classes of cases mentioned. We wish, consequently, to draw attention here to those cases of rupture of the gravid uterus not due to torsion or to diseases of the fetus, uterus or fetal membranes and occurring independently of dystocia or attempts at delivery. Saint Cyr terms these longitudinal or oblique ruptures.

The causes are variable. Generally, so far as known, such ruptures are the result of impacts of blunt bodies against the abdominal floor, such as the kick of a horse, the impact of a wagon pole, falling upon projecting stones, etc.

The symptoms are not at all uniform but dependent upon the extent of the rupture and other conditions.

The rupture may be incomplete, the mechanical insult or other cause serving merely to induce a more or less serious strain or partial rupture of the muscular walls of the organ. Such a lesion may result in appearances of ill-health, possibly slight colic or other symptoms leading to the belief that some digestive disturbance exists.

Later the weakened uterine walls may give way either as a result of the weight of the fetus or the greatly augmented intrauterine tension owing to uterine contractions. Then follow rapidly symptoms of great depression, weak pulse, accelerated breathing, cold body surface with probably cold sweats, followed in a few hours by death.

If the fetus, fetal membranes, and liquids are aseptic, the symptoms induced are chiefly those of shock and internal hemorrhage. If the uterine contents are infected, and these contents suddenly escape into the peritoneal cavity, there follows promptly the very grave depression of acute peritonitis.

External manipulation of the abdomen may reveal the fetus free within the abdomen and the fetal fluids outside the uterus presenting the appearances of ascites.

Exploration per vaginam reveals no data of value except the cervix be dilated so that the hand may be passed into the uterus, when the absence of the fetus in the uterine cavity becomes evident. The membranes have more or less completely escaped and the rent in the uterus is easily recognizable.

If the cervix is closed, the hand introduced into the rectum may yield all needed data for a positive diagnosis. The uterine body, somewhat retracted and without fetal contents, is recognizable. Outside the uterus, lying more or less free in the peritoneal cavity, the fetus may be detected.

The treatment of rupture of the gravid uterus in domestic animals has not yet been made practical. In most cases of the character here described, the patient dies without a positive diagnosis having been reached, and the actual nature of the accident is only revealed post mortem.

If recognized during the life of the patient there is scant basis for hope of overcoming it by surgical means. Cæsarian section is indicated, if thereby there is a hope that the fetus and its membranes may be removed, the hemorrhage from the ruptured uterine walls controlled and the life of the mother saved. (The operation of laparotomy is described later when dealing with obstetric operations.) In such cases, the operation should include the removal of the fetus and its membranes, and the closing of the uterine walls, with the consequent arrest of hemorrhage.

Ante-partum Prolapse of the Vagina.

Prolapse of the Vaginal Portion of the Uterus.

Prolapse, or eversion, of the vagina is observed in the pregnant cow and ewe and more rarely in other domestic animals. Fleming attributes the occurrence of this prolapse during pregnancy to a relaxation of the genital organs, and claims that it occurs mostly in those animals of a lymphatic temperament which are good milkers, have wide pelves and are fed abundantly upon bulky food. He also believes that cows which are kept on sloping floors are liable to this disease and that injuries of various kinds may cause it. He claims that it occurs chiefly in adult animals which have previously given birth to young. We have observed it also in primiparæ. The disease usually appears

during the later stages of gestation, sometimes only a few days prior to parturition, while at other times it may precede the advent of labor two to four weeks.

The actual cause is not well known. We have observed it more frequently in the ewe than in the cow. In the ewe it can not well depend upon lying upon a floor sloping backward. Sheep are not confined in stanchions and ordinarily lie upon a level floor, so that there is no sloping backward of the body. So far as we have observed, the affection is seen almost entirely in closely housed pregnant animals. We have especially noted the affection in ewes which were being bred for winter, or "hot house" lambs. In these cases the ewes are bred about August or September, so that they may give birth to lambs during mid-winter, which are fitted for the early market when prices are high. The ewes are closely confined in very warm stables and highly fed. Under these conditions we have found as high as 5 to 10% of a herd of ewes affected with this malady. So far as we have observed, the conditions under which the disease arises in the cow are similar. We do not recall having seen a case of prolapse of the vagina in a pregnant animal, except it was closely housed or had met with some accident.

The symptoms of the malady consist essentially of a prolapse of the vagina, which projects more or less beyond the vulvar opening as a bright, red tumor. After it has been prolapsed for a period of time it becomes swollen and the mucosa much thickened and very greatly irritated. The prolapsed part may become covered over with dried blood clots, bedding and dirt of various kinds, accompanied by more or less suppuration. During the earlier stages and in very mild cases, the prolapse may be visible only when the animal is lying down, and disappear spontaneously when she gets up. If the tumor remains when the animal is standing, and is pushed back by the hand, the vulvar opening is abnormally large, the result of the prolonged stretching of the sphincter muscles by the presence of the tumor.

In many cases the prolapse does not cause great inconvenience to the animal. In others there is considerable irritation, with straining, which increases the size of the tumor and gradually results in systemic disturbances which may cause the animal to lose flesh and vigor and finally to succumb.

Judging from our clinical observations, the essential causes of

the disease are a depression of the general vigor of the animal by the close confinement and overfeeding, combined with a heightened intra-abdominal pressure, due to the presence of the gravid uterus, intensified by bulky feeding. These lead to an infection of the vaginal mucosa, which induces swelling accompanied by straining—a chronic catarrh of the vagina with exalted intra-abdominal pressure. Sometimes the tumor projects for a considerable distance beyond the vulva and the cervix uteri may even appear and protrude beyond the vulvar lips. (Prolapse of the Vaginal Portion of the Uterus.) In most cases, especially in the ewe, the entire circumference of the vagina protrudes, as an irregular, ring-like tumor. In other cases, especially in the cow, only the floor of the vagina protrudes. Along with the vaginal floor the urinary bladder may be everted and protrude beyond the vulvar lips enclosed within the vagina, constituting vesico-vaginocele. In this condition, the urethra is found close to the lower commissure of the vulva and its canal extends upward and backward into the urinary bladder, which now lies reversed, with its fundus extending backward.

When the prolapsed organ attains a large size and remains exposed for a long time, it becomes excoriated and ulcerated and the mucous membrane vastly thickened so that it may be extremely difficult to bring about its replacement.

Prognosis. Once established, prolapse of the vagina in pregnant animals persists until parturition is completed, unless overcome by proper handling. There is no visible tendency toward spontaneous recovery. On the contrary, the malady tends to become aggravated with time.

The protruding organ comes in contact with bedding, manure and other infecting and irritating objects. Occasionally it is rubbed against the walls of the building or other objects, causing laceration. Feces from the patient must pass over the tumor and soil it. The tail is constantly in contact with the tumor and serves to abrade it.

Under these conditions the prolapsed organ becomes more and more inflamed, thickened and painful. Straining occurs frequently. The mucosa becomes greatly thickened and dark colored, and more or less gangrene may occur.

When vesico-vaginocele exists, the inverted position of the bladder, outside the body cavity, renders urination very difficult.

All aid normally coming from the compression of the abdominal walls is lost and the expulsion of urine must be accomplished by the contraction of the bladder walls alone, against serious obstacles to the escape of the urine through the urethra. The accumulation of urine in the bladder, causing the distension of the organ, increases greatly the size of the prolapse and intensifies the suffering of the patient.

The straining consequent upon the prolapse tends somewhat toward dilation of the cervical canal and favors the extension of the infection from the vagina along the cervical canal into the uterine cavity. Such infection tends to sooner or later bring about the death of the fetus, followed by its septic decomposition.

The expulsive powers of the genital canal are at once weakened so that, should the fetus perish, its expulsion is doubtful. Instead it is liable to be retained, decompose, and induce fatal sepsis of the mother. This is especially true in the ewe.

The affection in the ewe is highly fatal, and most of the animals succumb unless handled carefully and early. In the cow the affection has, in our hands, proven more amenable to treatment. When the vaginal portion of the gravid uterus is so far displaced that it protrudes beyond the vulva, the gravity of the malady becomes heightened.

A serious feature of the malady is the weakening of the inflamed vaginal walls. In some cases they become so fragile and inextensible that they rupture during the passage of the fetus through the vagina or during manipulation by the obstetrist or others. The accident ends in fatal peritonitis.

Treatment.—The treatment of this malady will vary materially in individual cases. If it is observed that the animal is forced to lie with the posterior parts depressed, as in case of a cow in a sloping stanchion, the declivity of the stall floor should be corrected. Since the exalted intra-abdominal pressure has much to do, in a mechanical way, with the causation of the disease, this tension should be largely overcome by giving a concentrated diet in limited amount and of a laxative character, to reduce the volume of the abdominal contents as far as practicable.

In those cases where the disease is well established and the mucous membrane inflamed, general precautions do not serve to overcome the disease. The prolapsed organ must be returned to its position promptly and means applied which will cause it

to remain in its normal situation. In order to maintain the organ in position, we need overcome the straining, due to the pain, and the infection. Before the prolapsed organ is replaced into its position it must be cleansed thoroughly. After its reposition it is to be straightened out in its normal situation ; the replacement must be as complete and perfect as possible. After it has been replaced, we should introduce into the cavity of the organ remedies which will overcome the infection and ameliorate the pain.

The reposition of the extruded organ is not always easy, because of the straining. First, the part should be bathed with a tepid antiseptic solution, for which lysol is especially useful because of its unctuous character. Care is to be taken that the antiseptic is not too irritant. The lysol solution should not exceed 1 %. It may even be omitted and tepid water alone used. If the organ is very irritable and painful and its reposition causes great resistance we may apply to it one of the local anaesthetics, such as cocaine, or eucaine in order to overcome the resistance in returning the organ and to diminish the straining after it has been replaced. An addition of adrenalin to the anaesthetic solution blanches the mucosa and decreases the congestion. The replacement of the organ in the cow should be brought about by gentle and careful pressure with the palms of the hands, until it has retreated within the vulva, when one hand should be introduced and the walls of the organ straightened out in their normal position. If for any reason the animal should be recumbent, great difficulty may be found in replacing it. Whenever possible, the animal should be caused to stand, preferably with its hind feet upon higher ground than the fore-feet, so that the anterior part of the body slopes downward and the abdominal viscera drop forward away from the pelvis.

The ewe, or other small patient, should be seized by the hind legs and suspended with the head downward, when the diseased organ will return to its position spontaneously or with very slight pressure. After the organ has been replaced, the operation may be completed by pouring into the vagina, through a funnel or tube, a tepid antiseptic solution. This tends to smooth out all irregularities and make the replacement complete. In the ewe we have found that a 1-1000 solution of corrosive sublimate is not so highly irritant in the diseased vagina as it would be in

the normal organ, and is usually borne without apparent irritation.

In order to prevent a recurrence of the eversion, and bring about disinfection and a decrease in the irritation of the part, we have found iodoform, or iodoform and tannin, highly beneficial. In the cow, the powder, enclosed in a gelatine capsule, which may be opened with the hand, may be introduced deeply into the vagina and scattered about in the cavity. In the ewe or other small animal the powder can readily be dropped into the vagina by holding the vulvar lips apart with retractors or by introducing a long pair of dressing forceps deeply into the vagina and opening them, holding the walls of the canal apart and dropping the powder into the organ, while the patient is suspended by its hind limbs.

Another effective means for applying iodoform and tannin or other astringents or local anaesthetics is by means of suppositories, which may be made by mixing the desired drugs with tallow and enough wax to give the proper consistency, and then pouring these into a suitable mould, according to the species and size of the animal. After they have hardened, they are introduced into the vagina. Such treatment is very soothing to the irritated organ and does much to overcome the infection and straining, which go hand in hand.

Fleming and others recommend the application of bandages, trusses or sutures to retain the diseased organ in position. We have not found these very satisfactory because there is no way, by either plan, to prevent the vagina from being pushed out against the mechanical devices, thereby causing irritation by pressure against these objects. We have not successfully controlled the straining until we have eliminated its cause or causes—until we have overcome the infection and inflammation. When this has been accomplished, the disease ceases. In other cases Fleming advises the use of the ring pessary, but the application of this can only intensify the infection. While it may keep the vagina in place, it does not cure, but merely disguises the existence of the malady.

It is not improbable that the prolapse is often due to fetal death. The general assumption is that the prolapse induces the death of the fetus and thereby complicates the disease, but the reverse may be true. We know that, following parturition,

endometritis frequently induces vaginal prolapse, which persists until the endometritis is definitely relieved, and this fact raises the question whether a macerating fetus in the uterus may not similarly cause prolapse of the vagina in the pregnant animal. If so, it would evidently be bad surgery to apply mechanical devices to overcome a prolapse dependent upon causes still existing, which the means applied would intensify, instead of overcome.

The bandage, truss, suture, pessary or other mechanical means for retention not only tends to aggravate the malady in many cases, but is a constant danger for the animal when parturition arrives. There is one redeeming feature in all these mechanical appliances when parturition arrives : they are each and all thrust aside ; sutures are torn out, with resulting deformity ; and labor generally proceeds in spite of the obstacles. This indicates that, if the irritation in the vagina is sufficiently great, each of these means is ineffectual in retaining the prolapsed organ. The application of each of these mechanical devices will be described under "Prolapse of the Uterus" as a post-parturient accident.

We have suggested above the use of astringents in combination with iodoform, applied to the diseased organ. Astringents are not to be carried too far. If applied too abundantly as a powder or in aqueous solution they may prove too dessicant and harden the vaginal walls. Pushed too far, they may even cause dessicant necrosis of the mucous and muscular walls. Such dessication endangers the life of the patient by inviting a rupture of the rigid or necrotic vaginal walls at the time of parturition. The vaginal mucosa should be kept moist. If necessary, the softness and pliability are to be maintained by the application of oil or heavy fats with the iodoform or other disinfectants.

Systemic medication should not be neglected. We have indicated that amongst the chief causes were a general atonic state combined with close confinement and heavy feeding.

The intestinal tract should be promptly and judiciously unloaded in order to overcome the abnormal intra-abdominal tension as well as to relieve the digestive system from an overload of aliment demanding digestion. If the object can be promptly attained by the use of laxative foods, the administration of drugs may not be demanded. Generally, the veterinarian is not war-

ranted in permitting such delay, but should promptly administer purgatives. The promptest and safest of these are the alkaloids, eserine and arecoline. Given in small doses they act within an hour, and if they fail to do so the dose may then be repeated. To an ordinary cow ½ to 1 grain of arecoline or eserine may be given. The ewe may take ⅛ to ⅓ of a grain, repeated in increased doses until the desired effect is obtained. Saline cathartics may be used instead, but they are very slow in action and cause disagreeable disturbances of the appetite. They have greater danger for the life of the fetus.

The general tone of the system should be favored by the administration of tonics, especially of nux vomica or strychnine.

When the affected animal has reached the normal duration of gestation and the prolapse is severe and inveterate, artificial delivery should be induced without delay. The os uteri should be gradually dilated and the fetus secured and brought away with light and careful traction.

We are strongly inclined to hasten parturition, especially if the normal duration of pregnancy has been about completed. The size of the ewe may render this difficult. If the ewe is large and the obstetrist's hand small, the task is greatly lightened and the operation rendered more safe. The operation should be carried out in the same manner as described on page 428. When the smallness of the vulvo-vaginal canal or the large size of the operator's hand precludes artificial delivery through the genital canal, hysterectomy may be considered and applied if deemed judicious. We shall describe this operation among "Obstetric Operations."

A heifer entered in our ambulatory clinic had suffered seriously from vesico-vaginocele for 24 hours. The animal had reached the end of the ninth month of gestation. When we were called, she was lying prone in the stanchion, unable to rise, even with assistance. She was somewhat emaciated, apparently very feeble, and there was possibly some degree of hydrops amnii. The floor of the vagina, within which was the bladder filled with urine, was extruded through the vulva and returnable only with great difficulty. It was impossible, from the beginning, to retain the organ in position after its return and it was evident that the only hope for the patient lay in immediate delivery.

The animal was dragged from the stanchion to a suitable place for operating, where the posterior parts could be somewhat elevated. After much tedious and patient labor, the os uteri was dilated and the fetus removed. The afterbirth was left in the uterus and its cavity was filled with a warm disfecting solution. The prolapsed organ remained in position without any mechanical appliance and the animal, relieved of the weight of the fetus, was soon able to regain her feet and made an uneventful recovery.

In all cases of this malady, we would advise that the chief effort be directed toward overcoming the causes and that close attention be given to the cleanliness of the parts and to keeping them in position by the gentlest possible means. In many cases the repeated replacement and dressing of the parts may be essential and, in some comparatively rare cases, the truss or sutures may be allowable. However, we would urge the avoidance of mechanical appliances, so far as practicable.

It must be borne in mind, also, that the disease is due very largely to close housing and consequently we may accomplish much good by causing the animal to take invigorating exercise. This should not be severe but should be abundant and regular. Such exercise aids in many ways: it stimulates the action of the bowels and decreases the fullness of the abdomen; it invigorates the general system and imparts an increased tone to the affected organ; and it serves to direct the patient's attention from irritation in the part and thus prevents straining. The movements of the animal further tend to bring about a correct position of the uterus and vagina.

Metrorrhagia.

Hemorrhage from the Gravid Uterus.

Hemorrhage from the gravid uterus is very rarely observed in our domestic animals. Carsten-Harms records the accident in the cow and mare, and admits its occurrence in all domestic mammals. The symptoms consist fundamentally of colic, straining similar to labor pains and an escape of blood from the genital organs. The symptoms are not constant and any one of them may be absent in a given case. Should hemorrhage occur from the cervix, the blood may escape from the vulva, and, if moderate, no symptoms occur except the visible hemorrhage itself. It may even be that colic or other disease which might later be regarded as a symptom of metrorrhagia actually causes the hemor-

rhage and may precede it by several days. The straining may vary greatly in degree and may not be very prominent.

The hemorrhage from the vulva will necessarily vary greatly according to the case ; in some instances it may be very extensive and apparent, while in others the blood may all be retained in the uterine cavity. If the hemorrhage is very extensive, whether the blood escapes from the uterus or not, it produces the usual symptoms of internal bleeding, such as colic, imperceptible pulse and blanched mucosa. In such severe cases the animal necessarily becomes very weak and staggers. The surface of the body becomes cold, and there is profuse sweating in the mare. The heart-beat is violent but the arterial impulse is weak.

The diagnosis of uterine hemorrhage, in pregnant animals, is not easy except by manual exploration. It is necessary to determine the source of the bleeding, and the manipulations necessary to this are sometimes undesirable. We were once engaged with a very serious case of dystokia in a mare, which occupied our time for some six hours. The work was performed in close proximity to other pregnant mares. When we had finished our work we observed that another mare, which was almost ready to foal, was discharging blood from the vulva and was considerably excited. The mare was secured and quieted, after which she seemed to be well in every respect ; there was no pain, the pulse and temperature were normal and the animal appeared perfectly well except for the discharge of a moderate quantity of bright red blood from the vulva. The flow soon stopped and it seemed to us inadvisable to undertake the manipulations necessary to determine the source of the bleeding, whether from the uterus, vagina, bladder or some other part. We consequently desisted from making any examination and allowed the case to go without interference, with the result that pregnancy was completed without further incident and a living foal was born.

We hold, therefore, that it is not essential in all cases to make a definite diagnosis when manipulation might imperil the life of the fetus. Under the circumstances which we have related, manual exploration of the vagina to determine the source of the hemorrhage would, in our judgment, have been unnecessarily hazardous, more so than had the animal not been greatly excited.

The hemorrhage may cease and gestation continue for the normal period of time and either living or dead young be pro-

duced. There may be but a single hemorrhage or it may recur several times. In severe cases, the hemorrhage may prove fatal to the mother.

The causes must be referred to a rupture of some of the uterine vessels, which may be due to the presence of a tumor or other disease or, as is probably most frequently the case, to some traumatic injury.

The prognosis of uterine hemorrhage in the pregnant animal is usually very grave, alike for the mother and the fetus.

The treatment will depend greatly upon circumstances. First of all, we should secure the most absolute quiet possible in the hope that the blood may form a thrombus and the hemorrhage from the wounded vessels cease. Harms recommends an application of cold water or of cooling mixtures or ice bags to the posterior part of the abdomen in the vicinity of the uterus, by which he hopes to favor the formation of thrombi. Ergot and hydrastis Canadensis may be given internally as styptics, but their effect is not always satisfactory. When the hemorrhage is very threatening, it may be desirable to bring about immediate delivery of the fetus. We would have one or more of three objects in view in bringing about the evacuation of the uterine cavity. 1. We may thereby save the life of the fetus, although not yet fully matured. 2. We may cause the hemorrhage to cease spontaneously by permitting an involution or contraction of the uterus when freed from its contents. 3. We may be enabled to apply remedies, of a topical character, directly to the bleeding parts.

The method of bringing about evacuation of the gravid uterus has already been discussed on page 428. The conditions here demand the greatest possible celerity compatible with safety, once the operation has been determined upon. We cannot readily bring about prompt evacuation of the uterus in the cow, because the cervix is so firmly contracted, but in the mare, with the very dilatable os uteri, delivery can be brought about very quickly.

After emptying the uterus of its contents, cold water or astringents may be injected into its cavity, or it may be packed thoroughly with gauze saturated with astringents, such as alum. Those astringents or styptics, like the persulphate or iron and some others which are irritant, should not be applied, because they tend to induce straining, which serves to cause the hemorrhage to continue and defeat the practitioner's aim.

DISEASES OF THE FETUS AND ITS MEMBRANES.

The fetus is contained in the hermetically sealed uterine cavity of the mother and is further protected by the fetal envelopes and fluids which surround and protect it from traumatic injuries and from thermic changes, so that it is well guarded against dangers from without. The maternal system furnishes, through the placenta, abundant nourishment and removes by the same avenue, its excretions. When describing the placenta we noted that its structure is such that, while freely permitting the passage of nutrient substances, from the mother to the fetus, and waste products from fetus to mother, it generally serves as an efficient barrier against the passage of disease-producing microorganisms. The fetus is thus protected upon every hand in an unusual degree against disease or accident.

Nevertheless the fetus is subject to many forms of disease and accident which may imperil its life or bring about changes which render it of little value when born.

In the preceding pages, in tracing the development of the fetus, we have from time to time mentioned some aberrations in the development of the fetus, such as monstrosities and defects which more or less destroy the value of the young animal.

Though some of these aberrations in development render the fetus incapable of living at the time of birth, and others have little danger to the life of the young animal but simply affect its value, none of them, as a rule, lead to death of the fetus during its intra-uterine life.

On the other hand, various diseases of the fetus or of its membranes lead more or less frequently to its death and expulsion.

Death of the Fetus.

Death of the fetus occurs in all species of animals and at any stage of intra-uterine life from the beginning to the end. In the majority of cases, when death of the fetus occurs, it is promptly expelled. This we know as abortion.

In other instances, which are far more rare, the dead fetus is not expelled but is retained within the uterus for a more or less indefinite period. The retained dead fetus may pursue a variable course, according to circumstances. It may undergo aseptic wasting or mummification. There may occur a maceration or

softening, in which, if there is infection present, it is not accompanied by the ordinary features of putrefaction. The fetus may undergo ordinary putrefactive decomposition, with the formation of gases. The recognized causes of fetal death are considered in the following chapters.

Mummification. When a fetus dies within the uterus and escapes infection, its fluids and soft parts gradually become absorbed, until finally there remains a hard, dry, blackened fetal mass. The skeleton is complete and perhaps normally formed, the skin intact and probably covered with hair, while the soft parts are wasted, hard and dry. See Fig. 86 and compare with Fig. 81. The cadaver of the fetus is usually without odor and has apparently escaped infection wholly.

Fig. 86. Mummification of Fetus. Cow.

This condition is dependent primarily upon the firm closure, or hermetic sealing, of the os uteri and naturally occurs with greatest frequency, if not wholly, in ruminants, where the long and narrow cervical canal is surrounded by a great abundance of dense and firmly contracted tissue, which holds and keeps the canal thoroughly closed. Among ruminants it is seen most frequently in the cow. As a general rule, death of the fetus occurs from the 5th to the 6th or 7th month and rarely somewhat later, so that the mummified fetus usually measures from 12 to 16 or 18 inches in its greatest diameter. In rare cases it may almost reach the normal measurement of a fully developed calf.

The cause of death, in cases of mummification, is not known and presumably varies according to circumstances. It is only

essential that the death has been brought about by some cause which has not been dependent upon, or accompanied by, an opening of the cervical canal and that no infection has gained access to the fetus or its membranes.

The symptoms of death and mummification of the fetus are negative. No signs of disease are present. It may first be suspected when the animal is found to be sterile, without signs of estrum. While the fetus is alive there is no departure from the ordinary signs of pregnancy and when it perishes the event is not marked by any external manifestations. The signs of pregnancy, however, cease to accumulate: the abdomen does not increase further in size; the milk glands do not continue to develop. On the other hand, there is no external evidence that the animal is not pregnant. The presence of the mummified fetus prevents ovulation and estrum. The cow remains quiet and tends to fatten. Finally she passes her normal period for calving and no signs of parturition, or the approach of it, appear. If at this period a careful examination be made per rectum, it will be found that the uterus contains a hard, rigid, unyielding mass, in which some parts of the fetus may be recognized. The fetal fluids have largely disappeared and the uterus closely invests the mummy. If undisturbed, the mummy remains indefinitely in the uterus as a permanent source of sterility. In some rare cases, for reasons unknown, the mummy is expelled after a variable duration of time and the cow may again ovulate and conceive.

In the vast majority of cases the condition is not discovered or suspected. The cow, remaining unfruitful for a long period of time and in the meantime becoming fat, is sold to the butcher, and upon slaughter the actual condition is discovered.

The treatment of this condition necessarily falls under the head of Sterility. Except as a cause of sterility, mummification of the fetus is without significance and does not injure in any way the well-being of the mother nor affect the value of her flesh for human food.

When an examination is made to discover the cause of sterility and the presence of the mummified fetus is discovered, the only course to pursue is clearly that of the extraction of the fetal cadaver. If it can be determined by rectal exploration that the corpus luteum resulting from the pregnancy still persists, it would appear,

according to Hess, that the expulsion of the fetus might be brought about by the artificial pressing out of this body, thereby inducing uterine contraction, which may be further favored by massage of the uterus per rectum. This failing, our only recourse is the mechanical dilation of the cervical canal and the extraction of the mummy. In the extraction of this unyielding mummy, considerable difficulty may be encountered if it is of very large size or when one or more of the limbs project in an unfavorable direction. It may be necessary to perform embryotomy.

Maceration and Putrid Decomposition of the Fetus.

When the fetus perishes in the uterus and the os uteri is pervious and permits the entrance of micro-organisms, the fetal body quickly undergoes maceration or putrefaction. The exact type of decomposition varies in different cases. In one, it may simply amount to a softening and solution of the fetal body and membranes, with some fetor. In other cases putrefaction takes on the ordinary type, with a great fetor and the formation of large volumes of gases. When the putrefaction is rapid, so that the uterine walls can not readily and quickly expand to accommodate the large volume of gases, rupture of the uterus may occur. If the decomposition and formation of gases are not so rapid, the walls of the uterus become inflamed and thickened and lose their contractile power. There is an abundance of pus formed from the mucous membrane. Sometimes the cavity of the uterus assumes the type of an abscess which eventually opens upon the exterior, either directly through the abdominal walls, or indirectly through the os uteri, vagina, intestines, or rumen. When the disease pursues such a course, the uterine walls become adherent to that part through which the opening is to occur and eventually the fetus, with other putrid contents of the uterus, is expelled. Through the abscess opening there may enter into the uterine cavity particles of food from the intestinal tract. When the uterine abscess empties itself through the cervical canal into the vagina, the os uteri becomes slightly dilated and portions of the fetus may from time to time be expelled through this opening.

The symptoms of maceration or putrefaction of the fetus are extremely varied. When portions of the fetus are expelled

through an abscess opening upon the surface of the abdomen, the diagnosis is easily reached. When the uterine contents are being discharged intermittently through the vagina, it is possible to determine the nature of the disease by examination of the maternal organs or of the expelled parts. When the discharge of the fetus and uterine contents takes place through the digestive tract, there is usually a fetid diarrhea at the time of discharge, which may reveal its nature by the presence of fetal bones or of other fetal parts.

When these fetal parts are not being discharged, the symptoms are not so clear. There is usually marked depression of the patient, and indications of some profound internal disease, with symptoms indicative of septicaemia. There is emaciation, with a general appearance of bad health, poor appetite, etc.

Such symptoms are not always present, however, and in some cases the patient may remain apparently well while a fetus is rapidly decomposing in the uterine cavity and is gradually escaping to the exterior through the genital canal or, more frequently, through some artificial channel. An examination per rectum may reveal the greatly distended and fluctuating uterus and even the character of its contents. The fact that an animal, which has been supposed to be pregnant, has passed beyond the normal date for parturition, and has become unwell, should arouse the suspicion of the veterinarian and lead him to make a detailed examination. If, in addition, there have been more or less evident signs of labor at or near the proper time for parturition, the symptoms become highly suggestive.

The cause of retention and decomposition of the dead fetus is exceedingly variable and depends for the most part upon some impediment to its expulsion after death. The prevention of expulsion depends frequently upon torsion of the uterus, especially in the cow and ewe, more rarely in the mare and other animals. In numerous cases of uterine torsion, in the ewe and cow, the uterus becomes transversely parted in its cervix or the vagina is ruptured transversely and the gravid uterus drops down upon the floor of the abdomen, a detached mass. The fetus decomposes, because infection has gained admission to the uterine cavity during torsion, and the detached organ serves as an asbcess cavity. This finally evacuates itself through the floor of the abdomen or through the intestinal tract.

In other cases, the retention and decomposition of the fetus may depend upon induration or constriction of the cervix, upon mal-presentation of the fetus or some form of monstrosity preventing normal delivery. Artificial delivery at the proper time has been neglected or has failed.

The treatment of retention of the fetus, accompanied by maceration or putrid decomposition, depends upon the removal of the fetus and disinfection of the diseased uterine cavity. The method for bringing about the removal of the uterine contents will depend upon the cause and will be considered under the various heads which may induce this condition, such as Torsion of the Uterus, Constriction of the Cervix Uteri, Fetal Dystokia and other chapters related to the causes which we have suggested.

ABORTION. STILL BIRTH. PREMATURE BIRTH

The term abortion admits of a variable interpretation and is used with a different meaning by various writers and by the same writers in different cases. Generally speaking, we understand abortion to mean the expulsion of the fetus from the uterus at such a stage of its existence that, if still living, it is not sufficiently developed to live.

When a living fetus is expelled prematurely and in a state of development which renders survival possible, the accident is designated premature birth. In human obstetrics it has been attempted to fix a given date or period in gestation which should constitute a dividing line between abortion and premature birth. This point cannot be definitely fixed and has in fact been changed somewhat recently by the introduction of incubators in human obstetrics for the preservation of the lives of prematurely born infants. It has been thereby rendered possible to save the lives of infants born at a stage of development which, in previous years, would have led to their death.

The designation of still-birth is applied to those young which are expelled at an age when they are sufficiently developed that they might live, but have in fact perished prior to their expulsion.

Another element has entered into veterinary obstetrics which serves to complicate our definition of abortion. We have an infectious disease which exerts its fundamental and marked influence upon the life of the fetus, and which we know as infectious abortion. In speaking of this disease, we are consequently dealing with an infection and it matters but little to us at what stage the fetus becomes affected with the malady or what its results may be. If the fetus dies in the uterus and is thereafter expelled at any stage of gestation, the occurrence is designated infectious abortion, even though the expulsion of the dead fetus does not occur until the close of the normal period of gestation. If the fetus is expelled alive, even though it has reached such a period of development that, under normal conditions, it might live, but, under the influence of the infection acquired within the uterus, succumbs early to the malady, we designate it infectious

abortion. Even if the fetus should become infected late in gestation, be born alive and comparatively vigorous though suffering from the infection acquired while in the uterus, and finally overcome the effects of the disease and live, we should still speak of it as infectious abortion. Thus, in speaking of abortion in domestic animals, we include a variety of conditions, which it is difficult to include under one definition.

We recognize three classes of abortion in domestic animals:

1. Sporadic or accidental abortion, in which, owing to disease of, or accident to, the fetus or mother, the fetus may be expelled dead or in a state of disease which renders it impossible for it to live.

2. Enzoötic abortion, due to some infectious disease of the mother, which brings about the death and expulsion of the fetus as a complication of the maternal disease.

3. Infectious abortion—an infection of the fetus and its membranes which causes the death and expulsion of the fetus or its expulsion in a living and enfeebled state at any period of gestation from the date of conception to the normal completion of pregnancy, without directly inducing material evidence of disease in the mother.

1. Sporadic or Accidental Abortion.

Any disease of the mother may more or less remotely involve the well-being and safety of the fetus and may bring about its death. Some infectious diseases cause the death of a large percentage of fetuses. These we shall consider under enzoötic abortion. Clinically, illness of the pregnant female does not as a rule seriously imperil the life of the fetus. Animals in various stages of gestation, suffering from high fevers and a great variety of disorders, if they recover, usually carry the fetus safely.

Painful diseases of the digestive canal, accompanied by severe tympany with exalted intra-abdominal pressure, may bring about abortion, but in the vast majority of cases do not do so.

The toxic effects of various drugs, especially of those which have some special effect upon the genito-urinary organs, are claimed to sometimes produce abortion. But we do not as a rule observe such effects from these drugs. Harms asserts that he has frequently administered aloes to pregnant mares without observing ill-effects, but that, when he gave an aloetic purge to a mare

which was suckling a foal, the latter died from superpurgation as the result of partaking of too great an amount of aloes in the milk of its mother. Harms had warned the owner against permitting the foal to suck the mare, but he milked her and fed the milk to the foal.

Foods of various kinds have been accused of producing abortion, but the basis for the charge is not very clear. It is exceedingly difficult to determine the facts in these allegations, because many of them go back to a period when the infectiousness of diseases in general was doubted and when various influences were invoked to account for the prevalence of a disease. In fact, that era of doubt has not yet wholly disappeared and perhaps never will. We find among laymen a strong tendency to doubt the infectiousness of abortion. Instead they invoke various theories to account for the disease. Even among veterinarians, we find doubters and skeptics in relation to infectious diseases, who must find some explanation for the appearance of the disease, other than infection. In the literature of earlier days, we find prominent mention of the injurious effects upon the fetus of fodder which has been more or less spoiled by rust or moulds of various kinds, and especially those fodders which have been affected with smut and ergot. These charges cannot well be traced to a definite and reliable source. Harms relates that he has seen ergot given to pregnant cows in very large quantities, without effect, and that in one case he killed a pregnant goat with ergot without producing any signs of abortion. We have been unable to find any definite records, in veterinary literature, where ergot or any other drug has caused abortion without first seriously jeopardizing the life of the mother.

We believe, therefore, that, while there may occasionally occur an abortion from the improper feeding of the pregnant animal, the losses from this cause have been greatly exaggerated and are not especially important. We would not be understood, however, as suggesting carelessness in the feeding of pregnant animals, but merely as insisting that the safety of the mother and fetus are bound up together in so far as diet is concerned and that whatever food may be healthful for the one is comparatively safe for the other. It is needless to advise against the use of mouldy, rusty or ergotized food for pregnant females,

because of the same considerations which lead us to advise against it for non-pregnant animals.

The low temperature of food or water has been invoked to explain some cases of abortion. In our observation, however, the ingestion of cold food or water acts injuriously only under exceptional circumstances. Harms asserts that large quantities of frozen food may bring about abortion and we may well believe this because it may produce very severe indigestion and toxaemia. So it is claimed that injection of cold water into the vagina may bring about labor pains and the expulsion of the fetus, and also that the drinking of a large amount of very cold water will produce the accident. There is another phase of the question which should be considered. In many parts of the country pregnant animals habitually drink ice-cold water during the winter months; they constantly eat food which is out of doors and in many cases has a temperature considerably below zero; they dig away snow from grass in order that they may eat it and many of them depend upon snow for their water supply. Yet, abortion does not occur in such animals. If, however, a pregnant mare is driven until very warm and fatigued, and then allowed to drink a large volume of ice-cold water, we may well believe that serious results to the fetus may occur. If pregnant cows are kept in a warm stable until they have become exceedingly thirsty and are then allowed to drink heavily of cold water, a severe shock to the fetus, as well as to the mother, may occur.

Habit apparently has a strong influence in the production of abortion in individual animals, or possibly we might say that in the individual herself there exists some peculiarity, some weakness or defect of the genital or of the general system, which tends to prevent a fetus from arriving at full maturity and leads to its premature death and expulsion. Such instances are frequently noted in woman and are not rare in the mare and cow, but the exact reasons therefor are not well understood.

Twin pregnancy in the mare generally leads to abortion at about the 8th to 10th month of gestation. Probably 90% of twin pregnancies in the mare thus end in the death of both fetuses. In many twin pregnancies in the mare, the two fetuses die at different periods but are expelled at the same time, the two showing different stages of development. The reasons for abortion, in case of twin pregnancy in the mare, are not understood.

It may be that the two fetuses in some way cause mechanical injuries to each other during movements of the mare and thus induce some injury to the placenta and lead to fetal death.

Psychic influences are claimed by some to induce abortion in rare cases. Cases have been related where mares have aborted immediately after suffering greatly from fright, but even here it may be that some physical injury resulted because of the fright. It has been stated by various writers that, if one animal in a stable aborts, the sight of the accident may cause neighboring females to also abort. Harms very properly remarks that, if such a view were correct, an animal giving birth to young at the regular time in the presence of other pregnant females should cause them to abort. So far as our literature indicates, it would seem that psychic influences play a very small part in the problem of abortion. Large herds of cows, ewes, mares and sows are permitted to regularly give birth to their young in the presence of the other pregnant animals, without visible danger of inducing abortion or premature birth. Simultaneous births in a herd may usually be regarded as coincident rather than consequent.

The castration of pregnant females usually causes abortion, although such a result is not inevitable. The danger of abortion following castration is sufficient to contra-indicate the operation in pregnant animals where it is probable that the accident would imperil the life of the mother. In some animals, like the bitch, we habitually remove the fetus and uterus at the time of castration, so that the question of possible abortion does not concern us.

Mechanical irritations of the os uteri and vagina are said to endanger the life of the fetus, but we have insufficient data to clearly indicate the degree of risk. In practice we ordinarily make manual explorations of the vagina, in our larger pregnant animals, without any apparent danger. We recall one case in which the owner of a valuable brood mare examined her per vaginam because he believed she was not in foal. He dilated the cervical canal and discovered the fetus, which he mistook for a tumor. Later I was called and found the fetus, about 12 inches long, still alive. Soon after this examination, the mare aborted. This, however, does not show that examination of the vagina in pregnant mares is dangerous, but merely that when the hand is passed beyond into the uterus, where it eventually disturbs the

union between the fetal membranes and the uterus, and causes infection, abortion is probable, if not inevitable. Perhaps it is through some such examinations that the manipulations of these parts have acquired the reputation of being highly dangerous. It is evident that, if we need make manual exploration of the vaginæ of pregnant animals, we should do so with judgment and be careful not to cause unnecessary disturbance.

Since severe hemorrhage of the mother tends to produce fatal collapse of the fetus and is considered at times to cause abortion, it is well that animals which are advanced in pregnancy should not be submitted to operations accompanied by extensive loss of blood.

Mechanical insults probably play a highly important part in the production of accidental abortion. They may act in a comparatively direct manner upon the fetus as when some vital portion of its body is lying in close contact with the abdominal wall and receives a powerful blow from outside. More commonly, mechanical injuries have their effect somewhat indirectly by disturbing the connection between the fetal membranes and uterus. Anything which can cause a separation between the maternal and fetal placenta tends to imperil the life of the fetus. If the separation is comparatively slight, hemorrhage occurs between the chorion and uterus, especially in animals with diffused placenta, as the mare. The extension of this detachment over a very wide area tends finally to cut off the blood supply to the fetus and to induce uterine contractions, with expulsion of its contents. If an animal well advanced in pregnancy falls violently, becomes cast in the harness or stall, or becomes mired, the violence of her movements may cause a detachment between the chorion and uterus and lead to the death and expulsion of the fetus.

The jamming and jolting suffered by pregnant animals during transportation by rail, and severe draft, is liable to bring about injuries which may lead to abortion. When pregnant mares are put to work where the draft is very heavy, or especially where it is intermittent or jerky, the danger of injury to the young is sometimes very great. Mechanical injuries are possible at any time, at work or play.

In dairies where the cows are kept in uncomfortable stanchions,

on slippery, wet floors, there may at any time occur a slip or fall which may imperil the life of the fetus.

Mechanical injuries leading to abortion are more common in uniparous animals, because in these the uterus is more fixed in its position and does not yield so readily to external forces. Moreover, it is in these animals that we most frequently observe injuries, either at work or in transport, as they offer greater difficulty in handling. When they fall, their greater height and weight increases the impact and intensifies the strain upon the placental attachments. The greater size and weight of the fetus concentrates its impact upon a comparatively small area and increases the injury to the placenta.

The recognition of an impending abortion is usually difficult until near its completion. Usually the abortion occurs before the owner or caretaker has become aware that it is threatened, so that the first evidence which is observed is the fact that the abortion has taken place, as is shown by the presence of the expelled fetus and membranes. In cases where a number of pregnant females are kept together, it may even be difficult to determine which one has aborted, except there can be found some marks upon the animal, consisting usually of soiled tail, perineum and thighs, due to blood and fetal fluids discharged from the genital canal.

In other cases the threatened abortion is indicated by swelling of the vulva and a muco-purulent discharge, accompanied sometimes by swelling of the udder. The symptoms increase generally as the duration of pregnancy increases, so that when a late period of pregnancy has been reached the symptoms are similar to those of normal birth. Rarely the expulsion of the fetus does not occur until some time after its death and there may be swelling of the udder, with secretion of milk, for days or weeks before the fetus is finally expelled. Sometimes in the mare, there is observed swelling of the udder and secretion of milk without apparent cause, which continues for several days and finally disappears. Later, in the course of some weeks, the mare aborts twins, one of which is found to be much less developed than the other. This suggests that the one had perished at the time when the swelling of the udder was noted, but had not been expelled, and the other had continued to live and grow

until finally it too perished and the two were then expelled together, in different stages of development.

The course of abortion is generally rapid and when once begun is usually completed quickly, offering little or no hope that it may be in any way averted. If the os uteri is still closed and there are simply some feeble labor pains, it is barely possible that, by quieting the animal, the normal duration of pregnancy may be reached and living young produced. Such a result is almost unknown clinically.

Harms suggests that we may check the labor pains by the internal administration of camphor, with opium, alcohol or other stimulants.

When abortion has actually occurred, it is not possible to at once determine if it is sporadic or infectious and consequently we should treat each case of abortion occurring in a stable or herd as suspicious of infection and handle it accordingly. This will be considered under Infectious Abortion.

The sequelae of the sporadic abortion are the same as those of the infectious kind, which will also be considered in that chapter.

II. Enzoötic Abortion Resulting from Infectious Diseases of the Pregnant Animal.

When considering contagious cellulitis, on page 68, we noted that nearly all pregnant mares suffering from this affection aborted. When describing venereal diseases, on page 73, we laid stress upon the frequency of abortion in certain of these maladies, especially in the granular venereal disease of cows and dourine of mares, in which affections a large proportion of the pregnant animals abort. In some other infectious diseases of animals, abortion is common. It occurs frequently in foot-and-mouth disease and contagious pleuro-pneumonia of cows. In sheep-pox, abortion is said to be frequent. Pregnant sows suffering from hog-cholera generally abort.

The reason for abortion in these affections is not well known. As the micro-organism which causes some of these diseases is not fully determined or its nature is in dispute, it is impossible to say whether the fetus contains the causative agent or not. It is quite possible that the death of the fetus, in many of these instances, is due to the passage, into the fetal circulation, of the toxic products of the malady. It is clearly possible that the

micro-organism of the disease itself may pass through the placental capillaries and gain entrance into the fetal circulation, thus accomplishing its destruction.

So far as known at present, the micro-organisms of those infectious diseases which frequently cause abortion in the pregnant female largely belong to the assumed ultra-microscopic group. The causative agent can pass through an ordinary filter and perhaps also through the dividing membrane between the placental blood-streams of mother and fetus. Among the diseases mentioned as causing abortion, dourine constitutes an apparent exception, the disease being clearly due to the presence of a trypanosome. But we do not know that it causes abortion. It prevents breeding certainly enough, but whether it inhibits fertilization in the affected mares or later destroys the young embryo is not ascertained. Even in the latter case the parasite enters by the genital canal, is known to exist in the genital secretions and can directly attack the fetal membranes.

The symptoms of abortion from such diseases present no differences from those of accidental abortion and can only be differentiated from such by the fact that the abortion occurs in immediate connection with the contagious fever itself and independent of any other known influence which could bring it about.

This form of abortion is important because the loss to the breeder is the same as in other abortions, with the additional danger that, by complicating the disease of the mother, it increases the mortality among pregnant females.

There is nothing to be done in the way of prophylaxis or control of such outbreaks of abortion, aside from the general measures to be taken in reference to the contagious disease of the mother. In this connection it might be well to emphasize what we have already said on page 68 in reference to contagious cellulitis, which, because of this tendency to abortion, constitutes one of the most dangerous diseases of stallions and brood mares.

III. Infectious Abortion.

The vast majority of abortions in domestic animals are due to infection. The disease is most common in the mare and cow and has been observed in the ewe, goat and sow.

According to many authors, abortion is most common and

serious in the cow, but it is questionable if this is correct in all respects. The loss from single abortion is generally greater in the mare than in the cow. A large proportion of calves are destroyed at once or soon after birth because they are virtually worthless or their raising entails more expense than their ultimate value when grown. The principal loss in the cow is the interference with the milk yield, which is of course highly important. In the case of the brood mare, it is desired to raise each foal and its death becomes a serious loss. Compared with the calf, its individual value is much greater.

Therefore, when abortion becomes widespread in a region where horse breeding is very extensive and where the animals have a high value, the losses are enormous and it is difficult to state, without reliable statistics, in which species of animal abortion causes the greatest monetary losses, although we must admit that the economic loss from abortion in cows has received more attention and is more apparent. The view is doubtless correct that abortion in cows is more widespread, largely owing to the fact that the infection apparently has a better opportunity for spreading. The disease in cows also has better opportunity for perpetuation owing to the fact that cows are bred throughout the entire year, whereas, in the mare, the breeding is more concentrated at one season, and an outbreak of abortion may vent its full force by destroying all the fetuses in a stable and then cease to exist for want of material to sustain it.

Most authors consider infectious abortion as a universal malady which may be transferred from one species of animal to another. A few cases have been cited, in our literature, where infectious abortion has prevailed simultaneously on the same farm among cows and mares, but this is a very rare occurrence and quite contrary to the rule. Infectious abortion occurring in different species of animals simultaneously upon the same farm is no more frequent than should be expected as a coincidence. There is no reason why infectious abortion of mares and cows may not co-exist as two distinct affections on one farm. In our earlier experience, we observed chiefly infectious abortion of the mare and, in our territory, the different species of pregnant animals largely occupied the same enclosures.

The abortions in the mare, in our experience, very largely occurred in the open pasture or field. Though there were habit-

ually pregnant cows in the same enclosures, we never observed abortion in these. In fact, during a period of 12 years in private practice, in a region devoted almost equally to the rearing of draft horses and beef cattle, we did not observe a single outbreak of infectious abortion in cows. On the other hand, numerous outbreaks of infectious abortion of mares occurred, which were widespread and caused an almost total loss of the foal crop. During these outbreaks of contagious abortion in mares, it also occurred very naturally that the aborted fetuses and afterbirths were very frequently eaten by pregnant sows. Yet, we did not observe that any of them ever aborted from this cause. Nor have we ever seen infectious abortion in the sow, although in the region of our practice swine breeding was one of the leading industries and many farmers habitually bred from 10 to 20 or more sows each year. From a clinical standpoint, it seems very certain that each of our herbivorous domestic animals has a form of infectious abortion peculiar to itself and not transmissible in a natural way to other species.

Bang (Journal of Comparative Pathology and Therapeutics, Vol. 19, page 191) holds that abortion among mares may be due to the same bacillus or micro-organism as that which causes the disease in cows and concludes that it "reminds us not to neglect precautions in order to protect mares against infection from aborting cows." Bang has by no means proven his suspicion, as he failed in his one recorded experiment with a mare to produce abortion, and the animal gave birth to a small living foal which continued to live for two days. He asserts, however, that he has produced abortion by the injection of his abortion bacillus into the veins of sheep, goats and rabbits, in addition to the cow. He has not shown, however, that any of these ever contracted the disease, in a natural way, from another species of animal.

Ostertag (Monatshefte fur Praktische Tierheilkunde, Vol. 12, page 385) records a careful study of infectious abortion in the mare, in which he concludes that the cause of the disease in this animal is different from that in the cow. He finds that the micro-organism of infectious abortion of the mare is a short streptococcus, instead of a bacillus, as described by Bang and others as the cause of abortion in cows.

Ostertag produced further evidence of the non-identity of infectious abortion, in various species, by experiment. He inoculated two pregnant goats with the membranes of foals which had been expelled as a result of infectious abortion, and each of them gave birth to living and vigorous kids. He further attempted experimental inoculation in four pregnant mares and ten pregnant cows, with the result that two of the mares aborted, the one after 8 days and the other after 20 days. Each fetus contained the cocci of abortion. The other two mares gave birth to living foals after 8 and 17 days respectively. The foals were weak and the chorion of each contained abortion cocci. The foal expelled on the 8th day after inoculation died soon after birth, while the other recovered and developed normally.

The ten experimental cows resisted the inoculation completely. Neither the introduction of portions of afterbirth or fetal fluids into the vaginæ of pregnant cows from aborted foals, nor the inoculation of them with abortion cocci induced abortion.

Whether we examine the question in the light of clinical experience, bacteriologic study or inoculation experiments, it appears certain that the infectious abortion of one species of animal is fundamentally and essentially different from that of another and that there is no probability of the disease spreading from one species of animal to another, in a natural way. Even by artificial inoculation, there is little to indicate that the disease, as such, can be transferred from one species to another.

We shall, therefore, deal with infectious abortion as a separate malady for each of our domestic animals, although granting that there may be a more or less intimate relationship existing between them, but not of a sufficient degree to render an outbreak of abortion in one species dangerous for other species which may come in close contact with the affected animals.

A. Infectious Abortion of Mares.

Fleming (Animal Plagues) records the occurrence of abortion prior to the Christian era, though definite records of the disease were not made to any great extent until late in the 18th century. As with all other infectious diseases, there was much doubt as to the infectious character of the malady until after the middle of the 19th century, when a large proportion of the foremost veter-

inarians began to hold that the prevalence of the disease was due to infection and not to climatic or other chance influences acting upon a great number of animals, in the same way, at the same time.

Infectious abortion of mares first acquired prominence in the United States about 1886, when it appeared in several states in the Mississippi Valley, in which horse breeding had become a very important industry. It soon acquired a very extensive distribution and high degree of virulence. The unorganized state of veterinary science in the United States prevented the recording of any definite statistics in reference to the losses, but they were certainly enormous. At the time of the introduction of this disease, or rather when it acquired general importance, the writer was in private practice at Bloomington, Ill., which was then one of the richest draft horse breeding districts in America, and we estimated that in 1888, in one county, at least 2500 foals perished from infectious abortion. Since these foals were generally valued at about $60 per head at weaning time, the monetary loss may be estimated at $150,000 in a single year in one county. That county was in no way essentially different from others throughout a number of states.

Were reliable statistics as to the actual losses available, they would be so enormous for the entire Mississippi Valley as to be astounding. In some townships where horse breeding constituted one of the principal agricultural pursuits, the abortions exceeded seventy-five per cent of the pregnant mares. The losses were most marked in large breeding establishments where highly valuable mares were kept for breeding purposes alone. The losses were just as real on small farms where but a few mares were kept, which, after aborting, could be employed to some extent in farm work. However, throughout this area, many farmers maintained a number of mares wholly for the purpose of breeding. In such herds, the losses of the foal crop were often complete. In one season, one of our clients with a highly valuable herd of imported draft mares, about 50 in number, lost every foal from infectious abortion, save in the case of one mare, which was in our hospital under treatment for a chronic disease and consequently carried her foal to full term. In another instance, in the territory of a neighboring veterinarian, a breeder had 100 pregnant imported draft mares, in which the loss from infectious

abortion was total as to foals, and four of the mares perished because of sequelæ. Other similar instances might be related without number and give a somewhat vivid impression of the enormous losses which may be caused by this malady.

The infectiousness of the disease is shown by clinical observation. In a large proportion of cases it is possible to trace the beginning of an outbreak of abortion in a herd of mares to the temporary or permanent indroduction of a mare from a herd in which the malady already existed. A pregnant mare is bought from an infected herd and placed in the stable or pasture with pregnant mares, which, up to the time, were free from the disease. Within a few days abortion sets in and nearly or all the pregnant mares in the herd abort as a result. In other cases, a neighbor has driven a pregnant mare, or one which has recently aborted, from his own farm to that of his neighbor and has placed it in close proximity to the pregnant mares or has temporarily placed it in the stable, and even in the same stall where pregnant mares are later brought. Within a few days, these mares in turn commenced to abort. Or, the owner of a number of pregnant mares drives one of them to a neighbor's or to a public stable where animals afflicted with the disease have been kept. Returning home, this mare soon aborts. After an interval, other abortions follow and finally destruction of the entire foal crop.

Guillerey (Archiv fur Tierheilkunde, Vol. 29, page 37) gives us some excellent data of the way in which an outbreak of abortion in mares spread in his territory. G. was called on January 27, 1897 to remove the afterbirth from a six year-old mare which had aborted at 10 months the previous evening. As the mare was unable to expel the fetus without assistance, the owner asked four neighbors to assist him. Three days later, infectious abortion of a virulent character broke out in the stables of each of these four friends. On the 4th of February, in the same locality, two mares owned by P. aborted. Three days previously P. had assisted a neighbor in a case of difficult labor from abortion. In another case he records that a mare aborted, and that neighbors who entered the stable conveyed the infection to their own animals, which, in turn, aborted. Following the entire outbreak, G. was able to trace the source of infection with uniformity from stable to stable and from village to village.

In two small villages, where there were 68 pregnant mares, 60 of them aborted.

An extensive array of clinical observations as to the infectiousness of the disease might be added. They all have the same general character and force. The disease does not occur except as a result of exposure to some animal, either directly or indirectly, which has previously aborted, and when this exposure does take place abortion is as liable to follow as is the occurrence of any other contagious disease known to veterinary science.

Experimentation affords good evidence of the infectiousness of abortion in the mare. Ostertag, as already related, records four cases, with abortion in two of the animals and suggestive results in the other two.

Guillerey cites one experiment, which in itself is admittedly inconclusive. A piece of afterbirth from a mare which had aborted was introduced into the vagina of a mare in the 9th month of gestation. Two days later there was a muco-purulent discharge and on the 3rd day the mare aborted. Here and there in veterinary literature, occasional cases are mentioned where mares have been caused to abort by experimental inoculation, but the number of these is not extensive. So far as these experiments have been carried, they are strongly indicative of the infectious character of the disease.

The bacteriologic researches of Ostertag and others furnish additional proof of the infectious character of the disease. Ostertag separated and cultivated a short streptococcus, which produced abortion after experimental inoculation. The microorganism was obtained in pure cultures from the aborted fetus and its membranes.

We have further proof of the infectious character of the disease in the fact that it may be largely controlled by disinfection and the isolation of pregnant animals. The significance of this proof will be brought out in our consideration of the control of the disease.

In common with the behavior of all infectious diseases, the contagious abortion of mares is most frequently seen and attains its greatest virulence in those regions where horse breeding is most concentrated and the animals have a high value. This involves, as a general rule, the close stabling of animals or their being kept in close contact with each other upon pastures.

Infectious abortion in the mare may occur at any stage during pregnancy—an observation which possibly holds true to a great extent for other domestic animals. The abortion is most frequently observed, however, after the fetus has acquired considerable size, so that it is most usually noticed after the 6th to 8th month and even more commonly during the 10th and 11th months. In some of our observations, however, the abortion had apparently occurred very early, although no positive proof of this was obtainable. In fact it is exceedingly difficult to obtain proof of abortion during the first few weeks of pregnancy, since the small embryo, with its inconspicuous membranes, may be expelled without attracting any attention whatever on the part of the owner and does not interfere in the least visible degree with the general well-being of the animal.

In our investigations, there was one well-defined instance where very early abortion seemed to be well proven. An extensive breeding farm had over 100 breeding mares, some of which were imported draft animals and the others highly bred trotting mares. They were unusually well kept, under as favorable conditions as breeding animals could well be placed. The mares were at pasture upon good blue-grass, which was quite free from herbage having any suspicious character in reference to breeding. The mares were young and in excellent general health. The stallions were vigorous and well handled and had previously shown themselves to be regular and sure breeders. During one season these mares of both breeds seemed to conceive readily upon being bred, and upon being re-tried to the stallion they showed no signs of estrum and were apparently safely in foal. After they had been re-tried one, two or three times successfully, it was found that later they showed estrum and again had to be bred. The condition was very puzzling to the superintendent and no explanation was apparent during the spring and early summer.

Finally, in early autumn, when some of the mares had safely carried their foals for several months, there was occasionally found in the pasture a partially matured fetus. As the season advanced well nigh all of the few mares, which during the breeding season had constantly shown signs of being in foal, aborted, and the foal crop was well nigh ruined. Here it would seem that there was good evidence that many of these mares aborted during

the first 60 days of pregnancy, but, running in pasture as they were, the fetuses would not be discovered, and would probably be picked up by scavenger animals or birds. The mares would show no signs of any accident having occurred, so that it was only later, when a few fetuses had become sufficiently large to be noticeable, that the true character of the interruption in breeding was discernible.

In other instances we have noted the disease occurring during the late summer and early autumn, when the mares had been pregnant from four to six months. In these outbreaks the disease was quite as virulent as in those outbreaks occurring during the 11th month of gestation. Many authors claim that abortion in the mare is more common as gestation nears its end. This difference, if it exists, is not so great as it seems, because the accident in the earlier stages of gestation is largely overlooked and passes unseen.

The symptoms of infectious abortion in the mare depend very largely upon the stage of gestation at which the disease appears. It passes virtually unnoticed during the earlier stages of pregnancy. During the first eight weeks of gestation it is usually by mere chance that abortion is discovered, In one case which we observed, a mare was being driven when the driver noticed some object protruding from the vaginia. Upon examination, this was found to be a fetus about 4 inches in length, enclosed in its membranes. Such a fetus is readily overlooked, and its expulsion was discovered only because the animal was being driven at the time. Even then it might readily have dropped out upon the road without being observed at all. Later in pregnancy there may occur slight symptoms of impending abortion for a few hours, or possibly a day, before the expulsion of the fetus. These symptoms consist essentially of some swelling of the vulva, with a more or less conspicuous muco-purulent discharge. Later, according to the period of gestation, there may be more or less prominent labor pains, with light symptoms of colic, a few hours prior to the expulsion of the fetus.

Even in the more advanced stages of pregnancy, however, abortion usually occurs without forewarning and the first evidence of anything amiss, so far as the owner observes, is finding the dead fetus in the stable or pasture.

The course of infectious abortion in the mare is usually very rapid and uneventful, in close correspondence with normal parturition. The fetus is quickly expelled when labor pains appear and, if the abortion occurs comparatively early during gestation, the fetus is expelled completely enclosed in its chorion. Later in gestation the chorion, and sometimes the amnion, ruptures as in normal parturition and the expulsion of the fetus is accompanied by more evidence of labor. The fetus does not always present in a normal manner, but there are frequent deviations of the head and limbs. In case of anterior presentation, the head is very likely to be turned to one side and one or both anterior limbs may be more or less retained. In presenting posteriorly, the breech presentation is very common. These vicious presentations are not serious obstacles to expulsion up to the 8th or 9th month, but during the 10th and 11th months may bring about light dystokia. However, unless gestation has been virtually completed, the dystokia is readily overcome by the veterinarian and the fetus easily extracted. After its extraction, in cases where the abortion occurs late in pregnancy, there is a marked tendency to retention of the chorion; whereas, as we have previously stated, if abortion occurs early, the fetus is probably expelled in its chorion.

The sequalæ of abortion in the the mare are numerous and frequently serious in character. They depend largely upon the period of gestation at which the abortion occurs, as is very well shown by three tables which Guillerey submits in the article which we have quoted. In his first table, in case of an outbreak of infectious abortion, he relates 17 cases, each of which were followed by more or less serious sequelæ, including the retention of the placenta, metritis, metro-peritonitis, tendinitis, synovitis, arthritis, lympho-phlebitis, mammitis, vaginitis and paraplegia. Most of these cases occurred after the 10th month of pregnancy, and the shortest duration of pregnancy was seven months. In his second table, where the duration of pregnancy varied from the fourth to the seventh month, the sequelæ were unimportant and virtually absent, whereas, in his third table, where the period of gestation ranged from the seventh to the ninth and exceptionally the tenth month, the sequelæ occupied a middle position between the other two tables.

The period of incubation is comparatively short, or we might say that it corresponds quite closely to that observed in most contagious diseases of animals. According to our personal observations, the incubation period usually ranges from 8 to 10 days. Guillerey considers the period of incubation from 3 to 5 days in virulent outbreaks. In the milder cases, according to his observations, the duration of incubation was from 10 to 18 days. This observation is interesting in that it would appear to indicate that the earlier during gestation infection occurs, the longer the period of incubation. The observations of G. in reference of the period of incubation do not materially conflict with our own. He gives, in a supplementary table, the average duration of incubation in the mild outbreaks as 12 days and in the severe outbreaks as four days.

The bacteriology of infectious abortion in mares has not been determined in a manner universally acceptable. Ostertag found, in the blood of the fetal heart, in the thoracic cavity, and in the intestinal tract, short streptococci which were readily stained by the Gram method. In serum agar, this micro-organism grew in very small areas scarcely visible to the naked eye, while in a stick culture it assumed the form of a thread-like colony throughout the length of the tube. It also grew in a serum bouillon and caused, after two days, a general cloudiness of the entire mass. Sometimes Ostertag secured pure cultures from the body of the aborted fetus, while from the surface of the chorion he obtained the same cocci in company with various bacteria.

In one experiment Ostertag injected a pure culture of this streptococcus into the jugular vein of a pregnant mare. Twenty days later the mare aborted.

A question of the correctness of the findings of Ostertag is raised by the fact that he is in apparent conflict with Bang, who finds in the infectious abortion of the cow a short bacillus instead of a streptococcus. Bang even claims, as we shall dwell upon more particularly in the next article, that his abortion bacillus is capable of producing abortion in almost any pregnant animal, and would apparently have us believe that the contagious abortion of various animals is identical and interchangeable. As we have already stated, we consider that clinical evidence shows very clearly the non-identity of infectious abortion in the various species of animals. Nevertheless, we should expect that

the mirco-organism should be somewhat similar in the different species and should belong to the same genus of bacteria. We would compare the bacteriology of infectious abortion to that of tuberculosis, in which there is a very close resemblance between the bacilli causing tuberculosis in the various species of animals, so much so that the differentiation between certain forms is somewhat in controversy, or at least has only recently been definitely settled. We are strongly inclined to believe that, if the infectious abortion of the cow is caused by a bacillus, that of the mare is also referable to a bacillus ; if the infectious abortion of the mare is caused by a streptococcus, as Ostertag claims, the corresponding disease in the cow is likewise caused by a streptococcus. The evidence submitted by Bang and Ostertag is alike good in each case, so far as it goes, nor is there anything definite to show that each may not be correct in his findings.

There exists the further possibility that the eventual explanation of this apparent conflict may rest upon a similar basis to that of hog cholera, where it has recently been admitted, upon high authority, that the disease can be produced in a typical form without the presence of the hog cholera bacillus. This leads one to conclude that the hog cholera bacillus is usually present in hog cholera and may have some secondary relation to the disease or the lesions, and that the essential cause of the disease consists of some micro-organism which has not yet been discovered. It is so small that it will pass through a filter fine enough to remove the hog cholera bacillus, and the filtrate will produce the typical disease in the hog without the presence of the hog cholera bacillus. It is best, therefore, to accept the researches of Ostertag and others as tentative, and to await further researches before finally accepting any conclusion as to the fundamental cause of the disease.

The Avenue of Infection. The manner in which the infection is carried from one animal to another, and the avenue by which the infection reaches the fetus and its membranes, are highly important, from the standpoint of the control of the disease. Of first importance is the manner by which the disease is introduced into a herd or stable. According to the observations of Guillerey, which have already been cited, the disease was carried in several instances from one stable to another by men. Neighbors were called by a client to aid Guillerey in

extracting an aborted fetus, who, returning to their own establishments, carried with them the germs of the disease and transmitted it to their own mares. This experience was repeated several times, with the uniform result that the disease was spread wherever the men went into other stables, after having visited those where the disease existed. It appears quite unnecessary that the visitor to an infected stable or pasture should handle the mare which has aborted, the after-birth or the aborted fetus, but he may readily carry the infection upon shoes or other portions of clothing which may chance to come in contact with infected bedding or ground. This method of distributing the disease seems to Guillerey one of the most important and dangerous. Neighbors habitually, and without thought, visit each other's premises and examine and handle diseased mares, and thus may readily carry the infection to their own or other premises, in such a manner that it is frequently difficult to trace. Guillerey also observed cases of abortion which were traceable to the use, upon a pregnant mare, of a blanket which had been used upon another mare, which had recently aborted. The blanket had become somewhat soiled by the disharges. In another case, it seemed to him that the disease was traceable to a harness that had been used upon an aborted mare and which had then been transferred to an uninfected pregnant mare.

If one introduces a mare from an infected stable into a stable of pregnant mares, whether the new mare has recently aborted or soon aborts, she constitutes a certain vehicle for the transmission of the disease into the uninfected stable. Guillerey relates a case in which a peasant placed his pregnant mare in the stable of a distant neighbor, where abortion had existed. The mare, in due time, aborted and constituted a new center of infection.

When the infection has once been introduced into a stable or harem of mares, the spread of the disease is rapid and certain, although the exact method by which it comes about is not definitely known. It probably occurs largely from direct contact. The tail of the mare becomes readily and inevitably soiled by any discharges of the vulva and creates an excellent vehicle by which the infection can be transmitted to a neighboring animal. Since mares, as a rule, come in comparatively close contact, where they may strike each other about the vulva with

their tails, it is easy to understand how this comparatively direct transmission of the disease may occur.

On the other hand, the infection may occur in a comparatively indirect manner, since mares in the same enclosure habitually rub against objects of various kinds, and thus, one after another, come in contact with the same object. If they use a common sleeping ground, the bedding, earth or herbage becomes soiled by the discharges from an aborted animal and the infection is obtained therefrom by a pregnant mare. Thus it spreads rapidly and freely, whether the animals are confined in close proximity in the stable or whether they are running free in extensive pastures or even upon comparatively open ranges. It is not known whether the disease can spread through the air without an intermediary bearer.

Some investigators of the infectious abortion of cows have come to the conclusion that the bull plays a highly important part in the distribution of the disease and in the introduction of the infection from one stable to another. The conclusion has been drawn from this that the male animal in general constitutes an efficient bearer of the disease, although himself not affected by it in any visible manner. It does not seem that the stallion plays a very important part in the distribution of infectious abortion of the mare. The incubation of the disease is so rapid that, if the infection is transmitted to the mare by the stallion, it would appear that abortion would occur very early and would not be observed. It is not safe to conclude, however, that he does not spread the disease in some cases.

The stallion may otherwise be an important factor in the spread of abortion by copulation. We do not know how long the micro-organism of infectious abortion may live in the vulva and vagina of a mare which is not pregnant or which has but recently been bred. It is quite possible that a stallion which had first served an aborted mare, and then covered a healthy one, might transfer the organisms to the genital canal of the healthy animal, which would then act as a bearer of the disease to any pregnant mares with which she might soon come in contact.

Reasoning from the observations of Guillerey, that the soiled hands or shoes of persons, or the soiled blanket or harness from an aborted mare, can carry the disease from one stable to another, it might readily follow that a gelding or other horse placed in

close proximity to a mare which had recently aborted, or which had come in contact with soiled bedding or with the aborted fetus or afterbirth, might readily carry the disease and convey it to healthy pregnant mares.

The veterinary obstetrist should not disregard the opportunities possessed by himself as an important bearer of infectious abortion. In attending mares for dystocia, retained placenta, metritis, etc., resulting from infectious abortion, his clothing, person, instruments, etc., become soiled and only the most rigorous care on his part will prevent his becoming a menace to other stables of pregnant mares.

As in other infectious diseases which are capable of being carried by an intermediary bearer, there is the constant possibility of the transmission of the disease by means of portions of the aborted fetus or its afterbirth being carried from one place to another through the agency of scavenger animals or birds—dogs, crows, buzzards, etc.

The vitality of the organism and the length of time it may persist and be capable of infection, whether lodged upon the hair or other portions of an animal, upon the hands of men, upon harness or blankets, we have no data to show. Neither do we know for how long a time the germs may remain inactive in the vagina and uterus of the mare and be capable of transmitting the disease. The impression seems to be that, after a mare has aborted, the organism continues virile at least as long as there is a discharge from the genital apparatus. It would not be safe to conclude, however, that the micro-organism disappears as soon as the discharge ceases, but rather that it may remain in a comparatively inactive state in the vagina for weeks, or possibly months.

Control and Eradication. The control of infectious abortion in the mare, as in other animals, is a complex problem. One of the chief obstacles in the control of infectious abortion, as in other transmissable diseases, is the difficulty of reaching an early diagnosis. At present we can not always positively differentiate the infectious abortion from the accidental abortion of class I or the enzoötic disease of class II. Accidental abortion may have a definite history of accident and a reliable record of non-exposure. Unless these data are very positive, little dependence should be placed in them. Enzoötic abortion due to infectious disease of

the mother may be differentiated from infectious abortion proper by the symptoms in the pregnant mare.

It has been claimed that infectious abortion can be differentiated from other types by the dark, dirty, grayish or brownish color of the chorion and the abundant dirty exudate upon its surface. If a fetus, dead from other causes, remains in the uterus until decomposition of the membranes begins, we know of no good reason why the appearances might not be the same as those described as characteristic of the infectious disease. Bacteriologic differentiation is not yet available.

When an abortion occurs in a stable, unless it can clearly and safely be attributed to other causes, a tenative diagnosis of infectious abortion should be made and the case handled accordingly.

It is very difficult to prevent the introduction of the disease into a stable of pregnant mares, when the malady is prevalent in a neighborhood. When abortion among mares exists upon a farm during a season of the year when the animals are habitually out in the fields, and the aborting mares are separated from the healthy ones of an adjoining farm simply by a fence, the transmission of the disease from the one farm to the other is well-nigh inevitable and can only be guarded against by providing a neutral territory between the infected and the non-infected mares.

It is also essential that owners of pregnant mares should guard them zealously against infection through the introduction of mares from stables where the disease exists. If it becomes necessary or advisable to purchase new mares and bring them upon the farm, and it is not certain that they are free from the infection, they should be isolated for an ample period of time before allowing them to come in contact with the pregnant animals. If any well-grounded suspicion of the animal exists, she should be thoroughly disinfected, perhaps even subjected to a bath in disinfectants, which would include the entire body, and a special disinfection of the vulva and vagina.

It is highly dangerous, when abortion is disseminated over a territory, to permit outside animals to come into the stable or enclosure where pregnant animals are kept. We have known instances where a mare, which had recently aborted, was driven into the barn-yard of a neighboring farm where the disease did not exist, and, although the stay of the infected mare was of short

duration, the disease was nevertheless carried and an outbreak of abortion resulted.

When the owner of a stable of healthy mares, drives one of them into an enclosure or places her in a stable where the disease exists, the mare may become infected and spread the malady to other animals upon the farm. In one outbreak observed by us, (American Veterinary Review, Vol. 21, page 303) an outbreak of infectious abortion in mares was apparently brought about in this way. The owner had a band of some 25 presumably pregnant mares, which were mostly highly valuable trotting animals, but included one grade draft mare, which was used for general work and was driven here and there to various farms without any particular thought of harm. Somewhere in the course of her work, apparently, she became infected, aborted and transmitted the disease to the other mares upon the farm, leading to quite serious losses, although the course of the disease was fortunately arrested before the loss of foals was complete.

The owner of pregnant mares will always do well to guard them cautiously against infection which may be carried by persons upon their clothing, hands or shoes. Neighbors coming from farms where the disease exists should on no account be permitted in the stable, barnyards or fields where the pregnant mares are kept. The owner of pregnant mares should also be careful, in reference to his own person, that he does not come into stables or enclosures where abortion exists.

Probably one of the most dangerous bearers of the infectious abortion of mares is the ignorant or careless veterinarian. We have already related that dystokia is common in abortion, occurring near the end of gestation; various sequelæ also occur after abortion, which cause the veterinarian to be called in attendance.

In these cases the obstetrist necessarily gets his person, clothing and instruments soiled with the contagion, and by either of these agencies may be the carrier of the disease from one stable or band of mares to another. The veterinary obstetrist here assumes a profound responsibility and should take every precaution known to modern medicine to avoid the transmission of so serious a malady to animals belonging to other clients. He should not make a second call, under any conditions or circumstances, until his clothing has been changed and his person has been amply

and safely disinfected. Any instruments or appartus which he has used about an aborted animal should be most scrupulously and thoroughly disinfected or sterilized. Ropes, cords and other cheap apparatus used in cases of dystokia should not be used again, but should be destroyed. All clothing worn by the obstetrist should be of a character which will admit of thorough boiling without injury, and this should always be done before it is used again. Even the case, bag or other container in which the veterinarian transports his instruments, clothing, etc., when attending cases of this kind, should be of a character which will admit of the most scrupulous disinfection.

When the malady has appeared in a stable or herd of mares, energetic measures should be instituted for its eradication. The following points should be included in any plan:

1. Immediately destroy, by burning, the aborted fetus and fetal membranes. It is essential that this be carefully and completely done, in such a manner as to eliminate all danger of infection from this source. If the fetus or its membranes be dragged, or carried dripping, over a path where pregnant mares may pass, they may get the infection from the infected path as well as from the fetus. Other animals, or persons, crossing the infected path may pick up and carry the infection to pregnant mares. A vehicle used for carrying away the fetus may serve to bear the infection to pregnant animals. The persons engaged in removing and destroying the fetus may be more dangerous than the aborted fetus itself.

Every detail in the process of the destruction of the fetus and its membranes should be carefully watched and, at every point of possible infection, disinfection thoroughly applied.

2. The mare which has aborted should be at once removed from the stable occupied by other pregnant mares and effectively isolated. Even then, it is important to terminate the infection as early as possible, so that the mare which has aborted may no longer serve as a possible center of contagion.

Internally, the uterus, vagina and vulva are to be thoroughly disinfected by irrigating the uterine cavity with a warm disinfecting fluid. For this purpose, 2% lysol or carbolic acid or a 1 to 2500 solution of corrosive sublimate may be employed. The disinfection should be repeated once daily for three or more days, and longer should vaginal discharges be present.

The exterior of the mare which has aborted should also be thoroughly disinfected. Special attention should be given to the tail, perineum, buttocks and posterior limbs. These parts at least should be thoroughly scrubbed with soap and hot water, to which has been added 2 or 3% of lysol or carbolic acid. Corrosive sublimate is inefficient here, as it is precipitated by most soaps and does not penetrate the hairy coats of the animal in an efficient manner.

Generally speaking, we regard the somewhat opposite plan of removing the pregnant mares from the infected stable as ill advised. When infectious abortion has occurred in a stable where other pregnant mares are kept, it is fair to assume that some of them have become infected. If removed to another stable, they too will abort and the other stable will also become infected. If the disinfection is complete, the stable in which the abortion has occurred is as safe as any.

3. Remove all bedding from the stall where the mare has aborted, burn it or otherwise render it safe, and thoroughly disinfect the stall. The general rules of the preceding paragraph, relative to the disposal of the fetus and its membranes, should also be applied to the bedding and manure from the infected stall. It must, on no account, be dribbled here and there, to scatter the infection; the undisinfected vehicle used for carrying it must not be placed where pregnant mares may come about it. If it is decided to preserve the value of the manure, it must be placed where pregnant mares cannot come in contact with it for two or three months.

The disinfection of the stall should be complete. The straw, chaff or bedding should not be swept out in a manner to cause dust to fly in every direction, but any dusty material should first be moistened, preferably with a disinfectant or with boiling water, then removed carefully, and the stall floor, manger, feed box and adjacent walls, thoroughly scrubbed with hot water, to which a reliable disinfectant in sufficient amount has been added.

When infectious abortion breaks out among mares at pasture, they should be promptly removed from the field and placed in a stable, and the measures above outlined followed. Disinfection at pasture is impossible, for very evident reasons. It cannot be known when a mare at pasture aborts, especially when early in pregnancy. When abortion does occur, the fetus and its mem-

branes may lie undiscovered for a long time and act as a focus for the spread of the disease to other mares. The vaginal discharges are also dribbled about over the herbage, to more certainly disseminate the infection. The mare comes in close contact with pregnant companions and may readily transmit the infection directly to them.

4. Exposed pregnant mares should at once be thoroughly disinfected, and especially the anus, vulva, tail, buttocks and hind legs. These parts should first be thoroughly scrubbed with soap and hot water to which has been added carbolic acid or lysol. After this thorough scrubbing, the parts should be daily disinfected with a warm 2 or 3% solution of carbolic acid or lysol, for six or eight days.

5. Immediately after the occurrence of an abortion in a stable, or at the commencement of control measures, the vaginæ of all exposed mares which have not aborted, and have not been isolated, should be subjected to rigid disinfection by irrigating them with a warm 1 to 2000 corrosive sublimate solution. Should no subsequent abortions occur, the vaginal disinfection need not be repeated.

After each fresh abortion in a herd, the control measures outlined should at once be renewed, each separate abortion being regarded as fresh exposure of all contiguous animals.

6. Ample precautions should be taken against the spread of the disease through the medium of secondary bearers. Blankets which have been used on mares which have recently aborted are highly dangerous when used upon, or brought in contact with, pregnant mares. Harness may bear the infection, as may currycombs, brushes and other stable utensils.

Workmen who have handled an aborted fetus, or its afterbirth, or who have cared for the aborted mare, may readily carry the infection to pregnant mares. Due precautions are to be taken against such accidents. The clothing of such persons should be kept clean; if necessary, it should be disinfected. The hands especially become soiled with infection-laden substances and readily carry the malady. The shoes also constitute dangerous bearers of infection. The manure, or other filth from the stall where a mare has aborted, clings tenaciously to the shoes, and upon these the infection may be carried from one stable to another.

If practicable, different persons should handle the infected and the presumably non-infected animals, and they should not pass from the infected to the non-infected stables.

When infectious abortion exists in a neighborhood, each person or animal approaching a stable where pregnant mares are kept should be regarded as suspicious and treated accordingly. Geldings, and mares not used for breeding, may serve as bearers of the disease from diseased to pregnant mares. Indeed, it is probable that the bacteria of the malady will live for a time in the vulva and vagina of a mare which has not been bred. Though such an animal does not become visibly diseased, she may nevertheless be a very dangerous bearer of the malady to pregnant mares, and such danger should accordingly be avoided.

Breeding should be suspended during an outbreak of contagious abortion. If a recently aborted mare is bred, and the stallion is then used to serve a mare from a stable in which there are healthy pregnant mares, the infection may first be transferred, through the penis of the stallion, from the diseased mare to the vagina of the healthy one and by her carried to healthy pregnant mares.

When the disease becomes widely prevalent in an area, all breeding animals might properly be regarded as suspicious. If such a view is taken, each mare may be regarded as possibly infected and, after permitting a stallion to serve her, the penis and surrounding parts of the male should at once be disinfected against a possible transmission of the disease to the next mare with which he copulates, and the carrying of the malady by her to healthy pregnant mares.

In the infectious abortion of cows, with which we shall deal in the succeeding section, some veterinarians have recorded apparently good results in the eradication of the disease by subcutaneous medication with carbolic acid ; others have attempted, with apparently good results, the production of serum immunity.

If the abortion breaks out somewhat early during gestation, it may be essential to determine as positively as possible which mares are pregnant and which are not, and for this reason it may become necessary to carefully examine each mare per rectum, in doing which the veterinarian should guard against danger to the fetus, from the manipulation, as well as against the transmission of the disease from one mare to another through the medium of his soiled hands or clothing. Consequently it would be well for

the veterinarian, in case such examination is made, to thoroughly disinfect the tail, buttocks and perineum of the mare about to be examined and then thoroughly disinfect his arms and hands after the examination, before proceeding to the next mare.

The handling of dystokia dependent upon contagious abortion is the same as that of dysiokia due to other causes. The sequelæ of abortion, such as retained placenta, metritis, laminitis, etc., present the same symptoms and are subject to the same rules of handling as apply to these diseases following parturition, and will accordingly be considered along with the post-parturient maladies. The disinfection of the animal should be complete. The disinfection of the veterinarian's person and his equipment should be emphasized, although in all obstetric work this precaution should be ample and should render the veterinarian secure against becoming a bearer of any infection to animals which he may later attend.

B. Infectious Abortion in the Cow.

For more than half a century, the leading veterinarians of the world have recognized the fact that most abortions occurring in cows are of an infectious character. The infectiousness of abortion was quite generally denied until near the middle of the 19th century, but even during the 18th century there were veterinarians who had become thoroughly convinced of its transmissability. When a very large number of abortions occurs in a given herd or in a community during a short period of time, they are quite uniformly traceable to infection.

Infectious abortion of cows occurs chiefly in dairy herds and only rarely among animals bred for beef purposes. It is not so much a question of the susceptibility of one animal as of the environment of the respective animals and the interchange of animals, by which the disease may be spread from one herd to another. Dairy cows are kept confined in close contact with each other throughout a part or the whole of the year, so that there is a better opportunity for infection by ordinary contact.

Another element which tends to largely confine the malady to dairy herds is the fact that among dairymen there is frequent interchange of cows and bulls for breeding purposes. Among breeders of beef cattle, the interchange of animals is comparatively rare and consists chiefly in the breeder buying young bulls,

which have not been previously used. In those sections of the country where beef breeding is the principal industry, it is found that a large proportion of the outbreaks of contagious abortion occur in those herds where pedigreed stock is bred and where there is frequent interchange with other breeders or the animals are habitually exhibited at agricultural fairs, where they become exposed to the malady.

Etiology. The bacteriology of infectious abortion of cows has not been fully determined, and the findings of different investigators are very contradictory. Bang, and those in accord with him agree that the malady is due to a short bacillus. This is a non-motile organism which contains no spores but, when artificially cultivated, frequently shows, at one end, a spherical enlargement. The micro-organism is easily stained with analine dyes, either aqueous or carbolized. It does not color by the Gram method. It may be artificially grown in an atmosphere of oxygen or in the almost complete absence of oxygen, but does not grow rapidly in ordinary air. It may be grown on gelatine, agar and various other media. In these media it grows in clumps the size of a pin-head, which are conical in form and have very definite outlines and, in transmitted light, have a bluish color. The bacillus perishes in these artificial cultures in about two weeks and is readily destroyed by heat and disinfectants. It is claimed, however, that they may continue to exist in the secretions of the uterus for month after month. According to experiments recorded by Bang (Jour. of Comp. Path. and Therap., Vol. 19, page 191) the injections of pure cultures of this organism into the vaginæ of pregnant cows and sheep caused abortion or premature birth in 8 to 10 weeks, in which cases the micro-organism was obtained in pure cultures from the vaginal discharges, as well as from the exudate upon the surface of the cotyledons and the chorion.

Bang also injected abortion bacilli into the jugular vein and, in case of two pregnant ewes, living lambs were produced. The specific abortion bacilli were found in the chorion. The same experiment was tried upon a pregnant mare, which gave birth after 27 days to a very small foal which died a day later. Here again he found, upon the chorion, bacilli which could not be differentiated from those which had been injected into the vein.

Bang injected a pure culture of the micro-organism into the

jugular vein of a pregnant cow, which aborted 90 days later, and in the exudate upon the afterbirth he found the abortion bacilli. In this connection he states : "Since that time we have made more or less extensive experiments with cows, sheep, goats and rabbits, and produced abortion in this way." One may infer from these experiments that, while it is not proven that the abortion of the mare is identical with that of the cow, he suspects that such may be the case, and that, consequently, when contagious abortion breaks out among cows, other pregnant animals should be protected against exposure.

Having satisfied himself that the bacilli could be carried to the uterus through the blood, Bang suspected the possibility of the organisms reaching the uterus through the alimentary canal also. He administered ¾ of a liter of an artificial culture of the bacillus in bouillon serum to a pregnant cow, on the 12th of June, and on the 7th of Sept. he gave her a quantity of exudate from an aborted cow. She gave birth to a living calf on the 26th of November, 80 days after having been fed upon the exudate. In the typical exudate upon the afterbirth, there were abundant bacilli. Later he repeated this experiment under conditions which, he claimed, "excluded the possibility of infection in any other way than through feeding." The heifer aborted 56 days later.

How the possibility of infection by other avenues was excluded in this experiment does not appear. If the bouillon, exudate and cotyledons were given to these animals as a drench or mixed with food, we see no reason why portions of the liquid escaping from the mouth might not soil the food or bedding, to later be accidentally moved backward and reach the posterior part of the stall, making it possible for the infection to gain entrance through the vulva. If the material were given in any other way than in an impermeable capsule, the mouth would inevitably become infected and the cow, in licking her posterior parts, as she habitually does, could transfer the micro-organisms to that portion of her body, whence they might enter the vulva.

Even should the abortion bacilli pass into the alimentary tract, we have no evidence that they may not resist the action of the digestive fluids, appear in the feces and enter the vulva. The mere assumption that the bacilli may be taken up from the in-

testines and carried to the uterus involves the persistence of the bacilli in the presence of the digestive fluids and the possibility of their appearance in the feces.

While it seems quite possible that the infection may be introduced in this way, we question very much if it constitutes an important source of danger. If the food were infected it would be virtually impossible to be sure that the infection might not reach the vagina and uterus, even though it did not do so through the alimentary canal.

The problem of the transmission of infectious abortion, either equine or bovine, by the introduction of bacteria into the blood or subcutaneous tissues, or by penetrating the mucous membrane of the digestive tract after having been swallowed, is a very interesting one requiring elucidation. Can bacteria, large enough to be recognized and clearly identified, without causing symptoms of maternal disease, pass through the maternal placenta, without inducing visible injury to the uterus, and cause a fatal disease of the fetus in the uterus? The evidence on this point needs be very much more exact before accepting an affirmative conclusion.

Bang claims that the abortion bacillus is purely pathogenic and does not lead a saprophytic existence. He kept the baccilli alive, but dormant, for 7 months in test tubes at a low temperature. In one case he found the abortion bacilli in an exudate surrounding a mummified fetus, which had been dead apparently for nine months. According to his view, apparently, the bacilli may live for an almost indefinite period within the uterus of the cow and be capable at a future time of starting anew the malady.

As stated on page 476, the bacteriolgic researches of Bang are in apparent conflict with those of Ostertag. While B. succeeded in causing abortion in various species of animals with the abortion bacillus of the cow, O. utterly failed to transmit, to the cow or other animals, the infectious abortion of the mare by the exudate or afterbirth from aborted animals or through his abortion coccus.

Braüer (Deutsche Zeitschrift für Tiermedicin, Vol. XIV, p. 95) recognized a micrococcus as the cause of infectious abortion in cows and experimentally induced the disease with the microorganism. Franck also recognized a micrococcus as the cause of the malady. Nocard recognized both micrococci and bacilli in the uterine discharges and fetal fluids.

Many elements serve to confuse the question of the bacteriology of infectious abortion. The normal bacterial flora of the vulvo-vaginal cavity of the cow has not been as fully determined as desired. Nocard has investigated outbreaks of what appeared to be simultaneous contagions of infectious abortion and dysenteria neonatorum or diarrhea of the new-born. Others have believed that infectious abortion and infectious diarrhea of the new-born were identical.

The period of incubation of the infectious abortion of cows is as much in dispute as the bacteriology of the affection, and adds to the confusion regarding the latter. Bang makes the incubative period two to seven months. This is wholly out of harmony with clinical experience with infectious diseases in general. Most transmissable diseases show a period of incubation ranging between three and twenty days, so that an incubation stage of eight to twenty-eight weeks naturally causes some doubt.

Braüer, Lehnert and others record an incubative period of nine to twenty days. Such a period is in harmony with the incubation period of infectious abortion in the mare and with the incubation period of infectious diseases generally.

The incubation period of infectious abortion, whether by experimental or natural infection, is probably more variable than most infectious maladies. The infection per vulvam is not direct. We have no definite knowledge of the time required for the infection to traverse the vulvo-vaginal and cervical canals before it can attack the fetal membranes. After the infection of the fetus and its membranes has occurred, expulsion usually does not follow until after the fetus has perished. In the cow, with the rigid cervix, it is not improbable that in many cases, the fetus is retained one, two or more days after its death before its expulsion. Since we generally regard the period of incubation in infectious abortion as extending from the date of exposure to the expulsion of the fetus, we evidently include not only the time generally alloted to incubation but also the duration of the disease itself.

It is highly important that additional observations be made upon the period of incubation. If the infecting micro-organism can live in the gravid uterus, in the fetus or its membranes, for six or seven months, that fact is extremely discouraging in

connection with the control of the malady. We know no way to disinfect the pregnant uterus, and if the infection may exist in it for seven months there can be little hope for the prompt eradication of the disease from a herd.

The Method of Natural Infection doubtless varies greatly in different instances. Consequently one author will place the principal emphasis upon a given method and another upon a different avenue of infection. Bang places considerable stress upon infection through the alimentary tract by means of contaminated food. While such a possibility should be recognized, we have little evidence that it plays a highly important part in the majority of outbreaks.

Some writers probably over-emphasize the frequency with which the disease is transmitted by the male breeding animal through copulation. Doubtless this mode of transmission is quite important, and should be fully recognized in all plans for control or eradication. When, however, a cow aborts during the 5th to 7th month of gestation, we are skeptical about the correctness of attributing the disease to infection by copulation. If the cow came in estrum during pregnancy, and copulated with the male, we might readily admit that the infection was probably transmitted in that way. Bang, in his published researches, makes the period of incubation in experimental cases about 8 to 10 weeks and in some rare cases as long as 12 weeks, but when he considers the transmission of the infection by the bull he apparently considers the period of incubation as much as 6 or 7 months, which seems to us to raise a very serious question of doubt. If the infection is capable of producing abortion at all, and is introduced by the penis of the male at the time of copulation, it would seem more reasonable to expect the bacilli to destroy the life of the fetus at a very early period, or perhaps even the ovum or spermatozoa prior to fertilization, and cause an invisible abortion. We do not believe that copulation constitutes the chief means of transmission nor that we should finally conclude that abortions occurring late during pregnancy are due to this mode of infection.

Clinical evidence indicates that the disease is most frequently transmitted, either directly or indirectly, through the vulvovaginal canal, from a cow which has recently aborted to one which is pregnant. If the disease breaks out in a stable, it tends

to spread first to those cows which are nearest to the aborted animal. In some outbreaks which have been recorded, it has been shown to spread chiefly in the direction of the slope of the gutter, apparently because the liquid discharges from the vulva had passed along the gutter and soiled the bedding of the succeeding cows. As in the mare, it seems quite certain that the infection is readily transferred from one animal to another by persons who are caring for the animals. Milkers may readily carry the disease from one animal to another upon their hands, thus transmitting it from udder to udder, from whence it may be transferred to the vulva through the medium of the tail or by other means which readily suggest themselves.

Symptoms. The symptoms of infectious abortion in the cow seem to be somewhat more pronounced than in other animals. It occurs most frequently in animals 5 to 6 months pregnant, although Bang records cases as early as 3 months and admits that it may occur very near to the end of gestation and that, in some cases, the diseased fetus may be born alive in a weakened state and may either perish within a few days or recover and continue to live.

Nocard states that when the calves are prematurely born alive, as a result of infectious abortion, they sometimes bawl in a peculiar manner, which would suggest to one the howling of a rabid dog. Nocard attributes this to involvement of the medulla oblongata. He was possibly dealing with infectious diarrhea affecting the calf at the same time.

There is some tendency to the appearance of the symptoms of genital catarrh as the forerunner of abortion. The vaginal mucosa becomes injected and the lips of the vulva somewhat swollen. Bang regards the malady essentially as an insidious uterine catarrh. Naturally the injection of the vulvar mucosa, accompanied by vaginal discharge, would follow.

Whether the swelling of the vulva and discharge from the genital tract are the effects of the death or serious disease of the fetus and of the disease process taking place in the fetal membranes, or whether they constitute a fundamental part of the disease itself, is not known. It has not been shown that the vulvar tumefaction and discharge precede the death of the fetus. If the swelling and discharge occur only after the death of the fetus, they should be regarded as the precursors of the expulsion of the

dead fetus rather than as a sign of impending fetal death. The disease has already worked its greatest harm by destroying the life of the fetus. It should be noted that such a condition does not occur in the non-pregnant animal as a result of exposure to infectious abortion.

Indeed we have no evidence to show that the micro-organism of infectious abortion has any power to produce symptoms of disease of any kind whatever in a non-pregnant animal. Even when pure cultures are injected into the jugular vein, they cause, according to Bang, only a temporary slight fever which quickly abates, and no further evidence of disease is observed until abortion occurs. It would consequently seem that there is something in the composition of the fetus, its fluids or membranes which makes it possible for organisms to multiply and to bring about pathologic conditions.

Hutyra and Marek state that the mucous membrane of the vagina sometimes shows granular enlagements as large as hemp seed. This seems to correspond with the most prominent symptom of the infectious nodular vaginitis of cows and may be simply a co-existence of the two diseases in one animal. It is to be remembered also that the nodular or granular venereal disease may cause abortion in 60 to 70 % of pregnant cows. See page 98. There occurs a white, reddish gray or yellow vaginal discharge. Two or three days later abortion occurs. Reindl records that, in the case of a bull, he observed small nodules upon the penis, which were similar to those seen in the vaginæ of cows just prior to their having aborted. This suggests that he also was dealing with the infectious nodular catarrh of cattle, possibly complicated with true infectious abortion.

When abortion occurs early in gestation, the fetus is usually expelled included in its membranes. Later in gestation the fetus is usually expelled naked and the membranes follow somewhat tardily. In a large proportion of cases, the afterbirth is retained and requires artificial removal. After the abortion has occurred, if the afterbirth has come away spontaneously or has been promptly removed, there frequently occurs a discharge from the genital tract, which continues for two or more days or as many weeks. This discharge is usually of a reddish-brown or reddish color, generally a repulsive appearing liquid containing small clumps of pus and fragments of afterbirth, and in some cases is

more or less fetid. Large quantities of this discharge may accumulate in the uterus and later be expelled at intervals, or the flow may be virtually continuous.

Generally the aborted fetus is dead, but not greatly, if at all, decomposed when expelled. Rarely the fetus is born alive. If dystocia occurs the fetus soon decomposes. The afterbirth is usually more or less discolored, there is edema and injection of the chorion, and between the cotyledons there is frequently seen a muco-purulent exudate. When a cow has once aborted and is bred soon afterward, it is claimed that she is very liable to again abort from the infection which caused the prior abortion and has persisted in the uterus during the entire period. This has not been well established. If the bacillus is already present in the uterus at the time of copulation, it would seem more probable that it would destroy the life of the spermatozoa and of the ovum even before impregnation took place. Should the ovum and spermatozoa escape such a fate, it would appear probable that abortion would occur so early during gestation that the expulsion of the very small embryo would pass unrecognized.

Diagnosis. Hutyra and Marek, and other writers, place great diagnostic value upon the swelling of the vulva and the genital discharge, which usually occur two or three days prior to the expulsion of the fetus. If the reliability of these symptoms can be clearly established, they become of fundamental importance in reference to the control and eradication of the disease by leading to earlier diagnosis of the presence of the infection in a given individual. When the abortion has occurred, some authors claim that the existence of a fibrino-purulent exudate upon the chorion speaks for the infectious nature of the disease, but it has apparently not been fully determined that the infectious abortion can thus be safely differentiated from that occurring from other causes.

Once the disease has become established in a herd, the best proof of its character is the gradual and more or less rapid spread of the affection from cow to cow. In many cases this is extremely rapid when the disease assumes a highly virulent type, whereas in other instances, when the disease has lost its virulence in a community or stable, the spread is very much slower and may be spontaneously confined to a very small percentage of the pregnant cows in the herd. Hutyra and Marek, citing Cagny,

observe that sometimes in young cows and mares there occurs a swelling of the vulva and a discharge of mucus, along with some slight symptoms of general disturbance, which later disappear, and the animal completes the period of gestation and gives birth to vigorous, living young.

Some investigators hold that a microscopic examination of the discharges from the vagina, and the indentification therein of the abortion bacillus, constitutes one of the most rapid and reliable methods for diagnosing the disease.

It would appear, however, that, while the symptoms recorded above are all valuable in aiding the veterinarian to reach a conclusion, until the disease is much better known than at present, it is safer to regard any case of abortion in a dairy as suspicious of being due to infection and to treat it as such, especially if that malady already exists in the vicinity or if a new animal has been introduced into the herd, which might carry with it the infection.

Infectious abortion is to be carefully differentiated from the granular venereal disease, which, although causing abortion in 50 to 70 % of the pregnant cows attacked, is nevertheless a quite distinct malady and offers a different problem in handling.

Since our account of this disease on page 97 has come from the press, the malady has been definitely recognized in Northern New York and is possibly extensively distributed in America. Its recognized existence in America demands that it should receive more extensive consideration at our hands. This we shall accord to it in an appendix.

The course of abortion in a stable or herd is very much like that of any other infectious disease. Upon its first appearance it usually assumes a highly virulent character and for a time may increase in virulence, to later slowly and gradually abate as if it had consumed the fuel upon which it might feed. Finally the disease gradually disappears, unless new material is constantly provided by the introduction of new cows which have not previously been exposed to the malady. Investigators of the disease usually claim that a cow will abort two or three times from the infectious disease and, after such a period, usually ceases to abort and again breeds. A large proportion of the cows which abort two or three times, however, are sold and thus disappear

from the herd and from observation, so that the data upon this point are probably not very reliable.

The control and eradication of the disease in cows is a problem which requires a very careful, detailed study in each instance, upon the part of the attending veterinarian. In a herd or stable where the disease exists, the same precautions should be instituted as we have already suggested, on page 488, for the mare. Cows which have aborted should be promptly removed from the stable; the aborted fetus, afterbirth and soiled bedding should be carefully removed and burned; and the stall and gutters should be thoroughly disinfected. The aborted cow should be effectively isolated, and the uterus daily flushed out with a warm antiseptic solution, such as 1 to 2 % of creolin or lysol. The solution should be of sufficient volume to fill the uterine cavity several times, so that the cleansing may be complete.

Each pregnant cow should be carefully observed, and if any signs of impending abortion appear, such as a vaginal discharge with swelling of the lips of the vulva, she should be promptly removed and the stall thoroughly disinfected.

The vulva, perineum, tail and neighboring parts of each exposed cow should be thoroughly washed daily for at least two weeks with strong antiseptics, such as a 2 or 3 % solution of creolin or carbolic acid or a 1-1000 solution of corrosive sublimate.

Whatever may be the possibilities of the invasion of the infection through other avenues, it must be admitted from all clinical data that the most important, if not constant portal, is the vulvo-vaginal canal. This renders it fundamentally important that the vaginæ of all cows, whether pregnant or not, in a stable where the disease exists, shall be thoroughly disinfected. A neglect of this precaution may leave the infection undisturbed for days or weeks, to later penetrate the gravid uterus and cause abortion in the animal harboring it, or serve as a new center of infection by escaping in the vaginal discharges to prove a menace to neighboring pregnant cows.

It is not advisable to use so strong a solution for irrigating the vagina as that suggested above for disinfecting the external parts, but instead one should employ a comparatively non-irritant antiseptic solution, in order to obviate severe straining, such as a 1 to 2 % lysol or carbolic acid solution. This should be injected into the vaginæ daily for two or three days. We cannot

readily use corrosive sublimate solution in the vagina of the cow, because it produces too great irritation of the mucous membrane and causes severe straining. In the mare, as related on page 492, we can introduce into the vagina a warm corrosive sublimate solution of the strength of 1-2000 or 2500 without causing severe irritation, but the cow does not endure it so well.

Brauer recommends very highly the use of subcutaneous injections of a 2 % solution of carbolic acid, 20 or 30 cm^3. to be given every two weeks during the period of danger. Combined with these, he recommends the same regulations in reference to disinfection which we have already related.

The bull should also have strict attention, as a probable bearer of the infection. It is highly inadvisable to allow a bull which is in use in a given herd to serve cows from other herds where abortion exists, and it is equally imprudent to permit a cow from an apparently healthy herd to be sent to a bull which has been used among infected cows.

When there is a suspicion of danger from the bull, and it is desired to use him, the prepuce and penis should be carefully disinfected before and after copulation.

The disinfection of the prepuce of the bull is best accomplished by means of a piece of pure gum tubing, ¼ to ⅜ in. in diameter and 4 to 6 feet in length, provided at its distal end with a funnel, into which the disinfecting fluid may be poured and thence flow by gravity through the tube into the prepuce. The force of the liquid may be moderated by the height at which the funnel is held. The most convenient form of rubber tubing procurable is the ordinary pure gum horse catheter.

The distal end of the rubber tube is inserted into the preputial opening and held in place during the operation. The orifice of the prepuce about the tube should be grasped and closed while the fluid is entering, causing a large volume of the disinfectant to enter the sheath and fill the entire cavity. Such distension of the cavity obliterates the mucous folds and enables the disinfectant to reach every part of the surface. Any reliable disinfectant may answer the purpose. The sheath will ordinarily withstand a warm 1 to 2000 corrosive sublimate solution or a 2 to 3 % lysol, creolin or carbolic acid solution. The long hairs about the preputial opening should be clipped away so as to render the part

more readily cleansed. The entire preputial region should be scrupulously cleansed and disinfected.

Great care should be taken at all times by owners of dairies or herds of breeding cows to prevent the introduction of the infection into the herd. One of the most common means for introducing abortion from a distance is the purchase and introduction into the herd of new cows or bulls for breeding purposes. New breeding animals should always be kept isolated from the general herd, until it is evident that they are free from any infection. It may even be advisable to thoroughly disinfect the genitals of new breeding animals, as a precaution, before using them for breeding purposes.

It is important also, if the owner of a herd desires to eradicate abortion from his premises, that he shall not introduce new animals while the disease is active. Should it become necessary to purchase new animals, they should be kept apart from the infected herd and cared for by persons who do not come in contact with the other animals. Neither should an owner sell animals which have aborted and buy new ones, with a view to getting rid of the disease. He can much more readily control the disease and eradicate it from the premises, by keeping the infected herd and applying means which we now regard as reliable for controlling the malady, than by disposing of the aborted animals and procuring new ones.

It is still more unfortunate, and to be vigorously condemned, for the owner of an infected herd to sell his cows for breeding purposes, without imparting to the buyer a full knowledge of the circumstances. Unscrupulous dealers may thus spread and distribute the infection over a wide area of country. The selling of cows which may be bearers of infectious abortion for any other purpose than immediate slaughter should be strictly prohibited by law and, so long as it is not, a sense of moral duty should prevent an owner of such cows from selling them in a way to render dissemination of the disease probable.

C. Abortion in Other Domestic Animals.

Infectious abortion in other domestic animals than the mare and cow is not very common, but we find instances recorded of comparatively severe losses from this disease in sheep, goats and swine. In these animals the disease has not been extensively

studied and there is nothing known regarding the character of the organism which causes the malady in each.

The symptoms and course of the infection are essentially the same as in the mare and cow, and the abortion usually occurs at a corresponding epoch in gestation ; that is to say, they usually abort early during the second half of pregnancy, but the abortion may occur at any time.

In the present state of our knowledge, we would apply the same fundamental principles to the control of the disease which we have suggested in the mare and cow. It is evident that we cannot so effectively apply some of the measures in these small animals as in the larger ones. We cannot so well disinfect the male genital organs and consequently need to take other equivalent measures by isolating the male and not using him for breeding purposes for a longer time than if we were able to thoroughly disinfect the parts. Similar conditions prevail in reference to the disinfection of the genital tract in the female, because we cannot so readily introduce the hand into the uterus and make sure that the afterbirth has been removed, nor can we readily introduce disinfectants into the uterine cavity itself. Therefore, we will generally need to isolate the aborted animals for a longer period of time, until we can safely assume that disinfection has taken place in a spontaneous manner, before we shall again permit them to be bred and thus take the risk of continuing the spread of the disease. Aside from these considerations, there is nothing in the present state of our knowledge to suggest any variations in the problem of control and eradication from that which we have already considered in connection with the disease in the mare and cow.

NORMAL PARTURITION.

Normal parturition is the birth or expulsion of the living fetus at the natural time, without artificial assistance and in a state of development which enables it to live. Although the act of parturition is a physiologic one, it is accompanied by pain and severe exertion upon the part of the mother and brings about sudden changes in the life of both mother and fetus which in a measure imperil the well-being of each.

The phenomena of birth vary greatly in detail in species and individuals and in no two are they precisely the same, either in the period at which they occur after impregnation, the length of time required for the expulsion of the fetus by the mother, the amount of force required for its expulsion, or in any other of the numerous details of this act. The fetus may present in many different ways for its passage through the birth canal, or offer a very wide degree of variations in detail and yet be virtually normal. A very slight divergence in a given direction may cause deviation of a part which may render birth more or less difficult, or even impossible without aid.

The causes of parturition are not definitely known. We have learned in preceding chapters that birth normally takes place after a somewhat definite duration of intra-uterine life, but the variations of the length of time in the larger animals, like the mare and cow, may reach extremes of 90 days or more, so that we cannot say that parturition is inevitable at a certain time. We know that the uterus and other portions of the genital tube undergo certain developments during pregnancy which constantly tend to fit them more and more for the act of birth, when that phenomenon finally appears, but there seems to be nothing in this development which marks a limit and designates a definite stage at which the uterus will necessarily expel its contents.

In studying the development of the fetus, we have noted that certain changes take place in its organs of circulation and nutrition and that they gradually acquire a completeness which closely simulates that which is seen in the adult animal. In this way the organism becomes fitted for an independent existence. However, there is nothing in this development which seems to mark a definite stage at which the fetus must be expelled.

According to researches made by various investigators, there is progressive fatty degeneration of the decidua or of that portion of the uterine mucous membrane which constitutes the external layer of the maternal placenta, so that eventually the nutrition of the fetus is disturbed and threatens to be cut off, and consequently it must be born.

This view of the cause of birth would suggest that the fetus itself largely takes the initiative in the act, but this would scarcely seem to be true in any important sense. It is a quite common observation that, just prior to birth, the fetus shows more or less vigorous movements, but we do not know whether these are due to some such cause as the foregoing or if they are the result of a re-action to the pressure exerted upon it by the contractions of the uterus, preparatory to the expulsion. We very well know by clinical experience that, if we touch or grasp a fetus from the vagina or rectum, it at once struggles and, if we grasp one of its extremeties, it immediately attempts to withdraw it. Accordingly, if the uterus begins contracting upon the fetus and disturbs its position, the fetus performs more or less vigorous movements, in an effort to adjust its position to the changes in form which are taking place in the uterine cavity, due to the contractions of its walls and the opening of the os uteri.

Movements of the fetus are not essential to its expulsion, as is frequently observed in cases of abortion and in stillbirths, where the fetus is usually expelled with promptness and under the same general conditions as in normal birth. It is only in exceptional instances that a dead fetus is retained within the uterus, and then we usually have some recognizable cause for such retention, which fully explains the departure from the rule that, when a fetus dies, it is expelled.

In a general way we attribute the act of birth to a reflex irritation of the nerves of the uterus. The causes of this reflex irritation we do not fully understand and they do not seem to always be the same. On page 227 we have noted the fact that abortion may be brought about by the pressing out of the corpus luteum from the ovary of the pregnant female. This apparently induces contractions of the uterus which cause the expulsion of the immature fetus, thus showing, or tending to show, that the presence of the yellow body in the ovary of the pregnant female

inhibits expulsive muscular contractions of the uterus. We have also learned, on page 165, that normally the corpus luteum begins to disappear late during gestation and that at the time of birth it has become completely atrophied. The relation of this disappearance of the yellow body from the ovary to the expulsion of the fetus has not been studied and may be quite interesting, as it possibly exerts a highly important influence upon birth. We know that the death of the fetus, as already stated, tends constantly to excite a reflex action in the uterine walls, which brings about contractions and the expulsion of the dead fetus. We know also that, in case of the aseptic death of the fetus, followed by mummification, the presence of the cadaver does not excite this reflex action, but permits the dead fetus to remain as an inert body in the uterine cavity for an indefinite period of time. It therefore seems that it is not so much the death of the fetus which, in this case, causes its expulsion as it is a beginning of putrefaction. It is not impossible that the excretions of the fetus after a time become so important in quantity and character that, passing into the blood of the mother, they bring about a certain irritation upon the central nervous system and cause contractions of the uterus, with the expulsion of its contents.

The Expelling Powers. The initial powers by which the fetus is expelled from the uterus reside in the unstriped muscle walls of the uterus itself, but the final power is very largely derived from the abdominal walls, including the diaphragm.

Labor pains are diminished or inhibited in many cases by circumstances of varying character. When there is torsion of the uterus to an extreme degree, there are no prominent labor pains present, because the contractile power of the uterus is destroyed. In transverse development of the fetus in the uterus of the mare, the physical relations of the fetus to the organ are such that they inhibit any very marked labor pains, and while we have good evidence of some uterine contraction, by the dilation of the os uteri and the expulsion of portions of the fetal membranes, we do not observe the vigorous expulsive efforts of normal parturition. It may be stated that we do not generally observe a full exertion of the expelling powers in any of those cases wherein the conditions are such that the fetus cannot pass from the uterus through the cervix into the vagina.

The force of the uterine contractions is not very apparent to the observer. The obstetrist recognizes them during parturition, when he inserts his hand between the fetus and uterine walls during labor. But, in cases of dystokia, the obstetrist does not note so vividly the contractions of the uterus, but observes chiefly the great pressure which is exerted upon his hand and arm when the animal makes violent expulsive efforts by the contraction of the abdominal walls and the increase thereby of the intra-abdominal pressure.

The uterine contractions dilate the os uteri, expel the fetus unaided in case the contractile power of the abdomen is destroyed by extensive rupture, and, after the birth of the fetus, expel the placenta.

By observing the contractions of the pregnant uterus when it is exposed to the air, we find that the movements are of a character closely analogous to intestinal peristalsis. At what time these contractions of the uterus begin, in relation to parturition, we do not know. Probably contractions of a peristaltic type occur continuously throughout the entire period of gestation, not of a character to threaten the expulsion of the fetus, but of a kind to favor its normal development and maintain its normal position.

Fleming maintains that during the labor pains the entire uterus contracts, but that the fundus does so most energetically. This opinion is apparently drawn from human obstetrics, because the uteri of domestic animals have virtually no fundus, and consequently contractions could not occur chiefly in that part.

Clinical observations upon the larger domestic animals would indicate that contractions of the muscular walls of the uterus frequently commence two or three days, or even longer, in advance of parturition, and that they are manifested by the appearance of slight colicky pains. This is especially noted in the mare, and suggests that labor is threatened and that there is actually some pain present, due to the vigorous contractions of the uterine muscles. These symptoms may appear in a very mild form for several days in succession before real expulsive efforts begin. As a general rule they pass unnoticed, and it is not until there are added to the uterine contractions, the expulsive powers of the abdominal walls that we really observe their presence.

When discussing the position of the fetus in the uterus toward the end of gestation, we took occasion to note that it is not rare to find a portion of it extending beyond the cervix and resting in a cul-de-sac of the uterus alongside the vagina. When parturition comes on, if the abdominal muscles alone should act on the fetus, they would simply tend to push the fetus further onward in this cul-de-sac and threaten finally to rupture the uterus.

If, on the other hand, the uterus contracts first, and especially the longitudinal fibers, their contraction would efface the cul-de-sac of the uterus alongside the vagina. This brings the presenting part of the fetus into a conical cavity which terminates with the os uteri and places the fetus in a position and direction which will permit of its expulsion.

The uterine contractions are essential for the dilation of the os uteri. Whenever these contractions take place, and consequently increase the intra-uterine tension, the walls yield at the point of least resistance. Normally this yielding occurs at the cervix, causing it to become dilated, and later the cervix and os uteri to become wholly effaced, so that the uterine and vaginal cavities are merged into one common passage, without any line of demarcation between them.

The contractions of the uterus during the act of birth are essential to the maintenance of the organ in its position in the abdominal cavity. If the expulsive powers were dependent upon the abdominal muscles alone, the uterus would tend to become expelled along with the fetus and thus to induce a prolapse, but the uterus, by its contraction, is able to maintain a natural position throughout the act and to avoid being pushed back into the vagina.

The dilation of the cervical canal is dependent partly upon the shortening of the longitudinal muscle fibers of the uterus, but largely upon the pressure of the fetal membranes, with the contained fluids, against its anterior opening. With the increase of intra-abdominal tension, the fluids about the fetus tend to move most readily toward the os uteri and push along with them the membranes. The fetal fluids within the membranes serve as an elastic dilator which, slowly becoming impacted in the os uteri, gradually dilates the passage by exerting equal pressure upon every part.

It is well to note that the os uteri is very much more dilatable when the force is exerted from before backward—intra-uterine force—than from behind forward—extra-uterine force—as the obstetrist must largely do when applying forcible means for dilation of the os uteri. As the os uteri becomes dilated and the cervix effaced, the pressure within the uterus presses the fetal membranes, with the contained fluids, out through the os uteri, vagina and vulva, until they appear externally.

The relations of the various fetal membranes to each other, and to the contained liquids, bring about very marked differences in the various animals. The chorion ruptures without having moved from its original position, or becoming extensively detached from the uterus. Normally it can not protrude far through the os uteri. It is essential that this should be so because it is through the maintenance of the intimate relation between the chorion and the uterus that the life of the fetus is maintained during the time of parturition. If the chorion should become so detached from the uterus as to interrupt the interchange of nutriment or excretions between the mother and the fetus, the life of the latter must quickly terminate unless the act of birth is abruptly completed. Normally, therefore, the chorion may push out only a little way from the os uteri before rupturing, without interfering materially with its general attachments to the uterus through the placenta. After the rupture of the chorion, some of the allantoic fluid may escape into the vagina and later externally. Through this rupture in the chorion, the posterior extremity of the amnion regularly protrudes until it reaches the vulva and projects out between the vulvar lips for some distance.

The allantoic sac of ruminants, that is, the endoblastic portion of the allantois, is so disposed that it may protrude through the rupture in the chorion to constitute the first "water-bag." In the mare this cannot occur independently of the chorion. Rupture of the protruding allantoic sac occurs early, and is followed by the appearance of the second or true "water-bag" which consists, as in other animals, of a portion of the amniotic sac enclosing some amniotic fluid.

In the cow and mare the protruding portion of the amnion, or "water-bag," appears as an elongated bladder with a thin, colorless membrane filled with a clear fluid. The bag may extend for

a distance of 6 to 10 inches beyond the vulva, and contain from 1 to 4 or 5 pints of amniotic fluid. With each labor pain, more of

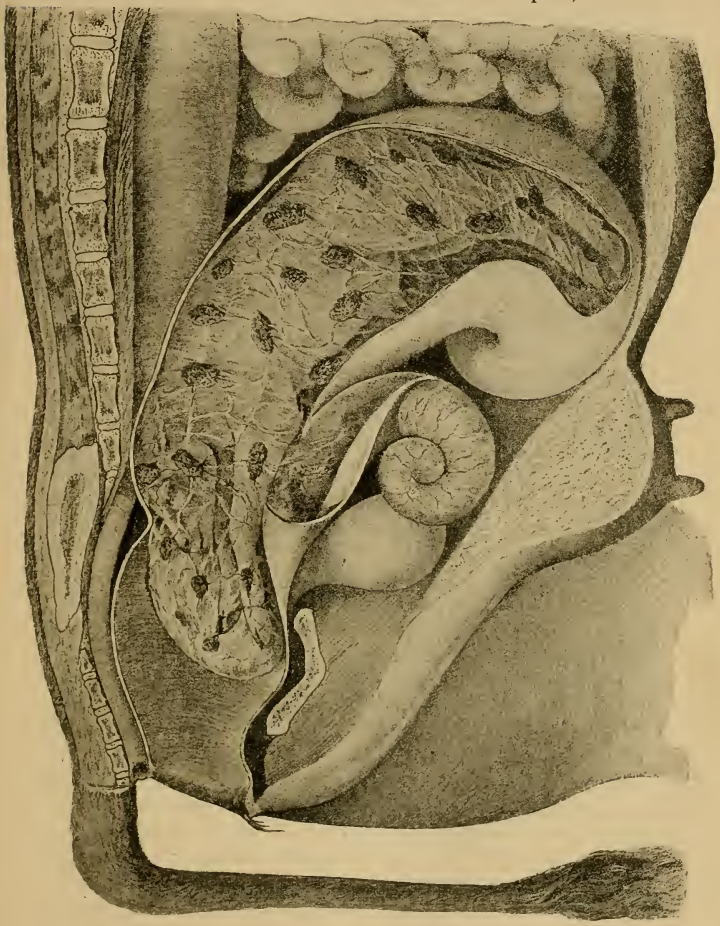

FIG. 87. NORMAL POSITION OF FETUS OF COW AT TIME OF BIRTH. (SKELETT.)

the amniotic fluid is pushed out into the water-bag, until finally the tension becomes too great and it ruptures. Slightly before this period, in normal cases, the presenting portion or portions of the fetus, usually the two anterior feet, followed closely by the nose, appear in the "water-bag."

Under more or less abnormal conditions, there are great variations in reference to the behavior of the fetal membranes at this stage of labor. In the mare it is possible for the chorion to become completely detached from the uterus without becoming ruptured. Consequently the fetus is in some cases said to be expelled completely encased within all its membranes. This is apparently a general statement and we do not know of a well authenticated instance where it has occurred in a fully developed fetus, though it is frequently seen in the mare, as well as in other animals, when abortion takes place at an early period in gestation. In one case which we observed, the chorion ruptured at the anterior end and was pushed over the fetus and expelled, along with the amnion, while the dead fetus remained in the uterus, owing to some deviation in its extremities which interfered with its expulsion.

In cases of twin pregnancy, it is essential that but one fetus should enter the birth passage at a time. In the cow and ewe ordinarily, when there are twins, one occupies each horn in part, while a portion of each fetus projects more or less into the body of the uterus and, when labor pains come on, that fetus which chances to be most advanced ordinarily gains the cervical canal and pelvic inlet first and by its presence prevents the other from entering. Thus the two fetuses are born one after the other.

In practice, this favorable disposition of twin fetuses is occasionally interrupted by some portion or portions of each fetus simultaneously entering the pelvic canal and causing more or less serious dystokia.

We have no evidence to show that the uterine contractions in the two horns may not be essentially equal, but apparently they soon become concentrated upon that portion of the organ which contains the fetus in the most advanced position, and consequently where the contractions will prove most efficient. As soon as the first fetus is expelled and the passage thus vacated and dilated, the expulsion of the other one, as a rule, follows very promptly.

In the mare, only a few minutes usually elapse between the

expulsion of the first and the second fetus. In the cow, where the act of parturition is more deliberate, there is a greater interval, sometimes 20 or 30 minutes. Under abnormal conditions the interval between the expulsion of the two fetuses may be much greater. The birth of the second of a pair of twin fetuses may be delayed for hours or even days after the birth of the first. Any great delay in the expulsion of the second fetus is usually due to some exhaustion in the contractile power of the uterus, resulting from the expulsion of the first fetus and the advent of a subsequent period of rest before the renewal of labor pains for the expulsion of the second fetus.

In multiparous animals, the entanglement of two fetuses during parturition cannot well occur. No fetus, or parts of a fetus, normally occupies the uterine body. The fetuses are wholly lodged within the two cornua. The body of the uterus is actually narrower, when labor sets in, than are the two gravid cornua, so that it is quite impracticable for a fetus from each horn to enter simultaneously the body of the uterus. One fetus enters at a time and it is assumed that they enter alternately from the two cornua, so that the two are emptied nearly together, that is to say, that one horn is not completely emptied of its fetuses until the other is also emptied of all but one.

Symptoms of Parturition. Preliminary to the completion of pregnancy there appear certain signs which indicate to us, with more or less certainty, the near approach of labor.

One of the most conspicuous of these is the increased functional activity of the milk glands. In all of our domestic animals there is a tendency for the glands to become gradually enlarged and tense as the period for giving birth to young approaches. The date at which this enlargement appears varies, being of longer duration in primipara than in those which have previously given birth to young. Usually a few weeks before birth there appears in the udder at first a watery secretion, which may be pressed from the teat, but which bears only a faint resemblance to milk. Later the secretion becomes more milk-like and assumes the characters of colostrum, which some claim is essential to the well-being of the young. When parturition is near, the milk secretion may be so profuse that it escapes from the teat in drops, or in streams.

However reliable this is as a sign that parturition is near, it may become very misleading. We have previously stated that sometimes during various stages of pregnancy the glands become swollen and contain milk and that this may disappear and not be seen again until at the close of pregnancy, weeks or months later.

Sometimes the milk glands become much enlarged and show great functional activity long before parturition, so that in the mare we have observed a profuse flow of milk escaping from the glands for two or three weeks before the birth of the foal, though everything seemed to be normal and parturition was regular. We have also noted in previous chapters that we have at times observed the secretion of milk by a mule during the estrual period.

On the other hand, it sometimes occurs, especially in the mare, that almost no milk is secreted prior to parturition and that the glands are very slightly enlarged. Such is especially the case in very old mares which have been bred for the first time.

Fleming suggests that this enlargement and increased functional activity of the udder is due to the diversion to it of the excess of blood from the uterus, which this organ no longer requires. This explanation is not clear. The nutritive demands of the fetus at the close of intra-uterine life seem to be even greater than at an earlier period. The fetus is larger and growing rapidly. The uterus must receive an increased amount of nutriment, in order to perform its function of expulsion of the fetus and placenta and repair of the injuries incident to parturition. It is rather a part of the general plan of nature in preparing for the nutrition of the fetus after its birth.

A very important sign of approaching parturition is the relaxation of the sacro-sciatic ligaments, which allows the muscles passing over them to drop inward causing a sinking of the croup. This relaxation increases the dilatability of the vulvo-vaginal canal and makes it easier for the fetus to be propelled through it. The relaxation in these ligaments is thought by some to be due to changes taking place within the ligament itself, consisting largely of an effusion of lymph into it, which leads to its softening. Others refer the phenomenon to a change in the relationship between the ossa innominata and the sacrum and coccyx. The sacro-iliac ligaments, according to this view, become somewhat relaxed, so that the articulation becomes less rigid and the

tuberosity of the ischium passes upward toward the sacrum and causes a decrease in the tension of the great sacro-sciatic ligaments.

Another symptom of approaching birth, which is important, is the preparation which is taking place in the vulva. The vulvar lips become somewhat thickened and tend to stand apart more loosely than ordinarily. From the vulva there generally appears, especially in the cow, a more or less abundant discharge of a thick, ropy mucus, which indicates an increase in the functional activity of the glands in the mucosa of the vagina and vulva. If the lips of the vulva are parted, there is observed an injection of the mucosa.

As the time for birth draws nearer, certain psychic signs are observed, which indicate that the period of labor is rapidly approaching. The animal seems to be somewhat disturbed and anxious. It tends to move slowly and cautiously and exhibits some tendency to isolate itself from its usual associates. There may be interruptions in feeding, suggesting that uterine contractions are taking place, which cause some degree of discomfort or pain. These may express themselves through an appearance of anxiety on the part of the animal. Sometimes the advent of the uterine contractions is suggested by the appearance of slight colic, accompanied by occasional pawing or lying down, or, in case of carnivora, whining or groaning. The mare may show evidence of pain by whisking the tail, a symptom which is seen to some extent also in the cow. Finally the pregnant animal, if at liberty, tends to withdraw from other animals of its own kind or of other species and seek a quiet and secluded place, where it may bring forth its young without disturbance or annoyance.

In herbivora, little care is taken in the selection of a place for giving birth to young, except that it is a quiet spot where the mother and young may for a time remain more or less in hiding. The carnivorous animal shows a tendency to select a comfortable bed.

The sow, in a state of freedom, will habitually gather coarse herbage or small brush into a conical mound, in which she may give birth to her young. If allowed the fullest liberty, at a season of the year when vegetation is abundant, she will select a spot where she can gather an abundance of coarse weeds or fine twigs which are covered with leaves. Beginning at the spot

which she selects for her nest, she will gather all the herbage in an ever widening circle and carry it to the central spot, where she deposits it in the form of a mound, until she has acquired sufficient to suit her purposes. We have seen such mounds as extensive as four or five feet in diameter and two or three feet in depth. Into the center of this mound she crawls in such a way as to become almost or quite hidden and there gives birth to her young. In confinement, she builds such a nest as her environment makes possible or demands, and it may vary in every degree from that which we have already described to no bed at all in some cases where she is denied the proper material for its construction. Increased domestication brings decreased instinct in preparing such bed.

The rabbit constructs a burrow and pulls from her own body a sufficient amount of fur to line a very complete and cozy nest in which to give birth to her very immature young.

Exploration of the genital passages just prior to labor reveals the fact that the cervix of the uterus has largely disappeared, and there simply remains a brief constriction at the os uteri externum. The os may be somewhat open, so that the fingers can readily be introduced into the uterine cavity and come in contact with the smooth surface of the chorion over the small area where no placental tufts exist. As labor progresses, the os uteri gradually dilates and, when the contractions of the uterine walls become more pronounced, the dilation of the os uteri externum rapidly increases, until it finally becomes wholly effaced and the uterine cavity continuous with that of the vagina.

When the os uteri has become sufficiently dilated, the water-bag passes into and through the opening and portions of the fetus soon advance into the os uteri and vagina and the definite symptoms of labor quickly become established. The uterine contractions now begin in earnest and are soon accompanied by contractions of the abdomen and diaphragm. The animal shows well marked pain and suffering. Depending somewhat upon species, the animal shows a tendency to lie down and rise frequently, and in general to show abdominal pain. The mare may paw with the fore feet and strike at the abdomen with the hind feet. The animal ceases to feed and shows much anxiety, which is indicated to some extent by a disturbance of the circulation, consisting chiefly in an increased pulse rate. In

the mare, there may be some sweating. The pain is somewhat intermittent and after each uterine contraction, which is of variable length but which rarely exceeds two or three minutes, there is a pause in the pain and anxiety until another period of contraction comes on. As the uterus is an unstriped muscle organ, its contractions are more or less slow, are virtually involuntary and, like other contractions of this type of muscle, are rythmic and recur at more or less regular intervals. The uterine contractions are almost wholly involuntary, but may be indirectly modified by fear or other emotions. As soon as the fetal membranes pass into and beyond the os uteri, the expulsive efforts of the animal increase in force and the full power of the abdominal and other muscles of the body is brought into play in a supreme effort to bring about the expulsion of the fetus.

When the labor pains become fully established, the animal assumes varying attitudes, somewhat according to the species and individual. Our larger domestic animals alternate between the standing and recumbent positions during labor, while multiparous animals lie almost continually and chiefly in lateral recumbency. The larger animals, when standing, arch the back, bring all the feet together and strain violently. This straining is aided materially by the animal taking a deep inspiration of air, closing the glottis so that the air cannot escape from the chest, and then powerfully contracting the muscles of the body, increasing enormously the intra-abdominal pressure and tending to force the contents of the abdomen in the direction of least resistance. With the contractions of the uterus, this force is concentrated chiefly upon the fetus and its envelopes, and forces them toward and through the dilated os and out through the vagina and vulva.

Herbivorous animals do not constantly maintain a given position during labor, but vary their attitude somewhat according to the progress of parturition and partly according to individual temperament. During the earlier stages of the act there is a greater tendency to maintain the standing position, than later. When the fetus has been well propelled into the pelvis and the anterior feet and head have passed beyond the vulva, there is a very marked tendency, in the cow and mare, to assume the recumbent position, and the animal may lie either in the sternal position, or prone upon the side, in lateral recum-

bency. Even here the position tends to vary to some degree, especially in the mare, according to the stage of the act. The mare generally lies upon her sternum until the head of the fetus has protruded some distance beyond the vulva, when, should she continue this position, there would be a tendency for the fetus to strike against the floor or ground and offer obstruction to its further expulsion. At this period she usually assumes lateral recumbency, in which position she is capable of exerting the maximum expulsive power, while the fetus may be expelled without obstructing its long passage by contact with the ground.

The standing position of large animals at the close of the expulsion of the fetus is unfavorable for the well-being of the young, because of the possibility of its injury in falling. It is not the best position for the mother, because she cannot exert the maximum degree of force.

In the multiparous animals the contraction of the abdominal muscles plays a comparatively unimportant part in the expulsion of the fetus. This is brought about chiefly by the contractions of the muscular walls of the uterus itself.

The "water bag" performs a highly important office in the expulsion of the fetus. We have already suggested that, in the dilation of the os uteri, the bag of water tends to bring this about, in the safest, gentlest, and yet most effective manner possible, by producing an equal pressure in every direction. Later it dilates the vulvar opening also, although here it is not so important because, when the water bag reaches this part, the membrane protrudes through the vulva and the fetal liquid is forced through the vulva in a stream, to accumulate on the outside till the amnion ruptures and the fluid escapes. Exceptionally, the "water bag" is said to not rupture in the mare, and the foal to be expelled inclosed within it.

In normal parturition, the allantoic and amniotic fluids serve to lubricate the passages throughout labor, and portions of the fluids remain within the uterus after the fetus has been expelled. The presence of this fluid in the uterus serves to fill out and efface all irregularities in the form of the fetus and prevents the uterus from closely investing the body of the fetus in such a way as to interfere with its expulsion.

Should the uterus contract directly upon the irregular fetal body and closely invest it throughout, it could not exert that

power upon the fetus essential to its ready expulsion. The uterus maintains a more or less spherical shape while the fetal fluids are retained, and consequently presses alike upon all portions of the fetus, and tends to press it backward through the vagina and vulva.

When dystokia occurs and the fetal fluids all escape, the obstetrist is made to realize the disadvantage of the absence of these and the close investment of the fetus by the uterine walls. This condition prevents him from readily changing the position of the fetus or from carrying out other manipulations. After the position of the fetus has been adjusted, the obstetrist still needs the fetal fluids. The uterine and abdominal contractions tend to force out some of these liquids with each labor pain, and consequently keep the passage constantly moist and somewhat unctuous throughout the entire duration of normal parturition.

The dilation of the passages is favored by the part of the fetus which normally presents. In the larger herbivora, the vast majority of fetuses present with the two anterior feet, followed shortly by the nose resting upon them at about the middle of the metacarpus. The three extremities constitute an elongated cone, which acts as a wedge in gradually dilating the passages. If the fetus presents posteriorly, the conditions are essentially the same, in reference to the mechanical plan, and the two hind feet present together. As the legs and thighs are advanced they serve again as a long wedge or cone to gradually dilate the passages for the expulsion of the fetus. In carnivorous animals, where the head is proportionately very large and the anterior limbs are comparatively small and flexible, the head usually advances alone and the fetus is expelled with the anterior limbs lying along the side or floor of the fetal chest.

When the young of large herbivora present anteriorly there is usually no very serious impediment to their progress until the head of the fetus reaches the vulva, when, especially in primipara, there is a delay in the progress of the fetus because time is required to bring about the dilation of the vulva to such a degree that the fetus can pass through without serious injury to the part. When the head emerges from the vulva, the other parts of the fetus usually pass with less difficulty, though there may be marked resistance when the chest enters the passages and

again when the hips advance until they come in contact with the pelvic inlet of the mother.

It is important to bear in mind that in our larger domestic animals the fetus lies *en arc* and that, in passing through the pelvic canal, in anterior presentation, the head and forefeet must pass upward and backward, and, when these extremities emerge from the vulva, the expulsion of the other portions of the fetus most readily occurs with the head and shoulders passing first backward and then downward and backward so that the fetus retains its arciform disposition.

If we measure an ordinary fetus, after its delivery, we find that the diameters of its chest are greater than those of the canal through which it has passed, and that consequently there must be some change in these diameters during its passage from the uterus. This is brought about, in the mare and cow, chiefly by the extreme extension of the shoulders, causing them to be displaced forward from the chest and lie chiefly upon the sides of the neck, anterior to the first rib, with only the prolongation of the scapula resting upon the chest. At the same time the sternum is drawn far forward, so that the sterno-spinal diameter of the chest is greatly decreased. This makes it possible for the chest to pass through an opening which measures less than its own diameter. This change in the relations of the chest and anterior limbs occurs in the larger domestic animals, whether the presentation be anterior or posterior.

When the hips reach the constricted portions of the passages they are not capable of any great change in form or volume and must necessarily pass through the birth canal approximately in their normal form and size and sometimes constitute a more or less serious impediment in the expulsion of the fetus.

The duration of normal parturition in animals is extremely variable, both according to species and individuals, and is dependent upon many circumstances. It is usually more prolonged in primipara, because the birth canal has not previously been dilated.

In the mare, where the vulva is very large and the cervix of the uterus very extensible, parturition is exceedingly prompt and, we might say, tumultuous. This is necessitated, in a large measure, because of the feeble attachment of the placenta, which tends to very rapidly become separated and cause the death of

the fetus through the cutting off of the nutritive supply, including oxygen. Hence, foals generally perish if dystokia occurs. This is in sharp contrast to ruminants, where the fetus may continue to live for hours after labor has set in. Consequently, in the mare the actual duration of vigorous labor usually does not extend beyond a few minutes and occasionally occurs so quickly in a work mare that she can scarcely be unhitched from the plow and have her harness removed before the living foal has been expelled. In cows which have given birth to a number of calves, the birth act is sometimes almost as prompt, although usually it is more prolonged because the os uteri does not dilate so readily and the labor pains are not so tumultuous and powerful.

In multiparous animals, the birth of each young animal usually follows quickly upon that of the preceding. A sow may bring forth 8 to 10 young in less than an hour. Sometimes parturition becomes tedious and a sow may be a day or more in expelling the fetuses.

When the fetus is expelled, the effect upon the umbilic cord will depend somewhat upon the position of the mother, but very largely upon the length of the cord. In the mare, the umbilic cord is quite long and the fetus may be completely expelled and the cord continue intact so long as the animal remains in a recumbent position. When she arises, the cord will probably rupture and, if not at that moment, it must give way when she turns to examine her young, if the chorion remains attached in the uterus. In some cases, however, the afterbirth immediately follows the fetus and remains attached to it by means of the cord until the foal itself ruptures it by its struggles.

The umbilic cord of the foal ordinarily ruptures at a point about two inches from the umbilic ring, and just beyond a point where there is a distinct line of demarcation between the cord proper and the cordiform extension of the abdominal wall, which is not covered with hairs. (See Fig. 90 B.) The exact point of rupture may vary, however, and the cord may become torn in two, 5 or 6 inches or even more from the umbilic ring, or it may give way very close to the ring. It has been alleged that the rupture may occur in the ring, but the writer has not observed such an accident and its occurrence may be doubted. The rupture of the umbilic cord is followed by some hemorrhage, especially if the placenta still remains

attached and consequently receives blood up to the moment of rupture. The umbilic cord may bleed from either end. From the placental end only that blood which has already entered its vessels from the mother usually escapes. From the fetal end there may ooze a few drops of blood from the broken ends of the umbilic veins. Some claim that there may be a more or less serious hemorrhage from the umbilic arteries, but this accident we have not observed. This can occur only very rarely, because the arteries are so elastic that they promptly recoil and retract up into the abdominal cavity, (Fig. 56), drawing their connective tissue envelopes along with them in such a way as to render hemorrhage virtually impossible. In all animals, there is a tendency for the mother to cleanse the ruptured navel cord with her tongue or lips. In the cow, the umbilic cord is so short that it usually ruptures before the hind feet of the fetus have escaped from the vulva. The necessary care of the broken umbilic cord will be discussed under "Care of the New-Born Animal."

EXPULSION OF THE FETAL MEMBRANES AND INVOLUTION OF THE UTERUS.

The expulsion of the fetal membranes normally follows birth after a very brief interval, depending upon the species of animal and the individual. The expulsion of the fetal membranes occurs most promptly in those animals like the mare, in which, owing to the diffuse placenta, the attachments of the chorion to the uterus are not so complex and consequently not so difficult of detachment. In ruminants, with the multiple placenta or cotyledons, the attachments between the fetal and maternal placenta are very intricate and the placental villi very long and branched, so that they do not so readily become detached from the maternal organ.

The detachment of the placenta is largely the result of the contraction of the uterine walls, which, acting upon the villi of the fetal placenta, tends to force them out and detach them, while the decrease in the size of the uterine cavity forces the detached membranes out through the vagina. The contraction of the uterine walls of ruminants cannot act so effectively upon the cotyledons as can the walls of the uterus of the mare upon the diffused tufts. The contraction or involution of the uterus and the expulsion of the membranes are therefore correlated phenomena which go hand in hand, and when one fails it tends to interrupt the other.

In the mare we have seen the entire placenta and all the fetal membranes promptly expelled from the uterus, while the fetus remained naked in the organ, because of some slight deviation of a fetal part which prevented its ready expulsion. In this case the contraction of the uterus, with the escape of the amniotic and allantoic fluids, was sufficient to cause the detachment and expulsion of the chorion. Fleming suggests that the same accident may occur in the cow, but this we have not observed. Owing to the character of the placenta in that animal, such an occurrence must be extremely rare, except in cases of prolonged dystokia, with decomposition of the membranes.

In some cases of birth, in the mare, especially where there has been a slight delay, the fetal membranes accompany the fetus or follow it immediately. In cases of dystokia in the mare, as a

general rule, the fetal membranes come away immediately following the fetus, or essentially at the same moment.

The placenta usually comes away, in the mare, a few minutes after birth and, in the cow, at a somewhat later period. In the multiparous animals, the afterbirth which has belonged to a given fetus must be expelled before the succeeding fetus from the same horn can be born, and consequently, as a rule, we observe the placenta of each fetus following it immediately and usually still attached to it.

The detachment of the fetal membranes or placenta in the normal way has little or no tendency to induce important hemorrhage in animals. Though the hemorrhage following detachment of the placenta in animals is quite uniformly of no consequence, it is present in a sufficient amount that we are able to say that it occurs. However, in the larger domestic animals, it generally amounts to a quantity which is scarcely capable of being measured and which is wholly without visible consequence to the animal. We do see hemorrhage, however, from the placenta of the larger animals when the fetal membranes are injudiciously and violently torn away. Following such cases we have seen fatal hemorrhage.

Frequently the fetal membranes do not come away promptly, but are retained for a greater or less period and may result seriously for the well-being of the animal. They are especially liable to be retained in cases of abortion and also in all those cases where, for any reason, the involution or contraction of the uterus is tardy.

As soon as the fetus has been expelled and the umbilic cord ruptured, the chorion, and other portions of the fetal membranes remaining, become essentially inert tissue, without circulation and without life. It is highly essential that these should come away promptly and that the involution of the uterus should take place quickly. When this fails to occur promptly, the fetal membranes quickly become infected and undergo decomposition; the uterus becomes infected and leads to metritis, placentitis, or to other more or less serious infections. Two things are essential to prevent these infections: the expulsion of the membranes and the contraction of the uterus. Even if the membranes are promptly expelled, it is essential that the uterine cavity should be effaced and the walls come in contact, in order to avoid infection in the uterine cavity. Any relaxation or debility of the

uterine walls invites infection. A contractile organ has in itself the power to overcome infection; hence the importance of the normal contraction of the organ. Retention of the placenta will be more fully considered later.

The expulsion of the fetus and its fluids is at once followed by contraction of the uterine walls, decreased vascularity, reduction in size and obliteration of its cavity by the walls coming in contact with each other. The placentæ disappear, the glandular layers of the deciduate placentæ are detached and removed and a new epithelial layer formed at the site of placental attachments.

The cervix uteri contracts rapidly and the cervical canal is well closed in 24 to 48 hours. The uterus, once pregnant, fails to wholly regain the size of the virgin organ. The broad ligaments retract and again suspend the uterus.

Collectively we know these processes as involution of the uterus, and regard them as highly important to the well-being of the animal. When the uterus contracts in a physiologic manner it tends to prevent infection of its walls, but if there is inertia or paralysis of the walls, infection is probable. If afterbirth or other dead tissue remains in the uterus and becomes infected, the infection not only brings about an inflammation of the uterine walls, but also increases the inertia or paralysis of them.

In most domestic animals, the mother habitually devours the entire fetal membranes immediately after their normal expulsion. This regularly occurs in ruminants and the sow, and sometimes, it is said, in the mare also. It has been suggested that the devouring of the fetal envelopes by the mother is the persistence of a precautionary measure from the wild state, for the defense of the mother and new-born against predatory animals, by destroying the evidences of the recent birth. The devouring of the membranes rarely results in accident, but there have been a few cases recorded where a cow has become choked upon her placenta and, in one case personally related to us, the cow became choked while the one end of the placenta still remained firmly attached in her uterus. Sometimes the placenta decomposes in the rumen or other portions of the alimentary canal and causes indigestion.

PRESENTATIONS AND POSITIONS OF THE FETUS.

In a general way, we have already outlined the physiology of labor and have indicated the means by which the fetus is expelled from the uterus when it has completed its intra-uterine development or when it has been thrown out because of its death or disease in case of abortion or premature birth.

It is essential that we should thoroughly understand that, in order for these physiologic processes to be carried out in a normal manner, it is necessary for the attitude of the fetus to be such that it will be practicable for it to pass through the birth canal. There are certain attitudes of the fetus which make its passage possible, while others render it virtually impossible. The possibility of a fetus being born alive and without assistance depends fundamentally upon which parts of the fetal body present at the inlet, and secondarily upon the relations of the parts which present to the circumference of the pelvis. In dealing with the mechanism of parturition, we recognize two fundamental elements in reference to the attitude of the fetus—presentation and position.

Presentation, mechanically expressed, is the relation existing between the spinal axes of the mother and fetus. The term indicates that portion or general region of the fetus which offers at the pelvic inlet at the time of parturition.

Position expresses the relation of the presenting portion of the fetus to the circumference of the pelvic inlet. It is the relation of the presenting part to the sacro-pubic or the bis-iliac diameter of the maternal pelvis.

Presentations of the Fetus.

The uteri of domestic animals are more or less tubular in their general outline, and the fetus represents an elongated oval, the long axis of which normally corresponds with the long axis of the uterine cavity. The transverse diameter of the body of the fetus approximately equals the dimensions of the dilated birth canal, through which it must necessarily pass in being born. The fetal chest has an even greater diameter than that of the bony canal through which it must pass. Not only is it necessary that the long axis of the fetus should be parallel to that of the

mother, but even the transverse axis of the fetal chest must be decreased. We may, therefore, recognize two normal attitudes of the fetus in relation to its long axis—the anterior and posterior presentations, in which the anterior or posterior end of the fetus respectively presents at the pelvic inlet.

The mere fact that the spinal axes of the mother and fetus are parallel does not insure that the attitude of the fetus is normal or that parturition can take place without aid, but merely that, upon examination, some portion of the anterior or posterior part of the body is met.

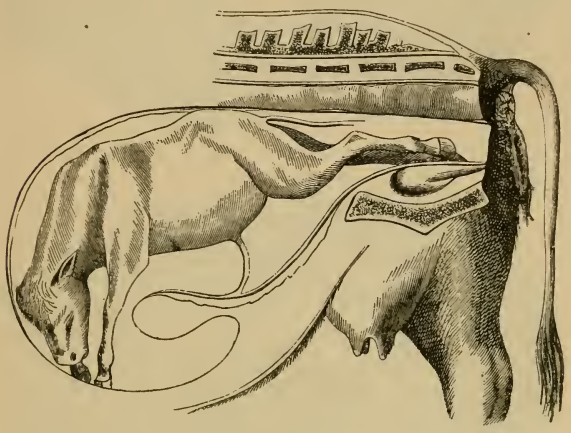

Fig. 88. Posterior Presentation.

Dorso-sacral position. (St. Cyr.)

Not every fetus, however, is presented in such a way that its long axis corresponds to that of the mother. Instead, it may be perpendicular to it, so that the fetus presents transversely, in which instance it cannot be born without a correction of its presentation, and therefore becomes abnormal.

The fetus may present transversely at the pelvic inlet, either by its dorsal or ventral surface, and consequently there may occur a dorsal or ventral presentation.

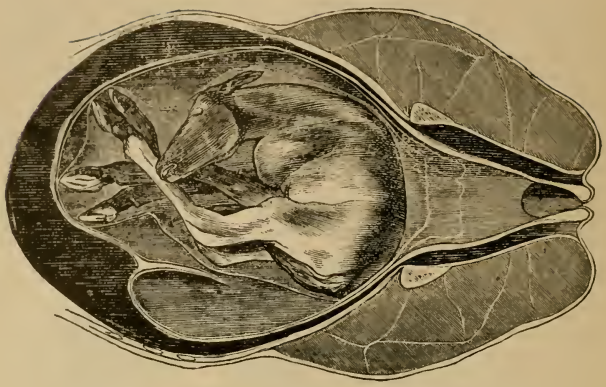

FIG. 89. DORSAL PRESENTATION. (FRANCK).

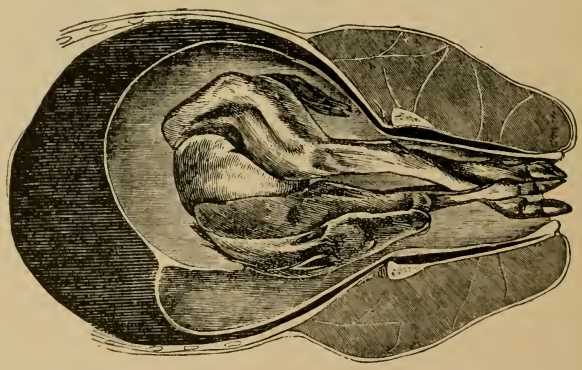

FIG. 90. VENTRAL PRESENTATION. (FRANCK).

POSITIONS OF THE FETUS.

Position is the relation existing between an arbitrarily selected part of the presenting portion of the fetal body and the circumference of the pelvic girdle. A fixed point upon the fetal body, the dorsum for the longitudinal presentation, and the head end for the transverse presentation, is chosen as a basis. The pelvic inlet

of the mother is divided into quadrants which represent the sacrum, pubis and right and left ilia. Toward either of these areas the dorsum of the fetus may be directed, whether presenting by the anterior or posterior end.

It does not follow that the dorsum of a longitudinally presenting fetus is always directed toward the center of one of the four areas mentioned, but there may be every possible degree of variation, the four cardinal points of the pelvic girdle serving as a basis for the designation of the intermediary or "oblique" positions, or simple variations, by which any one position may gradually merge into the next. In the longitudinal presentation, the fetus tends to spontaneously assume that position in which its dorsum corresponds to the sacrum of the mother. This we designate as the dorso-sacral position. (See Figs. 87 and 88).

It is pre-eminently the normal position. While it is theoretically possible for birth to occur, without assistance, in other positions of the longitudinal presentations, such has but rarely been observed. In the anterior presentation and dorso-sacral position, the disposition of the three extremities, the head and two anterior limbs, determines the practicability of the fetus being expelled without assistance. In animals with long and rigid limbs and a small head, such as the large herbivora, the normal relationship is for the two anterior limbs to be fully extended, with the soles of the feet presenting downward, while upon these rest the head and neck with the nose somewhat less advanced than the two anterior feet. In the mare the nose rests in the vicinity of the fetlocks ; in the cow the nose is somewhat nearer to the hoofs. Any deviation in the relationship of these extremities at once causes difficulty in the passing of the fetus through the birth canal and brings about more or less serious dystokia.

If the fetus revolves upon its long axis to the extent of a quadrant of a circle, either to the right or the left, the dorsum of the fetus corresponds to the right or left ilium respectively and causes the right or left dorso-ilial position, a position of the fetus which renders spontaneous birth difficult in all cases, and usually impossible without obstetric aid.

Should the revolution of the fetus upon its long axis continue a quadrant further, the dorsum of the fetus corresponds to the

pubis of the mother, or there occurs the dorso-pubic position. This position of the fetus is such that birth cannot usually take place without assistance and may consequently be regarded, for all practical purposes, as abnormal. In both the dorso-ilial and dorso-pubic positions, numerous deviations or misplacements of any or all extremities may occur and add to the complications and difficulties of the expulsion of the fetus.

We have already stated that the fetus normally lies *en arc* or curved somewhat ventralwards. The anatomy of the fetus prevents this curvature from being readily reversed, and consequently this curve of the body should always correspond to whatever curvature exists in the birth-canal. A study of the genital passage of the mother will show that this curvature, in the main, is concave above and convex below. Consequently, if the curved body of the fetus is to pass readily through the canal, it must present in such a position that its convex dorsal surface shall correspond to the concave line formed by the maternal sacrum and coccyx. Hence the dorso-sacral position is the normal one, because it is that which is most favorable to the prompt and easy passage of the fetus through the birth-canal with safety alike to the fetus and mother.

In those positions where the curvature of the fetal body does not correspond to that of the birth-canal, the extremities of the fetus tend to push against the sides or walls of the canal and become impacted therein, injuring more or less seriously the soft parts of the mother or blocking the progress of the fetus. It is also to be considered that when the dorsum of the fetus corresponds to the sacrum of the mother the actual transverse diameters of the fetal body assume the most favorable relations to the various diameters of the pelvis of the mother.

In the smaller domestic animals, the limbs of the fetus are not so long comparatively, nor so rigid ; the neck of the fetus is usually much shorter. The body is less curved and more pliable, so that it may be more readily bent dorsalwards than in the larger animals. The head, in some of the smaller animals, such as the carnivora, is large and offers alone as great an obstruction as the head and forefeet together in the larger animals. Therefore, in smaller animals, the anterior feet and legs usually project backward beneath the fetal body and the head advances alone. Because of the more direct and cylindrical form of the

body, the position of the fetus in relation to the circumference of the pubic inlet is not so important, although even here the fetus is generally and most readily expelled in the dorso-sacral position.

When the longitudinal presentation is posterior, instead of anterior, the same modifications of position prevail and are similarly designated. There is the dorso-sacral position, with the dorsum of the fetus presenting toward the sacrum of the mother; the right and left dorso-ilial positions, with the dorsum of the fetus directed toward the right or left ilial shaft of the mother; and the dorso-pubic position, with the dorsum of the fetus directed toward the pubis of the mother. Some writers designate these positions lumbo-sacral, lumbo-ilial and lumbo-pubic respectively.

Authors are not in accord upon the question of whether we can properly consider any position of the posterior presentation normal in the large herbivora. Certain it is that only very, very rarely is a calf or a foal born alive in the posterior presentation, unless assistance has been promptly afforded and birth greatly hastened. Whenever the fetal body has been so far expelled that the fetal umbilicus has entered the pelvic inlet of the mother and the umbilic cord is compressed between the pelvic brim of the mother and the ventral wall of the fetus, the life of the latter is at once threatened. It must quickly die from asphyxia unless very promptly expelled or extracted and permitted to at once breathé.

Precisely how long a fetus may live after the umbilic cord becomes compressed between the pubis of the mother and the body of the fetus, cutting off the fetal circulation, is not known, but it certainly cannot be for more than a few minutes. Some authors have suggested that, if the circulation be thus interrupted, the fetus at once inhales the amniotic fluid and thus drowns itself. We have found no data to show us to what extent this is true. It is evidently well-nigh impossible for such inhalation of fluids to occur clinically, because, at the moment when the strangulation of the cord occurs, the chest of the young animal is so tightly impacted in the inlet of the pelvis of the mother that it is difficult to understand how amniotic fluid or anything else could be inhaled. When the chest has passed through the birth canal, the head at once follows and it only re-

mains for the amnion to be removed from the nose to render respiration possible.

While normal and easy birth in the large herbivora is virtually limited to the dorso-sacral position of the anterior presentation, in the smaller domestic animals it is by no means rare for birth to take place easily and safely, for both mother and young, with the fetus in the posterior presentation.

In the judgment of some obstetric writers, the expulsion of the fetus is more difficult when presenting posteriorly than anteriorly, but we have not been able to verify this opinion. In our experience in the larger domestic animals, the posterior presentation is favorable, in so far as the amount of resistance to expulsion is concerned, provided always that the position of the fetus is dorso-sacral and that there is no deviation of the posterior limbs. When so presenting, the posterior part of the body forms a very elongated cone, which tends to dilate the passages gradually and causes the fetus to advance with the least possible difficulty. Some obstetrists suggest that the direction of the hair, being opposite to that in which the fetus is passing, offers resistance, but it should be remembered that the fetal hairs are very soft and flexible and that, if properly lubricated by the fetal fluids, they offer virtually no obstacle. What little resistance they may theoretically offer is far more than counterbalanced by the length and regularity of the cone which the posterior presentation furnishes.

However, dystokia is more liable to occur in our larger animals when the fetus presents posteriorly than when it offers anteriorly. The increased tendency to dystokia seems to be be due largely to the tendency for the hind limbs to become deviated from the normal position of extension and one or both of them to be more or less retained beneath the fetal body and thus offer obstruction to birth which cannot be overcome except by obstetric aid. In the mare and cow, also, there is a constant tendency for the fetus, when presenting posteriorly, to assume the dorso-pubic or dorso-ilial position, by which the arc of the fetal body is contrary to the curvature of the genital passage.

The posterior presentation is undesirable and unfavorable in our larger domestic animals, not because it fundamentally offers serious obstacles to the expulsion of the fetus, but because it tends to imperil the life of the fetus during the act of birth,

owing to compression of the umbilic cord before the fetus is in a position to breathe, and also because of the great tendency for deviation of the limbs to occur or for some unfavorable position of the fetus to exist, which may bring about more or less serious dystokia.

The transverse presentations of the fetus, whether dorsal or ventral, offer, in each, two positions. The fetus necessarily lies horizontally, since any other attitude would be unstable, and the head must lie in the right or left flank of the mother, corresponding more or less intimately to the right or left maternal ilium. Accepting the fetal head as the fixed point of the fetus for designating its position, there may exist either a right or left cephalo-ilial position, according as the head end of the fetus corresponds to the right or left ilium of the mother.*

The presentations and positions, normal and abnormal, which a fetus may assume may be tabulated as follows:

Longitudinal	Anterior Presentation	Dorso-Sacral Position
		Right or Left Dorso-Ilial Position
	Posterior Presentation	Dorso-Pubic Position
Transverse	Dorsal Presentation / Ventral Presentation	Right or Left Cephalo-Ilial Position

This gives a total of twelve fundamental positions, most of which are abnormal. These positions may be further complicated by a great variety of deviations of the extremities.

*According to some writers, there may be in the dorsal presentation a cephalo-sacral position, but they cite no clinical instances and the position is so unstable as to be at least very transitory if not impossible.

MANAGEMENT OF NORMAL PARTURITION.

In a general way it is safer that an animal be let alone during parturition, and that she be given an amount of freedom which will approach the natural state as nearly as possible.

Under domestication, the environment has been so changed and modified that it is essential we should consider the question of the care and surroundings of the mother and fetus during the period of parturition. The essential preparations should be those which insure freedom and comfort. In the larger animals, like the mare and cow, which are habitually kept secured in stalls or stanchions and frequently among a number of other animals, the safety of both the mother and fetus is increased by providing greater liberty for the animal during parturition and separating her to some degree from other animals of the same or other species. Sometimes the owner is not able to command proper quarters for an animal while giving birth to young and may find it necessary to keep her tied by the head. In reality, this is usually comparatively safe, providing always that the stall is so arranged as to guard the animal against the danger of becoming cast, and thus injuring herself.

Provision should be made against injury to the fetus from defects in the stable or from the presence of other animals. A good stall in which the animal is tied up by the head is better than a poor box-stall, because in the latter the mother is liable to lie down with her buttocks against or near to a wall in such a way that the fetus cannot readily be expelled, whereas if tied by the head in a single stall such an accident could not readily occur, unless the stall were very short or the animal tied very long. Both cows and mares repeatedly give birth to young, while tied by the head in a stable with a number of other animals, and are usually unharmed.

Some writers claim that the mother should be able to get to the fetus at once, in order to release it from its membranes, but clinically this is at least unimportant, if not untrue, and it is doubtful if the cow or mare ever saves the life of her fetus by quickly removing the fetal membranes from its nostrils so as to permit it to breathe. Admittedly, it is important that the mother

be allowed to cleanse her fetus thoroughly by licking and fondling it as soon as she has recovered from the exhaustion incident to labor. A danger of great importance, in cases where animals are tied by the head in a stable with other animals, is that the fetus may blunder into an adjoining stall and, especially a foal, may be seriously injured by coming within reach of other horses, which may kick, bite or trample it. With other domestic animals, especially with the cow, this danger is not so great, although present in a minor degree.

It is not always desirable to remove pregnant females too far from their usual place and surroundings at the time when they are to give birth to young, because in many of them it tends to induce a nervousness and unrest which may lead to more or less serious difficulty. Some animals, especially mares, become very nervous and even frantic when removed from their companions and placed in a strange stall. This should be avoided.

The stall in which an animal is to give birth to young should be ample in size and scrupulously clean. It should be well-bedded with as clean bedding as it is practicable to obtain. It should be kept quite free from feces and accumulations of urine and other decomposing substances. In case of a highly valued animal, it may even be desirable and economic to keep the stall and bedding disinfected in order to avoid the important and dangerous infections to both fetus and mother which may follow a normal case of parturition.

The best place in which a herbivorous animal may give birth to young is the open field or pasture, if the weather will permit, there being no place so safe from mechanical accident or from infection. In some cases complications arise which to some degree decrease the advantages to young of birth in the open pasture. During the hot summer months flies offer considerable annoyance and have special dangers as infection bearers for the mother and young when the act of birth takes place in the open field.

The care of the pregnant animal during labor should not be of a kind which will in any way annoy or disturb her. When the animal is of material value, it is well that the course of labor should be sufficiently watched in order to determine whether it is proceeding regularly or not, since it is always important that, if help must be extended to an animal, it should be early. A

great many pregnant animals resent the constant presence of persons during labor and become very nervous when too much attention is paid to them. Owners of mares have frequently noted, especially in those pregnant for the first time, that labor seems to set in when the watcher is away and not during his presence. The animal sometimes seems to await a favorable moment to begin labor, so that, when an intended constant watch is set, labor is liable to not begin until some slight intermission in the supervision occurs, when it at once takes place. When the watch is resumed, it is found that birth has taken place during the interval. The watch upon an animal should therefore be barely sufficient to guard against any serious accident.

In the care or watching of an animal during parturition, the breeder or his employees should be instructed as far as may be necessary, by the veterinarian, in reference to what constitutes the normal progress of parturition and when it is necessary to interfere in a case. Should the veterinarian be called to attend a case of what is suspected as irregular or abnormal parturition, he should determine by a careful examination the exact state of affairs and interfere only in those cases where there is some deviation from the normal which, in his judgment, it is best to correct, or which would not be ultimately and safely overcome by the mother alone.

He should determine if the labor pains are normal and whether the general condition of the mother is good. He should determine whether the genital passages of the mother are in normal condition and are dilating in a natural manner. The position of the fetus should be learned and the veterinarian should know if it will probably be expelled without assistance.

The veterinarian should determine if birth may properly take place at once or if in the natural course of events it should be delayed for a period of time. For this purpose it is essential to differentiate between false, or preparatory, labor pains and real expulsive efforts designed to bring about the immediate expulsion of the fetus. As we have suggested in preceding chapters, there may be premonitory pains indicated by some degree of uneasiness or slight colic symptoms, especially in the mare, some days prior to parturition. These should not be mistaken for parturition itself and the expulsion of the fetus hastened by artificial means, but the veterinarian should advise patient watching

until labor sets in normally. In such cases, however, it would be still more unfortunate to overlook some essential and fundamental difficulty which is preventing normal labor and which must eventually be overcome in order to save the life of the mother or fetus, or both. For example, in cases of torsion of the uterus, effective or vigorous labor pains do not occur because the conditions of the uterus are such as to prevent them. It would be exceedingly unfortunate and perilous to the lives of both mother and fetus to pass over this displacement of the uterus without recognition of its character, because a few days or even hours of wait may lead to difficulties which are insurmountable and which could readily have been remedied at the right time. In cases of the bi-cornual development of the fetus in the uterus of the mare, we are not likely to observe very pronounced and vigorous labor pains, and yet each hour that is permitted to pass makes the obstacle which is to be overcome more and more difficult and renders the death of both mother and fetus all the more certain to occur.

In other cases, as in the cow, where the cervix of the uterus is very long and dense and where its canal dilates very slowly, it is unwise to be hasty when it is possible or probable that, with a little patience and watching, the dilation will occur normally and the fetus be born alive without assistance. On the other hand, it is equally unwise to delay the dilation of the os and the extraction of the fetus if the conditions which are present clearly indicate that a natural dilation will not occur. Take, as an example, a case of rigidity or constriction of the cervix uteri observed by us, where a cow was allowed to go for some 10 weeks after the normal end of gestation with a fetus imprisoned within the uterus and undergoing putrefaction ; here it is evident that surgical interference should have occurred at the end of gestation, when it was noted that portions of the afterbirth had protruded beyond the vulva.

So long as the act of parturition seems to be progressing favorably, the caretaker of the animal should not in any way interfere. Owners of breeding animals should be carefully instructed by the veterinarian as to the dangers of unnecessary interference in cases of normal parturition. If the presence of the owner causes the animal to be nervous or irritable, he should remain at a safe distance until his services are required. On the

other hand, it must be constantly borne in mind that the well-being, or even life, of the mother and fetus may depend upon prompt aid from the owner or the attendant, of a kind which is too pressing to await the arrival of the veterinarian.

This applies with special force to the mare, where timely aid may preserve the life or value of the mother or the fetus, when the veterinarian could not possibly accomplish the same end later. It is a general rule, which we might almost say is merely emphasized by the few exceptions, that a veterinarian never saves the life of a foal in a case of dystokia, so abrupt is labor in the mare and so quickly does the foal perish because of the early separation between the fetal and maternal placentæ. It is, therefore, highly important that the owner or caretaker of breeding mares should be competent to give first aid in cases of parturition and it is a part of the duty of the veterinary obstetrist to instruct the owners of such animals, so far as it may be practicable, in these matters.

We might illustrate this by citing some of the common accidents of parturition in the mare. In some cases an extremity becomes pushed up against the roof of the vagina and into the rectum, so that a portion of the fetus may begin to protrude through the anus, still covered by the tissues between the two organs. If the owner promptly pushes these parts back and directs them properly in the genital passage, birth occurs safely and perhaps a living foal is produced, but a few minutes' delay leads to the rupture of the perineum and the virtual destruction of the value of the mare. In another case a fetus presents in an almost normal position and the nose or a foot becomes impacted against or caught upon the pelvic inlet. If the owner intelligently releases the part and gives it proper direction, the foal is born alive without further difficulty, but if it is allowed to go without this slight aid until a veterinarian has been called, the deviation of the part has then become much magnified, the life of the foal has been sacrificed and that of the mare more or less seriously endangered.

The genital tract, at this time, is in an exceedingly receptive state for infection, and consequently the veterinarian, owner or other person attempting any examination or manipulation should be exceedingly careful regarding cleanliness and the prevention of infection, and no examination should ever be undertaken except

it is first warranted by the apparent course of labor, which, after proper watching, seems to indicate the possibility of the presence of some obstacle to normal parturition.

The character of the labor pains should be observed and it should be determined if they are normal or otherwise. The labor pains may show a somewhat violent and clonic character, accompanied by inefficiency instead of that deliberate vigor which should accompany the act. This is claimed to occur chiefly in young and nervous animals, especially in primipara, and is due in all probability to the rather excessive pain accompanying the first uterine contractions and the very slow dilation of the os uteri and the genital passages. Under such conditions, any precipitate expulsive effort causes unusual pain to the mother and leads her to desist early in the effort, so that the labor is not marked by the expected efficiency. There is usually little need for interference. If the patient is kept quiet and allowed a little time, the labor pains soon acquire their normal vigor and accomplish the end without assistance.

It has been claimed that, in some cases, the cervix uteri is in a state of spasm, and that this may be quickly overcome by applying a little extract of belladonna to the parts. Other remedies of various kinds have been suggested, but clinically it cannot be demonstrated that any of them possess material value, and they probably in reality retard parturition, rather than help it, by simply serving as a source of annoyance to the animal. It is extremely doubtful if the application of belladonna to the cervix will cause it to relax. Fleming states that contractions of the uterus, in some of these cases, are reversed and that they begin at the cervix of the organ and pass toward its fundus, a sort of anti-peristalsis, thus tending to force the fetus toward the apex of the horn rather than toward the vagina. Upon what clinical or experimental evidence such a theory depends, he is wholly silent.

Some authors have emphasized the common clinical fact that easy parturition in the cow is more liable to be followed by parturient paresis than is a protracted birth. The connection between easy birth and parturient paresis is not fundamental nor essential, but simply coincident. Parturient paresis occurs before birth and during labor, so that the easy accomplishment of the act cannot serve as a cause. Clinically, difficult labor serves

as a bar to subsequent parturient paresis, but it does so indirectly, in a manner which we do not comprehend because we have not yet succeeded in fully defining the disease itself.

Prolonged labor of every degree may occur in a way which prevents us from drawing any fixed line of demarcation between normal and abnormal birth. What may be an abnormal duration of labor in one species of animal may be wholly natural in another ; what may constitute abnormal birth in one animal of the same species may be wholly normal in another animal ; or that which may be normal in a given individual at one birth may be wholly abnormal at another birth. We have already suggested that in the mare the duration of labor is usually but a few minutes, while in the cow it is from two to ten times as long, and may endure from two to four hours or even longer and yet run an apparently normal course without material danger or inconvenience for either the mother or the calf. It is constantly to be borne in mind that in primipara, where the genital passages have not previously been dilated by a birth, the dilation is slow as compared with animals which have previously given birth to young. If a heifer has been in labor for several hours and the cervix of the uterus is not fully relaxed, but the position of the fetus, its size and condition, and the character of the birth canal itself, all seem to be normal, there is no reason for great anxiety and we had best await the efficiency of nature to accomplish the desired result.

If animals are debilitated, whether from old age or inefficient feeding or care, they may be unable to normally give birth to young, although the fetus is in every way properly presented and the general condition of the genital organs is apparently normal. Heifers which are bred very young are liable to become weak and emaciated on account of the extra burden placed upon their nutritive systems by the pregnant condition, and thus arrive at the period of parturition in an enfeebled state. In addition there may be a relatively large fetus.

In such animals labor pains may be wanting in vigor and efficiency and after a time may more or less disappear and eventually wholly cease. The uterine walls are so lacking in vigor, in harmony with the general debility of the system, that they become exhausted and their force diminishes or ceases. The feeble pains may rupture the fetal membranes and permit the gradual discharge of the fetal fluids.

When it has been determined that there is a want of contractile power, although not dependent upon some mechanical obstacle to parturition, we have passed the border line between normal birth and dystokia. Without materially invading the latter field we may here suggest that the difficulty should be overcome by administering such stimulants or tonics as will tend to arouse the contractile power of the uterus and the general strength of the animal. Some have advised the use of ecbolics, such as ergot, rue and other drugs of this class, but their power to induce contractions of the uterus in domestic animals is very questionable, and they certainly do not tend to strengthen the system of the animal as a whole. It is probably better to employ such reliable stimulants to the nervous system as strychnine, or diffusible stimulants like alcohol and its derivatives, or coffee and other drugs.

Traction upon the fetus is evidently unnecessary in normal parturition and is only called for in those cases where there is some deviation from the normal course. It is well here merely to point out that, in some of those cases which mark the borderline between normal birth and dystokia, it may be desirable to apply more or less traction in order to aid the pregnant animal in her efforts to expel the fetus. Such aid should be intelligently applied in those cases where the pregnant animal is somewhat weak or debilitated, where for any reason the parturition has been more or less delayed and the animal is becoming exhausted, or where the life of the fetus may be imperiled by a tardy delivery. In primipara, especially in young heifers, gentle and judicious traction upon the fetus is frequently desirable in order to aid them in overcoming the obstacles presented, but it should always be borne in mind that any undue or unnecessary traction may prove exceedingly harmful by forcing the fetus through the birth canal before the latter has had time to become fully and effectively dilated. In this way the tissues become more or less seriously bruised or ruptured, which might well be avoided by allowing abundance of time and a natural dilation of the passages.

When a fetus presents posteriorly, especially in the mare and cow, it is essential to hasten its expulsion as soon as the body has advanced far enough into the canal that the umbilic cord is engaged and compressed between the fetal body and the pubic brim of the mother. In managing such a case, the advancement

of the fetus should be very deliberate and not hurried until the buttocks of the young animal have appeared at the vulva and have passed through it, thus dilating normally the entire length of the passage. Then, when the critical moment has arrived, the fetus should be promptly and carefully withdrawn in order that it may not be suffocated.

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It may be highly important to determine in a given case if the fetus is alive or dead, because in a case of dystokia the question of embryotomy may arise and, if one is so unfortunate as to badly mutilate a fetus and then extract it from the mother in a living condition, especially if it is highly valued by the owner, the error may become very embarrassing.

It is frequently very difficult during labor to determine whether the young animal is alive or dead, especially when it is firmly impacted in the pelvis, where it has no power to move and no opportunity to breathe or to show other definite signs of life. Fleming has asserted that fetor of the liquor amnii may not necessarily show that the fetus has perished. Upon what grounds such a statement is based we cannot comprehend, unless it be that, because there is an odor present, it is called fetid. The fetal fluids have a very marked and distinctive odor, which to the experienced obstetrist has no suggestion of fetor, but is simply the normal odor of a healthy liquid. In our experience, when the fetal fluids are fetid there is no longer reason for doubt that the fetus is dead, though admittedly the line of demarcation between a non-fetid and a fetid state of the fetal fluids is not always easily drawn. Any active movements of the fetus establish clearly that it is living.

When the fetus presents anteriorly, with the head protruded through the vulva, and remains incarcerated for some time, the head becomes engorged and swollen, the tongue swollen, blue-black and protruding from the mouth, and the eyes glassy and insensible. However, the conclusion is not to be hastily drawn that it is dead; on the other hand, it may be very much alive and recover immediately and begin to move as soon as it is released from its perilous position. In fact, such engorgement of the head and cyanosis of the visible mucosa show that the fetus was alive when the head appeared. Had it been dead at the beginning of labor, the engorgement could not have occurred.

In the mare, however, it may generally be considered that, if vigorous expulsive efforts have continued for two or three hours, or if the fetus has been engaged in the pelvis for even a half hour, unless we can observe some definite sign of life, the foal has already perished.

The death of the fetus, some claim, retards parturition, and the claim is apparently justified by clinical experience.

The contractions of the uterus upon the living young tend to cause the latter to make spontaneous movements and, in doing so, to extend its extremities in the most favorable position for their passage through the birth canal. If dead, this extension of the limbs is not likely to occur, because of the absence of reflex movements and of the rigidity of the foal. Some authors state that the death of the fetus tends to eliminate a certain stimulation to the uterine walls, which causes their contraction, but this is not verified clinically because, as a general rule, we see just as vigorous expulsive efforts in case of a dead fetus as in a living one. Others contend that the contractions of the uterus are not effective upon the dead fetus, because of the flaccid condition of its tissues.

As previously stated, the position of the fetus prior to birth is essentially different from that which it is expected to assume during its expulsion. Saint-Cyr is correct in holding that, if the dead fetus presents in a proper position, the expulsion is as easy as though the young were alive. Of course, if the fetus has undergone partial decomposition and is emphysematous, its expulsion is very much more difficult.

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The causes of the death of the fetus during the period of labor may be exceedingly varied. The umbilic cord of the human fetus sometimes becomes knotted, or it may twist about the neck, body or limbs of the child, and thus interrupt the circulation and cause its death. This does not occur in domestic animals with sufficient frequency to become of clinical importance. The umbilic cord is too short to favor such an accident.

Fleming claims that the death of the fetus may be due to the premature rupture of the membranes, the escape of the fetal liquids, and the consequent immediate pressure of the uterus upon the fetus. We do not understand how the pressure of the uterus

upon the fetus can be any greater after the expulsion of the fetal liquids than before, although we admit that it does closely invest the fetal body and may thus be prevented from expelling the fetus from its cavity. The escape of the fetal fluids indicates rather a delayed expulsion of the fetus than a premature rupture of the membranes; that is, the membranes normally rupture, but after their rupture some mechanical obstacle or some weakness of the uterus has served to prevent the expulsion of the fetus, and consequently has led to its death.

Indirectly the rupture of the fetal membranes and escape of the fluids is probably the most common cause of the death of the fetus during labor. The fact that a foal does not usually live more than one to three hours after the first expulsive efforts, while the calf may continue to live much longer, is explained by the differences in the character of the placentæ. The attachments in the mare are less intimate and become detached very shortly after labor sets in. The calf lives longer largely because the os uteri of the cow dilates more slowly and hence the fetal waters do not so completely escape, or they may be entirely retained and the membranes remain unruptured for a considerable period of time. In the cow also the allantoic sac may not rupture at first, but only the amnion, whereas in the mare the allantoic sac must necessarily rupture before the amniotic sac appears at the vulva and, consequently, when this latter ruptures both sacs are freely open and all the fluids may escape. The escape of these fluids permits a contraction of the uterus which certainly exerts an important influence upon the dehiscence of the placenta and leads to the death of the fetus.

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The rupture of the water-bag in an approximately normal parturition may well be left wholly to nature, as it ordinarily requires no interference, but, on the other hand, is usually better accomplished without it and will naturally occur at the most appropriate time. The water-bag cannot protrude far beyond the vulva in the cow or other ruminant, without rupturing, because the amnion is adherent to the chorion over a large part of its area, so that it cannot pass out with the fetus, but must rupture, and the fetus be born naked.

Some writers claim that it is at times necessary for an attendant to rupture, or even to cut the chorion of the new-born. We

have not had occasion to observe any such necessity. A living foal cannot be born in the chorion, because it would necessarily die from asphyxia before it could possibly be expelled. It would then be useless to open the chorion.

The expulsion of an aborted fetus in all its membranes is not rare, but the expulsion of a full-sized dead fetus enclosed within the chorion is improbable, if not impossible. Should such expulsion be threatened, and the chorion protrude into the vulva, it should be opened to allow the fluids to escape and render the expulsion of the fetus easier.

Occasionally the foal is born more or less enveloped in the amnion, but this is so delicate that a very slight struggle upon its part will free it from any adherent portions. It has also been stated that the mother gnaws through this membrane and releases the young animal, but she always rests for a time after the expulsion of the fetus, and consequently, if its life were jeopardized by being expelled included in its membranes, it would become asphyxiated long before the mother would give it any attention. We have not known a fetus to perish because of inclusion within the membranes.

It is needless to remark that, in cases where a living fetus is expelled more or less enclosed in the amnion in such a way as to interfere with respiration, the attendant should remove the obstruction as promptly as possible, preferably before the fetus is completely expelled.

THE CARE OF THE PARTURIENT ANIMAL AND OF THE NEW-BORN.

After the completion of labor, the mother should not be annoyed by the presence of other animals of her own or other species, or by the unnecessary presence of persons. She should have clean and comfortable quarters, whether in the stable or in the field, and her body should be kept as clean as circumstances permit; if present, any blood or discharges should be washed or wiped away from her tail and thighs or other parts of her body which have become soiled. In case of the large domestic animals, the afterbirth, if it has come away, should be removed and destroyed, although, as a general rule, no material harm comes to the mother from eating it. If the animal is stabled, allowing the expelled afterbirth to remain in the stall permits it to undergo rapid decomposition, entices flies, and tends to render infection of the mother or fetus more probable because of its presence.

An abundance of good drinking water and suitable food should be allowed. For herbivorous animals, which have given birth to young during the warm season of the year, grass constitutes the most favorable diet. Mares which are used for work purposes should be rested for a few days after parturition, as a safeguard against disease. As a general rule the mare may safely return to work in the course of three or four days, if parturition has been easy and without accident, but the labor must be of a gentle character.

If the genital organs have suffered any material injury during the act of birth, proper precautions should be taken against infection. For this purpose some mild disinfecting solution should be used to flush out the vulva and vagina. Unless these interferences are necessitated by conditions, the animal should be left quite alone.

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Immediately following parturition there occurs a series of rapid changes by which the genital organs resume the form and functions of the non-pregnant animal. In domestic animals this interval is brief, usually extending over but three to five days, and is marked by little exterior change. It is a period in which the maternal body is highly susceptible to insults of various

kinds and in which pathologic changes are very readily aroused in case of accident or undue exposure.

Normally this interval of time passes almost unnoticed in our domestic animals, and it is only when we give close attention that the changes which are taking place are observed.

After-pains in the domestic animals are unobserved as a natural condition, beyond some expulsive pains, which are noticed in some cases while the afterbirth is being detached and expelled. When this act is accomplished, we usually observe no pains, although Saint-Cyr claims that in some cases there is a whisking of the tail and an increased tension of the abdomen which indicates that the uterus is contracting in a manner to cause some pain to the animal.

As a general rule, when evidences of abdominal pain follow shortly after parturition, they suggest some pathologic condition, which may be more or less important, such as the retention of a portion of the fetal membranes or some displacement, such as a beginning inversion of the uterus. Consequently, whenever such pains are observed following parturition, a careful manual exploration of the uterus should be made to determine the cause, followed by the application of the necessary remedies.

After the expulsion of the fetus and its membranes, there inevitably occurs in all animals a more or less recognizable discharge from the uterus, consisting of blood and fragments of the uterine mucosa or of the villi of the placenta, which substances need be cast off before the uterus can resume its normal state. This discharge is known as the lochia. Though prominent in woman, on account of the very complex discoid placenta, it is inconspicuous in animals, where the placentæ are more extensive in area and less complex in their structure, so that one needs observe an animal quite closely in order to recognize the presence of the lochial discharge following an easy birth. It becomes least conspicuous when the placenta is distributed over a wide area and has a feeble attachment to the uterus. It follows that, in the mare, where a diffused placenta is found, in which the villi are not very extensive, the lochia can scarcely be recognized at all, while in the cow with the multiple or cotyledonous placenta it is more evident, but even here, under normal conditions, quickly disappears. In the mare the lochial discharge should not be recognizable except after a few hours, nor should it be conspicu-

ous in the cow for more than a day or two. At first it is a reddish or grayish-red discharge, owing to the admixture of blood, but this quickly changes to mucus, which may persist for a longer period of time.

Fleming considers this lochial discharge far more important than we have observed. He states that it may continue for days or weeks and that 7 to 8 quarts of lochial discharge have been removed from the uterine cavity of the mare three days after parturition. Apparently he and others have failed to recognize the proper line of demarcation between the physiology of the puerperal state and the pathology of this period. In our judgment, when these discharges become very apparent and acquire marked characters they are no longer physiologic, but are pathologic, and should be regarded as such.

The discharge of the lochia is of physiologic importance to the animal, since it rids the maternal system of an amount of tissue which has ceased to live and which must consequently be excreted either directly through the vagina or indirectly by being absorbed by the maternal system and later excreted through other channels. If it is not promptly discharged, it forms a dangerous culture medium in which bacteria may multiply and cause more or less serious disease.

Some believe that the suspension of the lochial discharge causes serious disease. This is difficult of proof. Admittedly we observe serious disease in animals when the lochia become infected and the products of infection enter the maternal system. This is not the result of lochial suspension, but of infection.

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Often the mother more or less resents the approach of other animals or of persons and is very liable to injure her young by treading upon them in an effort to protect them. Such danger is often observed with nervous mares. The same is especially noted if a sow is disturbed. She then shows great liability to trample her young, or, failing in this, she lies upon some of the pigs as a consequence of her excitement.

It should not be forgotten that many of our domestic animals are prepared to strenuously defend their young and will vigorously attack other animals, or man, when they approach. Such an attitude is not confined to any one species, but is a maternal instinct which is shown to some extent by all animals which

naturally fight in self-defense. It is very common in the mare, and in many cases it is more or less dangerous to approach her when she is giving her first attention to a new-born foal. Not only may she trample the foal, but may bite, strike or kick any person who approaches her. A mare resented strongly the actions of an attendant, who had placed his arms about her foal in order to move it from one enclosure to another. In an effort to defend the foal she kicked so vigorously at the attendant that, striking instead the head of the foal, she killed it instantly in the attendant's arms. It is consequently discreet, when one wishes to handle a new-born foal, to have a second party present to control the mare and thus avoid accident, until her attitude has been fully determined. We note a similar degree of danger in approaching cows with new-born calves, especially those which have been allowed to run at large during most of their lives and have acquired a rather strong sense of self-defense. The danger of approaching a bitch with new-born puppies is very well known and should always be recognized. The sow habitually and vigorously defends her young and sometimes imperils the life or limb of any attendant who may injudiciously approach her.

In some instances the mother fails to show any maternal affection for her young, will repel it, not allow it to suck, nor take any care of it, and may instead destroy it because of its attempts to approach her. In such instances some writers suggest various expedients to induce the mother to permit the young to suckle or to cause her to care for it, but as a rule these efforts are not highly successful if the repulsion is well marked and strong. In some cases it may be that attendants can quiet the mother, and, by carefully bringing the young animal in contact with her for a time, overcome her repulsion. Frequently such refusal of the mother to own and care for her young is referable to interference and annoyance by attendants.

Multiparous animals sometimes give birth to more young than the mother has teats, in which case the supernumerary ones usually perish. In the sow and other multiparious animals each young has its own particular teat, to which it regularly goes at feeding time. The sternal teats of the sow are generally better developed and supply more milk, and the most vigorous young usually take to these teats and crowd the weaker ones to those

glands which supply the lesser amount. In this way it frequently occurs that one or more of the pigs is very poorly nourished. It has been suggested that these weaker individuals be put upon the larger teats, but this is not a very easy process to carry out, since the selection of the teats is generally made by the pigs themselves and adhered to quite vigorously. When there are more young than there are teats present, the excess should be destroyed, reared by hand or placed upon another animal. The latter plan is most convenient, but does not always succeed, because the foster mother will not always allow the young animal to suck.

Sometimes, when several animals of the same species, with young, are kept in the same enclosure, the older or stronger young animals may rob the younger ones of food by sucking not only their own mother but also that of their younger neighbors, and being stronger can readily push them away from the teat. Such an occurrence should be watched for and the needed measures taken to insure the younger animal its normal food supply.

The identification of the new-born young of a given parent sometimes offers serious difficulty, and the veterinarian should be in as good a position as possible to aid owners in escaping from such a dilemma. When females of the same species give birth to young at about the same time and in the same enclosure, their offspring may become interchanged. The young of one may be stolen by another mother, and considerable confusion thus brought about. Sometimes an animal which has not yet given birth to young may take the young of another animal and suckle it and drive away the actual mother. One case, which we observed, raised a serious question as to pedigree. A client owned a valuable herd of pedigreed draft mares, among which there was a grade draft mare of very low value. Our client, upon going to the pasture one morning, found a very excellent foal being cared for by the cheap grade mare. The disparity between the form and quality of the foal and what he would expect from the inferior mare was so great that his suspicions were at once aroused. In the same enclosure was one of his best pedigreed mares, which looked as though she had foaled, although there was no great evidence and there were scarcely any traces of blood or fetal fluids upon the tail or thighs. On the other hand, the grade mare had her tail and thighs badly soiled and portions of the afterbirth were

hanging from her vulva. Under the circumstances, I was asked to aid in solving the problem. Upon examination, it was found that the valuable mare had indeed given birth to a foal and that her uterus was vacant, while, upon examining the grade mare, it was found that her foal was lying dead in her uterus. It thus became clearly established that she had stolen the foal of the pedigreed mare.

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In other cases the mother, owing to some abnormal appetite, proceeds to destroy her young and eat them. This is especially notable in the sow, which will not infrequently eat her entire litter of pigs shortly after they are born. In some instances this abnormal appetite or cannibalism does not confine itself to one mother, but seems to involve an entire herd of sows during a given season, so that the pig crop on a given farm may be utterly destroyed by this perversion of the maternal instinct. The causes of this perversity are not well understood. It occurs most frequently in those sows which are kept in styes, but sometimes also in those which run at large. In individual cases it would seem to be due sometimes to the accidental death of one or more of the young, followed by the eating of it by the mother, in conformity with her general omnivorous character. Once having tasted this flesh, she may proceed to kill and devour the others, but this does not account for the wholesale perversion which is sometimes observed.

In one instance coming to our knowledge a herd of ewes devoured their new-born lambs with great uniformity, so that the entire lamb crop of a given year was virtually destroyed. We have also observed the cat devour her new-born kittens.

In these more rare cases we can only attribute it, in the present state of our knowledge, to some general defect in the care of the pregnant animals at the time of their giving birth to young or shortly preceding. It might be well to try, in such instances, the changing of the animal's food and the allowance of some alterative, such as an increased ration of salt or the administration, in the food, of alkalies, like bicarbonate of soda.

Harms recommends, as a remedy for sows which devour their young, that they be watched during parturition and the fetal membranes be removed so that they cannot eat them and thereby

arouse their appetite for eating their young. He suggests, in addition, that she be given veratri radix, and cites Vogel as recommending 0.3 to 0.5 grammes given internally, while Harms prefers to take a small piece of the root cut in the form of a wedge and insert it beneath the skin of the animal. Others suggest that vomition be induced by administering tartar emetic, or that opium or camphor be given. Harms also cites Professor Landois, who mentions an instance of a sow which showed a tendency to devour her young and was cured of the habit by sorcery. In this instance a local expert repeated a series of words for 100 consecutive times, stroking the sow over the head, and thereafter she showed no further tendency to eat her young. As Harms very well remarks, however, the best known remedy for these animals, in which the vice has once occurred, is to fatten, and send them to the butcher.

The new-born usually gets the best care from its mother, when she has been given natural and proper environment in which to bring forth her young and the birth has been normal. So far as is practicable, the care of the young should be left to the instinct of the mother, but the conditions of domestication impose certain dangers and risks to the new-born which intelligent care upon the part of the owner may minimize or obviate.

It is essential to an intelligent consideration of the question to bear in mind the changes in environment and function which must occur when the fetus is expelled from the uterus and must begin its extra-uterine life. Certain functions which have previously been carried on through the medium of the placenta of the mother must now be taken up by the young animal itself in a semi-independent manner. It is the safe establishment of these functions which constitutes the chief concern to the owner.

1. Prior to birth, the supply of oxygen for the fetus has been carried from the lungs of the mother to the maternal placenta and thence to the fetus, while the carbon dioxide and other waste or injurious substances have been carried from the fetal circulation through the fetal placenta, and thence through the circulation of the mother, to be excreted from her lungs or other organs. This relationship has become suddenly interrupted by the act of birth and must quickly be replaced by direct respiration through the lungs of the new-born animal. The urgency for the establishment of this respiration is such that it permits no delay. The

first object, therefore, of a care-taker or watcher of new-born animals is to see that they begin breathing promptly and that any impediments to this act are removed as quickly as possible or that any other necessary means which might insure the prompt establishment of respiration are employed.

It should be immediately seen that the nostrils of the fetus are free, so that air may readily enter the lungs; if portions of the fetal membranes cover the nose they should be removed; if mucus has collected in the nostrils, it should be taken away promptly. In a litter of new-born pigs we noted that there was difficult respiration, although the nostrils were not blocked. Upon post-mortem examination of some of these, we found that a clot of firm mucus was lodged in the larynx. It is quite possible that such a condition sometimes exists in other young animals, and should have the attention of the care-taker. In many cases, perhaps, this mucus could be dislodged by manipulating the tongue—by alternately drawing it forward and then allowing it to retract.

In some cases the fetus has apparently been strangled to some extent during birth, owing to the inhalation of fluids because of interruption of the umbilic circulation, in which instance it may be advisable to drain out some of the fluid by suspending the young animal for a few moments by the hind legs or by placing it in a position with its head declined. If, however, the fetal circulation is good, any fetal fluids which may have been inhaled are promptly absorbed and cease to have danger for the young animal.

In tardy birth there may occur suspended animation because of a too long delayed respiration. According to some writers, the principal stimulus in establishing respiration is the shock which the new-born receives from being expelled from the uterus, where the temperature has been 105 to 108 F., to the exterior, in the cold, dry air. The importance of this in the arousing of respiration is not very clear clinically, and there seems to be little difference in this respect whether a fetus be born where the temperature is at zero F, or 90 to 100° F. It seems, however, that the dashing of cold water upon the fetus or vigorous stroking of the chest will arouse the act of respiration in some cases. Generally, we should probably attribute the induction of respiration to the reflex influence of the venous blood upon the central nervous system. In order to arouse this reflex, it may be of advantage to place the animal with its head in a declining

position or to pick the fetus up by the hind feet for a few moments.

Artificial respiration may also be induced by the usual compression and relaxation of the chest walls, or by inflating the lungs by forcing air through the nostrils with a small bellows, should such an apparatus be at hand. So long as the heart continues to beat, there is a possibility of inducing respiration, and efforts should consequently be continued, so long as the cardiac action persists. As a general rule, respiration cannot be established at all unless it succeeds very promptly, so that in those cases where the animal does not breathe within two or three minutes it will probably die in spite of the fact that the heart may continue to act for 10 or 15 minutes.

2. The umbilic cord must be divided and the last direct relation between the mother and young severed. This division results in a wound which involves the arteries, veins and urachus, each of which communicates with internal parts of the system of the young animal. Different writers assume different attitudes toward the care of the navel of the new-born. Naturally, the umbilic cord becomes ruptured in a variety of ways. In the foal the cord is so long (3 feet) that it is usually not ruptured when the fetus is expelled, if the mare is recumbent, but gives way only when she rises to her feet, and even then in some cases not until she turns her head toward the fetus in order to care for it, and in so doing pulls the cord in two near the umbilicus. In other cases, in the mare, the chorion becomes detached from the uterus almost immediately after the expulsion of the fetus and comes away with the cord still intact. It is then ruptured later by the struggles of the fetus itself. The mare may step upon some portion of the membranes when the foal is attempting to get up, and the foal, in falling, throws its weight upon the cord in such a way as to rupture it.

In the cow the umbilic cord is very short (about 12 to 15 inches) and is almost always ruptured just as the fetus emerges from the birth canal, or even slightly before. In carnivora and the sow the umbilic cord is frequently not ruptured in a spontaneous way, but is torn in two by the teeth of the mother.

The point at which the navel cord naturally ruptures or is divided by the mother corresponds quite closely in all our domestic animals. In examining the navel cord of the foal, we

find that immediately against the umbilicus there is a dense area extending for a distance of about 1½ inches, which ends somewhat abruptly by a marked ring in the soft umbilic cord. This projection, A, Fig. 90 B, consists of a hairless skin, which, in the healing of the navel, atrophies and disappears. In the calf, the corresponding cutaneous navel is haired and persists for some months as a conical projection of skin, thickly covered with long hairs. Just beyond this point, one or two inches from it in the foal, is the weakest point in the cord, and it is at this point that it ruptures or is torn in two.

FIG. 90 B. UMBILIC CORD OF FOAL.
A, Cutaneous portion of cord. B, Amniotic portion of cord.

After it ruptures, the behavior of the parts when left undisturbed is interesting and highly suggestive of the degree and character of interference demanded upon the part of the attendant. One of the most prominent effects of the rupture of the cord by linear tension or by laceration by the teeth of the mother, is the promptness with which hemostasis is brought about, so that as a rule there is but little hemorrhage, appearing usually to not exceed the amount of blood lying in the umbilic veins outside the umbilic ring.

The two fetal ends of the umbilic arteries retract very promptly toward and into the abdominal cavity, and in doing so their cavities become decreased by the shortening and consequent thickening of their walls, which tend to close them completely and prevent hemorrhage. Additional security against bleeding arises from the fact that, in retracting, they must draw back with them the loose areolar tissue, which produces an impermeable net-work of fibers just beyond their broken ends. The result is well delineated at UA in Fig. 56, page 337. The ruptured umbilic veins, after some of their contained blood has escaped, collapse and remain almost empty in the region of the umbilicus, although still partially filled with blood in their course through the abdominal cavity to the liver.

The urachus is so intimately associated with, and attached to, the two umbilic arteries that it recedes into the abdominal cavity to some extent, along with the latter. The Whartonian gelatine surrounding the vessels in the cord loses almost its entire substance by its liquid portions slowly oozing out from the broken surface of the cord, a process which is usually favored and accelerated by the licking of the stump of the cord by the mother, which presses the fluid out by a sort of massage.

Occasionally we meet with variations as to the promptness and exact position of the rupture of the umbilic cord. Cases have been recorded where it has given way immediately against the umbilicus, although these accidents are very rare and apparently accompanied by little, if any, danger. A more common deviation from the normal rupture of the cord is its giving way at a point too remote from the abdomen, so that in some cases we find the navel stump of the foal or calf 5 or 6 inches in length. This leads to two dangers. The extra length of the cord prevents the rapid escape of the Whartonian gelatine and also prevents the retraction of the umbilic arteries from the exterior; infection and putrefaction occur in the cord, which may lead to an inflammation of the veins, arteries or urachus, and thereby greatly imperil the life of the fetus. In other cases, when the cord is too long, it may be trampled upon or become otherwise caught, and the fetus, in struggling, may tear it away too close to the umbilicus and make a fresh wound, inviting infection.

Two apparently conflicting courses are advised by different veterinary obstetrists in reference to interference with the umbilic cord; without and with ligation.

We very greatly prefer either to allow the cord to be ruptured naturally and go wholly without mechanical interference, or, in case of valuable animals where interference will not harmfully annoy the mother and young, to imitate and supplement nature with antisepsis and artificial dessication. If the cord has not ruptured spontaneously, or if the stump is too long, it is to be ruptured at the proper point by linear tension. The cord is grasped at the point where we desire it to be severed, with the thumb and index finger of each hand and, by drawing the hands apart, it is torn asunder between them. If the cord is too strong, we may facilitate the rupture with the thumb nail, or by scraping the cord in two with a dull scalpel.

After the cord has been divided, the Whartonian gelatine and all fluids should be pressed out of the remaining stump as completely as possible, by grasping it close against the umbilicus, between the thumb and finger, and then drawing downward, forcing the fluids out from the broken end. This operation is to be carried out under strict antiseptic precautions, and as soon as completed there should be applied a dessicating antiseptic powder which may consist of almost any reliable antiseptic of a character which will not prove caustic to the surrounding parts. We would suggest, as such an antiseptic, a powder composed of equal parts of alum, tannin and oxide of zinc, or of equal parts of tannin and iodoform.

A variety of antiseptics may be selected, according to the custom and habit of the practitioner. The essential point is thorough antisepsis and prompt dessication of the stump. When the navel heals under natural conditions, it dessicates and dries as a hard, black eschar in 24 to 48 hours after birth, which brings about a hermetic sealing of the wound and the vessels of the cord, and renders infection thereafter impossible. We simply aim to second the efforts of nature to bring about aseptic or antiseptic dessication of the stump. We advise the application of the dessicant antiseptic powder as soon as possible after birth, to be repeated every hour or two until the dessication of the stump has become complete.

Many veterinary obstetrists advise that the cord be ligated and then divided beyond the ligature; others advise that two ligatures be applied and the division be made between the two. Some suggest that the ligated fetal stump should be frequently

washed with a liquid antiseptic and thus guarded against serious nfection. It is evident that, if these antiseptic solutions are applied with sufficient frequency and thoroughness, they must accomplish their purpose of preventing putrefaction of the cord, with its accompanying dangers.

This is neither so efficacious nor so convenient as the preceding plan. The presence of the ligature tends to prevent the retraction of the stumps of the umbilic arteries, and keeps them in a position where they are far more exposed to the possibilities of infection. There is probably also an increased liability to hemorrhage, as viewed from the standpoint of clinical experience. We have known but one fatality from umbilic hemorrhage in the foal, and this was caused by, or at least occurred with, ligation and excision of the cord. We all recognize clearly the far greater tendency toward hemorrhage from an artery when it has been divided by cutting instead of by linear tension, scraping, or other kind of mutilation. If, in addition to this, the artery is not allowed to retract or its proper retraction is interfered with, the tendency to bleeding is greatly increased.

Ligation of the umbilic cord by an ignorant layman or careless veterinarian is one of the most dangerous interferences with a wound known to surgery. Frequently the work is done with dirty hands, and a common cord is used without sterilization. Often the cord used is repulsively dirty. The Whartonian gelatin is imprisoned on the one hand by the ligature, on the other by the almost impervious amniotic sheath of the cord. The imprisoned fluid furnishes an excellent culture medium for decomposition bacteria; the dirty hands of the operator, the dirty ligature, or flies attracted by the moist cord, furnish the infection and cause putrid decomposition of the cord, which should dessicate instead.

The ligature detains the arteries, veins and urachus in the infected area, and eventually a more or less extensive infection occurs and there results a series of highly fatal maladies which we shall consider under "Infections of the New-Born."

3. The urethra, anus and other external openings should be observed to see that they are normal. In case of abnormality it should be determined whether or not they require attention.

4. It should be determined that the various excretions of the body are taking place normally. It must be learned that the

intestinal contents are being normally expelled. We are chiefly concerned with the discharge of the accumulated excretion in the intestines, known as meconium. Normally, this should be expelled very shortly after birth, which in some cases does not occur, especially in the foal, and as a result there soon appear symptoms of rentention of the meconium, which we shall consider later, among the diseases of the new-born. It is highly important that the care-taker should see that the meconium is promptly expelled, and if necessary its expulsion should be favored by means of enemas of warm water, warm normal salt solution, or soda bicarborate solution. The enemas should be continued until all hard pellets of meconium have come away and there follows instead a soft, pasty meconic mass.

5. The young animal should be promptly supplied with nourishment. In the larger domestic animals, the need for early nourishment is important, and it is best that the young animal should receive a liberal supply of milk within an hour or two after its birth, since otherwise it suffers more or less from hunger. It is essential that the young animal is enabled to reach the teat and suck, or that milk be administered to it artificially. In herbivorous animals the mother always stands for the young to suck, and consequently it is necessary that the latter be able to stand or be assisted in standing, in order that it may reach the teat and procure nourishment. If for any reason the young animal cannot stand, milk should be drawn from the udder of the mother and given to it in sufficient quantity and at proper intervals.

The young animal should not be allowed too much milk, however, since it will frequently overfeed. This is especially true of the foal, which sometimes shows an inordinate appetite and seems to consider it incumbent upon it to take all the milk which the udder of the mother contains, and thereby seriously overfeeds, which may end in more or less severe indigestion. It is consequently advisable, in many instances, to withdraw a portion of the milk for the first few days in order to prevent the overfeeding of the young foal, a danger which does not seem to exist to the same degree in other young animals.

Some writers insist that it is highly essential for the young animal to receive from the mother the first milk, or colostrum, because, they say, this acts as a laxative and brings away the

meconium which has become accumulated in the intestinal tract. Clinically this theory is apparently not so important as some persons would have us believe. The udder of the mare frequently becomes so distended that the milk flows out in large quantities for hours, days or even weeks before the birth of the foal. Yet this does not seem to have any very definite relation to the retention of the meconium, although we would assume that the colostrum has wholly disappeared before the birth of the foal. As the foal is born with the rectum impacted with hard masses of meconium, the condition is not acquired after birth through the absence of the colostrum, and we are unable to see clinically that the retention is any more probable or serious in the foal of a mare from which the colostrum has escaped than in those instances where the reverse is true.

* * * * * *

The artificial feeding of the new-born has until recently been considered a difficult and uncertain task. The chief difficulty has been in reference to the question of intestinal infection because of contaminated food. The comparative composition of the milk from various species of animals has been well studied and understood, and attempts have been made in artificial feeding to modify the milk by the addition of sugar, water or other normal constituents in amounts which would cause it to approach approximately the composition of that of the species to which the young animal belongs. Thus, in case of the artificial feeding of a foal upon cow's milk, the milk is diluted with 10 to 20 % of water, and sugar is added, in order to have it approach the composition of the milk of the mare. This is attempted under the assumption that the young of a given species thrives best upon the milk derived from that species, and next best upon a milk which has been artificially modified to closely resemble that of the mother of the new-born animal. This artificial change in the composition of milk has not produced the satisfactory results which, for a time, were expected and, although important, is not of the same value as the control of the bacterial contents of the milk.

At present we place the chief emphasis in artificial feeding upon the question of having the milk, as far as possible, free from the presence of pathogenic bacteria. Hence it is aimed to keep the milk, and the vessels from which it is fed, scrupuously clean,

and to take every measure known to prevent its contamination with dangerous bacteria. Some advise the sterilization of the milk, while others are opposed to it. If the milk is clean and free from injurious bacteria, it is better for the young that it be given in the raw state; but, if it is contaminated or if it comes from an animal which is suffering from an infectious disease, like tuberculosis, it is essential that the milk be sterilized before being fed to the young, if we are to prevent disease.

The amount of food to be given at a meal and the frequency of the feeding will depend largely upon the size, species and individual. The new-born young need to feed at frequent intervals and in small quantities; but, as they increase in age and the alimentary tract becomes more and more developed, the amount of food may be increased, while the frequency of feeding may be constantly decreased until it is reduced to two or three times per day.

During the puerperal state there occur well-marked modifications in the function of lactation, varying in the different species of animals and in individuals of the same species. The cow may milk continuously. If the cow is milked through the entire period of gestation and is not dried up prior to parturition, there is little if any change noted in the milk except that it is increased somewhat in amount just before calving. In all domestic animals there is a tendency for lactation to be well established when the young is born, especially in the larger herbivora, where the young are very active immediately after birth. These must, in the wild state, at once possess strength and endurance to escape from predatory animals, and this necessitates the securing of abundant nutrition in the form of milk. Consequently, in the cow, mare and ewe, the milk secretion has become well established before the birth of the young, and the amount is frequently so great that it escapes from the udder in streams for days or weeks before parturition.

From the 3d to the 5th or 6th day after parturition, the colostrum disappears and ordinary milk is present, so that in dairy animals the milk is generally considered to be normal in from 3 to 5 days after parturition and is sold as human food. The milk has a density of 1032 to 1041 and is composed essentially of water, fat, casein, albumen, milk-sugar and salts. The principal constituents of milk are somewhat easily separated by various means.

The composition of milk varies widely according to species and individuality, the methods of feeding, the period of lactation, and numerous other conditions. The following table by Vernois and Becquerel gives a comparative idea of the composition of the milk of various animals, the figures representing the amounts of each constituent in 1000 parts of milk :

	Woman	Cow	Goat	Sheep	Camel
Specific Gravity	1032.67	1033.38	1033.53	1040.98	-----
Weight of Water	889.08	864.06	844.90	832.32	-----
Weight of Solid Parts	110.92	135.94	155.10	167.68	134.00
Fat	26.66	36.12	56.87	51.31	36.00
Casein and Extractive Matters	39.24	55.15	55.14	69.78	40.00
Milk-sugar	43.64	38.03	36.91	39.43	58.00
Salts (by incineration)	1.38	6.64	6.18	7.16	-----

	Mare	Ass	Sow	Bitch	-----
Specific Gravity	1033.74	1034.57	-----	1041.62	-----
Weight of Water	904.30	890.12	854.90	772.08	-----
Weight of Solid Parts	95,70	109.88	145.10	227.92	-----
Fat	24.36	18.53	19.50	87.95	-----
Casein and Extractive Matters	33.35	35.65	84.50	116.88	-----
Milk-sugar	32.76	50.46	30.30	15.29	-----
Salts (by incineration)	5.23	5.24	10.90	7.80	-----

Cows which give a large volume of milk may do so at the expense of the solid constituents, and especially of the butter fat. Thus one cow, which yields a very large amount of milk, may show only 2 or 3 % of butter fat, while another, which yields a much less amount of milk, may show 6 to 7 % of butter fat.

Generally speaking, the milk of the smaller domestic animals is richer in casein and fat than that of the larger species. The milk of the mare, compared with the milk of other animals, is very rich in sugar.

The milk of carnivora is exceedingly rich in casein and fat, so that, while it is not abundant, it nevertheless has a very high nutritive value, as is well shown by the exceedingly rapid growth of their new-born young. On the other hand, the milk of carnivora is said to contain almost no sugar, which is in marked contrast to that of other animals.

Milk contains all the elements necessary for nutrition, constitutes the natural food for new-born animals and induces in them, when supplied in due quantity and of proper quality, very rapid growth.

6. The young animal should be placed and kept under comfortable and favorable conditions, free from extremes of temperature. Although it may withstand quite high and low temperatures without serious injury, if the temperature be extremely low the extremities of the new-born, especially the ears and tail, very readily freeze, or its life may be quickly imperiled under such extreme conditions. In very hot weather flies may be exceedingly troublesome and annoying to the young, or even very dangerous. For example, they may carry putrid infection to the navel of the young animal and cause thereby serious and fatal disease, so that we should, as far as possible, protect it against these dangers.

7. Exercise is as essential to the new-born animal as to the adult, and possibly even more so. With some species, like the carnivora and rabbit, the young are born in so immature a state that no marked degree of exercise is possible, but with the larger herbivora the young animal is ready for a considerable degree of exercise within a few hours after birth, and this should be promptly provided in all cases. When the mare is allowed the run of a pasture, exercise is fully secured to the foal. In case of other animals a similar freedom accomplishes the necessary ends in the safest and best manner. Otherwise, some provisions should be made for the daily exercise of the young animal as soon as it is capable of taking it. With work animals it is not injurious, but rather beneficial, for the foal to follow the mother if engaged in slow, light work.

DYSTOKIA.

In the preceding pages we have dealt with birth as it occurs normally. While it is accompanied by pain and violent efforts on the part of the mother, the act is natural and comparatively safe for both the mother and the young. There is constant danger that birth may become difficult or impossible, without artificial aid, and when these difficulties arise we know the condition as dystokia or difficult labor.

Normally the obstacles to be overcome in expelling the fetus are exceeded by the expelling powers of the female. The obstacles to normal birth consist chiefly in the narrowness and undilated condition of the birth canal as related to the size, form and presentation or position of the fetus. When any one of these impediments becomes exaggerated in any way, the obstacles to birth become accentuated. Constriction of the cervix uteri, displacement of the uterus by revolving upon its long axis, narrowness of the vulvo-vaginal passage or other impediments may be met, which render parturition difficult or impossible except by surgical aid. If the fetus should be of abnormal size as related to the dimensions of the birth canal, if it should be deformed or distorted from disease or aberration in development, if its presentation or position should be unnatural, or there should be present some deviation of an extremity or other part of the body from a natural attitude, the impediment to birth may be so great as to render artificial aid essential.

Accordingly dystokia may be divided into two fundamental classes.

1. **Maternal dystokia** dependent upon some defect, disease or displacement of the maternal organs.

2. **Fetal dystokia** due to some disease of, or to abnormality in the size, form, presentation or position of the fetus.

The occurrence of dystokia in our domestic animals depends very largely upon species, being comparatively common in some and comparatively rare in others. The cow readily takes the first place in the frequency of dystokia, both of the maternal and fetal types. Dystokia in the mare is not uncommon and takes first place in gravity. The bitch, sow and ewe also suffer frequently from dystokia.

It is difficult to state whether the comparative frequency of dystokia is dependent directly upon species or if it is due to the prevailing environments or care of the species of animal under consideration. The comparative frequency of dystokia in the cow and mare varies greatly in different regions of the country, according to the character of the breeding industry. Veterinary obstetrists, as a whole, agree that the cow is far more subject to dystokia than the mare. For example, Fleming cites two Danish veterinarians, who have had 16 to 19 cases of dystokia in the cow to one in the mare, even though there were more horses than cows reared in their districts. Our own experience does not verify this view, and is probably due to the difference in the character of our practice as compared with that of most writers upon veterinary obstetrics.

We constantly met in our private practice with more cases of dystokia in the mare than in the cow, although in our judgment there were annually more cows than mares giving birth to young in our territory. It should be explained, however, that the calves which were bred in our territory were raised for beef purposes and that the pregnant cows were habitually out of doors throughout the entire year, were well-fed and strong, were not bred until they had attained sufficient size that they would not be likely to suffer from dystokia because of immaturity, and were usually sent to the butcher before they had attained extreme old age. In these animals dystokia was exceedingly rare, and it was only in exceptional cases that there was any great difficulty in parturition.

One other element probably served largely to make an apparent difference in the frequency of dystokia in the two animals in our practice. Owners very generally did not hesitate to attempt assistance to the cow and very frequently succeeded fairly well, so that our attention was not called to the cases. In mares, which, in our territory, were of high value, the owners usually desisted from any attempts at bringing about delivery themselves and we were more or less promptly called. These considerations may have served to make the difference in our experience as compared with that of other obstetrists.

It is constantly to be noted that dystokia runs parallel in frequency to the confinement of the animal. Consequently we find that those females which are most closely housed and least exercised are the ones which suffer most frequently and seriously

from dystokia. Hence among all domestic animals the dairy cow, which is frequently kept closely confined in a stanchion year in and year out, easily takes the first place of importance in reference to difficult labor. Cows of the same or similar breeds, when not so closely confined nor so intensely used for dairy purposes, are not so subject to these accidents, while in beef cows, which are habitually permitted to run at large throughout the year, dystokia is apparently almost, if not quite as rare as in any domestic animal.

The frequency of dystokia as related to environment is greatly emphasized by observations upon the bitch and cat. In agricultural communities, where these animals are habitually out of doors daily and lead an active life, dystokia is almost unknown; whereas, in pet females which are kept closely confined in the city houses, dystokia is frequent. In Illinois, though we were in an extensive swine breeding district, dystokia in the sow was almost unknown to us. In New York State, where swine breeding is very limited, but the sows are kept closely confined in styes, dystokia is comparatively common.

We are not prepared to state exactly the reasons for these differences in the frequency of dystokia as modified by environment. Fundamentally, it seems that the proper development of the young is largely dependent upon the freedom of the mother during gestation, as is shown by the fact that aberration in development, such as double monsters, and other teratologic conditions, are most frequently observed in those animals which are closely confined. The general system, as well as the generative organs of the pregnant female, does not preserve its normal vigor whenever the animal is closely confined by housing, and so when parturition arrives the mother does not possess the needed vigor for the expulsion of the young.

The influence of the number of young at a given birth upon the occurrence of dystokia does not seem to be of very great importance. In the cow, ewe and goat, twins may simultaneously approach the pelvic inlet and, by one or more of the extremities of each entering the pelvis, may bring about dystokia, but this is not very common. In multiparous animals, the simultaneous entrance of two fetuses into the pelvis does not readily occur, and dystokia is dependent upon the individual fetus, so that the possibility of difficult birth is simply multiplied by the number

of fetuses in the uterus, any one of which, except the first, which is the most dangerous, is almost equally liable to cause difficulty in birth. Should dystokia occur from one of the first fetuses to be expelled, it inevitably blocks the passage of the following fetuses, either from both horns, if lodged in the uterine body or in the vagina, or from the involved horn in case it becomes arrested in its passage before leaving the cornu. In spite of this fact, however, dystokia in these small animals, as we have already stated, is very rare, with the exception of those which are closely housed.

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The importance of dystokia, as related to the possibility or probability of delivery, as well as to the recovery of the mother and the life of the fetus, varies greatly according to species. Among our domestic animals dystokia in the mare easily takes first place in its seriousness as affecting the life and well-being of the dam and still more in relation to the life of the fetus. The great seriousness of dystokia in the mare is largely dependent upon the tumultuous character of labor and her susceptibility to infection, as well as upon the differences in the conformation of the fetus, which renders an adjustment more difficult and injuries to the uterus or other parts more liable to occur.

Parturition is so tumultuous in the mare that serious and fatal injuries may occur to her in a very short time, frequently long before the obstetrist can arrive, even if called by the owner without delay. This is in sharp contrast to the cow, in which serious injury from labor is not liable to occur until a number of hours have passed.

The exceedingly rapid birth in the mare tends constantly to produce ruptures of the uterus, in which the wounds penetrate the peritoneal cavity and, as a general rule, end fatally for the mother. In the cow these penetrant wounds of the peritoneal cavity rarely occur directly from the labor, and even when they do they are not nearly so fatal as in the mare.

The tendency to infection in the mare is very much greater than that noted in the cow and constantly assumes a more serious aspect for the life of the animal.

The length of the extremities of the young foal tends constantly to increase the difficulty of labor in all cases of vicious position, because they are far more difficult of adjustment, so that embryotomy is more frequently required. Not only are the

extremities longer, but they are comparatively more rigid. In addition to all these, the fetus of the mare is usually larger and consequently not so readily adjusted as that of the cow.

Dystokia is not only more serious for the mare than the cow, but it is also far more serious for the foal than for the calf. During an extensive experience with obstetrics in mares, it has not been our fortune to deliver a living foal where there was actual dystokia. Our experience is in accord with that of most practitioners, and it is only very rarely that the veterinary obstetrist succeeds in delivering a live foal in cases of dystokia. We have attended mares when living foals were born, but in those instances we were hurriedly called by owners of mares under the impression that there was something abnormal, which, upon our arrival, proved to be normal, and the fetus was very quickly born in a natural manner. On the other hand, in the cow the common experience is that, if the fetus is alive when labor sets in and the veterinarian is called promptly, a living calf is secured. This dissimilarity in the two animals has its basis largely in the differences in the placentæ. The foal quickly perishes because of the detachment of the fetal from the maternal placenta, whereas the calf continues to live because the placental circulation is not interrupted for a long period of time after the advent of labor pains.

From the standpoint of the veterinary obstetrist, dystokia in the mare is usually far more formidable than in the cow. The tumultuous labor in the mare usually very quickly expels the fetal fluids and leaves the passage dry, while it also tends to constantly accentuate any deviation of fetal parts and otherwise to rapidly increase the obtacles to delivery. When the veterinarian reaches the case, the violent expulsive efforts of the mare interfere very seriously with his operations and try his patience and endurance to the utmost degree, while the cow is more deliberate and the labor pains are much less violent.

The size of the foal and its very long and rigid limbs and the excessively long neck all conspire to render the obstetrist's task more difficult and laborious. The tumultuous character of labor in the mare calls for greater promptness in bringing about the delivery of the fetus, from the standpoint of its own life and that of the mare. The mare also is liable to annoy and endanger the operator by vicious kicking.

The cow, on the other hand, shows one marked disadvantage in manipulation, because she is less amenable to command in reference to her position. While the obstetrist usually prefers to carry out his examinations and operations with the animal in the standing position, the cow is frequently very obstinate and will persistently maintain the recumbent position, whereas the mare will habitually stand throughout the operation or will promptly rise, if able, after she has once gone down. It is worthy of note also that inability to rise in the case of the mare is very rare, while in the cow it is not uncommon.

The difficulties of dystokia in all animals bear an almost constant relation to the promptness of veterinary attendance. If the case has been neglected for a long period of time, the fetal fluids escape and permit the fetus to become closely invested by the uterus and its membranes, so that any changes in the position of the young become much more difficult than when the fetal fluids are still present. During the period of delay any vicious position of the fetus tends to be constantly accentuated. An extremity, which in the beginning was only slightly deviated from the normal and could have been corrected in a moment, may have become very greatly displaced, and its adjustment rendered exceedingly difficult or even impossible, so that it may call for embryotomy.

If the veterinarian is not called promptly, the fetus perishes and *rigor mortis* sets in, which renders any adjustment of its position exceedingly laborious. After the death of the fetus, it undergoes very rapid decomposition, accompanied by emphysema, which increases its size by 50 to 100% or even more, thus greatly increasing the difficulties in delivery and the dangers to both the animal and the operator from the standpoint of infection. In the meantime the mother becomes more and more exhausted and less capable of enduring the ordeal through which she must pass.

A very important element of delay in veterinary attendance upon cases of dystokia is the meddling of inexperienced, if not ignorant laymen, or still worse, of charlatans, with their crude instruments and dirty hands and arms, which have perhaps been befouled in attending other cases of a septic character. They frequently carry out operations which very greatly increase the difficulty for the obstetrist and enormously increase the risk to the animal. Perhaps they have already, by some awkwardness,

placed the life of the mother beyond the possibility of being preserved by the veterinarian.

It is consequently of great importance that the veterinarian should use every opportunity to instruct his clients in reference to the great importance of calling him early and of leaving the case entirely alone until his arrival, except in those instances where a little intelligent manipulation may bring about a prompt and easy delivery.

The subject of veterinary obstetrics has not been well studied or taught, and the work of many American veterinary obstetrists has been entirely too inefficient to command that confidence and respect of the stock-owner which it should. If the practitioner desires to be called early he must first be able to impress upon his clients, by means of efficient work, the economic advantage of an early call. In order to do this, the veterinary obstetrist needs prepare himself in an intelligent manner, by study, experience and equipment, to render the highest possible service in promptness and efficiency.

Some writers upon obstetrics would well-nigh exclude many veterinarians from obstetric practice because of their physique. But some of the conditions which they regard as essential to success are not really of such great importance as they would have us believe. Any man of moderate size, strength and power of endurance can succeed as an obstetrist, if he will but give his subject that amount of study and research which its importance demands. Some say that long and powerful arms are absolutely necessary, and we will admit that they possess certain advantages. But a "long head" is worth more than an extra one or two inches in length of arm.

As in other surgical operations, the veterinary obstetrist requires, above all, intelligence, education, experience, and determination.

He must husband his strength, must possess the ability to have others carry out any manipulations or work which they can properly do under his directions, and must reserve his own force and strength for the proper direction of the work of others and for those manipulations which he alone is competent to properly perform. It is not his office to exert traction upon a fetus when a bystander can do it equally well. Such labor is

directly opposed to the interests of the animal, the owner and himself.

The veterinarian is called upon to carry out no work in his profession which is more exacting than the overcoming of dystokia in our larger domestic animals. It calls for the highest possible training and the most ready mental resources at every turn. No two cases are alike, and each demands effective judgment rather than conformity to a fixed rule of procedure. The veterinarian must be ready to judiciously meet each obstacle as it presents itself, must meet it promptly, sometimes in a moment, and yet throughout the entire procedure, from the beginning of the examination to the extraction of the fetus, must preserve his patience and equanimity, and in order to do this must conserve his physical powers as far as is possible.

EQUIPMENT FOR OBSTETRIC WORK.

In order to succeed in obstetric work, the veterinarian must be judiciously equipped for it, not only from the standpoint of quantity and quality, but also in reference to the readiness of his equipment for immediate use. The obstetric equipment of the veterinarian should be carefully selected and arranged, should include every article which is likely to be needed during any obstetric operation, and should be carefully packed in one or more containers ready for immediate transportation, so that no article of importance will be left behind or forgotten.

The instruments of the veterinary obstetrist should be ample in number, simple in character, and efficient for any operation or manipulation which he may possibly be called upon to perform. Obstetric instruments are of the greatest possible design and variety, and it is not practicable for us to enter into detail in relation to the multitudinous varieties which have been proposed by various operators and writers.

Obstetrical instruments are intended to aid in, or to accomplish three distinct offices : traction, repulsion and incision or excision.

For the production of traction, the appliances most frequently used are cords, bands, halters, hooks, forceps and nooses.

Cords and bands are of every possible description and variety and may be either very simple or quite complex. Usually speaking the simplest are the best for two important reasons. One may accomplish with simply a looped cord any operation which is possible with the most complex. When one operation with a cord, band or halter has been carried out, the apparatus is of no further value for obstetric uses, but becomes a danger in succeeding cases, which is to be constantly avoided by the destruction of the apparatus after a single use, and this means an important expense in case of complex appliances.

We prefer the simple, cotton cord, Fig. 91a, about ⅜ inch in diameter and 4 feet in length, one end to be wound with strong thread to prevent ravelling, while at the other a spliced loop is formed of sufficient size to permit the cord to play through it freely. It is not advantageous to have all these of uniform size because, in some instances where the traction is not to be severe, a smaller cord than ⅜ in. may be more easily applied and retain its hold more securely upon a part. In some cases it

is advantageous to use various sized cords because they may thus be more readily distinguishable from each other. When severe traction is required, a ½ in. rope may be found necessary.

The ropes should be prepared carefully and should preferably be sterilized or disinfected in advance and carefully wrapped in impervious paper in such a way that they will not become contaminated before ready for use. They should be made in sufficient numbers, according to the volume of the practitioner's obstetric work, and should be ready when wanted.

Other veterinarians use and advise bands of various kinds, such as are shown in Fig. 91, c, and d, instead of cords. These are more difficult to obtain, are expensive, and have no advantage in efficiency. They may wound or abrade the genital passage of the mother somewhat less, but the difference is not important, and the cotton cord which is twisted only moderately hard meets the requirements quite fully in reference to this danger. Some writers claim that a cord with a running noose may injure the part of the fetus to which it has been attached, but this we have never observed. Others prefer a leather band, but, while this is efficient in many respects, it does not keep its hold upon a part as well as a cord and it is highly expensive and cannot be readily sterilized.

Halters, h, Fig. 91, are recommended by many obstetrists, where the traction is to be applied to the head, but these are exceedingly difficult of adjustment and are but little, if any, superior in efficiency to the simple cord or to the hook. They are expensive, and the difficulty of rendering them sterile constitutes a formidable objection to their repeated use. Numerous head collars or halters are described by various veterinary obstetrists, such as those of Binz, Rueff, and others, while for the smaller animals Binz recommends what is termed a forceps-band.

When the halter has been applied to the head of the fetus it possesses an advantage over the simple noose around the neck because, if the halter stale pulls upon the chin of the fetus, it tends to keep the head in a direct line, which favors its passage through the canal. Even with the halter adjusted in the best possible way, the simple cord can be so applied that it fully answers the same purpose. If we take a long cord and apply it as a noose about the neck of the fetus with the loop in the region of the larynx, we can then place a half-hitch around the nose in

such a way that we can draw directly upon the median line of the ventral surface of the head with the same accuracy and efficiency as with the best adjusted halter. The application of the cord in this way is simpler and easier than the halter. The objection may be raised that the running noose about the neck

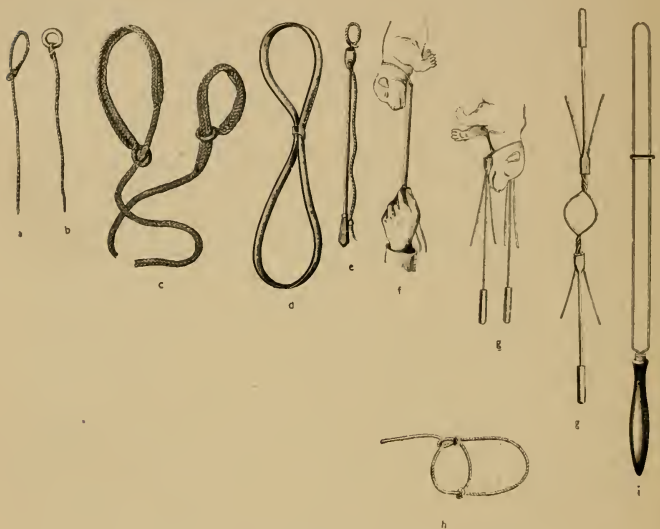


FIG. 91. CORDS AND TRACTION APPLIANCES.

a, Ordinary noose with spliced loop.
b, Ring noose.
c, Braided obstetric noose.
d, Loweg's obstetric strap.
e, Darreau's long noose carrier.
f, Breulet's obstetric noose for dogs.
g, g, Defay's obstetric noose for dogs, closed and open respectively.
h, Rueff's obstetric halter.
i, Obstetric noose of annealed copper wire. (Hauptner.)

may strangle or otherwise injure the fetus. This is sentimental rather than scientific, because while traction is being exerted upon the head of the fetus it is not breathing, and consequently there is no interference with respiration, and evidently no other serious harm is probable. Evidently traction should not be exerted by means of a running noose upon the neck of a live fetus

after its chest has emerged from the vulva and the establishment of respiration has become necessary. Neither is traction by the neck demanded at such stages, since this may be preferably applied to the fore-legs.

Cords are applied to the limbs and head by two distinct plans. The running noose of the cord, already formed, is introduced into the genital passages and slipped over the foot of the fetus up to the pastern, above the fetlock, or even higher, according to conditions. The distal end of the cord is then drawn taut by the operator or an assistant, and thus made fast upon the part in a manner which permits any degree of traction desired.

A second method of applying the cord to the limb is used in those cases where the foot is not available to slip the ready-formed noose over it, and it must instead be passed around the limb to be later made fast. For this purpose the looped end of the cord may be carried in the hollow of the hand to the limb which it is desired to secure, the end carried around the limb as far as possible, and then grasped from the opposite side of the limb and drawn out through the vulva. By passing the distal end of the cord through the loop and drawing upon it with one hand while pressing upon the loop with the other, the noose is guided back to that part of the limb to which it is desirable or possible to secure it, and drawn tight.

In order to accomplish this operation, the fetal membranes must be removed from the limb at the point to be secured with the cord. This sometimes offers considerable difficulty. When the cord is passed partly around the limb and dropped, before the membranes have been well ruptured, and the hand passed around to the other side to grasp the cord, the end of the cord is, by the elasticity of the membranes, thrown away from the position in which it was deposited, and consequently cannot be secured from the other side. Even when the membranes are fairly well ruptured, there is sometimes difficulty because of the cord following the hand backward as it is withdrawn, and thus becoming displaced. We find it a great advantage, in overcoming this difficulty, to fold the looped end of the rope in a comparatively large mass, which is carried in the hollow of the hand. When this folded cord is delivered as far around the limb as is practicable, we find that while the hand is being withdrawn the rope may partly uncoil and follow it, but most of the rope, including the loop, will remain in

position and may be grasped from the other side and drawn out.

Some practitioners use what is known as a porte-cord or cord-carrier, Fig. 106 f, in order to aid in securing the limb under the conditions we have just named. Such an instrument may be made to serve the double purpose of a cord-carrier and a blunt hook. There are numerous patterns of these, but they do not seem to possess a very high value in actual practice and are not largely used. In some cases, where there is great difficulty in passing a cord around a limb because of the presence of fetal membranes, the instrument may be of great advantage. With it the operator can hold the cord in place by means of the instrument, while the hand is passed around the other side of the limb and the cord grasped. Once the cord is grasped the instrument is usually withdrawn, while the operator holds the looped end of the cord and guards the end of the instrument to prevent its catching in any of the soft parts. When the porte-cord has been withdrawn, the fastening of the cord about the limb is carried out in the same way as without the use of the instrument. Personally we have found little use for the porte-cord and have not seen a case where we might have applied a cord with the aid of this instrument in which we could not also accomplish this without it. In some instances the application of the cord is easier with the instrument.

When cords are to be applied to the neck, and the head is in a direct line, the nose presenting, the cord may be applied to the neck, as an open noose, by slipping it back over the nose and later the ears, until it rests upon the poll above and in the pharyngeal region below. Then drawing upon the cord we may exert whatever traction is desired. With a simple loop about the neck there will be a constant tendency for the head to deviate from a direct line, which may be overcome by taking a half hitch around the nose or around the lower jaw, so that any traction which may be exerted will keep the nose and head in a direct line with the genital canal.

When the head and neck are so deviated that it is impossible to slip the completed noose over the head, and back upon the neck, the looped end of the cord may be carried as far as possible over one side of the neck, deposited at that point and then, by reaching around the neck from the other direction, grasped from the opposite side. When the looped end has been secured, it

should be drawn out through the vulva, the free end of the cord passed through the loop and, by drawing upon it, the neck secured in the running noose. In order to aid in passing the cord around the neck in this way, various devices have been proposed in the form of curved sounds or curved porte-cords, but they have apparently acquired no permanent place in obstetric practice. In some instances they may prove quite useful, especially if the head cannot be reached in such a way as to cord the lower jaw or to engage the head with a hook in the orbit. In those cases of extreme deviation, however, where the head is out of reach, it is often desirable to not try to secure the head, but rather to perform embryotomy and to decrease the size of the fetus to such an extent that the deviation of the head may be easily corrected or the fetus may be extracted without correcting the deviation.

One of the most useful places for the attachment of cords is the inferior maxilla of the fetus. In the various deviations of the head there are few methods which are more advantageous to the practitioner than traction upon the lower jaw. When properly applied, it affords a very secure attachment, which permits an almost unlimited amount of traction and in a very advantageous direction. Some obstetrists have said that they could not securely apply a cord to the lower jaw of the fetus, and especially to that of the foal, because it very readily slips off and so does not offer a secure hold. Our experience has been wholly different, and we have constantly found that a cord can be very securely fastened to this part, as shown in Fig. 108. We proceed as follows: First, with the ring-knife or other cutting instrument we make an incision 3 or 4 cm. long, between the rami of the lower jaw, through the skin and superposed tissues, into the oral cavity. Next, we pass the prepared noose of the cord over the jaw and push it back beyond the incision with the loop resting in the mouth of the fetus. We then pass the free end of the cord through the incision from the oral cavity outward, and draw firmly upon the cord so as to tighten it, after which any amount of traction desired may be employed without any danger of slipping or of tearing out. By this method the two rami of the jaw are held together, instead of being split apart as when a hook is used. The objection may be raised that, in case of a living fetus, mutilation is caused, but the wound is so insignificant in

character that there is no reason why it should not heal very promptly and without blemish.

A few practitioners also pass cords around the loins of the fetus, in case of posterior presentation, with the hind limbs completely retained, but, so far as we know, this plan of procedure has not been generally adopted. Personally, we see no need for this very tedious plan, which, if completed, still offers very great danger for the mother and virtually no hope for the life of the fetus. In our experience there are other plans of procedure which are simpler and more effective.

In addition to cords and bands there are other methods for applying traction, among which may be mentioned the annealed wire-loop, Fig. 91 i, for the larger animals. Similar devices for small animals may consist of a small tube of metal or other suitable material, through which is passed a wire loop, as shown in Fig. 91 f, or a more complex device such as that of Defay, g. g., Fig. 91.

Hooks. Few obstetric instruments have been so much used and made of so many patterns as hooks. They may be divided into long and short. Those which, when attached to a portion of the fetus within the birth canal, will be completely hidden, are called short hooks, j and k, Fig, 92 and b, Fig. 106. Those which are of such a length that, when applied to a given part of the fetus, their distal ends project beyond the vulva like a to e, Fig. 92, and g, Fig. 106, we denominate long hooks. Hooks may be either sharp or blunt.

Some hooks are used singly and others doubly or in pairs. In case of the short hooks, especially the finger hook, the traction must be applied through the medium of a cord passsed through an eye in the hook or through the medium of the operator's hand. The long hooks are applied to the desired point accompanied by the hand of the operator, and traction is exerted from the outside through the aid of an assistant.

The advantages and disadvantages of long and short hooks are largely matters of personal experience. One practitioner becomes accustomed to the short hook, another to the long, and each believes that his kind is the better. As a matter of fact there are few things which can be accomplished with one of these hooks which cannot be done with almost the same facility with the other. There are few, if any, places that a short hook can be

applied where a long hook could not also be inserted with equal facility, or vice versa.

There is one difference which is of importance. With the long hook the operator may, by pushing upon the instrument from the outside, aid the hand in reaching a trifle further and implanting the hook in a part not practicable with the short instrument. Also, the point of the long hook may be turned in any direction

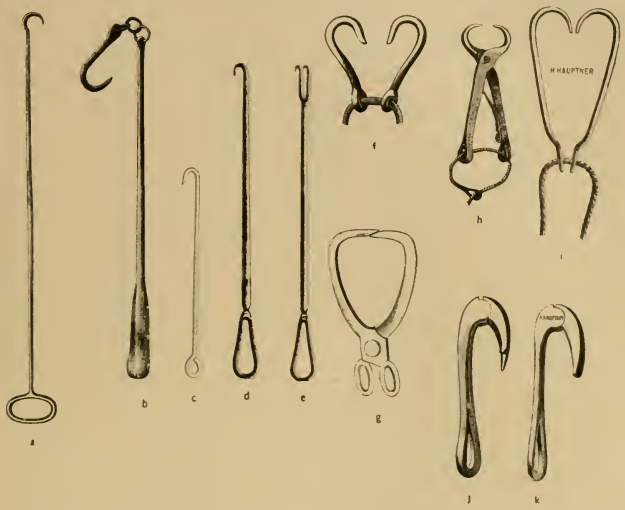


FIG. 92. OBSTETRIC HOOKS.

a, Long embryotomy hook (39 in).
b, Jointed obstetric hook .
c, Rectal hook of Harms.
d, Single hook for small animals.
e, Double hook for small animals.
f, Harms' eye hooks.
g, Riemer's double obstetric hooks.
h, Brogniez' obstetric hooks.
i, Harms' flank hooks.
j, Sharp hinged hook of Scharnier.
k, Blunt hinged hook of Scharnier.
-(Hauptner).

through the agency of the outside hand, when such control might not be possible with the short hook dependent for guidance wholly upon the inserted hand.

In comparing the sharp and blunt hooks, most practitioners favor the latter for most excellent reasons. It is exceedingly difficult to apply a sharp hook with safety for either the mother

or the operator. It is an ugly instrument to handle unless we first place our patient under complete anaesthesia, because, while carrying a sharp hook in the hand for insertion at a given point, we are almost certain to have our progress interrupted by violent expulsive efforts on the part of our patient, and it is only by the very greatest caution and dexterity that we avoid at such times serious wounds to our hands or to the genital organs of the mother. After repeated trials with the sharp hooks, without having been benefitted by them in a single case, we finally abandoned all attempts to use them. Even should we desire to fix a hook in a part where the blunt point would not enter on account of the skin, we may, as a rule, incise the integument and thus prepare an opening for the blunt instrument.

The form of the hook is highly important. They are made in every conceivable form, and many makers apparently ignore all mechanical principles and construct an instrument which does not serve the purpose with that security and safety desired. Aside from the question of strength and finish, it is essential that a hook be so constructed that, when once inserted into the tissues and traction is exerted upon it, its form shall cause it to sink deeper and deeper into the parts and acquire a hold with constantly increasing security. The hook should leave the shaft at an angle of about 45° and need continue in a straight line, or nearly so, to the end. The right and wrong forms of hooks are illustrated by Figs. 92 a, d, and 106 g. A study of these instruments will show that 92 a would have scarcely any tendency to sink deeper and deeper into the tissue, while Fig. 106 g would constantly press deeper into the parts to which it is applied. The width of the opening of the hook should not exceed 2.5 to 3 in. so that the operator may readily conceal it in his hand during insertion or withdrawal.

Double hooks have been proposed by many obstetrists, and some of them have been used extensively. Harms especially recommends his flank hooks, Fig. 92 i, which are about 17 cm. long and are intended to be inserted one in each flank, when the fetus presents by its croup and it is wished to bring about forcible extraction. We constantly prefer embryotomy to forcible extraction, which Harms and others recommend, and consequently find no need for these appliances. Others use hooks of a somewhat similar character for correction of the deviation of the head by applying one hook in each orbit.

When a hook is used for the development of traction, whenever force is applied, the instrument must be constantly guarded by the operator's hand lest it slip or tear out and lacerate the uterus. This applies with special force to the sharp hook.

In the application of hooks, the operator should always aim to select a point where the instrument will be secure against tearing out, and in order to do this he needs have well in mind the anatomical structure of the fetus and the resistance of various parts.

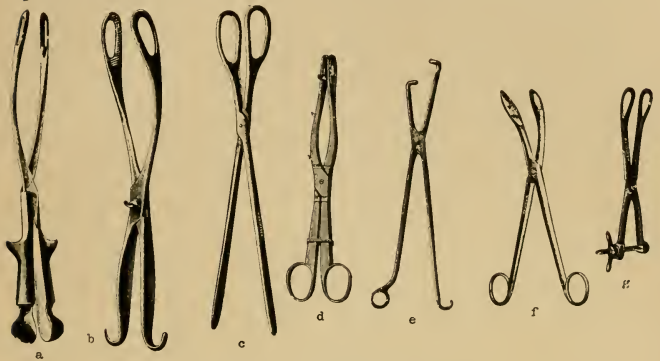


FIG. 93. OBSTETRIC FORCEPS.

a, Roeder's obstetric forceps for swine.
b, Pig forceps. Walch's.
c, Obstetric forceps for swine and goats. Witt's.
d, Moeller's bitch forceps.
e, Ellinger's pig forceps.
f, deBruin's forceps for sheep.
g, deBruin's bitch forceps.
(Hauptner).

Anteriorly the hooks may be inserted with comparative safety in the orbits. The point of the hook should be sunk deeply into the orbit and should force its way through the bony walls of that cavity into the sinuses of the face. For this purpose the hook should be about 3 inches in length. In correcting a slight deviation of the head, it may be allowable at times to insert the hook into the lower jaw between its two branches, but this constitutes a very insecure hold, which will give way under very moderate traction and consequently does not permit of great force. When it is wished to apply severe traction to the lower jaw, the cord should be used as already described.

When the fetus presents posteriorly, the points which offer the most secure insertion for hooks are the borders of the bones of the pelvis. The hooks may be implanted in front of the pubic brim or of the ilium, or in the oval foramen, either from without or within. It is much safer to insert the hook in the pelvis from without, inwards. If inserted from within, the point of the hook must be constantly guarded, lest it push through the soft tissues of the fetus and lacerate the genital canal of the mother.

Obstetric forceps of great variety have been proposed by various writers, but they have not come into general use and apparently cannot serve any important purpose in the larger animals. The immense forceps of Jörg are too voluminous and heavy to be applied to the head of the fetus in the genital canal and, were they once applied, no power of any efficiency could be exerted thereon. Various types of these forceps have been invented, but each alike has failed to serve any purpose.

In smaller animals obstetric forceps have proven highly useful and practical. They constitute one of the safest and most efficient methods for applying traction to the fetus of the cat, bitch, sow and, to a lesser degree, the ewe and goat. Some of the most useful of these are illustrated in Fig. 93.

Among the various means for the application of traction, the safest is the cord. It constitutes the only appliance which the operator can leave unguarded.

The application of traction to the fetus in cases of dystokia will vary largely in the intensity allowable, the direction in which it is best to exert it and the means which may most usefully be employed in developing the necessary force.

The direction in which traction is to be applied will depend very largely upon the attitude of the fetus and the point which it has reached in the birth channel. As we have already suggested in a preceding chapter, the fetus of our domestic animals, and especially of the larger ones, normally assumes a somewhat curved position. The ventral surface of the fetus is concave and the dorsal is convex, which curvature may be increased very greatly by artificial means, but the normal curve in the fetal body does not readily undergo obliteration or reversal by the fetal body being bent dorsalwards.

As the fetus approaches the pelvic inlet, in our larger domestic animals, and especially in those cases where the animal is stand-

ing, it is located below the pubic brim and must mount that obstacle in order to gain the pelvic canal. Presenting thus, if traction should be necessary or desired, it should be applied to the fetus somewhat obliquely upward, so as to lift the fetus upward and backward over the pubic brim.

During the progress of the fetal head through the pelvis, the traction should be directly backward or slightly upward and backward, but, when the fetal head arrives at the vulva, if the traction is continued upward it tends to force the poll of the head too powerfully against the superior vulvar commissure, and not only tends thereby to cause an obstruction to delivery by jamming the fetal head against this part, but also endangers the integrity of the superior commissure of the vulva itself and tends to cause more or less laceration of it. Consequently the direction at this point should be somewhat downward in order to avoid, as far as possible, any injury to the soft parts.

After the head has passed through the vulva, the traction should be continued more and more downward as the body of the fetus advances, until finally, when the withers have passed the vulva, the line of traction should be almost perpendicular to the long axis of the spinal column of the mother or parallel to the long axis of the posterior limbs of the mother.

If the animal is standing, the direction of traction, when the fetus is well advanced, should be immediately downward toward the floor, or if she is lying down it should be directed toward her hind feet. Such a direction in traction permits the ventral wall of the fetal body to become somewhat relaxed, and in this way the fetal viscera may pass backward or forward in the body cavity and thus escape from that part of the cavity which is being most compressed in the birth passage, thereby decreasing the diameter of the fetal body at the most critical point.

The downward direction of the traction pulls the tuberosities of the fetal ilia downward from the uppermost part of the maternal pelvis, and prevents their becoming interlocked with those of the mother.

Unless care is exercised at this time, the fetal and maternal pelves become immovably locked. We have repeatedly seen this occur where one or two horses have been hitched to the head of a calf and violent traction employed in a direct line without

moving the fetus, although the presentation, position, fetus and maternal pelvis were each apparently normal.

The amount of traction. In passing through the birth canal the fetus and the maternal parts in contact with the fetus undergo an enormous pressure because of the comparative narrowness of the canal. This pressure is to a great extent inevitable, and it is only when it becomes excessively high that it has any danger for the fetus or mother.

In veterinary practice we scarcely recognize the presence of any danger whatever to the fetus from the pressure during its passage through the birth canal, nor as a rule do we observe any injury to the fetus because of traction applied to any of its extremeties. The amount of traction which will be borne by the head or the limbs of a fetus during its passage through the canal is astonishing. It far surpasses any point which an average person would believe possible for the fetus to endure without more or less serious injury, and yet, as a rule, strain or other injury to the fetus from such traction is virtually unknown in practice.

The mother, however, not infrequently suffers seriously from severe, or rather we might say, from injudicious traction. How much pressure the pelvis of our domestic animals will withstand, when applied through the medium of a fetus impacted within its canal, we do not know. Experimentally, it has required from 375 to 635 pounds pressure upon a round ball representing the head of the fetus, to produce a fracture of the bones or disunion of the pelvis of woman.

The great danger to the organs of the domestic animal is not to the bony, but to the soft parts, and it is these which are first injured by an excessive pressure.

The amount of traction which may be applied to the fetus varies with its position. When the fetus is presenting normally and the traction is exerted in the direction which we have suggested, there is no point where the soft tissues of the fetus may not move to some extent upon each other and thus relieve the pressure upon a given point, so that in normal cases the pressure of the fetus against the walls of the birth canal is well nigh equal over the entire surface.

When the fetus presents improperly, when an extremity is retained in such a way that a greatly increased pressure is brought

to bear upon one small area of the genital passages of the mother, the question of the amount of admissible traction changes greatly. For example, if a fetus is presenting with its head deviated to the side, one man by drawing upon it may cause far more injury than five men might do if the fetus were presenting normally.

Different practitioners, working under varying conditions, have obtained apparently contradictory results in reference to the amount of traction which it is desirable to employ. Some claim that only moderate traction should be employed, and define their term "moderate" as the force of from 2 to 4 men pulling simultaneously. Others have unhesitatingly employed the combined strength of from 6 to 10 men and have claimed that their success has fully warranted the amount of force employed. Personally we have, when hard pressed, applied a force which would equal that of 6 to 10 ordinary men, in those cases in the cow and mare where the fetus lay in a wholly natural position, and when the force of the traction fell alike over the entire birth canal. Usually, when it reaches the point where so great force has become necessary, we have not used this number of men, but have substituted some mechanical appliance for their power, such as the lever or pulley.

Donnareix claims that three assistants are usually sufficient for handling dystokia in the cow. Of these, he places one at the head, another at the tail and a third to aid the operator. In contrast with this he finds 10 men necessary for the mare and distributes them somewhat similarly, except that an extra man is needed to confine the limbs of the animal, while 5 or 6 are needed to pull at the fetus. While the amount of assistance required in a given case constantly varies in either the mare or the cow, we have never found the great number either neccessary or desirable, and have always considered that we could better manage from 3 to 5 men than a larger number and that we could always develop mechanical force of sufficient degree to get the power desired.

When traction is applied to a fetus which is not in a proper position and in which the fetal pressure is not alike upon the entire area of the maternal passages, great and even fatal injuries to the mother are constantly threatened. If a limb is retained or misdirected it is liable at any time to be forced through the uterine wall into the peritoneal cavity and produce a rupture,

from which the animal usually dies as a result of shock, hemorrhage, or infection.

In other cases, when a portion of the fetus is deviated, the walls of the uterus, which are closely investing the fetal body, may be caught during severe traction and dragged along until a small rupture is caused, or the uterine walls so seriously crushed and maimed that they later become necrotic and a secondary perforation of the uterus occurs. When the fetus is further advanced in the pelvic canal and approaches the outlet, any great deviation o the presenting parts of the fetus may cause a very serious rupture of the perineum. **Therefore, the application of great force to a fetus in an improper position is constantly to be condemned.**

In the selection of assistants, when there is a sufficient number present to permit of selection, one should take by preference those persons who are somewhat experienced in the handling of animals and who are strong and of equable temperament. One needs to have these men thoroughly at his command and to know that they will obey his orders promptly and without question. It has been a common experience of the writer, when he has asked that two or three men shall take hold of a rope to exert traction, that upon turning his head he finds that the number has doubled or trebled. This must be constantly watched in case of a crowd of bystanders.

When traction is being applied the operator should take his place immediately behind the patient, constantly watch and examine the progress of the fetus, command the direction and amount of force to be applied at this or that time, and determine when the traction should cease. Various conditions may arise demanding that the traction shall be more to the right or the left, upward or downward, or otherwise modified.

When there seems to be any great impediment which apparently bars the progress of the fetus at a given point, the traction should cease and the operator should determine the nature of the obstacle to its progress and devise the necessary means for overcoming it. The operator should not join in the traction unless circumstances should arise making it necessary, but should devote his attention to the direction of the force to be applied by others.

Haste in traction upon a fetus is only very rarely justifiable, and the maternal parts should be allowed to dilate gradually as the fetus slowly advances in the form of a wedge. In posterior presentation, when a supposedly live fetus is well advanced in the pelvis so that the umbilic cord is impinged between the fetal body and the maternal pelvis, hasty extraction of the fetus may be warranted in order to save its life. Very rarely, possibly, other conditions arise to warrant hasty extraction of the fetus.

Traction should, if possible, only be applied during the expulsive efforts of the mother, since at these times it is very much safer, and more efficient. Traction applied in the absence of expulsive efforts constantly tends to drag the uterus along with the fetus, with danger of uterine rupture.

Expulsive efforts of the mother may usually be artificially aroused by slight traction upon the fetus or by the operator passing his hand between the fetus and the vaginal walls. When these efforts have been aroused they should promptly be seconded by firm traction, to be regulated in amount according to the circumstances in each case. Before traction is applied, and as far as possible during its continuance, the birth canal should be kept moist and well lubricated by means of oil, fat, or warm lysol solution.

While traction should be applied, as a rule, only during expulsive efforts, in some cases, when the animal is exhausted or under the influence of an anaesthetic, the expulsive powers may be partly or wholly wanting and forcible extraction made necessary.

The general rules for the application of traction—the direction, amount and method—are essentially the same whether the fetus presents anteriorly or posteriorly.

The development of the required amount of force, when applying traction to the fetus, may be brought about in a variety of ways.

We have already suggested that the difficulties increase as the number of men increases, because a large number of men is difficult to control. They are almost always excited and tend to exert their force in an irrational manner. Since they necessarily work behind the operator's back, he has little opportunity to watch them, while giving proper attention to the progress of the fetus. In some cases the men who are at the command of the operator

are not very intelligent, and such persons at once render his task more difficult in controlling the application of force.

The barbarous method, which is more or less in vogue, of developing force by hitching one or more horses to the foal or calf, requires no condemnation. Such a force is quite beyond control. The horses become excited and jump or jerk in such a way as to be exceedingly dangerous for the mother and fetus, if the latter is yet alive. After one or two ineffectual efforts to overcome the resistance, the horse behaves so badly that his starting and stopping cannot be depended upon. Besides this we have very poor control, under these circumstances, of the direction in which the force is to be exerted. Any sudden movement of the patient changes the direction of the traction quite as suddenly and may be fraught with serious results.

When power must be developed, requiring the force of more than 4 or 5 men, it is preferable according to our experience to supplant the men with mechanical appliances, of which we have many. The two to which we have usually resorted, and which have given us highly satisfactory results, have been the lever and the pulley.

The lever is universally available and can be applied under almost any conditions which might be named, except possibly in those instances where the stall in which the operation is undertaken is too small to permit of its use. In such instances, however, it is almost equally difficult to apply other mechanical force. Our method has been to procure a stout beam from 8 to 10 feet in length and to find a secure resting place for the fixed end of the lever, which is to act as a fulcrum, against a door, post, or other solid object. If the animal is in the pasture, or otherwise in the open, and recumbent, a stout stake may be driven in the ground to serve as a fulcrum and the end of the lever placed against this. A hole may be made in the ground or in the floor and the end of the lever inserted into this. The cord or rope which is attached to the fetus may then be made fast to the lever at a distance of about two feet from the fulcrum and the power applied to the long arm of the lever, by one, two or more men, as conditions may warrant. The amount of power which may be developed in this way is virtually unlimited, its direction is under excellent control, and it is free from irregularities in its application.

Much the same may be said of the pulley, by which we can increase the force at will and can quite readily control the direction of the traction at every stage of progress. The pulley has the one very marked advantage that it may be carried in a very compact form by the operator, as a part of his equipment, and be ready for application whenever occasion arises.

Others have used, for the purpose of developing mechanical force, various apparatuses in case of emergency, such as the windlass, capstan, and various obstetric machines, which have been worked by means of a screw or otherwise. However, the two which we have suggested are so universally available and so efficient that it would seem scarcely necessary to discuss the others beyond admitting that, when they chance to be at hand, they may act quite as well as those which we have habitually used.

While these mechanical devices for the development of force seem in some respects cruel, they are not so at all when compared with other means for which they are substituted. Veterinarians in general condemn the practice of hitching horses or oxen to a fetus in order to draw it away, as being cruel and unjustified by any principles of surgery or of humanity. Unless a number of men can be well controlled in their efforts, it is no more humane, nor is it any more scientific, to place 8 or 10 men upon a cord to draw upon a fetus than it is to hitch a horse to it.

Mechanical means for the application of force are far more under the control of the operator, are more continuous and better directed. In our judgment, where a certain force is necessary, which cannot be accomplished by three or four men, the mechanical appliance is safer and more effective. In our comparison we are dealing with the question of the application of a given amount of force with like supervision. Admittedly, with mechanical means we can apply such an unlimited force as to tear either the fetus or mother asunder, but so we may by manual force if we but sufficiently multiply the number of men.

The amount of force to be applied in a given case constitutes a severe test of the judgment of the veterinarian. It is a practical question which should be decided upon sound principles. In almost any case of dystokia we may reduce the size of the fetus, by embryotomy, to such dimension that but little force will be required to bring about its extraction from the uterus. If this can be readily accomplished, and the fetus is dead, it follows that

such is the proper action to take. We are not justified, for example, in applying great traction to a fetus presenting posteriorly with the two hind feet completely retained, when by intra-fetal embrytomy, with removal of the two hind limbs, we may so reduce the size of the fetus, in the course of an hour, as to permit of its easy extraction by the traction of say two persons.

On the other hand, we recall an instance in our personal experience where a foal was in the breech presentation with both hind limbs completely retained, and, as it had been dead for some time, the waters had all escaped. The fetus was enormously enlarged because of emphysema as a result of decomposition. We removed the two hind limbs, the pelvis and all the fetal viscera, and then attached a cord to the posterior end of the spinal column and applied traction. The fetus was in the dorso-sacral position and there was no impediment to its extraction except the great emphysema.

We might have further reduced the size of the fetal body by removing the ribs and then withdrawing one of the shoulders, and with it the fore-leg. We might have repeated the process upon the other fore-leg, and perhaps this would have been the more surgical and approved method, but, before we realized the seriousness of the obstacle to extraction, we had wedged the fetus quite tightly in the birth canal so that further operation was rendered exceedingly difficult. Rather than go through the tedious work essential for the desired reduction in size, we applied force which we estimated at more than 1000 pounds, by means of a lever, and drew the fetus away. However cruel some operators might consider the operation, the animal did well.

We doubt very much indeed if she could have done any better, or even if she would have suffered less had we further reduced the size of the fetus by a very tedious and difficult operation.

Other similar experiences might be cited, but what we wish to insist upon most strongly is that, if such great force is to be applied for the extraction of a fetus, it should first be brought into a natural position so that in its passage all the soft tissues will be pressed upon alike and that consequently the danger of predominant pressure upon one area is reduced to a minimum.

In the application of powerful traction, the operator should take particular care to properly command the direction and

amount of force which is applied. In some cases it is essential to fix the animal's body so that it shall not be drawn from its position instead of the fetus being extracted, while in other cases it is necessary that the body of the parent be fixed in order to permit of the traction being applied in the desired direction.

As a general rule, when severe traction is applied the animal assumes the recumbent position, and, when the fetus is well advanced in the pelvic canal, it may be necessary to in some way fasten the posterior part of the body of the mother so that, when the traction is directed toward her feet, she is not constantly moved from her position. In order to overcome this movement of the body of the mother, we may in the mare fix a rope to the tail and, by attaching it to a solid object, prevent the constant slipping of the body in a ventral direction. In either the cow or the mare, a long rope may be passed between the hind limbs or around the buttocks somewhat below the vulva and then attached to some solid object beyond the dorsum of the mother in such a way as to prevent her gliding in a ventral direction.

Repellers and Repulsion.

In obstetrical operations it frequently becomes essential that the fetus be pushed back into the uterine cavity or the abdomen, in order that room may be obtained in which to make certain changes in the position of parts or to carry out other operations which may be essential to the extraction of the fetus. This procedure we know as repulsion or retropulsion. It may be carried out in a variety of ways, and naturally the most primitive method is that of pushing the fetus backward by means of the operator's hand. This most primitive and simple of all methods has great advantages over the others, especially because the force can be applied with intelligence and safety.

It is the most effective means for bringing about changes in the location and direction of the fetus, because the force may be constantly applied at the proper angle and may be at once modified according to any changes in the position of the fetus during the progress of the operation.

Manual repulsion has the great disadvantage that it places upon the operator the full burden of a more or less difficult task and makes a demand upon his physical resources, which may later be sorely needed for the accomplishment of other important opera-

tions. In harmony with the rule which we have already suggested, that the operator should delegate to other persons whatever they may safely and properly do, leaving him to direct the application of force, various appliances have been introduced to relieve the obstetrist from the physical strain involved in this operation.

Some obstetrists have an assistant push against the operator's shoulder or, grasping his arm, push it forward so as to increase his power in that way, but, however great additional force he may secure in this manner, the impact still falls wholly upon the operator's hand and tends finally to produce fatigue.

Another plan is to have an assistant insert his hand and arm alongside that of the operator and the two push unitedly against the fetus, but this does not give the very best results because the room for working with the two arms in the passages is not very ample and the two persons are somewhat in each other's way. In attempting this method of repulsion, the assistant stands with his back to the back of the operator, and, if the operator is using his right hand, the assistant inserts his left hand.

More commonly and preferably the extra force is applied by means of instruments, usually by a repeller or crutch, Fig. 94. This instrument is shaped somewhat like a crutch and is made of wood, iron or steel, of variable size and form, usually about 30 to 36 inches in length. Cleanliness and neatness dictate that this instrument should be made of steel, which is to be well polished and then plated with nickel so that it will not rust.

The crutch, or repelling end, is usually made solid and describes the segment of a circle. It is made of varying width, and most of the instruments are very much larger than is necessary or desirable.

Instruments made of good steel, ½ inch in diameter, are abundantly strong for all the force which one will have occasion to apply, and the length of the crutch itself should not exceed 4 inches, while 3 inches is quite ample for all purposes. Some make them very much wider than this, with the idea that they may thereby secure a safer hold upon the fetus and thus do away with the liability of the instrument slipping off and injuring the mother.

In our experience there is no occasion for a repeller to slip from its point of fixation, if properly made, applied and guarded. If

the instrument has too great a diameter, it is exceedingly difficult to introduce and may cause injury to the soft parts of the mother while being applied. After it has been located at the proper point and force applied to it, if the transverse diameter of the crutch is very great, the ends may project beyond the parts of the fetus to which it is applied, catch in the walls of the uterus or vagina and more or less seriously injure them. We therefore prefer a repeller with a very short crutch, or transverse piece, which may be readily introduced completely covered by the hand and easily applied to the desired part of the fetus.

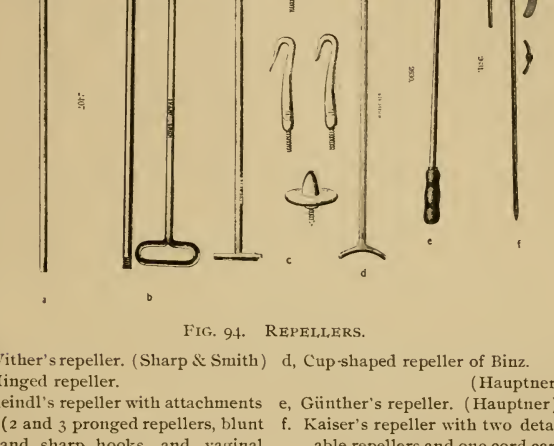


FIG. 94. REPELLERS.

a, Wither's repeller. (Sharp & Smith)
b, Hinged repeller.
c, Reindl's repeller with attachments (2 and 3 pronged repellers, blunt and sharp hooks, and vaginal dilator). (Hauptner).
d, Cup-shaped repeller of Binz. (Hauptner).
e, Günther's repeller. (Hauptner).
f. Kaiser's repeller with two detachable repellers and one cord carrying hook.

In a large proportion of cases where repulsion is desired, the fetus is dead. In such we use a repeller having a sharp spike in its center, Figs. 94 a and 106 e, which sinks into the tissues of the fetus and gives the instrument a secure hold.

If the fetus is alive, the small spike, passing into the soft tissues, produces an aseptic wound, which heals without inflammation and without requiring material attention, so that it is not

highly objectionable. In order to overcome any such objection, however, the spike should be detachable and, in case the fetus is alive and the spike not absolutely necessary to secure fixation of the instrument, it may be unscrewed and removed and the instrument used without it.

When using any type of repeller, the hand of the operator should constantly accompany the end which is in contact with the fetus during the entire operation of repulsion, and thereby guide the direction and amount of force and guard constantly against its slipping or doing injury to adjacent parts. When the repulsion has been accomplished and it is desired to hold the fetus in its position while the operator carries out some change in the position of an extremity or brings about some other modification in position, it is allowable to take the hand away from the instrument and instruct the assistant to press steadily upon it. The party handling the repeller must be prepared to immediately withdraw his force, and even the instrument, in case there is any suspicious change in position of the fetal body, especially if it seems to yield in such a way as to suggest that the instrument may become displaced.

Some obstetrists condemn the repeller as a dangerous instrument, but we have not found it so in any case. We consider that the repeller should be used in most cases where repulsion is desired and that the operator must, as a rule, abstain from using his own power for bringing about this movement of the fetus when others may do it quite as well or even better if he will but place the instrument securely against the desired portion of the fetus and, accompanying it constantly with his hand, direct the force of the assistant or assistants.

In the repulsion of the fetus it is essential that the uterus should be extended somewhat in order for its contents to move backward. Consequently, whenever force is applied to the fetus with the idea of pushing it backward, it almost inevitably arouses more or less vigorous expulsive efforts, which tend to prevent the desired repulsion. Whenever these expulsive efforts come on, little progress, if any, can be made in the operation, and the operator must wait until the expulsive efforts cease and then, by a prompt thrust, push the fetus away toward the anterior end of the uterus. During the expulsive efforts, however, the operator should attempt to prevent the fetus from being driven toward the pelvis or

into it, by maintaining a steady pressure in the opposite direction and then being ready, as soon as the expulsive efforts relax, to quickly accomplish the results which are desired.

Instruments for Section.

Traction and repulsion, with any accompanying changes in the position of the fetus, cannot always bring about a sufficiently favorable position of the fetus or other essential conditions to allow of its extraction whole. Consequently the operator is frequently compelled to diminish the size of the fetus by removing one or more parts so as to permit of its easy passage through the birth canal. For the carrying out of embryotomy, a greater variety of instruments has been devised than for any other obstetric purpose.

Each operator has his own preference in the selection of his means for bringing about these ends, and for each operator those instruments to which he is accustomed may be the best because there is no place in the realm of surgery where familiarity with an instrument constitutes so great a part of its value to the operator as in embryotomy.

Knives. First and most important in this group of instruments are the knives, of which we have an infinite variety offered by the various instrument makers. We may divide these into two great classes; the finger-knife, and the short-handled knife or scalpel.

The finger-knife, Fig. 95, which is attached to one of the fingers by means of one or two rings, is one of the simplest and most effective of all embryotomy section instruments, and is perhaps the most universally used. It is made in various shapes, according to the individual preferences of the operator. Most frequently it consists of a somewhat narrow blade which is curved downward. The blade may advantageously be hooked for all those operations where it is desired to make a long, drawing cut, by inserting the hand to the point where we wish the incision to begin and then making the cut as the hand is drawn outward. In such a case the hooked knife sinks into the tissues automatically and the operator simply keeps his hand against the surface which he wishes to cut and draws it outward.

Finger knives, as made by most instrument dealers, are too long for the average operator and cannot be easily handled. The

operator with a small hand cannot guard the ordinary finger-knife in such a way that he can readily introduce it to the point where he desires to work. We have been compelled to have finger-knives constructed to order, because of this difficulty. The blade of the finger-knife should be of such a length that, when it is placed upon the finger, the hand can close about it in such a way as to protect the point completely, with safety alike to the operator and to the patient.

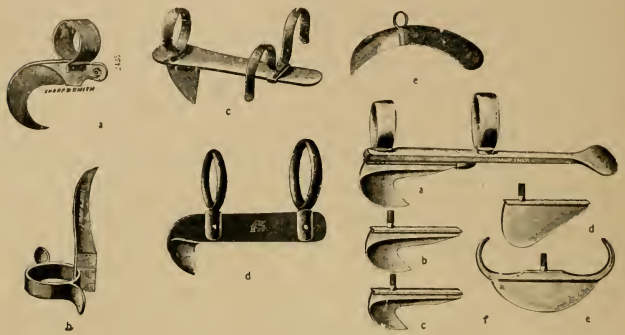


FIG. 95. FINGER KNIVES.

a, Full-curved obstetric knife.
b, Half-curved obstetric knife.
c, Karl's embryotomy knife.
d, Günther's embryotomy knife.
e, Vienna embryotomy knife.
f, Danish embryotomy knife, with detachable blades of various patterns.

The types of these finger-knives, Fig. 95, are exceedingly variable, but the simpler ones a and b, are perhaps as efficient as any after the operator once becomes accustomed to them, though we would not say they are superior to the many other types. These instruments admit chiefly of incisions in a line parallel to the long axis of the operator's hand and arm, and cannot very well be used for section in a transverse direction. If we take one of the finger-knives with but a single ring, which is larger than the finger, it may be turned more or less obliquely across the hand and, by bending the hand somewhat also, we may be enabled to make a transverse incision.

Scalpels. We also find a very extensive list of scalpels or bistouries with straight handles, the blades of which may be

either naked or concealed. In some cases the blade is concealed within the handle, and in others by a moveable guard alongside the blade.

The concealed types have a tendency to become swollen and refuse to work after they have been immersed in liquids for a time, especially those with wooden or bone handles. This criticism does not apply when the instrument is constructed entirely of metal. A very good type of the concealed knife is that of Kauffman, Fig. 96 e, f. An equally convenient type of knife, which to us seems even superior, perhaps because we are more familiar with it, is the Colin scalpel, Fig. 106 b, and as in other cases we greatly prefer that the instrument be constructed wholly of metal so that the guard will not become caught because of swelling of the handle.

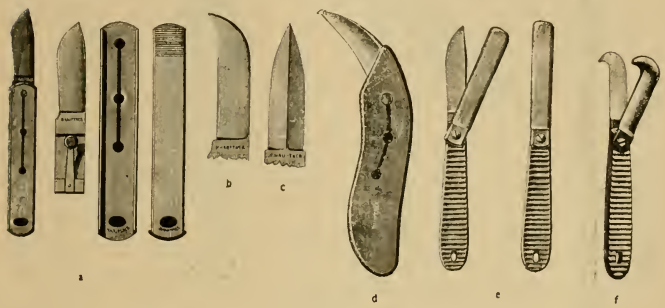


FIG. 96. CONCEALED AND GUARDED KNIVES.

a, b, c, Concealed knife of Günther, with convex, concave and double edged blades.

d, Concealed knife of Deutsch.

e, f, Guarded knife of Kauffman, with convex and hooked blades.

The advantage of the scalpel over the finger-knife is that it may be turned in any direction, so that an incision may be made longitudinally or transversely, as the operator may desire. It has been suggested that an objection to this kind of knife is the possibility of losing it in the uterus, but in our clinical experience this objection is not well grounded. To guard against such a possibility, some of these instruments are made with an eye at the extremity of the handle, through which a safety cord may be passed so that the instrument, if lost, may be recovered.

It is important that such scalpels be made very short and the handle be of such a character as to afford a firm hold. Such a knife should not exceed 4 inches in length, so that it may readily be concealed in the hand and carried to any part of the uterus.

Long Cutting Hooks, Sectors and Embryotomes. In addition to the finger knives and scalpels, there has been devised a great variety of larger instruments for section or other divisions of the fetus, known as long cutting hooks, sectors, embryotomes, etc.

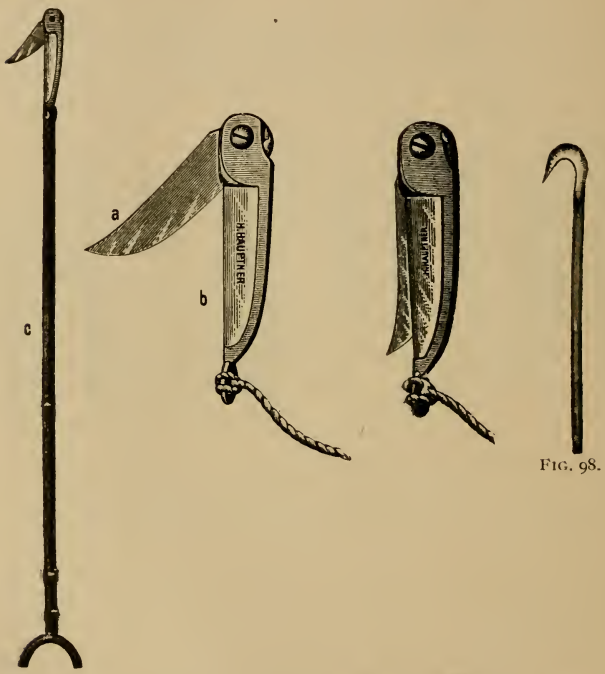


FIG. 98.

FIG. 97. LONG HANDLED CUTTING INSTRUMENTS.
97. Embryotome of Dopheide. (Harms). 98. Sharp cutting hook of Withers.

The Long Cutting Hooks consist of long-handled hooks with the concave face of the hook consisting of a cutting edge, as in Fig. 98, or h in Fig. 106. The cutting end is introduced to

the desired point carefully guarded by the operator's hand and a drawing incision is made as the instrument is withdrawn, the operator's hand still accompanying the hook and controlling the extent and degree of the cut. The sharp pointed ones are very dangerous to handle, and if they are to be used at all the hook should be very small and short, so that it can be easily guarded. The long, stiff handle makes it exceedingly difficult to safely guard the instrument while it is being introduced, so that any violent expulsive efforts or accidental movements of the mother are liable to cause a displacement of the instrument, with painful consequences to the hand of the operator or to the uterus of the mother.

The objections are overcome in some of these instruments by making the hook probe-pointed, like in h Fig. 106. This instrument is easily and safely handled and proves highly useful wherever it may be applied. The obstetrist may readily sever the fetal ribs with it after evisceration, or may divide the pelvic symphysis, or the pelvic girdle at other points, or accomplish other operations. They cannot be used for cutting the skin unless an incision be first made, through which the probe or sphere may be introduced.

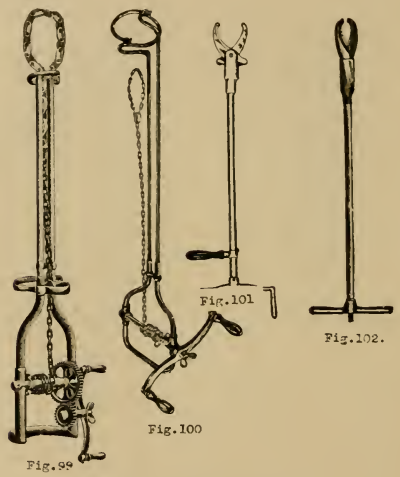
Embryotomes. The group of instruments known as embryotomes are of great variety in design and purpose. Some of the simpler ones do not differ essentially from the cutting hooks. The embryotom of Dopheide, Fig. 97, consists essentially of a closed knife attached to a long and rigid handle. When introduced to the part upon which it is desired to operate, the instrument opens automatically when the operator begins to withdraw it, and may thus serve to cut deeply and freely through the soft tissues. In case it is desired to stop the incision at a given point, it is simply necessary to push the instrument backward again, when it closes, and can be grasped by the hand of the operator, which has been in contact with it at all times, and be easily withdrawn.

The embryotom of Oehmke, which appears to be a very practical instrument, has a lance-like blade which is exposed by pressing upon a spring with the index finger and is kept exposed as long as the pressure is continued.

Most embryotomes, Figs. 101 and 102, consist of more complex machines, designed to cut, crush or tear through any portion of a

fetus to which they may be applied, whether the tissues be soft or hard. They have been used in obstetric practice for a great many years, but have not acquired a very wide application.

They consist in many cases of two powerful, sharp blades operated as shears by some mechanism which gives them sufficient power to cut through an extremity at any point where it may be grasped. Sometimes the instrument is constructed somewhat on the plan of an ecraseur, and by some mechanical appliance a sharp chain is forced through the tissues. Representing this type of instrument, which has recently become quite popular in Germany, is the Pflanz embryotome, Fig. 99, and the Pflanz extractor, Fig. 100.



FIGS. 99–102. EMBRYOTOMES, ETC.

99. Pflanz' embryotome (Hauptner) 101. Obstetric shears (Haussman).
100. Pflanz' extractor (Hauptner). 102. Cullen's embryotome.

The former consists of a heavy frame-work which might be likened to that of an ecraseur, with an ordinary strong chain, which is passed around the part of the fetus to be divided. By drawing upon this, the sharp chain or sector is brought in contact with the part to be amputated and forced through the soft tissues and bone.

The instrument is said to be highly effective, but according to reports by some of those who are its most enthusiastic admirers, it frequently cannot be applied to a part which is to be amputated. The instrument weighs approximately 10 pounds, and is consequently quite cumbersome to handle. Its expense is about $30 in America.

Similar objections apply to other embryotomes. They are so large and heavy that they are exceedingly difficult to introduce into the genital passages and, once this has been done, the part which is to be amputated must present in a position essentially perpendicular to the long axis of the pelvic canal, since otherwise the instrument cannot be applied to it.

Aside from their expense, their cumbersomeness in carrying and the difficulty or impossibility of applying them to the desired part, they are exceedingly difficult to properly care for and disinfect. When once applied, their action is generally satisfactory, if not ideal. The extractor of Pflanz, Fig. 100, is designed through its powerful mechanism to tear away a fetal limb, the ring at the distal end receiving the entire impact of the tension upon the limb by the chain, thus relieving the maternal parts from any pressure whatever.

Chain-Saws. Somewhat closely allied to the embryotomes are the chain-saws, like that of Persson, Fig. 103 a, or the chain sector of Masch, Fig. 103 b, which have been recommended for

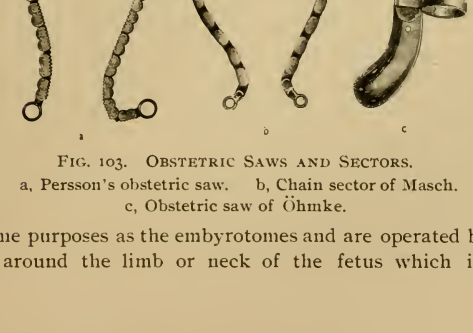


FIG. 103. OBSTETRIC SAWS AND SECTORS.
a, Persson's obstetric saw. b, Chain sector of Masch.
c, Obstetric saw of Öhmke.

the same purposes as the embyrotomes and are operated by being passed around the limb or neck of the fetus which is to be

amputated and then drawn back and forth in a sawing manner. They are effective in their work and in some cases offer special advantages, but on the whole they have not come into general use. They are comparatively expensive, rather difficult to apply, are not very rapid in execution, and are exceedingly difficult to maintain in aseptic and working condition.

Stiff-handled obstetric saws are also recommended by some practitioners. Short finger saws, with short handle and finger-ring like c, Fig. 103, are recommended by some, but they have little efficiency in most cases because wholly dependent upon the inserted hand, tightly compressed and largely powerless, for any use. Long handled saws are more workable because the saw can be guarded with the inserted hand and the force applied with the free hand. They can be used in no operation and applied to no part for which the obstetric chisel is not equally efficient and safe. We have repeatedly attempted the use of chain-saws, sectors, and stiff handled saws, and have always laid them aside as greatly inferior to chisels.

Obstetric Chisels. The simplest and most effective implement for section of fetal bones is the embryotomy chisel, which, like other instruments, is constructed in a variety of forms. We use a chisel, Fig. 106 d, made of the best steel, of ½ or ⅝ inch diameter, and about 30 inches in length, with the chisel end about 2 inches wide and tapering gradually backward toward the handle for a distance of 4 or 5 inches. The chisel blade is about $\frac{3}{16}$ to ¼ in. thick, so that it may safely pass through the hardest bone in the fetal body, and the cutting edge of the chisel is made slightly concave in order to render it less liable to slip to one side.

Such a chisel is readily kept in order and is easily applied by the operator to any portion of the fetus which is within his reach. Grasping the chisel blade in his hand, he carries it to the part to be operated upon and, placing the instrument in the best direction possible, against the part, he instructs an assistant to drive it through the tissue with a mallet or hammer. When driving the instrument through bone, it should be forced but a short distance at a time, then loosened and perhaps revolved on its long axis in order to pry the bones apart and also to avoid driving the chisel too far and having it become caught in such a way that it is difficult to remove it.

In amputating a limb, the chisel should not be placed upon its

center, but at one side, so that it will cut completely through the tissues on that side to which it is applied, and not be driven clear through the limb with some of the tissues intact upon either side and thus be caught and held as though in a vice.

Such an instrument is cheap, is easily and safely applied by the operator to any point within his reach, can be readily driven

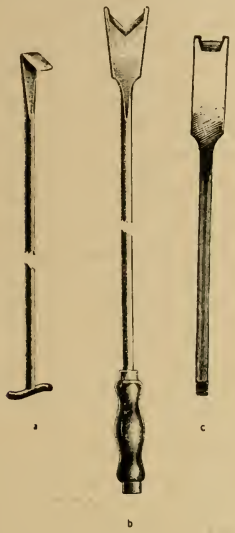


FIG. 104. OBSTETRIC CHISELS.

a, de Bruin's vertebra knife.
b, de Bruin's embryotomy chisel.
c, Withers' embryotomy chisel.

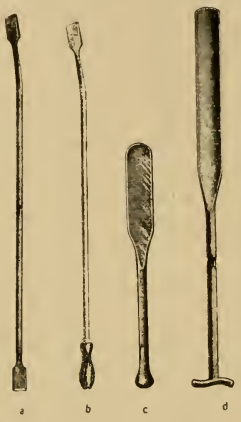


FIG. 105. SPATULAS.

a, Spatula of Harms.
b, Spatula with handle.
c, Small spatula of deBruin.
d, Curved spatula of de Bruin.

through any tissue of the body whether soft or hard, has little tendency to break or get out of order, is easily kept clean, and will accomplish any task in embryotomy which can be performed by the chain-saw, by the Pflanz embryotome or by any machine however complicated or expensive. It can be applied to any part where the other instruments can and in many places where they cannot be at all, or only with very great difficulty. In the

amputation of the pelvis and posterior limbs, in the breech presentation, it is the instrument par excellence. In the amputation of the limbs it is quickly applied and safe, and its work is rapid and efficient. Other types of obstetric chisels, all efficient, are shown in Fig. 104.

Supplementary to these instruments for section, there have been introduced and recommended by various operators a group of blunt, flat instruments known as spatulæ, which are designed primarily for the purpose of separating the skin of the fetus from the subjacent tissues. They have a degree of merit, and aid considerably at times in hastening the operation of detaching the skin from the fetus, and thus facilitate an early completion of the operation. Like all the other instruments they are made in a great variety of types. Some of the most useful of these are shown in Fig. 105. They are not essential, but rather auxiliary, and their place may well be taken by other instruments. The chisel, which we have already described, answers quite well the purpose of a spatula at any points where the resistance may be very great, while elsewhere we are in the habit of using the thumb or fingers or the entire hand for separating the skin from the under-lying parts.

General Observations Upon the Construction of Obstetric Instruments.

We have already suggested casually that obstetric instruments should be of such a character as to render them easily cleaned. In our personal experience we have found that instruments are most readily kept in order when they are constructed of a good quality of steel, highly polished and nickel plated. Such instruments are not readily attacked by rust, are very clean and present the smoothest possible surface, so as not to irritate the genital organs. The instruments should be as smooth and well-rounded in all their parts as is practicable, not only that they may work more readily, but also that there may be less opportunity for the collection of dirt at any point, which may interfere with their operation or constitute a bearer of infection. This naturally suggests that the instruments should be of the simplest character consistent with efficiency and that screws, joints, links and chains should be avoided whenever and wherever practicable.

There has recently entered into veterinary practice, in both

Europe and America, a strong tendency to the construction of sectional instruments which may be unscrewed and consequently occupy a small compass, or rather a shorter space, than if made solid in a single length. It must be granted that such instruments admit of being placed in a more compact case, and this is really the only advantage which can be claimed for this plan of construction.

The plan possesses many disadvantages. The jointed instrument is inevitably weaker than the solid one, and must be made heavier in order to compensate for the joint. The joint, especially the female screw, constitutes an ever present danger from the standpoint of infection and renders the instrument exceedingly difficult to clean. One of the most serious objections to the obstetric instrument with a screw joint is its inefficiency at a critical moment. An operator works for a long time to apply an instrument at the proper point in order to accomplish a certain purpose, and, just as he is ready to do his work, a sudden movement of the animal, or other causes, leads to an unscrewing of the instrument. His time and labor have been wholly lost ; the instrument must be withdrawn and the screw joint tightened and the operator must begin over.

It is a custom also, of the instrument makers, to fit a series of obstetric instruments to one handle by means of a screw, with the idea that they thereby render the outfit cheaper, lighter and more compact. This plan has a very serious disadvantage in reference to efficiency in practice. Convenience in carrying an instrument should be subordinate to the question of efficiency when the operator has reached his case. If he has been using an adjustable handle with a hook, and finds that he would like very much to have a repeller instead, he will perhaps find the hook so tightly screwed fast that he cannot release it and must ask some bystander with dirty hands to unscrew it for him. In the meantime delay of an important character may have occurred, and the position of the fetus may have undergone unfavorable change.

He may desire to hold a certain part with the hook while he uses the bone chisel or some other instrument, and he is without a handle for the other, so that he cannot simultaneously use the two. At every point the plan of a universal handle for all obstetric instruments is wasteful of time and detrimental to effi-

ciency. After all, the gain in reference to compactness is not very great. If the instruments are solid throughout their entire length, the case or roll to contain them is necessarily longer, but need not be so wide nor so thick, and the actual cubic space occupied by them is not changed. The weight is no greater with the solid instrument than the jointed one. It is therefore a question of the form of a container and not of its cubical contents or weight. We are therefore strongly in favor of a solid instrument, believing that with it the veterinarian can do more rapid, more efficient and safer work.

The handles of obstetric instruments are variously formed and have certain advantages in their structure. In our judgment and experience, the most efficient handle is that consisting of an oval ring of sufficient size for the insertion of a man's hand, or we might say of a width of 3½ inches. The advantage of such a handle is that it gives a secure hold, through which the operator may exert his full force in any direction that he may wish, and supplies a form of handle which is not readily caught or entangled upon surrounding objects. With this ring handle, the operator or an assistant can exert his full power either in repulsion or in traction, or may revolve the instrument upon its long axis or push it in any direction. The revolving of the instrument upon its long axis is frequently of supreme importance in obstetric operations, and one needs have a secure hold in order to accomplish this movement.

It is especially important to be able to rotate a chisel upon its long axis when it is being driven through bones and it is desired to break apart and separate the bone which has been only partially divided. It is also highly important that the operator or assistant shall be able to revolve the instrument upon its long axis in case he is attempting to implant a hook in a given part. The repeller also is much safer if the operator or assistant can control it completely and either turn it upon its long axis or prevent it from turning, as demanded. The other forms of handle ordinarily seen in obstetric instruments are the straight or olive-shaped handle, usually of wood, and the bar or transverse handle, usually of metal. The olive-shaped handle is in many respects the neatest and occupies less space in a container, but it is decidedly wanting in efficiency as compared with the ring handle.

The bar handle is efficient, but we believe it less convenient for grasping than the ring, and the projecting bars tend to catch against objects.

Obstetric Outfits.

We have already asserted that the veterinarian should have ready at hand an outfit for obstetrics, which he can secure promptly upon the receipt of a call, knowing that he will have in his possession every instrument and appliance or other material which the exigencies of difficult labor may demand. Instrument makers in many instances prepare sets of obstetric instruments in neat cases, which are very convenient in so far as the instruments themselves are concerned. They contain, as a general rule, an extensive array of instruments which, in many cases, are better fitted to impress the bystander than to accomplish efficient work. The obstetrist's outfit need not be expensive nor consist of a great number of instruments or appliances. We would suggest, as a simple outfit of instruments, the following articles, as shown in Fig. 106 :

1. Two ¼ inch cotton cords, two ⅜ inch cotton cords, one ½ inch cotton cord, each 4 or 5 feet in length, with a prepared loop at one end, and the other securely wound with thread to prevent untwisting ; 2. long, blunt hook ; 3. short blunt hook ; 4. chisel ; 5. repeller ; 6. finger-knife ; 7. scalpel ; 8. injecting pump. We use a small pump to which is attached a pure gum horse stomach tube to serve as tube and nozzle. The apparatus is simple, easily cleaned, withstands boiling perfectly, and the distal end of the tube is sufficiently rigid to serve all purposes of a nozzle, while so pliable, well-rounded, smooth and soft that it cannot well injure even very delicate tissues. The horse stomach tube with an ordinary funnel makes an excellent gravity injector, in some respects preferable to the pump. It is quite as efficient and durable, is cheaper, and lighter to carry.

These instruments we would have placed, in an orderly manner, in a compact case of metal (tinned copper) or in a canvass roll, so that we could at any time thoroughly disinfect the case, either with or without the instruments, by immersing it in an antiseptic fluid or by boiling. The tinned copper case could be filled with hot water and placed upon a stove, where it could be boiled for any length of time desired, and both the case and contained instruments rendered thoroughly sterile.

If it is desired to protect a metal case of this character in handling and carrying, it can be enclosed in a canvass jacket. In addition to the instruments which we have suggested here, the veterinarian may readily add others, which he can include in the same case if he desires, and which may in his experience possess a very high value which would fully warrant their use.

For a number of years we carried a list of instruments consid-

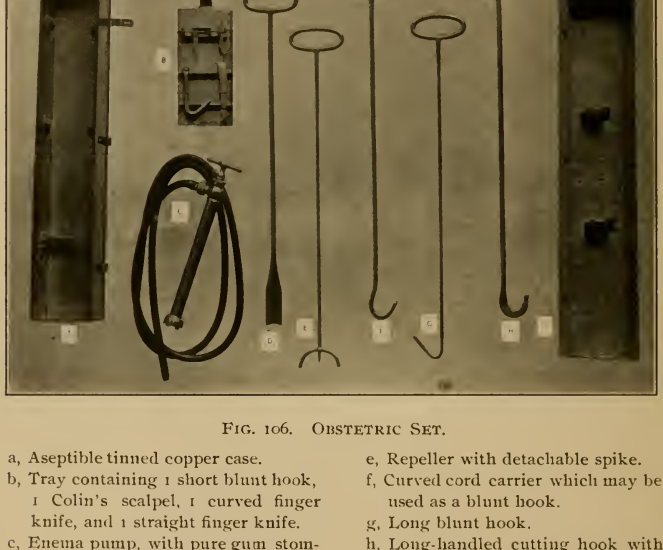


FIG. 106. OBSTETRIC SET.

a, Aseptible tinned copper case.
b, Tray containing 1 short blunt hook, 1 Colin's scalpel, 1 curved finger knife, and 1 straight finger knife.
c, Enema pump, with pure gum stomach tube instead of customary tube and nozzle.
d, Embryotomy chisel.
e, Repeller with detachable spike.
f, Curved cord carrier which may be used as a blunt hook.
g, Long blunt hook.
h, Long-handled cutting hook with probe point, for severing ribs and pelvic bones.

erably in excess of those which we have here designated, but from time to time first one and then another was discarded or left unused, until finally they were narrowed down to the very brief list which we have here suggested.

In addition to this outfit of instruments, there are other neces-

saries which the veterinarian should always carry in cases of dystokia, but which we would prefer to not include within the instrument case, but would carry in a second container. This, like the instrument case, should be of a construction which would render it capable of complete and thorough disinfection or sterilization, and to this end we would have it constructed, like the other, of canvas or of metal. In it we should carry: clothing for the operator; disinfectants, including creolin, lysol and iodoform; anaesthetics; general operating instruments, including a trachea tube and trocar; hypodermic syringe; strychnine ergotine or other hypodermic remedies.

In the experience of different practitioners, other apparatus or materials may be suggested. Some of the German operators aim to carry with them constantly some form of truss or bandage to prevent prolapse of the uterus or vagina after parturition, while others advise the carrying of an obstetric pulley or other means for developing mechanical force.

The Dress of the Operator.

In dressing for an obstetric operation, the veterinarian should have due regard for his personal health and comfort, for the safety of himself and the animal from infection, and for convenience and economy. He is quite unwarranted in going into work with dirty clothing, which may be the bearer of serious infection for the mother, and is equally unwarranted in ruining expensive clothing in the course of his work.

The habit of some veterinarians of wearing overalls which have been used in general work and have been befouled with discharges from suppurating wounds, putrid afterbirths or in previous cases of parturition, without having been thoroughly washed and cleansed, cannot be too strongly condemned.

Two features should be considered in the question of clothing. It should afford the obstetrist ample protection from cold and wet, and should be scrupulously clean. Whenever the weather and surroundings will permit, one of the most convenient and efficient methods for operating is for the practitioner to strip to his waist line, and whenever conditions will not warrant this he should, after stripping, put on a white blouse without sleeves, which has been thoroughly washed and boiled and is at least practically, if not technically sterile. If it is necessary for his

comfort that he shall wear still more clothing about his chest, it should consist of cotton under-clothing without sleeves.

One may work fairly well in a blouse with long sleeves by rolling them up, but the rolled sleeves soon become saturated with discharges from the animal and probably annoy the operator also by becoming unrolled. Moreover, the roll interferes to some degree with the reach of the arm, and the operator cannot bring the shoulder in so close contact with the vulva of the patient.

Some writers upon obstetrics advise the use of woolen instead of cotton clothing and speak especially of a warm woolen jacket, but this material is difficult to cleanse because it will not withstand boiling. The operator is consequently forced to resort to the use of disinfectants which may prove more or less inefficient for the purpose desired.

The protection of the lower parts of the body from the waist down offers a problem which varies greatly under different conditions. In protracted cases of dystokia, ordinary overalls of ducking fail to protect the operator's clothing, and he becomes quite wet.

Occasionally also the operator must kneel or lie down behind a recumbent animal in a place which is none too clean, with the result that, with any form of pervious clothing, he is soon saturated to the skin. To guard the operator in these respects the best plan that we have found is the wearing of rubber trousers, which are highly efficient for the purpose and are reasonably cheap and durable. These trousers, made of rubber cloth, are quite impervious to fluids of every kind, so that one can kneel, sit or lie in any position behind a recumbent animal with impunity. If to these we add rubber boots, the operator is in a position to thoroughly protect himself and to come out of the worst and most repulsive dystokia reasonably clean and comfortable. The rubber trousers and boots have the disadvantage of not being very resistant to some antiseptics. A strong solution of carbolic acid may ruin the fabric. However, they will withstand a moderately strong solution of antiseptics with comparative impunity, and wash so easily that they can be quite thoroughly cleansed in a mechanical way. They may be quite well disinfected after use with a solution of corosive sublimate, or still better with formalin.

Position and Control of the Patient.

One of the most disagreeable features to the veterinarian is the surroundings in which he finds his patient and is compelled to do his work. In many cases this is inimical to his comfort and health, and it is sometimes a question how far it is proper for him to ignore these factors in the course of his professional duties. It is clearly the duty of the owners of animals to provide a comfortable and proper place in which the veterinary obstetrist may work, and it is clearly not the duty or function of the veterinarian to ignore comfort beyond a reasonable degree.

Sometimes a stable is exceedingly cold, but this, as a rule, does not seriously discomfort the veterinary obstetrist, since once he is engaged in his work he can usually keep warm, and it is less difficult and disagreeable for him than for the bystanders, but even this discomfort should not be carried too far. The veterinarian is entitled to demand a reasonably comfortable place for his work.

Sometimes the place for his work is disagreeably hot, and we have suffered at times from working upon a recumbent animal in the bright sunlight, our arms having been badly blistered by the sun's rays. Clearly it is the duty of the owner of an animal in such a position either to provide some means for transporting it elsewhere or a shade for the protection of the operator during the work.

In many cases we find the animal affected with dystokia confined in an exceedingly filthy place, where we cannot touch anything without becoming begrimed with dirt. The veterinarian should demand that such a place be cleaned up, and that appropriate tables or other conveniences be supplied upon which his instruments and apparatus can be placed, where they can be handled without getting them befouled. In other instances, the stall or stanchion is wet and filthy from feces and urine. The practitioner should demand that the filth be removed and an abundance of clean, dry straw or hay supplied to cover over the floor of the stall and surrounding parts where the work must be done.

Sometimes the room is inadequate, so that one cannot operate. The room may even be unsafe, as when an upright post stands in close proximity to the rear end of the patient, so that in case

of lateral movements the operator may be caught between the post and the patient and his arm more or less seriously injured. In other cases a cow suffering from dystokia may be confined in a stanchion with a deep gutter behind her, and this may form a constant menace to the veterinarian, if he makes a misstep. If an animal must be operated upon with such a gutter in close proximity, it should be securely covered over with boards in such a manner as to insure against accident, and over these there should be spread a goodly amount of clean bedding.

If the room, where the animal suffering from dystokia is confined, is wholly inadequate for any of the reasons which we have mentioned or for others, the animal should be removed to a proper place for the work. If a mare or cow is able to walk, it is an easy matter to move her to another building, where reasonable comfort and convenience can be had ; but if she is recumbent it is still no bar to getting her into a comfortable place. If a goodly amount of bedding is thrown upon the floor, a cow or mare can be taken by 4 or 5 men for a few feet, or a few rods for that matter, without much delay or difficulty, if the veterinarian knows how to control their efforts. For this purpose it may be necessary to demolish a partition or to take other action which may to some extent injure the owner's property or cause him some labor to repair, but the operator is entitled to such surroundings as will furnish him with a reasonable degree of safety and comfort and permit him to do his work in a way which will promise some hope of success. In many instances the obstetrist must put up with very numerous inconveniences, but these should be reduced to a minimum.

The position of the pregnant animal during obstetric operations is of fundamental importance. Generally, in the larger animals most operations can be best carried out with the patient in the standing position. In this position the abdominal floor slopes downward and forward below the pubis and the gravid uterus drops forward toward the diaphragm. This admits of more ready repulsion of the fetus, facilitates the correction of any deviations in its extremities, and favors the carrying out of most obstetric operations.

Sometimes the animal, especially the cow, is exceedingly obstinate and refuses to stand even under the greatest punishment. It is usually of little use to lift the cow by force, because she

absolutely refuses to try to stand. If slings are placed under her and she is raised by means of pulleys, she still thwarts the obstetrist's aim by lying limp in the apparatus and producing the same or even worse conditions than though she were lying down.

The most efficient method of getting an obstinate cow to stand is by means of a well-trained dog. When such a dog is brought into the stall and will take hold of the cow in a vigorous manner, if she has enough strength to rise, she will get up very promptly, and, as long as the dog will stand by, ready to interfere the moment she attempts to lie down, she will continue to stand as long as she is able. It might not be an unwise plan for the veterinary obstetrist, with much cattle obstetrics, to regard a well-trained dog as a part of his obstetric equipment and have the animal accompany him in all cases of dystokia, ready to render such a service.

Some animals suffering from dystokia are vicious, and the operator must take precautions against injury from them. In carnivora it is wise to muzzle the patient before attempting any work which may induce any vicious resistance. In ruminants there is almost no danger to the operator because of any viciousness upon the part of the patient. Very rarely the cow may kick, but this we have not observed.

It is very rare that the mare offers any violent resistance to the work of the operator. Some have suggested that in all, or in most cases, an assistant should hold up the mare's forefoot, but in an extensive experience among mares we have encountered only one which required any definite restraint in so far as viciousness was concerned. Almost always the mare stands quietly, or at most merely steps from side to side, and does not offer to kick. In the one exception in our experience we found it necessary to cast the mare and tie all four feet, because she persistently and viciously kicked and fought, and rendered our work both highly dangerous and wholly inefficient until she was thoroughly secured. The securing of the animal, by tying, compressed the abdomen and greatly increased the difficulty of our operation. The difficulty would have been largely obviated by general anaesthesia.

Although the standing position is usually the most favorable one for operating, it is not uniformly so, and in some instances recumbency is preferable.

Whether the recumbency is unavoidable or is brought about

by the operator for special reasons, the position of the recumbent animal is highly important.

If, for instance, an animal is recumbent and there is a deviation of the fetal head toward the left side of the mother, it would be highly unfavorable for the operator, should the mother lie upon her left side, because the weight of the fetal body would thus be thrown upon its head. This would necessitate lifting the fetal body in order to correct the deviation of the head and bring it into the proper position. If the patient lay upon her right side instead, the fetal head would rest upon its body and it would be more readily extended. Hence in many instances it is desirable to change the attitude of the recumbent animal or even to cast the patient in order to effect certain manipulations or changes of position. Usually, when an animal is recumbent, she should be placed with her hind parts elevated, in order that the fetus may drop away forward toward the diaphragm, and afford increased room and facility for repulsion, changes in position or other desired operations. It is important generally that the recumbent animal should lie prone upon her side with all her limbs free and extended.

It is very disadvantageous to the operator for the patient to lie upon her sternum, since this position causes undue pressure upon the abdomen and crowds the gravid uterus against or into the pelvis so tightly as to render repulsion well nigh impossible, and any other changes in the position of the fetus or the correction of any deviation of an extremity very difficult.

In order to elevate the hind quarters of a recumbent animal, extra bedding may be placed beneath the posterior parts to any degree desired. Sometimes advantage may be taken of sloping ground, like a terrace, and we have placed such an animal in a door-way where the floor within was higher than the ground without. Padding the door well with straw, the cow is placed with her head outward and her buttocks in the stable, at a higher elevation.

The elevation of the posterior parts may also be brought about by placing the recumbent animal upon a heavy door or on a platform of heavy boards, and raising that portion of the door or platform upon which the posterior portion of her body rests, support it by means of blocks placed underneath. Usually, the greater the elevation of the posterior parts of the recumbent ani-

mal, the better for the operator. In order to prevent the patient from sliding down the incline, ropes may be attached to the hind feet, and held by assistants or attached to a post or beam.

Even greater advantage may be afforded sometimes by placing stout ropes upon the hind legs, carrying them over pulleys attached to a beam above, and, turning the patient upon her back, more or less completely suspend her with the head downwards. This causes the fetus, along with the rumen and other viscera, to drop forward by gravity, and affords room for version or other manipulations. The position cannot be maintained for a very long period.

The question of the exact attitude of the patient during obstetric operations is to be determined in each case by the character of the obstacle to parturition.

* * * * * *

The expulsive efforts of the mother frequently constitute an important impediment to obstetric operations, and sometimes render an otherwise very trivial procedure exceedingly difficult, or impossible. Sometimes the slight deviation of a forelimb could be corrected in a few minutes if the patient would not strain, but under constant and violent expulsive efforts it may become a very laborious operation of long duration. So with many other manipulations. It is consequently important that we should understand and apply as fully as possible our means for controlling the expulsive efforts of the mother.

In many cases the expulsive efforts can be largely prevented by attracting the animal's attention, either by frightening it somewhat or by some physical punishment of a moderate character. In the mare a twitch upon the nose will sometimes tend to inhibit violent expulsive efforts. In other cases slight strokes upon the nose and lips with a strap, stick or rope will so attract her attention as to stop the straining. The owner may be able to attract her attention by gently stroking her with the hand, by moving the head up and down or otherwise keeping her attention somewhat attracted by caressing her.

The mare may also be largely prevented from straining by pinching the back or loins with the fingers or by placing a stick of wood, especially one with square corners, across the loins, and having a man on either side press down upon the stick in a

way to cause pain when the animal attempts to arch her back during an expulsive effort. This plan is even more effective in the cow, or her straining may be overcome by tying a hard rope across the back in such a way that it will not permit her to elevate the spinal column in order to strain. For this purpose we use a coarse rope, attach one end near the floor on one side, carry it directly over her loins, draw it through a ring or around a post near the floor upon the other side, and make it fast at such a point that the cow's back cannot be raised above the normal level.

It has been proposed to overcome the violent expulsive efforts of our larger domestic animals by means of tracheotomy. In this way the animal cannot strain so hard because of the fact that she cannot close the larynx and retain the air in the lungs, since it promptly escapes through the trachea tube. This cannot, however, wholly overcome the expulsive efforts, but is worthy of trial.

When these expedients fail, or we desire to wholly control the struggles and expulsive efforts of the animal, we may resort to anaesthesia. We have resorted to chloroform anaesthesia in dystokia in the mare, with the best results, and feel that this method of control has been entirely too much neglected by veterinary practitioners. The veterinary obstetrist, especially when dealing with mares, should always carry a sufficient amount of chloroform to produce anaesthesia, and should be ready to resort to it whenever the exigencies of the case, either from a humane or a surgical standpoint, may demand it.

The Prevention of Infection During Obstetric Operations.

There is no place in veterinary practice where the rules of disinfection are more important than in obstetric work. Nowhere else do we encounter so large and highly receptive a surface for infection as in the uterus, denuded as it is of its protective epithelium at the time of birth.

The operator should be provided, as we have suggested, with ample clothing, which has been thoroughly sterilized and disinfected. If he has recently been engaged in the handling of a putrid wound or some infectious or transmissible disease, and especially if he has recently been engaged upon a case of retained

afterbirth or in removing a putrid fetus from another animal, he should first, by all rules of surgical practice, have taken a thorough bath and had a complete change of clothing, in addition to having thoroughly and carefully disinfected all those portions of his body which have been in any way soiled or contaminated during the previous operation. He owes this duty, not only to the owner of the animal, but equally to his own reputation as a practitioner.

When called to a case of dystokia, he should prepare an abundant supply of efficient disinfecting solutions which he can use in disinfecting anew his hands and arms immediately before beginning his operation.

The thorough cleansing and disinfection of the hands and arms serves a double purpose in practice. It protects the patient against any infection which the operator may carry upon his hands or arms and, when the skin and skin glands of the operator's hands and arms are well saturated with a disinfecting solution, it affords to him a definite protection against infection from the animal.

This danger of infection to the operator, especially in cases of a putrid fetus or afterbirth, constitutes one of the greatest risks with which the veterinarian has to contend. There are few veterinarians who have not, at one or more times, suffered more or less seriously from infection from these causes, and it is of fundamental importance that this danger be guarded against as thoroughly as possible.

Such infection usually occurs, not on the hands, but on the arms, where the skin is more delicate and the hair folicles and sweat glands offer a better opportunity for the entrance of microorganisms. Apparently those persons who sweat freely are most subject to infection in obstetric operations.

Some depend chiefly upon the lubrication of the hands and arms with oil or fat, to which possibly some disinfectant has been added, but it has been our constant observation that fats and oils are immediately dissolved by the fetal fluids, and consequently cease to afford any protection almost as soon as the hand and arm have been introduced into the genital passages. Such anointing of the arms is of little value from the standpoint of the prevention of infection of the operator, but has some value as a lubricant. Infection of the operator's hands and arms may be largely or wholly prevented in several ways.

We may use a variety of disinfectants, and the thorough use of any one of them will render a more or less efficient service. Lysol has a marked superiority as a disinfectant in these cases, because, in addition to possessing a high bactericidal power, the solution is unctuous and renders the hands and arms slippery as would oil or fat, and thus favors their introduction into the genital passages. Possibly a better protection to the operator may be afforded by astringent antiseptics. Corrosive sublimate, with its high bactericidal power, possesses astringency to a considerable degree, and tends thereby to close the mouths of the hair follicles and glands in a way to prevent the invasion of the disease organisms. Permanganate of potash also has a very high efficiency, and is more astringent than the corrosive sublimate. It has still another very estimable quality, in cases of putrid decomposition of the fetus, in that it is one of the best, if not the best deodorizer which is in common use. After using this drug it is necessary to use a warm concentrated solution of oxalic acid to decolorize the stain on the skin. If some one of these antiseptics is used frequently and freely in this way and, as soon as one supply of the solution becomes contaminated, it is thrown away and a fresh solution prepared, much will be accomplished toward preventing any infection of the operator's hands or arms.

Preliminary to any measures looking to the prevention of infection of the hands and arms of the operator by the direct application of antiseptics to these parts, should be the disinfection of the patient. Before undertaking the examination or operation, the tail, vulva, and all the surrounding parts should be thoroughly cleansed and disinfected. If the vaginal canal is soiled, it should be thoroughly flushed out with a disinfectant. If the fetus is putrid, there should be repeatedly forced into the uterine cavity, alongside of the fetus, large volumes of a warm disinfecting fluid, preferably of lysol, because of its unctuous character. Not only should the uterine cavity be filled with large volumes of such disinfectants prior to the beginning of the operation, but the disinfection should be repeated frequently throughout the entire operation. By such a plan, not only is the operator protected, in the largest measure possible, but the patient also is protected against serious infection through abrasions which may exist or be caused in the course of the operations.

If the animal is recumbent and cannot be induced to stand, it

is desirable to spread a clean sheet or cloth, which has been dipped in a disinfecting solution, immediately behind the animal in a way to cover over any bedding or litter and prevent it from being dragged into the genital tract of the mother upon the hands or arms of the operator.

After the removal of the fetus, in all cases of dystokia, it is important at once to follow with the removal of the membranes, if practical, after which the uterus should again be disinfected thoroughly with a large volume of antiseptic solution, providing always that we can be sure that the integrity of the uterine walls has been preserved and that there are no penetrating wounds into the peritoneal cavity. In the latter case we should simply attempt to remove mechanically all the infectious material, so far as is in our power, and be very careful to not inject fluids into the uterus which will find their way into the peritoneal cavity and probably at once cause the collapse and death of the patient. If it has been clearly determined that the uterus is wholly intact, the injection of large volumes of warm disinfectants into its cavity produces three important results: disinfects the cavity and decreases the danger to the patient later, from infection and its consequences; serves an important purpose by straightening out the walls of the uterus and tending to correct any displacements of the organ—if one of the horns is somewhat displaced or has begun to evaginate or evert, it tends to restore it to its proper position; the presence of the warm solution in the uterus, in sufficient volume to cause distension, stimulates a quite vigorous contraction of the organ—involution—which tends strongly to eliminate the uterine cavity and prevent prolapse of the uterus or vagina.

The Examination of the Patient.

Before proceeding with any operations in cases of dystokia, it is essential that the practitioner should make a careful examination of his patient. First he should determine as well as practicable her condition, whether she is strong and vigorous or weak and debilitated, or he should determine if there is anything in her general condition which would suggest some serious or fatal lesion, such as internal hemorrhage from a uterine rupture. This knowledge can be gained partly by the general appearance of the patient and partly by examination of the pulse and visible mucous membranes.

It is highly important also that the veterinarian determine very early, both from a forensic and a professional standpoint, whether empirics or others have meddled with the case prior to his arrival and have caused thereby more or less serious injury, which, if passed unnoticed, may later lead to serious embarrassment to him.

It is exceedingly unfortunate, for example, for a veterinarian to be called to attend a case which has previously been meddled with by an empiric, to the extent of rupturing the uterus or causing some other fatal lesion, and to proceed with the operation of delivering the animal without having first discovered that the fatal injury exists. Should this error be committed, the veterinarian is almost inevitably blamed with having caused the injury himself and might even be held legally responsible for the consequences.

In one case we were called to attend a valuable mare suffering from dystokia, in which the head of the fetus was deviated to the side and an empiric had attempted to catch the head with a butcher's hook in order to correct the deviation, but failed to do this and had ruptured the uterus instead. We were not advised that anyone had attempted delivery, and in fact meddling with the case was denied. We proceeded to perform embryotomy without examining the uterus very carefully except in the posterior region. When nearly through with our operation of embryotomy, the rupture was discovered owing to the prolapse of the intestines of the mare through the rent in the uterus. It was only under hard pressure that the owner was finally compelled to admit that other parties had attempted the delivery before we had been called.

Similar experiences are common in veterinary practice, and should always be guarded against as carefully as possible, because such oversight is liable at any time to very unfavorably affect the professional standing of the veterinarian.

In such an examination the practitioner should also determine the condition of the genital organs in every way, whether the passages are fully dilated or are dilatable, whether they are normal or obstructed, or if they are inflamed, swollen or necrotic.

It is highly important also to learn at once whether or not there is any displacement of the uterus, such as torsion. The condition of the fetus is also highly important in reference to the course to be pursued and the prognosis. It should be de-

termined as early as possible if the fetus be dead or alive, and, in case it is dead, much depends upon whether or not it has undergone decomposition.

In ruminants an emphysematous or putrid fetus may frequently be removed with excellent results, since they are very resistant to infection from this source, while it is a well known clinical fact that it is difficult to save the life of a mare if her fetus has become putrid. It is also exceedingly difficult to save the life of a mare if she has been in labor more than 24 hours, although much will depend upon the position in which the fetus lies, whether it has become impacted in the pelvic canal or not, and the amount of interference which the mare has suffered at the hands of incompetent persons.

* * * * * * *

It is highly important that the veterinarian determine precisely the nature of the obstacle which is to be overcome, to which end it is essential that he should be able to identify the various portions of the fetus by the sense of touch, and to determine thereby the presentation, position and deviation with which he has to deal. While apparently it should be easy for the operator to determine the portion of the fetus which he touches, it is not, after all, a light task.

The differentiation between the anterior and posterior limbs sometimes offers very great difficulty. Some writers give certain rules by which one may differentiate between an anterior and a posterior limb, but their rules are not wholly applicable. Some suggest that certain joints of the limb bend in a given direction. In dystokia, however, a limb may be in such a position that it can not possibly be determined in which direction it would bend, because it is so firmly impacted that it cannot be bent or moved in any direction.

Inside the uterus, with that organ closely investing the fetus, the differences, to the touch, between the anterior and posterior limbs are not so marked sometimes as the obstetrist would wish. If he can readily reach the fetal body, he may quite easily determine which leg he is dealing with. He cannot, however, tell the fore and hind feet apart until he at least reaches the carpus and tarsus. Even then the tarsus may be so extended that it presents a very strong resemblance to the carpus, though they may generally be differentiated because the os calcis, with the

tendo-Achilles attached to its summit, is more prominent and clear-cut than the pisiform bone of the carpus with its attached tendons. If the elbow can be reached and compared with the stifle, they are generally quite easily distinguished, and as soon as we can reach above these two parts the difficulty of differentiation usually ceases to exist.

In examining the limbs for purposes of identification, the inexperienced veterinarian must preserve his equanimity and not be too hasty in his conclusions, but deliberately search the extremities with which he is dealing until they are clearly identified upon anatomical grounds.

In the event of 3 or 4 limbs being presented simultaneously, it is sometimes more difficult to trace and identify each member because of their intricate entanglement. The passages are so filled, because of the extra number of limbs, that one can insert the arm only with difficulty, and under such severe pressure that the sense of touch is somewhat dulled. When the feet of two fetuses present simultaneously, they are liable to cause very great confusion in diagnosis, and one needs be very careful to determine if twins exist or not.

Sometimes twins may offer in the inlet one hind limb of each fetus, the head and one or both fore feet of one fetus with one or both hind feet of the other twin, or other confusing variations. All such possibilities are to be carefully considered.

In fact, we might state, as a rule in practice, that a foot should not be drawn upon to any great extent with a view to extracting a fetus, unless we have first determined by exploration that it belongs to the fetus which we desire to exert traction upon. If the veterinarian is at all careless in his diagnosis, he may get hold of one limb belonging to one fetus and another limb belonging to a second fetus, and proceed to draw upon them as belonging to one, with embarrassing results.

It must be constantly remembered also, in the identification of the feet of one or more fetuses which are presenting, that a single fetus may be deformed in such a way that both the anterior and posterior parts of the body are simultaneously presented, and thus we may have offered at the pelvic inlet the head and all four feet. This is especially true in the cow, where we meet with two forms of monsters which are exceedingly confusing in this respect. The most common of these forms is the *schistocormus reflexus*, in which the fetus is virtually turned inside out, so that its viscera

are lying outside the fetal body, free in the uterine cavity, while the skin of the posterior part of the body is turned inside out and envelops the anterior portion as a bag, with the hair on the inside and the head and all four feet presenting toward the pelvis, without regard for any systematic arrangement, in a confusing tangle.

A more orderly deformity of the fetus, which we have seen in the cow, is the *campylorrhachis contortus*, in which there is an abrupt lateral curvature of the spine, without the body being open. In this we find the fetal head, resting upon the two fore limbs, presenting at the pelvic inlet, and with it the two hind-feet with the soles of the feet turned upward; or in other words, we find the anterior portion of the fetus in an apparently normal anterior presentation, dorso-sacral position, with the head and anterior feet presenting in the most favorable manner, and also an apparently normal posterior presentation, dorso-sacral position, with the hind feet fully extended in the pelvis. Such a presentation is exceedingly confusing because it constantly suggests twins, though when attempts are made to repel one part and advance the other it is found to be impossible. On the other hand, when one part is repelled the other recedes, and when one is advanced the other advances likewise.

In some cases, where there are important teratologic conditions, it is difficult to determine the part of the body with which one is dealing. It is necessary to study carefully the anatomical relations of each part. In hydrocephalus, with a large amount of fluid in the greatly distended cranial cavity, the part sometimes reminds one very much of the fluctuating abdomen of the fetus, and can be differentiated only by finding and recognizing the ears, eyes, mouth, or some other definite part of the fetus.

So with every other part, the veterinarian must continue his search until he is able to fully recognize the anatomical characters with which he is dealing. It may be necessary, for this purpose, to extend his search for a considerable distance in every direction in order to make out fully and safely the character of the position with which he has to deal. The special difficulties of diagnosis in given cases will be more fully considered under their various heads.

The General Handling of Dystokia.

A thorough examination, such as we have already outlined, should result in a diagnosis of the presentation and position of

the fetus and its relation to the genital organs and the pelvis, should give us a clear conception of the difficulties which are to be overcome, and indicate the method by which they may be surmounted.

It is also essential, after the examination has been made, that a judicious prognosis should be reached, both as related to the mother and to the fetus or fetuses. It should be determined whether the life of the mother can probably be saved, and by what means, and whether, in case she is saved, her condition will be such as to render it worth our while either from an economic or a sentimental standpoint. If the life of the mother cannot be saved by an operation, it is evidently needless to make a prolonged effort in her behalf. If she may be saved, but her condition will render her of little or no economic value, or would overcome any sentimental reasons for preserving her life, then the situation should be made perfectly clear to the owner. For example, in a case of dystokia in the mare, which has been meddled with by an empiric, and in which the fetus has been dead for a long period of time and has become putrid, and perhaps in addition there is a rupture in the uterus which must inevitably lead to a fatal termination, it is clearly injudicious for the veterinarian to attempt delivery, and he should strongly insist upon the destruction of the animal.

On the other hand, so long as there is reasonable hope that the animal's life may be saved, it is the duty of the veterinarian to do whatever may be in his power to accomplish this purpose.

The veterinarian, in his prognosis, should refrain with equal care from radical optimism and pessimism. The destruction of a patient suffering from dystokia should not be recommended or urged except upon the most unequivocal grounds. It is a common observation for one veterinarian to pronounce a case hopeless and the dystokia insurmountable, and for another veterinarian, by intelligent work, to save the life and value of the animal.

Sometimes the veterinarian gives an unfavorable prognosis and advises destruction in order to escape from a difficult or repulsive task. This is very bad policy, and lowers the standing of the veterinarian. If possible to save the patient, the veterinarian should proceed to make an earnest attempt to do so. After having done his utmost, his responsibility ends. In other instances, like in severe cases of rupture of the prepubian tendon, it is impossible to bring about a recovery of the mother from the

injury, in so far as her general appearance is concerned, but she must be forever left with an immense hernia which virtually destroys her value in any position where appearances have any weight. Hence, although the life of the mare may be saved, her value is usually destroyed. But she may have a temporary value for raising the foal which is to be born at the time, or even a permanent value if the owner does not object to the appearances.

The obstetrist must also reach as reliable a conclusion as possible in reference to the life of the fetus, and determine if it is possible to save it or not. We have already suggested that the foal perishes quickly when expulsive efforts set in, while the calf does not, and this and other known facts should be considered in determining the probability of extracting the fetus in a living condition, if it is still alive when the veterinarian reaches the patient. In the mare, if the obstacles to birth are of such a character that much time will inevitably be demanded to overcome them, it is quite clear that a living foal is not to be expected, and consequently, if conditions so indicate, the veterinarian is fully warranted in proceeding at once with embryotomy.

Sometimes the obstacles are such that we may be able to save the life of either the mother or fetus equally well, but cannot save both. In such instances the veterinarian is placed in a position where it is necessary to consider which of the animals, the mother or the fetus, possesses the greater value, and the life of which can be most certainly saved. The decision must largely rest with the owner, though the veterinarian needs be in a position to place the question clearly before him.

Having reached a satisfactory diagnosis and prognosis, the veterinarian needs determine upon a definite plan of procedure, and this may be either tentative or final. Generally speaking, the veterinarian must consider the consequences of his plan upon the mother and the fetus, the amount of labor which will devolve upon him, and the consequent economic feature to the owner.

In many cases it is desirable to adopt a tentative plan of procedure, with an alternate final operation in case the first should fail. It is essential that the tentative plan should possess certain definite possibilities, and consequently offer hope of a favorable solution. We might illustrate this by comparing two analogous positions in the foal and calf. In each of these, in the anterior presentation and dorso-sacral position, the head is frequently deviated laterally. In the calf the neck

is very short, and the head is usually within reach, so that the deviation may be corrected with more or less facility. With the foal this deviation is quite frequently due to a deformity of the neck, known as wry-neck, in which case the neck has been extremely bent during a great part of its intra-uterine life and the head rests far back in the foal's flank, where it is difficult or impossible for the obstetrist to reach it. Even if it can be secured, it may still be almost impossible to correct the deviation because of the deformity. In case of the calf, the tentative plan of correcting the deviation almost always succeeds, and should be applied. In many instances, in the foal, the correction of the deviation is so improbable that it may be injudicious to attempt it, but we should rather proceed at once to embryotomy. Even if such a foal be extracted alive, it would still be worthless because of its deformed head and neck. Judgment must be used, and a tentative plan not carried too far, exhausting the strength of both obstetrist and patient in an attempt to accomplish something which must eventually be abandoned and another plan substituted.

Already we have had occasion to suggest that the obstetrist should carefully husband his strength. There is still an abundance of work for him, and the overcoming of dystokia not infrequently proves a herculean task and leaves him in the end quite exhausted from the severe ordeal. We would not, however, over-emphasize this strain upon the physical powers of the veterinary obstetrist, as some writers have done, and have him believe that this work is extraordinarily trying or dangerous. We have not found that it offers any markedly greater difficulties than other surgical procedures. When the veterinary obstetrist promptly attends a case, he usually has time to plan his work deliberately and to carry it out without extraordinary haste. There come crises in these operations, as well as in others, where a man must act quickly at a given point in order to accomplish his purpose, but as a general rule there is every reason for deliberation and careful planning of every portion of the work.

A great source of strength and efficiency to the veterinary obstetrist is ambidextrousness, which can be acquired by any one with proper practice. When the operator can use each hand and arm with equal facility, his efficiency is more than doubled. It is usually the hands and arms, not the body, which really become fatigued during obstetric operations.

OBSTETRIC OPERATIONS.

In overcoming dystokia, a number of operations may be demanded, which vary greatly in character and which may admit of many variations in technic. It is but natural that the obstetrist should be as conservative as possible in the selection and carrying out of a plan for the overcoming of obstacles to delivery. He should have in mind the entire list of available obstetric operations, and determine which of these he should elect to carry out in a given case. In determining upon a plan for operating, he should consider first that plan which is the most conservative, since if it succeeds it is best from the standpoint of the well-being of the mother, of the fetus, of the operator, and of the economic interests of the owner.

The chief obstetric operations are:

1. Mutation, or changing the position of the fetus.
2. Forced extraction.
3. Embryotomy.
4. Caesarian section, or gastro-hysterotomy and hysterectomy.

I. Mutation.

In the preceding pages we have indicated that, in order for birth to take place normally, it is essential that the fetus should present in a longitudinal direction, either anteriorly or posteriorly, and that it is highly important, if not quite necessary, that the fetus should be in the dorso-sacral position. In the larger domestic animals, it is essential that, in the anterior presentation, both fore-feet should be well extended, and the head resting upon these with the nose reaching nearly to the fetlock joint. In the posterior presentation, the two posterior limbs should be fully extended. Any deviation from this attitude in the larger animals calls for more or less interference on the part of the obstetrist, in order that birth may occur.

It has been noted that in the smaller domestic animals the attitude of the fetus in its passage through the birth canal differs somewhat from the above. In the carnivora, when in the anterior presentation, the head usually presents alone, with the feet doubled back beneath the chest. The position of the fetus or the deviation of parts is exceedingly variable, and it is the function of the obstetrist to bring each part into the normal presentation

and position, or otherwise overcome the obstacles to birth. The chief operations or manipulations by which it is hoped to correct the position or attitude of a fetus are repulsion, rotation, version and extension.

A. **Repulsion or retropulsion** of the fetus consists of pushing it backward, or away from the pelvis, toward the diaphragm, in order that it may be returned into the abdominal cavity, and contemporaneously into the uterine cavity, where space is available for changing the position of the various extremities or of the entire body. It is necessitated by the fact that the pelvic canal is so narrow, and so completely filled by the fetus when it has once entered, that there is little or no room for carrying out any extensive changes in the attitude of the fetus, and consequently it must be repelled or pushed away from this narrow channel into a more commodious cavity, where ample room may be obtained.

While considering the various obstetric instruments and their uses on page 595, we have described the methods for producing repulsion.

B. **Rotation.** It has already been stated that, in order for a fetus to pass readily through the birth canal, it must offer in the longitudinal presentation and the dorso-sacral position. When presenting otherwise, it is desirable, if not necessary, that the fetus be rotated upon its long axis until it is brought into the dorso-sacral position, and its expulsion or extraction thus facilitated or rendered possible.

The rotation of the fetus upon its long axis is naturally most practicable when its body is lying within the abdominal cavity, because, when it is advanced into the pelvic canal, it is exceedingly difficult to bring about such a rotation owing to the limited room. In accomplishing rotation it is to be borne in mind that a fetus entering the birth canal in any other than the dorso-sacral position is in an unstable attitude and tends to rotate to the proper position, except as prevented by the firm impaction of the fetal body in the narrow channel.

The aim of the obstetrist is to aid these natural forces as far as possible in accomplishing the object desired. First of all, the body of the fetus should be pushed away, if possible, into the abdominal cavity, while its limbs are retained in the pelvic canal, as levers, through which the rotation may be largely accom-

plished. Preparatory to rotation it is highly advantageous to inject into the uterus, about the fetus, a weak solution of lysol or other emollient liquid, to lubricate the uterine cavity and permit the body of the fetus to be more readily revolved.

Most cases demanding rotation offer in the posterior presentation, and usually in the dorso-pubic position. In these, after the repulsion of the fetus and lubrication of the parts, the two posterior feet should be secured by means of cords, to be held by assistants. The operator inserts one hand with the palm upwards and passes it over the brim of the pubis beneath the buttocks of the fetus in such a way that the buttocks rest in the palm of his hand. The pubic brim serves as a fulcrum, upon which the operator uses his hand and arm as a lever of the first class. Lifting upwards against the buttocks of the fetus renders its position less stable and tends to cause it to revolve to the right or left and approach the dorso-sacral position. The instability which has thus been produced may be accentuated by the operator exerting his force somewhat obliquely upwards to the right or left, instead of pushing directly upward. This tends to rotate the body of the fetus in that direction which may seem most favorable.

The assistant in charge of the corded hind feet actively seconds the efforts of the operator by such means as the obstetrist may direct. It has been suggested by some writers that the two feet may be tied together and a short lever passed between them, upon which the assistant may exert a rotary force upon the fetal body in that direction which the operator may direct, thus rendering effective the efforts of the veterinarian. In our personal experience, we have usually had the assistant grasp one or both of the hind limbs, flex the feet at the fetlock until the pastern of each foot is at right angles to the metatarsus, and, using the pastern as a lever, exert a rotary force upon the limb and through it upon the fetal body. We have found this method highly efficient.

Another very effective method, in our experience, has been the application of what we may term cross-traction upon the hind limbs. A cord is placed upon each limb, and each cord given into the hands of separate assistants. The operator places his hand beneath the croup of the fetus, over the brim of the pubis of the mother, as in the preceding plan. If he wishes to rotate

the ventral surface of the body of the fetus toward the right of the mother, he lifts upward and to the left, upon the buttocks, while the assistant having charge of the cord upon the right foot stands upon the right side of the patient and draws obliquely upward to the right, changing the direction gradually to the right and thence downwards. The assistant having charge of the cord upon the left foot crosses it behind the right, draws gently obliquely backward to the left, and aids the rotation by holding the fetus away from the right side of the pelvis.

In the anterior presentation, the general plan of the operation is similar, though it may be rendered far more difficult by the presence of the head and neck. It may even be necessary that the head be amputated before the rotation can be effected. Aside from this the plan should be carried out essentially the same, except that the operator's hand acts upon the withers of the fetus, instead of upon the buttocks, as in the preceding case.

C. **Version.** Since it is essential that a fetus present longitudinally in order to be expelled, it follows that, when it presents more or less transversely, such an attitude needs be changed to the longitudinal presentation before the fetus can enter the pelvic canal. In other words, we must change the presentation of the fetus by bringing its long axis into a line parallel with the spinal axis of the mother. Empirics occasionally state that they have accomplished version of the fetus when it has presented longitudinally and have changed a posterior presentation into an anterior one. This assertion has been to some extent copied by some veterinary writers. It must be very plain to any intelligent veterinary obstetrist of experience that such an operation is impossible, under normal conditions, and could only be carried out in cases where the uterine cavity is very large and the fetus very small, in which case there is evidently no good reason whatever for carrying it out. Version is confined in obstetric practice to the changing of a transverse into a longitudinal presentation.

Version may be of two classes—anterior and posterior. The operator usually prefers to convert a transverse into a posterior presentation, because he then needs deal with but two extremities, the hind limbs; whereas, were he to convert into an anterior presentation, he would need bring the head and both anterior limbs into the passage.

When the fetus presents transversely, with either the dorsal or the ventral surface toward the pelvic inlet, its version must be accomplished by causing one extremity of the fetus to advance and the other to recede. This is caused by exerting traction on one extremity while repelling the other. When the fetus presents transversely it usually does so by the ventral surface, with the head and all feet more or less in reach, and several or all of them requiring attention upon the part of the obstetrist. Assuming that the obstetrist desires to convert a ventral transverse into a posterior presentation, he first identifies the two posterior limbs and attaches cords to these. In the foal he should usually next amputate the two anterior limbs (see Subcutaneous Amputation of the Anterior Limbs) in order to render the operation easier for the operator and safer for the mare. The amputation is not usually advisable in the cow, and is not always absolutely necessary in the mare.

When the question of amputation of the forelimbs has been decided, and carried out or not as circumstances may dictate, an assistant exerts traction upon the two posterior limbs, while the operator applies or directs repulsion upon the sternum or other portion of the head end and pushes it away as far as possible into the uterine cavity, while the posterior end of the fetus is being advanced by the traction upon its hind limbs. While the version is being accomplished the operator should see that the necessary rotation of the fetus on its long axis is also occurring. The required rotation is best attained, in such cases, by what we have described on page 633 as cross traction. When the version has become essentially completed and the rotation accomplished, the extraction of the fetus is continued by means of traction upon the posterior limbs.

Should the operator desire to convert a ventral transverse into an anterior presentation, which we never advise, he would secure and apply traction to the two fore limbs and the head, and at the same time repel the posterior limbs as far forward as possible.

In the dorsal transverse presentation, the version needs be executed in a manner similar to that designated for the ventral presentation. Here extremities are not available for the exertion of force. If it is desired to convert into a posterior presentation, which we prefer, the head end of the fetus is to be repelled by force applied obliquely forward and toward the head end of the

fetus, until the tail may be reached and traction applied to it, or a hook implanted in the anus or about the buttocks, so that traction may be applied to the tail end, causing it to advance until the hind legs may be secured and the traction applied to them. When the posterior limbs have been secured and the feet have been brought into the passage, it yet remains to rotate the fetus and convert the dorso-ilial into the dorso-sacral position, after which the rules for delivery in posterior presentation, dorso-sacral position, apply.

D. **Extension and Adjustments of the Extremities.** In dealing with the attitude of the fetus during parturition, we have described the normal position of the extremities and have noted that, when they become materially deviated, they produce more or less serious obstacles to the expulsion of the fetus. The deviations with which the obstetrist must deal are those of the head, neck and limbs.

The correction of these deviations must be carried out anterior to the pelvic cavity, within the abdomen. It is consequently essential, in most cases, that the fetus be repelled in order to bring about these corrections. It should be constantly remembered that, in a large proportion of cases, repulsion of the body of the fetus, and those extremities which are presenting normally, has a constant tendency to bring about a correction of the deviation.

If the head is deviated to the right or the left, upward or downward, repulsion of the fetal body tends constantly to cause the head and neck to become extended. The reflexed head comes in contact with the uterine walls, which resist its retreat while the body is being repelled, and the head then tends to come forward into its normal attitude. The same is more or less true with most of the deviations of the extremities, which are constantly aggravated as the fetus advances toward the vulva, and tend as constantly to be ameliorated or even overcome when the fetus is repelled into the uterine cavity.

In addition to the two foregoing factors, the securing of room and the natural tendency for these parts to become extended in their proper position during repulsion, the veterinarian must intelligently apply his knowledge of mechanics and anatomy to his task. If the head is reflected to the left side of the fetus along the right side of the mother, it is very evident that, if

the patient is lying upon her right side, the weight of the fetus upon its bent neck will offer a serious mechanical obstacle to the correction of the deviation. In such a case the recumbent patient should be turned to her left side. Similar directions apply also to deviations of the limbs, and should constantly be borne in mind in all such work.

Another point of mechanical advantage which should be constantly applied is that, if we wish to extend a flexed extremity, we can at least double the efficiency of our efforts by the simultaneous application of traction upon the distal end of the flexed

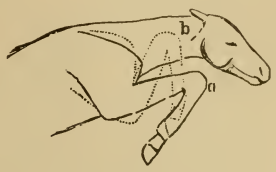


FIG. 107. SCHEMATIC ILLUSTRATION OF THE EXTENSION OF A FORE LIMB FLEXED AT THE CARPUS. (FRANCK.)

extremity and repulsion upon its proximal end or upon the fetal body. For example, in the deviation of the head to the left, if we can apply traction to the head by means of a hook in the orbit, mouth or nose, or by a cord attached to the inferior maxilla, as shown in Fig. 108, and described on page 581, while the body of the fetus is being repelled by force applied to the sternum or base of the neck, the efficiency of our efforts is very greatly increased. The simultaneous application of these two forces should be the constant aim of the veterinarian. The traction may be applied with hooks or cords; the repulsion by the operator's hand, or by a repeller in the hands of an assistant.

In extending a flexed limb, the same general mechanical rules are to be applied. Take for example a fetus presenting anteriorly in the dorso-sacral position, an anterior limb flexed at the carpus, Fig. 107. When the fetus has been repelled, with or without decapitation, and sufficient room for operating obtained, the retained foot is corded at the pastern, or as near to that point as is possible, by one of the two methods described on page 579, and the cord is entrusted to an assistant.

If impossible at first to attach the cord about the pastern, it should be made fast as low down on the metacarpus as possible. While traction is applied upon this cord by an assistant, the operator may pass a second cord beyond the first, and, as the foot is being brought nearer by traction upon the first cord, the noose of the second may be pushed over the fetlock and engaged upon

FIG. 108. METHOD OF SECURING THE LOWER JAW BY MEANS OF A LOOPED CORD.

the pastern. It is to be emphasized that in correcting a deviation of a limb, whether anterior or posterior, the ultimate aim is to get the noose upon the pastern. Until that can be accomplished, the correction of the deviation is uncertain.

While the fetus is being repelled, the assistant draws upon the cord and advances the foot. The carpus, by this process, and with the aid of the operator, passes into the lumbar region, directed obliquely outwards and upwards into the upper portion of the flank in order to afford the greatest possible amount of room. The carpus (or tarsus) must not, for this purpose, abut against the unyielding lumbar vertebræ or lateral processes, but must be pushed outward against the yielding flank, and room thereby afforded for the necessary extension of the foot. At the proper time the operator inserts his hand, palm upwards, between the pubic brim and the foot of the fetus; grasping the toe in the palm of his hand, the assistant, by the operator's direction, applies traction upon the cord, and the foot glides over the pubic brim, to become extended in the pelvic canal.

Should the anterior limb be completely retained, instead of merely flexed at the carpus, the procedure is similar. The foot is now wholly out of reach, and the forearm can be reached only with difficulty, or not at all until repulsion has occurred. When sufficiently repelled, the forearm is grasped with the hand and corded while the repulsion is continued, and the carpus is gradually drawn up until it comes against the pubic brim, when its further correction is carried out in the same manner as above suggested.

Similar rules apply to the corrections of the deviations of the posterior limbs; that is, the fetus must be repelled from the pelvic inlet, and that part of the limb which can be reached must be corded and brought up. This in itself acts as a repellant to the fetal body, and finally the tarsus is pushed obliquely outwards and upwards into the upper flank region, the pastern corded, and the toe, enclosed in the hollow of the operator's hand, is guided over the pubic brim and extended in the pelvic canal.

These changes in position constantly require a careful application of mechanical principles, and are to be carried out with caution. The work should be done as gently as possible, in order to avoid arousing violent expulsive efforts. When they do occur, and constitute too great an obstacle, they should be overcome by such means as those suggested on page 619. While generally we would bring about these corrections without haste, when we reach a critical point it is frequently essential that they should be accomplished very promptly. Thus, when the carpus or tarsus

has been pushed into the upper flank region and the toe or fetlock is impacted against the brim of the pubis, it is important that the operation be completed promptly, both because any unnecessary delay may lead to a return of the foot to its former position and because violent expulsive efforts of the mare may cause serious injuries to the uterus or other parts.

II. Forced Extraction.

By forced extraction we understand the withdrawal of the fetus from the mother, through the genital canal, by the application of traction, without changing the position of the fetus or any of its extremities which may be deviated, or reducing its size. It is applied in those cases where the abnormal size or position of the fetus, or of one of its extremities, is such that the obstetrist believes that it is better to draw the fetus away by force than to correct the position, or deviation, or to perform embryotomy or Cæsarian section.

The reasons which may prompt the obstetrist to resort to forced extraction may be quite varied. It may be that forced extraction will offer the best or only opportunity for saving the life of the fetus. In the foal, for instance, forced extraction, in rare cases, might save its life, whereas the delay which might be essential to the correction of the position would lead to its death.

From the standpoint of saving the life of the mother, it may sometimes be safer to resort to forced extraction than to submit her to a tedious operation, not unaccompanied by dangers, in correcting the position of the fetus, in embryotomy or in Cæsarian section. As a general rule, in the larger animals embryotomy, properly carried out, is less dangerous to the mother than forced extraction. It is only in very rare cases that this rule is reversed. In the smaller animals embryotomy is usually impractical, and our choice of procedure frequently rests between forced extraction and Cæsarian section.

From the standpoint of the operator, forced extraction is easier and consumes much less time, but the results are generally unsatisfactory. The higher the knowledge and skill of the veterinary obstetrist, the less frequently does he resort to forced extraction of the fetus.

The empiric habitually resorts to forced extraction in a very brutal manner, and with great losses to the owners of patients.

We have frequently known empirics, who were not competent to perform embryotomy when a foal presented anteriorly with the two anterior limbs in the birth canal and the head completely deviated to the side, to apply a sufficient amount of brute force to tear the fetus away in a most inhuman manner. Sometimes they hitch a horse or horses to the foal, and tear it away very roughly. One empiric in our territory resorted habitually to tying a strong rope to the two anterior feet of the foal and fixing the other end of it to a tree or a strong post, and then, by means of a whip or other punishment, forcing the mare to pull away her own fetus in a most brutal manner. So far as I was able to follow his operations, they invariably resulted in the death of both the mare and fetus.

Other veterinary obstetrists advise forcible extraction in various positions, though with more foresight and care. Some report good results, but so far as we have learned never so good as though embryotomy had been properly performed.

Forced extraction should not be employed in most cases of improper presentation or position of the fetus. It cannot succeed in any transverse presentation, but only in those which are longitudinal.

Forced extraction should be limited, in its application, to those cases where the fetus is comparatively large and in the normal position, and in which the withdrawal of the fetus by force will, in the judgment of the obstetrist, prove better for the interests of the owner, as affecting the life of the mother, the fetus, or both, than would other means of delivery; and to those cases of unnatural position or deviation of the extremities in which it would be better and safer for the mother or fetus, or both, to force the fetus through the birth canal without its position having been corrected.

Personally, we have limited forced extraction to those cases where a large fetus, or a fetus of normal size enlarged because of emphysema, presents in a normal position, and in our experience such a course has been fully warranted. We have already dealt with the technic of forced extraction when dealing with instruments of traction on page 586.

III. Embryotomy.

Embryotomy is the diminution of the size of the fetus by means of the removal of some of its parts, in a manner to overcome

the obstacles to its birth. Necessarily embryotomy involves the sacrifice of the life of the fetus, if it is still living, and the object of the operation becomes limited to the preservation of the life of the mother. It is a comparatively common operation in the larger animals, but is virtually inapplicable in the smaller ones.

Embryotomy possesses certain dangers, such as injuries to the maternal organs, from a slip or misdirection of an instrument or from the projection of a severed fetal bone which may wound or penetrate the uterus or other parts. Not infrequently it involves a long and tedious operation, which may greatly exhaust the strength of the patient.

For the operator, embryotomy frequently means a protracted and disagreeable operation, with danger of wounds from instruments, injuries from the mother, or infection in case the fetus is putrid. Nevertheless embryotomy is one of the most common and valuable obstetric operations, and requires, for its proper application, thorough study, supplemented by extensive and practical experience.

The performance of embryotomy may involve any portion of the fetal body, and presents the greatest possible variations according to the presentation and position. The veterinarian must have a thoroughly practical knowledge of the anatomy of the fetus and the resistance of tissues and parts. Embryotomy may be necessary or advisable in every presentation and position which the fetus may assume, whether it be normal or abnormal. We shall deal with the question as related to the removal or destruction of certain portions of the fetal body, and leave the application of these to be considered under the various forms of dystokia.

We shall consider the technic of the various embryotomy operations, as they may be demanded in the four fundamental presentations, in the order we have already described on page 537.

A. The Anterior Presentation.

a. **Amputation of the Head. Decapitation.** In the anterior presentation, with one or both fore limbs retained and the fetal head engaged in the pelvic canal or protruding from the vulva, repulsion of the fetus is generally necessary in order to correct the deviation of the limb. In many cases the repulsion of the

head is inexpedient or impossible, and the amputation of the head is made advisable or necessary in order that the fetal body may be repelled and the deviated extremity brought into position.

Technic. Attach a cord to the inferior maxilla, as shown in Fig. 108, or around the neck of the fetus, or fix a blunt hook in the orbit, and have one or more assistants draw the head out as far as possible.

Make a circular incision through the integument, encircling the head at a convenient point, and separate the skin backward, by forcing the hand between it and the bones or by using the chisel or spatula or dissecting it away with a scalpel, continuing the separation over the occiput to the atloid region. Make a transverse incision below, across the trachea and esophagus and surrounding muscles, and above through the ligamentum nuchae. Grasp the head firmly with both hands, flex it upon the neck, and twist it forcibly on its long axis, rupturing the articular ligaments and the remaining soft tissues, detaching the head at the occipito-atloid articulation. The removal of the head greatly diminishes the bulk of the fetus; the remnant may now be repelled, the deviated parts brought into the desired position, or other operations performed.

b. **Cephalotomy.** When the fetal head has not advanced far into the pelvic canal or cannot enter the pelvic inlet on account of the comparatively large size of the head, when the pelvis is narrowed by a tumor or callus, or when the fetal head is grossly enlarged because of hydrocephalus, it may become necessary to diminish the size of the head, though it is not in a position to be amputated.

Technic. In these cases the head is usually so firmly engaged in the canal that no further fixation is necessary. After thoroughly cleansing and disinfecting the parts, inject a copious amount of tepid lysol solution into the vagina. Carry the obstetric chisel into the passage, carefully guarded in the hand, and place it accurately upon that part of the head of the fetus where it is desired to begin the operation, generally on the median line of the nose with the blade of the chisel standing parallel to the septum nasi of the fetus. Holding the blade of the chisel firmly against the part, with the hand in such a position as to effectively guard the instrument from slipping aside and wound-

ing the maternal organs, steady and direct the handle with the other hand and have an assistant drive the chisel, by means of blows of proper vigor with a mallet, into the bones of the face and head.

Do not drive the chisel deeper than the length of the blade, without first stopping and forcibly revolving the instrument upon its long axis and breaking the fetal bones apart. The partially detached pieces of bone may be torn away with the fingers of one hand, and the chisel used to complete the separation of the fragment. Repeat the use of the chisel here and there upon the head, as often as may be necessary in order to bring about the required diminution, taking care, at all times, not to wound the maternal parts and to conserve as far as practicable the fetal skin of the face and head, in order that it may protect the maternal parts from the jagged fetal bones during the remainder of the operation. The removal of the partially detached pieces of bone may in many cases be greatly facilitated by looping a cord over them and having an assistant apply traction sufficient to pull them away, while the operator guards the maternal organs by holding the piece of bone, during its detachment and extraction, in the palm of his hand.

In hydrocephalus the diminution of the head alone usually removes the sole obstacle to delivery. The same is true occasionally of beginning emphysema, where as yet only the head is greatly involved. In other cases, the destruction of the head and face does not wholly relieve the dystokia. It may be necessary to continue the diminution by decreasing the volume of the neck and body. The cervical vertebræ may be divided with the chisel on their median line, the muscular and ligamentous attachments broken down or cut with the chisel, and the bone fragments secured in a rope noose and drawn away, covered by the hand during their withdrawal. Later the fetal body may be further diminished by subcutaneous amputation of the fore limbs at the shoulder, evisceration, destruction of the pelvic girdle, or other means to be later described.

c. **Amputation of the Head and Neck.** In the anterior presentation, when the head is completely deviated and it is impossible or impracticable to return it to its normal position, some veterinary obstetrists advise that the neck be severed and the head with the distal portion of the neck withdrawn, after which the body of the fetus is extracted.

Technic. Some obstetrists advise the use of Persson's chain-saw, Fig. 103, or the chain sector of Masch. More recently there has come into high repute, in some portions of continental Europe, the embryotom of Pflanz, Fig. 99. These instruments are passed around the curved neck, and act chiefly from the distal side of the member.

The most effective instrument of the group is apparently the Pflanz embryotom. However, any one of them will accomplish the purpose, once they have been passed around the neck, but this offers considerable difficulty. The chain-saw and sector have the disadvantage, as compared with the Pflanz embryotom, that they must be drawn backward and forward in order to saw their way through the tissues, and constantly tend to wound the soft parts of the genital canal by coming in contact with them. This may be largely or wholly obviated by passing a sheath of leather or other material over the chain, and working it through this.

When the Pflanz embryotom has been applied to the part, danger of injury becomes virtually excluded, and the work of section is rapidly and easily carried out.

In the application of these instruments, some operators claim that there is an advantage in first passing a cord around the neck, with the bent porte-cord or the bent cord-sound. Once the cord has been passed around the neck and is attached to the chain-saw or sector, the latter may be easily drawn into position.

With the Pflanz instrument, a smooth chain is first used to pass around the neck, which is free from any danger of injury to the soft parts of the mother and is comparatively easy to handle.

Other operators divide the neck by means of cutting instruments acting upon the front or proximal side, and use for this purpose the finger-knife, bistoury, or chisel, but with these instruments the process is a comparatively tedious one, as it is difficult to cut through every portion of the tissues. With the knife it is impracticable to sever the cervical column, since the vertebræ cannot be disarticulated, and it becomes necessary to use some more powerful instrument for severing the bony column. This may best be done with the chisel.

Each plan has its advantages and disadvantages. The latter may be preferable or necessary where it is extremely difficult or even impossible to apply the chain to the neck.

In our personal experience we have not found it desirable to resort to the amputation of the neck in cases of deviation of the head, but have constantly preferred to amputate one anterior limb subcutaneously, followed by evisceration, which operations we shall describe below, after which the fetal remnant may be extracted without difficulty, with the head turned back, or the head may be readily brought into position, as the operator may prefer.

d. **Subcutaneous Amputation of the Anterior Limbs.** Amputation of the anterior limbs is very frequently called for in obstetric practice, especially in the mare, chiefly in cases of the ventral transverse presentation, with all four feet offering

and the head retained ; in cases of wry neck in the foal in the anterior presentation, dorso-sacral position, when it is impracticable to correct the deviation of the head ; or in any case in the mare or cow where deviation of the head cannot be corrected or is not so readily performed as is the amputation of the limb.

Technic. The larger herbivorous animals are devoid of a clavicle, and the anterior limb is attached to the thorax by means of the skin and muscles only, and is therefore comparatively easily amputated. Attach a cord to the pastern of the limb, the shoulder of which lies most exposed or is most readily reached, and have one or two assistants exert traction upon it, and draw it out as far as possible with safety to the mother. Insert one hand, armed with the hooked embryotomy knife, well guarded in the palm of the hand and resting against the limb of the fetus, up to the top of the scapula or as nearly thereto as can be reached ; press the knife into the skin and subcutaneous tissues and, drawing the hand downward along the leg, slit the skin and subcutaneous tissues freely and deeply from the top of the scapula down to the pastern. Lay aside the knife and force the fingers between the skin and subjacent tissues of the limb and, while the assistant maintains gentle traction, separate the skin from the parts beneath by forcing the hand or the ball of the thumb through the loose connective tissue until the upper region of the scapula is reached.

The separation of the skin from the subjacent parts may require at certain points, like the region of the olecranon or carpus, the aid of the chisel or knife to divide firm bands of connective tissue. The separation of the skin from the subjacent parts removes the chief resistance to the tearing of the limb away from the body. Until the skin has been separated from the subjacent tissues over the leg and shoulder, it should be kept intact at the pastern, so that, when traction is applied, the skin as well as the leg is rendered tense and the skinning is greatly favored. When the skinning of the leg and shoulder is completed, the skin is to be divided at the foot by girdling the pastern. The detached skin will be of no further importance, and may be ignored. If required, it may be grasped and corded with a small cord.

Next in power of resistance are the pectoral muscles. These may be torn asunder by first being separated into small bundles and then torn through with the fingers, between the sternum

and the limb. The process may be aided by incision with a knife or with the chisel.

When the foregoing are well divided, the remaining impediments to tearing the shoulder away consist essentially of the trapezius and rhomboideus muscles at the top, the latissimus dorsi behind, and the great serratus and angularis scapula, all of which come into action only when the shoulder is nearly severed, and then offer no serious resistance. Consequently it is only necessary to separate the skin from the limb and divide the pectoral muscles in order to readily draw the limb away by traction.

When the skin has been detached and the pectoral muscles divided, two or three assistants exert traction upon the limb, while the operator places his hand against the sternum and pushes in the opposite direction. The impact upon the maternal organs from the traction may be reduced to any desired degree, by applying a repelling force to the sternum of the fetus.

The impact upon the maternal organs equals the difference between the traction applied upon the cord and the repulsion applied to the fetal sternum. Should the hand of the operator not suffice, the repeller should be applied, carefully guarded by the hand of the operator, the necessary force being supplied by one or more assistants.

Should the traction fail to bring the limb away promptly, the operator should attempt to extend the division of the muscles attaching the limb to the thorax, while moderate traction upon the limb is continued.

Further diminution of the size of the fetus may now be had by the removal of the other limb in the same way. This is especially desirable in the transverse presentation with all four limbs in the passage. The size of the trunk may also be further reduced by evisceration, as described on page 658.

When a foal presents anteriorly in the dorso-sacral position, with lateral deviation of the head which it is impracticable to correct, the subcutaneous removal of one anterior limb, followed by evisceration, so reduces the volume of the fetus that the remnant can be easily withdrawn without correcting the deviation of the head. It also renders the fetal remnant so flaccid, and so far increases the room by the reduction of size, that the deviation is easily corrected.

In the ventral presentation, the subcutaneous removal of both anterior limbs greatly facilitates version, and reduces to a minimum the dangers of injuries to the uterus during version, owing to a foot being caught in its walls.

e. **Amputation at the Humero-Radial Articulation.** Amputation at this point is rarely desirable, but may at times be necessary in the mare in order to remove an anterior limb when it is impossible, on account of the position, to reach the shoulder.

Technic. Attach a cord to the pastern, as in the preceding, and have an assistant render the leg tense by exerting moderate traction. Introduce the hand, armed with the embryotomy knife, carefully concealed in the palm, and girdle the skin around the articulation. Passing above the head of the olecranon on the posterior side, divide the attachment of the anconean group of muscles by a cut directed forward. Then divide transversely, as far as possible, the muscles and ligaments passing over the articulation. Rotate the limb forcibly on its long axis while strong traction is maintained, and rupture the remaining ligaments until the limb is completely detached and comes away.

In cases of limited room, it may sometimes be easier to detach the skin of the limb from the pastern up to the articulation, as in the operation for the subcutaneous amputation of the limb at the shoulder, as described above. By this plan the skin is separated up to the olecranon, the muscles divided transversely, and the operation otherwise carried out as in the preceding paragraph.

f. **Detruncation in the Anterior Presentation.** When a fetus in the anterior presentation has one or both posterior limbs deviated forward beneath its body, and the feet engaged against or in the pelvis, it may be necessary or advisable in the mare, and possibly rarely in the cow, that the trunk of the fetus be divided in order to bring about delivery without serious or fatal injury to the mother.

Technic. Secure the two hind feet by means of cords. Apply cords to the two anterior limbs and head, and have one or two assistants draw the anterior part of the fetus as far out as is practicable and safe. Then girdle the fetal body immediately against the maternal vulva, by making an incision through the

skin and skin muscle. It is frequently best at this point to remove one shoulder subcutaneously, as described on page 645, and follow with evisceration, as described on page 658, in order to give greater operative room and increased mobility of the fetus.

Insinuate the hand between the skin and the deeper structures, and forcibly separate the skin from the fetal body backward until the last rib is passed. Force the finger tips through the abdominal wall behind the last rib and, passing along the entire posterior border of each last rib, separate the abdominal walls from the ribs and sternum. After the abdominal muscles have been detached and the fetus has been eviscerated, rotate the thorax upon its long axis. This will cause a division of the vertebral column near the dorso-lumbar articulation, and the anterior portion of the fetus will fall away.

Secure the two posterior feet with cords, unless this has already been done; spread the detached skin, which has been pushed back from the thorax, carefully over the stump of the lumbar vertebræ; push the remnant of the fetal trunk into the uterus with the hand, while an attendant draws upon the cords attached to the hind feet and advances them along the genital passages, thus causing a posterior presentation. This may result in a dorso-pubic position, which should be converted to dorso-sacral, when the extraction of the fetus can be readily brought about.

g. **Destruction of the Pelvic Girdle in the Anterior Presentation.** Somewhat rarely, perhaps most frequently in the cow, the pelves of the mother and fetus become interlocked and the antero-external angles of the fetal ilia, I′ Fig. 109, become locked with the shafts of the maternal ilia I, at C, in such a manner that any safe degree of traction fails to overcome it.

Technic. Remove one anterior limb subcutaneously, page 645, and eviscerate, page 658, through an opening made by the removal of two or three of the exposed ribs. Introduce the chisel through this opening, carry it back with the hand and place it against the shaft of the fetal ilium I′. Have an assistant drive the chisel through the iliac shaft, from before to behind, and, when the chisel blade is well buried in the ilium, revolve the instrument forcibly upon its long axis and thoroughly divide the pelvic girdle by separating the cut ends of the bone. Then withdraw the chisel and replace it against the pubic brim, either

at the symphysis pubis or opposite the foramen ovale, and drive it through the pubis and ischium at either of these points. Again

FIG. 109. DESTRUCTION OF PELVIC GIRDLE, ANTERIOR PRESENTATION. C, Chief point of impact between pelves of fetus and dam; I, Maternal ilium; I', Fetal ilium, representing chisel passing through its shaft; A, Coxo-femoral articulation of mother.

revolve the chisel forcibly upon its long axis, and thoroughly break the bones apart. The coxo-femoral articulation is thus detached and isolated, so that the entire limb may drop back-

ward beyond its fellow, and the remnant of the severed ilium I′ can drop inward or move in any direction. The entire pelvis thus loses its rigidity and undergoes diminution in size, so that it can readily be withdrawn.

B. Embryotomy in the Posterior Presentation.

a. **Amputation of the Posterior Limbs at the Tarsus.** When a fetus, especially a foal, presents posteriorly, with one or both posterior limbs retained at the tarsus, it may be difficult or impossible to repel the fetus and extend the feet. The difficulty of the correction of such a deviation is intensified by recumbency, the comparatively large size of the fetus, and by fetal emphysema. In such cases it is frequently easier for the obstetrist and safer for the mother to amputate the limb or limbs at the tarsus.

Technic. Pass a cord around the leg above the tarsus, as indicated in Fig. 110, and have an assistant hold the leg steady by gentle traction. Introduce the chisel, carefully guarded in the palm of the hand, and place it against the lower part of the tarsus, as shown between T and T. The chisel should be placed as nearly perpendicular to the long axis of the metatarsus as possible. The proper direction of the chisel may at times be greatly favored by placing the cord upon the metatarsus instead of the tibia, thus forcing the tarsus toward the sacrum of the mother and tending to throw the metatarsus straight across the pelvic cavity.

The chisel should at all times be held in the palm of the hand, with the dorsal surface of the hand against the vaginal or uterine walls, and the instrument carefully guarded and guided during the entire operation. The amputation should preferably be through the lower section of the tarsus, but may be made through the head of the metatarsus. The chisel should not be driven entirely through the hock without removal, as it may become caught and clamped between the divided bones; instead, drive it first for only a few inches along the lateral side of the tarsus, being sure that the skin at that point is included in the cut along with the bone. Then loosen the chisel, and force the divided bones apart by rotating the instrument upon its long axis, after which it may be driven somewhat deeper into the tarsus, until the foot is completely severed.

Withdraw the severed metatarsus, remove any dangerous fragments of bone remaining on the stump, and see that the latter is safely secured by a cord passing around the leg above the os cal-

FIG. 110. AMPUTATION OF POSTERIOR LIMB AT TARSUS.

cis. Repeat the operation on the other hock in a similar manner. Apply traction to the two limbs, and effect a posterior delivery.

The technic for amputating at the tarsus varies with different

obstetrists, and those who prefer to use the chain-saw, sector, Pflanz instrument, or other form of embryotom, would amputate with such an instrument. Any one of them is efficient, providing always that the hock is easily reached and lies, or can be placed, in such a position that the instrument can be applied. It is possible also, though very difficult, to amputate the hock with a scalpel.

Instead of amputating the hock, in cases where it is offering a serious obstacle to parturition, some operators sever the tendo-Achilles, by which means they permit the metatarsus to fold against the inferior surface of the tibia and the toe of the foot to become somewhat extended, so that it will offer less obstruction.

b. **Intra-Pelvic Amputation of the Posterior Limbs in the Breech Presentation.** This operation is designed for the overcoming of dystokia due to a posterior presentation with the hind limbs completely retained in the uterus, the so-called breech presentation, when the deviation cannot be readily corrected.

Technic. Introduce one hand, armed with the embryotomy knife, scalpel or chisel, through the maternal passages, until the perineum of the fetus is reached, and make a free incision through that part, including the anus in the male fetus and the anus and vulva in the female, enlarging the incision sufficiently to admit the operator's hand into the fetal pelvis.

Locate the great sciatic ligament of the fetal pelvis and, inserting the knife into it just behind the shaft of the ilium, divide the former backward to the perineum, thus enlarging the pelvic cavity and giving ample operating room. If the pelvis of the fetus is too small to admit the hand of the operator at all before severing the sciatic ligament, this may be accomplished by cautiously cutting from behind forward with Colin's scalpel or with the chisel.

When this has been severed and sufficient operating room attained, carry the chisel in the hand and place it against the shaft of the ilium, as shown between I′ and I′, as nearly perpendicular to the long axis of the iliac shaft as possible. Keeping the hand in touch with the chisel blade, have an assistant drive it through the bone until it and its periosteum are completely severed. Forcibly rotate the chisel upon its long axis, in order to complete the division of the bone and attached soft parts. Disengage the chisel, and then place it against the symphysis pubis or

against the ischium opposite the foramen ovale, and drive it through the ischium and pubis at one of these points. Again revolve the chisel upon its long axis and, using it as a

FIG. 111 A. INTRA-PELVIC AMPUTATION OF POSTERIOR LIMBS AND PELVIS. Representing chisel as severing ilium at *I'*.

lever, separate the isolated portion of the pelvis as completely as practicable from the surrounding tissues. With the fingers, aided by the chisel if necessary, detach the muscles from

the isolated segment of the pelvic girdle for a short distance from each severed end. Attach a strong looped cord about the detached pelvic segment, and tighten the noose. Have one or more assistants apply traction as indicated in Fig. 111 B. The chief obstacle to the withdrawal of the limb is the great gluteus muscle, which should be sought for, identified, and torn through with the fingers at a distance of 5 or 6 cm. from its attachment to the great trochanter of the femur. This is best done while steady, firm traction is being applied to the limb by an assistant, thus tensing the muscle.

Other important points of resistance are the attachments, posteriorly, of the skin, vulva and anus to the ischium through the medium of aponeurosis; and anteriorly, chiefly on the median line, of the prebubic tendon. These should be divided with the knife or chisel. Vigorous traction may now be applied by means of the cord, while the operator guards the advancing end of the detached piece of pelvis with the palm of the hand, in order to prevent injury to the maternal organs.

Sometimes the isolated piece of the pelvis tears loose from the femur and comes away alone. In such a case, the cord is to be applied over the head and trochanter of the femur, and traction again exerted, drawing the limb away in a reversed position. As it advances, the skin is turned backward or everted until the region of the hock is reached, where the integument does not so readily separate and only requires to be divided to allow the limb to come away.

During the removal of the limb, the operator is to constantly note the progress by manual exploration, and sever by tearing or cutting any tendons or muscles which offer special obstruction to the operation. During the tearing away of the limb, the operator largely or wholly counteracts the impact of the traction upon the maternal organs, by applying repulsion to other portions of the fetal pelvis, either with his hand or with the aid of a repeller in the hands of an assistant.

Repeat the operation upon the opposite limb in the same manner, except that but one incision need be made through the bone, that is, through the shaft of the ilium. During the entire work the operation is carried out subcutaneously, or rather intrafetally, and, if properly performed, the maternal parts are amply guarded against injury.

The size of the fetal trunk may be further reduced, if desired, by evisceration, as described on page 658. The remnant of the

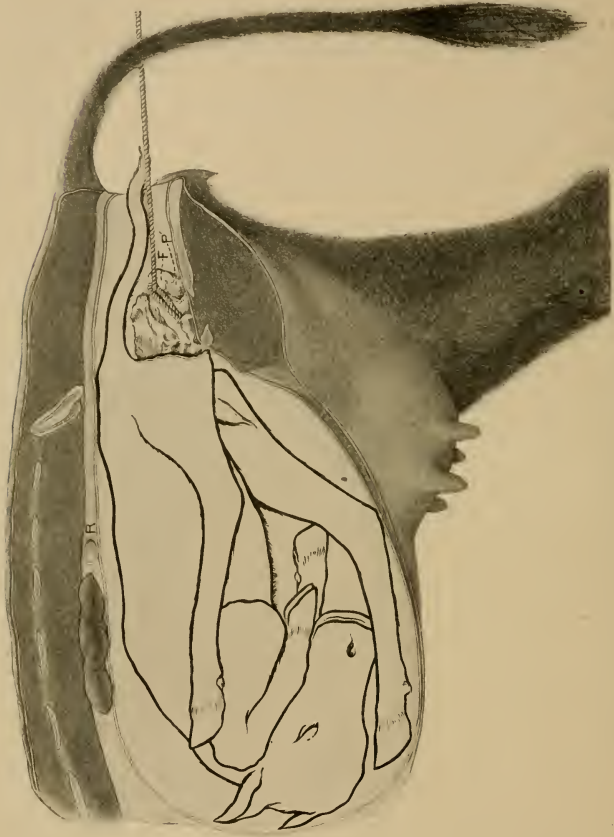


FIG. 111 B. INTRA-PELVIC AMPUTATION OF PELVIS AND POSTERIOR LIMBS. Extracting hind limb with cord.

fetus may then be extracted, by traction upon a cord looped about the lumbar region of its spinal column.

After evisceration has been accomplished, should the fetal rem-

nant still seem too large, because of emphysema or for other reasons, to be safely drawn through the pelvic canal, further diminution in volume should be accomplished. The chisel may be carried into the fetal cavity and placed against the last rib, close alongside the spinal column. Light blows upon the chisel by an assistant, the cutting end constantly accompanied by the operator's hand, readily severs each rib successively. The operation can be applied on each side of the spinal column, so that all ribs are divided.

The ribs may also be severed by means of the long-handled sphere-pointed cutting hook, Fig. 106 h. The instrument is introduced into the fetal body-cavity and hooked over the first anterior rib, or the most anterior rib within reach, and the ribs are cut one after another as the instrument is drawn backward. The sphere upon the point obviates the danger of the instrument penetrating the fetal skin and wounding the maternal organs.

If neither of these instruments is at hand, the obstetrist may destroy the ribs by manual force. The tips of one or more fingers may be forced through the intercostal muscles between the last two ribs, the intercostals then torn asunder from the base or spinal end down to the sternal cartilages, and the rib grasped and broken. Rib after rib may be treated thus until all are broken. This is a tedious operation, and there is constant danger to the operator of wounds from the sharp broken rib ends.

The division of the ribs is of very great importance. It allows complete collapse and obliteration of the fetal body cavity, and renders the fetal remnant very flaccid and pliable. More important perhaps, it permits the escape of the imprisoned gases of emphysema under the pressure of the labor pains.

When the ribs have been destroyed, further diminution may be accomplished by securing a scapula from inside the chest, cording it and drawing the leg out through the cavity of the fetal body.

The amputation of the hind limbs may be accomplished by other means. The above plan offers the greatest decrease in the volume of the fetus ; the manipulations are carried on exclusively within the fetal body, insuring the greatest possible safety to the patient, and when completed afford ready means for evisceration. The operation is neither tedious nor difficult, when compared with obstetric operations generally.

Some operators advise the use of Persson's chain-saw, or the Pflanz machine, and amputate the posterior limbs as close to the hip-joint as possible. The application of these instruments is not always easy. In either case a cord or chain is passed around the limb as close as possible to the hip-joint, and the limb is then severed in the manner described on pages 604 and 644, for the neck in the anterior presentation.

Other operators would cut through the soft tissues with a scalpel and attempt to disarticulate the femur from the pelvis. It must be extremely difficult to disarticulate such a joint as this while the fetus is confined in the uterus and the limb is virtually immovable.

c. **Evisceration.** The evisceration of the fetus is frequently desirable in obstetric practice, and has a variety of uses. It decreases the volume of the fetal trunk greatly, and permits its more ready passage through the genital canal. For example, in the anterior presentation, with lateral deviation of the head, it renders the fetal trunk flaccid, through the removal of the viscera supporting the body walls, and permits the body remnant to be bent or moved more readily for the correction of any deviations; it permits freedom of intra-fetal operations directed against other parts, as for detruncation, page 648, or for the destruction of the pelvic girdle, page 649. When a putrefying fetus becomes enormously enlarged as a result of emphysema, evisceration removes the gases collected in the viscera and body cavity, and permits the escape, under pressure in the birth canal, of much of the gas imprisoned within the body walls.

Technic. Evisceration may be employed in either the anterior or the posterior presentation, possibly in extremely rare cases in transverse presentations.

1. In the anterior presentation, unless the fetus is far advanced through the vulva, evisceration is best performed by the removal of one or more of the anterior ribs. The ribs are generally best reached by the removal of the shoulder, as already described under subcutaneous amputation of the anterior limbs, on page 645.

When the ribs have been laid bare in the manner described, the operator can thrust the finger tips through the muscles in the first intercostal space, and enlarge the opening thus made by tearing through the muscles, upwards to the spinal column and downwards to the sternum; then, grasping the rib near its middle, he can fracture it by means of a sudden and vigorous pull. The fractured ends may then be grasped, and pulled, broken or twisted off.

The chisel may be brought into use, if required, in order to divide the rib, the hand of the operator constantly guiding and guarding the chisel blade. The operation is then to be repeated, if required, upon the second and third ribs, until an opening into the chest is secured, ample in size for the introduction of the operator's hand.

Force one hand through the opening, and tear the mediastinum from the thoracic walls, above and below. Then grasp either the trachea at its bifurcation, or the heart, and tear away the lungs and heart, as nearly as possible in one mass. The heart, which constitutes the greatest bulk of the thoracic viscera, is best grasped in the palm of the hand, with the fingers engaging the aorta and pulmonary arteries.

When the thoracic viscera have been withdrawn, thrust the fingers through the diaphragm, locate the liver, isolate the area of the diaphragm to which it is attached, and, engaging both with the fingers, remove the two together.

The liver, in a normal fetus, constitutes the chief intra-abdominal mass, and occupies more space than all the other organs combined. After the liver has been removed, the intestinal tube, with its contents, may be withdrawn without difficulty, as its attachments are feeble. The kidneys may also be removed.

Evisceration of a fetus in the posterior presentation is preferably performed through the pelvis, generally in connection with intra-pelvic amputation of the posterior limbs, page 653. It may be performed without destruction of the pelvic girdle, by making an incision through the perineal region and then severing the sacro-sciatic ligament as directed for that operation.

When free entrance has been gained into the abdominal cavity, introduce the hand and withdraw the alimentary tube; then rupture the diaphragm about the liver and tear away the latter organ in the same manner as in the anterior presentation. The liver is so friable that it cannot well be removed by grasping the organ itself, but comes away entire, with the central part of the diaphragm.

Remove the heart and lungs as directed in the anterior presentation.

The efficiency of the evisceration in decreasing the volume and rigidity of the fetal body may be furthered by the division of the fetal ribs as noted on page 656.

Embryotomy under Special Conditions.

In the foregoing pages we have described embryotomy as it may be carried out in dystokia, with the fetus presenting under conditions which are more or less subject to classification. These directions constitute a general outline, the principles of which are more or less applicable in all cases. There occur, however, many quite atypical cases to which these general principles must be adapted.

In the various forms of monstrosities, some plan must be evolved by which the monster may be sufficiently reduced in size to permit of its removal. Double monsters may be divided as nearly as possible, or a portion of each body may be removed, including evisceration, so that the remnants of the more or less double body may be removed together.

Sometimes other persons have performed partial embryotomy, in a way to greatly embarrass the veterinarian. A limb has been amputated, at such a place that it becomes a positive menace to the patient and interferes with, rather than aids in, its delivery. Such, for example, is the amputation of an anterior limb at the carpus, when the foal is presenting anteriorly or in the transverse presentation. In such cases the stump of the limb must not be pushed back into the uterine cavity, but must be amputated higher up, until at least the fore-arm has been removed. We meet with similar mutilations, when the fetus presents posteriorly and some portion which has protruded beyond the vulva has been cut away. We have also met with cases in the anterior presentation, with the two hind feet projecting forward and engaged in the pelvis, in which detruncation had been performed through the thorax, and jagged bones left, which seriously abraded the soft tissues of the mother. It is absolutely necessary in such a case that the spinal column be shortened by the removal of all the dorsal vertebræ and ribs, in order that version may be accomplished and the remnant converted into the posterior presentation. It is also essential that the spinal column be shortened in order that a flap of the skin and soft tissues may be acquired, which will cover the spinal stump and protect the uterus and vagina from injury.

Early in our obstetric career we were called to attend a cow which was suffering from dystokia. The presentation had been

anterior, and apparently normal, but the calf was somewhat large and it was necessary to apply traction. A local practitioner hitched a horse to the calf, and succeeded in advancing it until the fetal and maternal ilia became interlocked. The fetus was then cut in two in the dorso-lumbar region, and the posterior portion remained in the uterus. With our inexperience, we failed to accomplish delivery.

Various courses might have been successfully pursued. It would not have been difficult to have reached into the fetal pelvis and engaged it with a blunt hook fixed over the posterior border of an iliac shaft. Holding the fetal remnant securely by means of the hook or, if preferred, by a cord passing around the iliac shaft, we could place the chisel against the other iliac shaft and divide it. Next we could place the chisel opposite the pelvic symphysis or the foramen ovale, and again divide the pelvis on the median side of the hip joint. We could then loop a cord about the isolated segment of the pelvis and, exerting traction thereon, remove it, with the hind limb. The remnant would then be easily extracted, since the size of the croup would have been reduced one-half.

Complications of the greatest variety may thus arise, and are to be met by judicious planning and having the necessary instruments and appliances at hand for carrying out the work.

Exercises in the Mutations of the Fetus and in Embryotomy.

The veterinarian who attends a case of dystokia, without having first learned by personal experience the mechanism by which dystokia is to be overcome, always labors under a serious handicap. Every veterinarian, before entering upon an obstetric practice, should make himself personally familiar with the various operations which he may be called upon to perform in the overcoming of dystokia. Each of these operations may be planned and carried out without great difficulty, and in a manner which will give to the veterinarian valuable training, which will prove a great help to him in the actual work.

Various plans are proposed and carried out with a view to teaching these operations in an efficient manner.

The author has had prepared a special skeleton of the cow, which has been strongly mounted and securely fixed, so that any desired force may be used upon it without danger to the apparatus. Inside the skeletal cavity we have placed a leather sac, in imitation of the uterus. New-born calves are procured and killed, and the body placed in the artificial uterus in any position which may be desired, and the student is asked to correct the vicious position or deviation of an extremity, or to perform embryotomy by a definite plan. In such a case, the work closely simulates that encountered in actual practice. The fetus is out of sight, and the leather sac may be so adjusted that any desired degree of pressure upon the fetus may be commanded.

The operation must be carried out through the pelvis, and the height of the pelvis from the floor is essentially the same as encountered in actual practice in the standing animal.

Any veterinarian who has not enjoyed the privilege of such opportunities in college, or who has not satisfactorily availed himself of such opportunities, need not be debarred from the benefits of such work. Numerous devices have been described and used, many of which are easily and cheaply constructed, and readily available to any practitioner. One can take an ordinary stout box, of sufficient dimensions to contain the new-born fetus, and may make an opening at one end, about the size of the pelvic canal. He may then procure, from time to time, new-born calves and, placing them in the box, proceed to practice the various changes in position or different forms of embryotomy, as described. If he desires to approach more nearly to the normal conditions, he may use the pelvis of a cow or mare, through which to do his work, and beyond it secure the fetus in a box or bag. Such apparatus may be placed upon a strong table, or otherwise secured, at a height convenient for the work. Such exercises in obstetric surgery are of so great importance that any inexperienced veterinarian who has to do with dystokia can not properly afford to neglect them, because they give to him an experience which renders his actual work far more efficient and satisfactory. They decrease greatly the strain of his work in actual practice, and increase enormously his success as a practitioner.

IV. CAESARIAN SECTION OR GASTRO-HYSTEROTOMY.

Cæsarian section is the removal of a fetus or fetuses from the uterus by means of an incision made through the abdominal walls.

It has its use as a last resort in an attempt to save the life of the fetus, the mother, or both, when other forms of delivery are impossible or impracticable.

It is one of the oldest operations in history and has been performed since the earliest times, both in human and veterinary obstetrics. In earlier times it was performed chiefly with a view to saving the life of the fetus, and in many cases that of the mother was deliberately sacrificed in order to accomplish this end. Since the advent of antiseptic surgery, added to the use of anæsthetics, the operation has attained a wider application and tends frequently to conserve the life of both mother and fetus.

Quite naturally the operation is most readily carried out and is most successful in the smaller domestic animals, both on account of their size and because of their comparative immunity to septic infection. In the sow, bitch and cat it frequently occurs that both parent and offspring survive if the operation is performed at the proper time and under strict aseptic precautions.

It is usually comparatively easy to extract a living calf from the cow, but the mother, under present plans of operating, generally succumbs.

The operation may be successfully performed in the mare, in so far as extracting a living foal is concerned, but we have no records where the life of a mare has been thus saved. Necessarily the foal must be extracted very early in case of difficult labor, or it perishes because of the detachment of its placenta.

The chief indications for the performance of hysterotomy in the larger animals are: imminent death of the mother, where there is hope of saving the life of the fetus; displacements of the gravid uterus, such as irreducible torsion or hernia; and extra-uterine gestation.

In the sow, bitch and cat, should the pelvis be abnormally narrow or a fetus become lodged anterior to the pelvis, whether from over-size, mal-presentation or emphysema, embryotomy is impossible, owing to the smallness of the pelvic canal; mutations for the correction of deviations are well-nigh impossible; and forced

extraction is frequently dangerous or impossible. Thus the veterinary obstetrist is forced to choose between hysterotomy and the destruction of the patient.

Technic. When a pregnant animal meets with a sudden and fatal accident, is in death throes, or her death is imminent, Cæsarian section may be roughly performed by quickly making a free incision through the abdomen at the most convenient point, exposing the uterus, incising its walls, and promptly liberating the fetus. When such emergency does not exist and the operation may be more deliberately planned and performed, the technic may be varied according to the individual case, the species of animal or preferences of the obstetrist. Some operators prefer to make the laparotomy upon the median line in the linea alba; others prefer to operate in the flank. In the smaller animals, it seems to be largely a question of choice on the part of the individual operator, though evidently there are advantages and disadvantages in each plan. In the larger animals, like the mare and cow, the operation through the linea alba is impracticable under present conditions, so far as the preservation of the life of the mother is concerned, because the immense weight of the abdominal viscera prevents the surgeon, with his present appliances, from closing the abdominal incision in such a manner as to support the viscera and prevent their protrusion.

In all animals the flank operation is evidently safer in reference to prolapse of the abdominal organs as a result of the breaking, or tearing out of the sutures. After the operation the flank wound may be kept cleaner, since it does not come into so constant and immediate contact with the ground or floor when the animal is lying down. In the bitch and sow the flank incision has a further advantage over that through the linea alba. In these animals the double row of mammæ leaves the median line in a deep furrow, which renders suturing difficult.

One advantage of the linea alba incision is the possibility of affording drainage to an infected uterine cavity, when such is not available through the vagina because of some serious displacement of the organ, such as irriducible torsion or transverse rupture through the cervix. In a pet animal, the resultant scar may be less objectionable in the linea alba.

The securing of the animal for the operation must correspond with the plan and the intended position of the laparotomy.

Harms states that the operation on the cow may be performed upon the animal in the standing position, but it would seem to us that such a plan would offer very great difficulties. With most, if not all animals, it is essential that they be cast, or secured and placed upon the operating table in lateral recumbency, for the flank incision, or in the dorsal position in case the linea alba is selected.

From a humane as well as an operative standpoint, anæsthesia or narcosis should be induced. Keller (Zeitschrift fur Tiermedizin, B. 11, S. 122) recommends for the bitch the subcutaneous injection of muriate of morphine in doses not exceeding 0.06 g., and later, if marked pain and struggling ensue, the inhalation of a small amount of ether. De Bruin (B. T. W., January 3, 1907) considers chloroform or other anæsthesia highly dangerous in the sow, and has had unfortunate results therefrom, so that he recommends local anæsthesia, consisting of cocaine muriate 0.3—0. 5 g. in 10 cc. of distilled water, with the addition of 5 drops of 1-1000 solution of adrenalin chloride. Other plans for inducing local anæsthesia of the abdominal walls may be used, and when the abdominal cavity is open the anæsthesia may be extended to the uterus itself.

Chloroform anæsthesia in the cow and sheep is somewhat dangerous, because of their great tendency to regurgitate food from the rumen and then inhale it into the bronchi. If chloroform anæsthesia is produced in the cow, it might be well to administer it through a trachea tube in order to guard against food inhalation. We may also resort to local anæsthesia in the cow, remembering constantly that the principal pain in the operation consists of the incision through the skin, after which as a general rule there is little evidence of intense pain. Complete anæsthesia is essential in the mare, if we propose to attempt to save her life by the operation.

In securing an animal for the operation, she should always be extended at full length, the hind legs drawn backward and the anterior limbs forward, so that they will be completely out of the way. In small animals this extension of the limbs may be maintained with the aid of assistants, but in the larger animals it is essential that the patient be stretched by means of ropes attached to the hind and fore limbs respectively, the other ends of which are securely fixed to posts or other secure objects.

If we wish to preserve the life of the mother, we should be careful to select a place for operating which is clean and free from dust. If the animal is placed upon a bed of straw or other material, the bedding should be carefully moistened with an antiseptic and all necessary means taken to prevent any stirring up of dust by the struggles of the animal.

The operating field should be carefully cleaned and disinfected. The hair should be removed by shaving over an ample area, which should then be disinfected by cleansing with soap and hot water with a stiff brush, followed by a thorough washing with alcohol or ether to dissolve the fat, after which the part should be thoroughly washed with 1-1000 corrosive sublimate solution or other reliable disinfectants.

In addition to these precautions, Keller suggests that at the point of incision the area should be saturated with tincture of iodine in order to complete the disinfection of this region. Prior to the application of the tincture of iodine, all liquids should be wiped away with antiseptic gauze.

After thorough disinfection, the neighboring portions of the body of the animal should be covered over with cheese-cloth, towels or other suitable fabric, which has been sterilized or disinfected so as to prevent dust and hair getting into the wound from the animal's body. The sterile or antiseptic cover also affords a safe resting place for any protruding abdominal viscera. Immediately over the location where the wound is to be made, there should be placed an ample piece of sterilized gauze, in which an opening is made of the same dimensions as that in the abdominal wall.

The incision is then to be made into the abdominal cavity. Generally one scalpel should be used for making the skin incision, laid aside, and a second scalpel used to continue the incision into and through the deeper parts. In the flank the incision should begin at about the level of, or slightly below, the external angle of the ilium, midway between it and the last rib, and extend downward in an approximately perpendicular direction.

After the skin incision has been made, we may continue it directly through the muscles; or in the flank operation we may separate the muscle fibers in their longitudinal direction, either with the blade or the handle of the scalpel, and not cut across the muscle fibers at all. The latter plan of incision would involve

a different direction of the opening for each layer of the abdominal wall. That through the external oblique muscle would be obliquely downward and backward, while that of the internal oblique would be downward and forward, and the two openings would consequently cross each other like an X.

The peritoneum may be incised with the scalpel, by placing an index finger against it and then passing the scalpel along the finger until it reaches the membrane, when a very slight thrust will force it through. This should be done carefully in order to avoid wounding the viscera, and as soon as the scalpel has penetrated the peritoneal cavity, as is indicated by the disappearance of resistance, the instrument should be promptly withdrawn. The incision can then be enlarged by means of a probe-pointed bistoury guided by the finger, or it may be readily torn by the fingers.

The X-formed incision closes automatically, without sutures in its deeper parts, and prevents any protrusion of the viscera. It is more tedious than a direct incision into the peritoneal cavity, and is not so convenient for the operator. The size of the wound must necessarily depend upon that of the species, and should be no larger than necessary to permit the ready withdrawal of the fetus, enclosed within the uterus.

If the laparotomy is performed upon the median line, the incision is made direct, and should begin slightly anterior to the pubis, and extend forward a sufficient distance to provide an ample opening for the withdrawal of the gravid uterus.

Having made the incision into the peritoneal cavity, the operator passes his hand around the gravid uterus, draws it out and lays it carefully upon the sterilized gauze surrounding the wound. An incision is then made into the uterus at the desired point, generally upon the convex surface opposite the attachment of the broad ligaments, and in a longitudinal direction. If the incision is made near the broad ligaments, it causes more hemorrhage, because the blood vessels at this point are more numerous and larger.

Should the suggestion of Harms be followed and the operation on the cow be undertaken in the standing position, the incision in the right flank is made merely large enough to permit the extraction of the calf through it. The uterus is then pressed against the abdominal opening, the organ incised, and the fetus

extracted, care being exercised to prevent liquids from falling into the peritoneal cavity.

In multiparous animals it is usually desirable to extract all the fetuses through a single uterine incision, and for this purpose it is more convenient to make the opening in one cornu, near the bifurcation, so that the fetuses from the other horn may be readily pressed around through the uterine body to the incision which has been made. In some cases, where the fetuses are emphysematous and dry, they adhere so firmly to the uterine walls that they cannot be moved any great distance without serious injury to the organ, and consequently it may be necessary to make two or more incisions.

When the incision into the uterus has been made, the fetus, or in multiparous animals, that fetus which is nearest to the incision, is pressed out through the wound by compressing the uterus, or the hand may be passed into the uterine cavity and the fetus grasped in its membranes and drawn out. In the smaller animals, with several fetuses, the others in the same horn are pressed toward the opening one after another, or the operator reaches his hand into the organ and removes the fetuses one by one. When the incised horn has been emptied, he proceeds to empty the opposite horn by pressing the fetuses into the body of the uterus and then turning them toward the incision.

When making the incision into the uterus, care should be taken not to incise the fetal membranes if it is possible to detach them and press the fetus out completely invested in all its membranes. This may be done in the sow, bitch and cat. In the cow we cannot accomplish this, and consequently it is necessary to incise the fetal membranes before the fetus is removed from the uterus. The longitudinal incision in the uterus should be ample to permit the fetus to pass from it without great force, lest the incision become extended, probably in a transverse direction, by the tearing of the muscular walls, producing a very difficult wound to suture.

If the fetuses are living, they should be freed from their membranes as soon as extracted, and an assistant should be ready to take care of them. If the fetuses are dead and the fetal membranes decomposed, it may be advisable to carefully mop out the uterine cavity with antiseptics and then to remove all liquid as far as possible by means of sterilized gauze.

The wound in the uterus is then to be closed by means of Lembert's or other intestinal sutures of silk.

Before suturing the uterus, all parts except that in which the incision has been made should be returned into the abdominal cavity. After the uterine wound has been closed by a series of interrupted sutures, the remainder of the organ should be allowed to drop back into the peritoneal cavity.

The abdominal incision should be closed by interrupted sutures. If the laparotomy has been performed through the linea alba, it is desirable to suture, separately, the peritoneum, the muscles and the skin. The peritoneal wound may be closed with continuous or interrupted catgut sutures which have been immersed in tincture of iodine. The sutures for the muscles and skin should be of strong silk, thoroughly sterilized or rendered antiseptic. After the skin has been sutured, Keller suggests that all the external sutures be saturated with tincture of iodine, to guard against suture infection.

The animal should then be placed in a comfortable room to recover from the anæsthesia, and allowed to rest quietly. No food whatever, and only very small quantities of water, should be allowed for 24 to 48 hours after the operation, but later, if the animal shows an appetite, it may have a small allowance of suitable liquid food, later a restricted allowance of succulent or soft food, and finally in the course of 8 or 10 days may be put upon a regular diet.

Hysterectomy. Under certain conditions of dystokia which cannot be relieved by other means, where the fetus or fetuses have undergone putrid decomposition and the uterus is in such a state of infection or disease that, according to the judgment of the veterinarian, recovery of the organ cannot be reasonably anticipated, it may be deemed best to amputate the entire organ. Such an operation totally destroys the breeding value of the animal, and its sole use is the saving of the life of the mother. The operation has been limited to the smaller animals like the sow, bitch and cat, in those cases where decomposition of the fetus or fetuses and infection of the uterus are such as to bar successful hysterotomy.

The confinement of the patient, disinfection of the operative area, anæsthesia or narcosis and other preparations, along with the abdominal incision, are the same as for hysterotomy and the

uterus is to be lifted out of the abdominal cavity in the same manner. After the organ has been exposed, the utero-ovarian arteries and all visible arteries in the broad ligaments should be securely ligated, and a firm ligature of silk placed around the cervix or vagina. The entire uterus, horns, and ovaries should then be excised, and the vaginal stump securely detained outside the wound.

In order to prevent the escape of the putrid contents of the uterus in the neighborhood of the wound, it is best to apply a double ligature to the cervix or vagina and sever the organ between the two. The vaginal stump should be thoroughly disinfected, by drying it first with sterile gauze and then thoroughly cauterizing the mucous membranes with the thermocautery or nitrate of silver. Tincture of iodine thoroughly applied to the stump, while it is held outside the wound until the alcohol has evaporated, may also suffice. The stump of the vagina is then to be allowed to return into the abdominal cavity. If infection of the peritoneal cavity is feared, it may be irrigated with normal salt solution in the hope of mechanically cleansing it.

Sometimes partial hysterectomy is preferable to the preceding. In irreducible torsion of the uterus or transverse rupture of the uterus from torsion the uterine cavity may not be safely closed as in hysterotomy, nor completely amputated because of adhesions. A portion of the organ may then be excised and the margins of the stump securely fixed to the margins of the abdominal incision, thus affording exterior drainage for the suppurating uterine cavity.

Prognosis. The prognosis of hysterotomy and hysterectomy is generally unfavorable, though it is gradually becoming more successful in veterinary practice, as veterinarians become better acquainted with anaesthesia and asepsis. It is most favorable in small domestic animals, in which incidentally there is less susceptibility to infection, although perhaps the main consideration is that of the size of the animal and the practicability of proper control of the wound after the operation. Keller records the operation of hysterotomy in 10 bitches, with recovery of 8 of the mothers, or 80 %. In 8 out of these 10 cases, some or all of the fetuses were saved. In the other cases the fetuses were dead at the time when the operation was undertaken.

De Bruin records 23 hysterotomies in the sow, with 11 recoveries and 12 deaths, or a loss of 60%, but he accepted all cases of dystokia which were offered and which it seemed impossible to deliver in any other way. Among these were several sows which were already comatose and virtually dying when presented. He concludes that, when the fetuses have become emphysematous, the sow has a high temperature accompanied by loss of appetite with no milk in the teats, or is in a comatose condition, the operation will most probably be followed by death. He submits also that, according to the statistics of the cases which he publishes, the results are very favorable if the patient has not been manipulated prior to the operation, and there is no extensive necrosis of the vaginal walls as a result of the forcible extraction of one or more fetuses or attempts at that operation by laymen. De Bruin regards the operation as highly successful in those cases where no manipulation of the genital tract has been made, except by the veterinarian, under proper precautions, for purposes of diagnosis, and where labor has not continued for more than 24 hours.

Kasselman (D. T. W., 1899) operated on 25 sows, with recoveries in 19 cases. In his statistics, all those cases in which the fetuses were putrid perished.

So far as we can determine by the available literature, the operation is somewhat less favorable in the cat. In our clinic, in two cases, one of the cats died, but the fetuses were saved in each instance.

Hysterotomy in the sheep and goat has not been largely practiced, so far as indicated by our literature, although a few successful operations have been chronicled.

It has been clearly shown in the cow that, if the fetus is alive, Caesarian section is highly favorable for preserving the life of the calf. Its attachments to the maternal placenta are of such a character that it is very easy to perform hysterotomy and preserve the life of the fetus if it is in good, vigorous condition at the beginning of the operation.

Little is known regarding the percentage of recoveries of the cow, although there are isolated records where recovery has occurred. Franck places the loss in cows at 65%. This appears to be a very great loss, and suggests that perhaps many of the cases were in a very serious condition before the operation was

undertaken, and were virtually hopeless. The cow withstands laparotomy splendidly, as is well shown by the operation of spaying through the flank. She is quite resistant to lesions of the uterine walls, and so it would appear that she could withstand hysterotomy with comparative safety if we had, to begin with, an aseptic uterus and uterine contents. The difficulty with the operation is largely due to the fact that the fetus and its membranes have undergone putrid decomposition and that the uterine cavity has become infected before the operation is attempted. Under such conditions, success can scarcely be hoped for in a reasonable number of cases. In many instances it is quite impracticable for the veterinarian to determine early the advisability of the operation.

Living foals have been repeatedly removed from the mare by Cæsarian section, but we have been unable to find a record where the life of the mare has been preserved. We do not believe that this total want of success is necessary. We know full well that, under modern surgical methods, we can perform laparotomy in the horse without serious danger. Since this is true, there is no essential reason why hysterotomy should not succeed in some cases. We grant that it never can be made as successful as in the cow. There are, however, some cases, especially those of transverse or bi-cornual development of the fetus, in which no successful delivery has yet been recorded, where the prompt performance of hysterotomy might offer some hope for the life of the mother. The foal is already dead when the veterinarian is called, but it and the uterus need not yet be infected to any great degree.

MATERNAL DYSTOKIA.

Maternal dystokia may be dependent upon a great variety of causes. Any general disease or disorder which may unfavorably affect the maternal system may render the pregnant animal incompetent to expel the fetus; that is, maternal dystokia may be, and frequently is, dependent upon constitutional disturbances of the maternal system.

A majority of the cases of maternal dystokia are due to some defect, disease or displacement of the genital organs or to disease of the maternal pelvis. Maternal dystokia may consequently be said to be either systemic or organic.

1. Inadequate Expulsive Powers.

Systemic causes of dystokia, of whatever kind, may be considered in a single group, since they ultimately induce the one phenomenon of inadequate power, on the part of the mother, to expel a normal fetus, in normal presentation and position, through a normal birth canal. Anything which interferes with the general health of the animal and causes extreme emaciation or weakness may at the same time induce difficult labor, because of the feeble contractions of the uterine walls, as well as insufficiency of the contractile powers of the abdominal muscles and diaphragm. It is consequently not rare to meet with cases of ill-fed animals, especially heifers or very aged cows, in which the general debility of the system so affects the expulsive powers that labor becomes more or less tedious or difficult.

During some seasons in certain communities, the hay or other food is of bad quality, the weather conditions may be bad, and other unfavorable conditions arise which serve to cause great emaciation of entire herds or all the cattle of a district. In such instances maternal dystokia may become well nigh enzootic, especially involving immature heifers and aged cows.

Such maladies as osteomalacie, page 423, and paraplegia, page 431, are frequently accompanied by dystokia, the debility of the disease being accentuated by the decubitis. While voluntary recumbency is not inimical to parturition, involuntary decubitis tends to cause dystokia. Hence disabling accidents,

such as serious fractures and dislocations, when causing decubitis, tend strongly to induce maternal dystokia.

Parturient paresis, in those rare cases where it attacks a cow prior to, or during parturition, inhibits the expulsive powers and causes dystokia. The fetus, though normal in size, presentation and position, is not expelled, but lies in the inert uterus throughout the course of the disease, unless artifically extracted.

The diagnosis of dystokia due to deficient expelling powers is to be based primarily upon the general condition of the animal, its emaciation and weakness, the presence of decubitus, and with these a fetus of normal size, form, presentation and position. The maternal passages are normal, and the os uteri dilated or dilatable, but there is an absence of vigorous expulsive efforts.

The handling of dystokia of this character will depend upon the cause. If the feeble labor pains are referable to debility and emaciation, stimulants are indicated, combined with judicious traction. The case should not be left in the hope of a natural delivery, risking the exhaustion of the patient.

We have already dealt with the dystokia of the ante-partum paralysis in the cow, and shall later consider the question of parturient paresis.

2. Pelvic Constriction.

The pelves of breeding animals may depart more or less from the normal, in such a way as to render parturition difficult or impossible. Pelvic constriction may be due to disease of the general system, or to deformity of the pelvis as the result of some accident.

a. **Rachitis.** Rachitis is not at all rare among domestic animals, but does not as a rule result in serious deformity of the pelvis, as is so frequently observed in woman. The principal part of the weight of the quadrupedal animal falls upon the anterior feet, so that the weight upon the pelvis is comparatively slight and not well calculated to cause pelvic deformity. Besides, the bones of most species of domestic animals are well advanced in ossification at the time of birth, and in rachitis tend rather to break than bend. This is especially true of horses, cattle and sheep, and in these we have no very good proof of serious rachitic deformity of the pelvis. In countries where swine are kept largely in styes, and upon a more or less limited

diet, it is not rare to meet with rachitic deformity of the pelvis which leads to serious dystokia and renders it wholly impossible to extract the fetus through the pelvis. In a series of cases of dystokia recorded by De Bruin in the sow, (B. T. W., January 3, 1907) the pelvis was so constricted from rachitis as to barely admit two fingers to pass through it. Hysterotomy became necessary.

b. **Callus from Healed Pelvic Fractures.** We occasionally meet with fractures of the pelvis in which, when the animal recovers, there remains an enlarged callus, with perhaps some additional deformation by one fractured portion of the pelvic girdle pushing inward, so that it may greatly narrow and obstruct the pelvic canal, rendering birth through it exceedingly difficult or quite impossible. These cases are not very common, but occur in the experience of most veterinary obstetrists, and constantly suggest that a female which has suffered from a fracture of the pelvis should not be used for breeding purposes, except the pelvis has first been examined and found to be sufficiently wide to permit of safe birth.

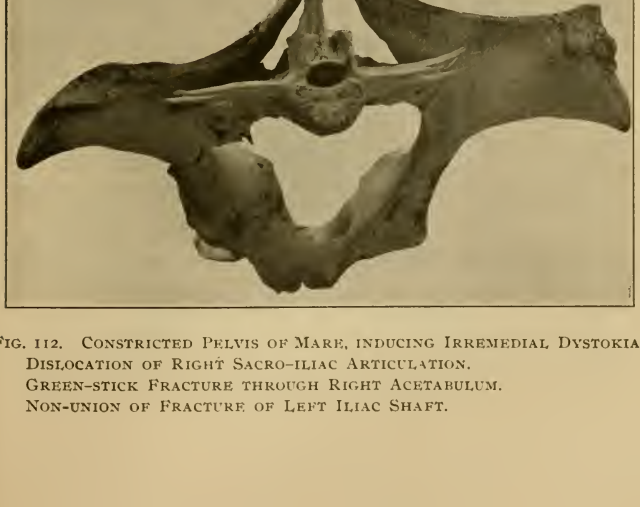


FIG. 112. CONSTRICTED PELVIS OF MARE, INDUCING IRREMEDIAL DYSTOKIA.
DISLOCATION OF RIGHT SACRO-ILIAC ARTICULATION.
GREEN-STICK FRACTURE THROUGH RIGHT ACETABULUM.
NON-UNION OF FRACTURE OF LEFT ILIAC SHAFT.

c. **Unhealed Fractures of the Pelvis.** We observed in one case a fracture of the pelvis in a sucking filly, Fig. 112, which was broken down by a large stallion. There was a dislocation of the sacro-iliac articulation, a green-stick fracture through the acetabulum, and a fracture through the shaft of the ilium. The latter failed to heal, but the filly recovered sufficiently to get about. She was crippled, but in good flesh and vigorous. Later she was bred without the pelvis having been examined. At foaling time we were called, because of severe dystokia, and found the fetus presenting normally at the pelvic inlet; but the pelvic canal was very constricted, and whenever we applied traction to the fetus it seemed to recede instead of advance. The foal could not possibly be extracted by traction because, on account of the non-united fracture on the one side

FIG. 113 A. CALLUS DUE TO DISLOCATION OF THE FEMUR OF COW THROUGH THE FORAMEN OVALE.

A. Acetabulium. B. Exostosis from permanent dislocation of femur through foramen ovale.

and movable sacro-iliac articulation on the other side, whenever traction was applied, the pubis moved toward the sacrum and the channel closed like a cam. The fetus was dead and the mare was worthless, so that delivery by other means was ignored and the animal was at once destroyed.

d. **Exostosis, as a result of dislocation of the femur through the foramen ovale.** Fig. 113A illustrates the pelvis of a cow, in our collection, in which there has been an old standing dislocation of the femur through the foramen ovale. As a result of the constant irritation there has developed a large exostosis inside the pelvis, which would naturally cause serious obstruction in case of parturition. Exostoses or bone tumors may arise in the pelvic canal from various causes, and offer more or less serious obstruction to birth.

e. **Eminences along the ischio-pubic symphysis,** Fig. 113 B, are not rare in the pelvis of the mare. Their cause is

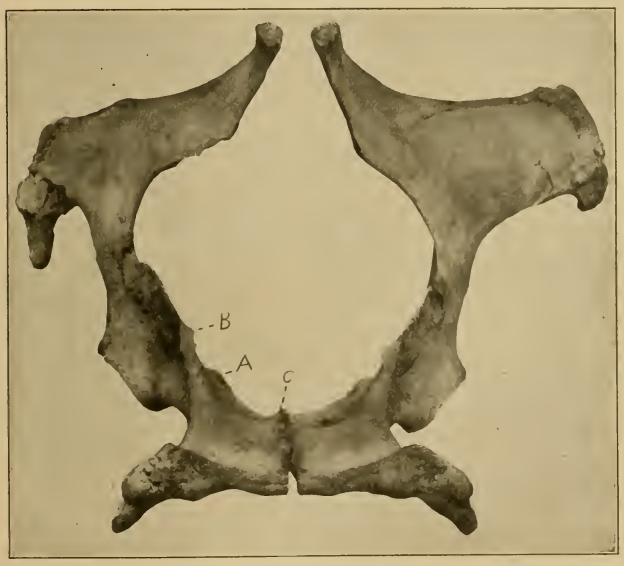


FIG. 113B. PELVIS OF MARE.
Showing prominent elevations, A, B and C on the anterior margin of the pelvic inlet.

unknown. Usually they present no evidences of being of pathologic origin, but seem merely a deviation from the normal type of development. They occur chiefly upon the median line of the anterior pubic border, within the area of insertion of the prepubian tendon, and may be directed more or less forward and upward. At other times they are located, as in Fig. 113 B, just posterior to the pubic brim along the symphysis, and project upwards into the pelvic cavity as a sharp cone. They more rarely occur along the ischial symphysis and elsewhere.

It is not impossible that they result from some disturbance of the nutrition of the general osseous system, and originate in a way corresponding to spavin and similar exostoses in other parts of the body.

Whatever their cause, they constitute serious pelvic obstructions when the time for parturition arrives. They differ, however, in their significance, from the preceding classes. Though they offer some mechanical impediment to the passage of the fetus, unless the projection is very large the fetus may pass over. The chief danger is to the utero-vaginal walls, which, becoming impinged between the conical projection and the fetal body, become contused, lacerated or perforated, to end finally in septic peritonitis.

Handling. In the handling of this group of cases, three distinct possibilities offer to the obstetrist.

1. Prophylaxis.

Should the veterinarian be consulted regarding pelvic injuries to a female which might be used for breeding purposes, he should always consider whether the animal may later be safely bred or not. If the pelvis has been fractured, if there has been a coxo-femoral dislocation or disease, the possibility of changes in the dimensions of the pelvic canal should be considered, the parts carefully examined, and, if necessary, the owner warned. Should the veterinarian be asked to examine the pelvis of a female with reference to her capability as a breeder, the various impediments should be carefully estimated and a judicious answer given.

2. Artificial Abortion.

Pelvic deformities of a character to induce dystokia may occur or become known during pregnancy, at a time when the

fetus is so small that it might safely pass the pelvic canal. In such instances, if it is clear that normal birth cannot take place, and the mother is prized aside from her power to breed, the question of inducing artificial abortion should be considered. If it seems that the life of the mother can thus be rendered more safe than by permitting the fetus to remain and develop until the normal time of parturition, then the operation should be performed.

Artificial abortion may be induced in a variety of ways.

a. It has been stated that artificial abortion may be brought about by the administration of ergot, savin and other drugs. So far as we have been able to learn, however, this plan of bringing about the expulsion of the fetus has not been successful in domestic animals, and the only cases recorded which have apparently succeeded are those where the life of the mother has been greatly imperiled through the toxic action of the drug. It seems that these medicines are as likely to kill the mother as the fetus.

b. Irritation and Dilation of the Cervix Uteri. The hand may be introduced into the vagina and one or more fingers or the entire hand forced through the os uteri into the cervix of the uterus, thereby producing an irritation which may cause expulsive efforts and expulsion of the fetus. It seems, however, that this plan possesses no reliability. While in some instances it may produce the expulsion of the fetus, in others it may not.

c. In the larger animals we may readily carry the preceding operation further and, introducing the hand through the cervix, separate the fetal membranes from the maternal placenta, thus inducing uterine contractions with considerable certainty, especially in the mare.

We may render this still more certain by puncturing the fetal envelopes. If we introduce the hand through the cervix, as already described, and then force one or more fingers through the fetal envelopes and permit the fetal fluids to escape, the fetus will ordinarily be expelled within 48 hours, providing the uterus is in healthy condition. As we have already noted on page 424, rupture of the fetal membranes and escape of the liquids may fail to induce expulsion of the fetus in amniotic dropsy.

d. Vaginal irrigation with cold water, continued for 15 minutes every three hours, is said to bring about expulsive efforts and

evacuation of the uterine cavity, but this does not seem to be entirely reliable. According to Fleming it has certain dangers, especially that of metritis as a result of the shock.

e. Dislodgement of Corpus Luteum. Hess, page 227, claims that the safest and best way to induce artificial abortion in the cow is by dislodging the corpus luteum by compression and then applying massage to the gravid uterus from before backward. In his hands this plan of inducing expulsive contractions of the uterus has proven highly efficient.

3. Overcoming Dystokia due to Pelvic Constriction.

When gestation has passed unheeded until the time for parturition has arrived, and the veterinary obstetrist faces a case of dystokia due to pelvic constriction, various plans for the removal of the fetus present themselves.

a. **Forced Extraction.** First to be considered as affecting the lives of both mother and fetus is that of forced extraction through the narrowed canal. If in the judgment of the veterinarian it is practicable to force the fetus through the canal without serious injury to the mother, this should be done. If forced extraction is decided upon, the operator should properly secure the presenting parts, thoroughly lubricate the passages by means of a warm lysol solution, or otherwise, and proceed with the extraction under the general rules on page 586.

If the fetus has already become advanced in the pelvic canal and is firmly impacted, it is difficult to do otherwise than to attempt the completion of delivery by means of traction. The fact that it has been forced along the passage for a considerable distance should be considered evidence that it may be completely extracted without very great danger.

b. **Embryotomy** may be possible in the larger animals, but is not available in the smaller ones. We have already described, on page 641, the technic for carrying out embryotomy operations.

c. **Cæsarian Section.** Finally, when other means for saving the life of the mother or fetus or both are excluded or rendered very doubtful by the conditions which are present, hysterotomy should be employed, under the general plan which has been suggested on page 663.

This constitutes the most promising method for overcoming

pelvic constriction in the sow, bitch and cat. When dystokia occurs in these animals from pelvic constriction, the obstetrist should definitely decide upon the course to pursue. If hysterotomy is performed at all, it should be done at once, without first attempting forced extraction or other manipulations in the genital canal, since the inevitable insult to these parts and the exhaustion of the patient greatly complicate the case and seriously reduce the prospects for recovery should hysterotomy be later decided upon.

RIGIDITY OR SPASM OF THE CERVIX UTERI.

In the cow a condition is occasionally met with which is attributed to a spasmodic contraction of the cervix uteri, of such a character as to constitute a more or less serious obstacle to parturition. It is difficult to define clearly and definitely what constitutes rigidity or spasm of the cervix, and to differentiate between it and induration. At best this condition is largely a comparative one, and may be due as much to defective uterine contractions as to an abnormal contraction or spasm of the cervix.

Symptoms. The symptoms by which, it is claimed, we may recognize rigidity or spasm of the cervix consist largely of a non-dilation of the cervical canal, in spite of the fact that the labor pains are apparently normal and that no disease of the cervix itself can be detected by examination. In describing the cervix of the uterus in ruminants, we noted its elongated and narrow canal the abundance of circular muscle fibers in its walls, with the large amount of connective tissue. This gives a very firm and rigid character to the normal organ.

In one instance which came under our observation, the keeper of some pedigreed cows had one morning found, projecting from the vulva of a cow, the head of a fetus. The cow was at about the 6th month of gestation. The head of the fetus was removed by the attendant ; its body promptly dropped back into the uterine cavity ; the cervix contracted, and the canal was closed. The attending veterinarian failed to introduce his hand through the constricted cervical canal, and the fetus was allowed to remain in the uterus until thoroughly decomposed, when, some 10 weeks later, the remains were expelled. Such would seem to be a well-marked case of rigidity of the cervix, because its dilatability had been proven by the fact that the head of the fetus had passed through it. Its rigidity was emphasized by the fact that the attending veterinarian was unable to introduce his hand through the cervix, through which the fetal head had passed but a few hours before.

As one of the prominent symptoms, we must consequently recognize first of all the existence of expulsive efforts without corresponding dilation of the cervical canal. Upon examining

the latter with the hand, no actually diseased condition of it can be recognized.

The prognosis of rigidity or spasm of the cervix of the uterus is usually favorable. Occurring almost wholly in the cow, where labor is frequently prolonged, and where the fetus may live for a long time, the rigidity usually gives way to the pressure of the fetal membranes or of the advancing portions of the fetus, in the course of 24 to 48 hours, and delivery is effected. The prognosis must depend to a great extent upon the position of the fetus in the uterus. If it chances to be in some vicious position, by which a very large mass presents at the cervix, it may have little tendency to cause its dilation. We frequently observe great delay in the dilation of the cervical canal, when the fetus presents by its breech with both hind legs extended forward beneath the abdomen, because in such a case the buttocks are too blunt to act as a wedge.

There are other cases in which the non-dilation of the cervix may be primarily due to debility on the part of the mother or to some debility or disease of the walls of the uterus.

Treatment. In the handling of this condition it should be remembered that in the ruminant the process of parturition is usually deliberate and that, if the fetus is presenting normally and the mother seems to be well and strong, the veterinarian should be in no haste until some hours have elapsed after expulsive efforts have become evident.

When, however, labor becomes unduly protracted, and there seems to not be satisfactory progress, intervention upon the part of the obstetrist is advisable. The dilation of the cervical canal is indicated. He should resort first to the most simple means, such as the injection into the vagina, and if practicable also into the cervical canal, of warm emollient liquids, like a 1% solution of lysol or bi-carbonate of soda.

Various drugs have been suggested to overcome rigidity of the cervix. Presumably, any drug introduced into the general system acts alike upon all parts of the uterus, and while decreasing the spasm of the cervix, also decreases the expulsive powers of the organ as a whole. The chief drugs which have been advised for this purpose are opium, chloral hydrate and chloroform. Some have advised the application of extract of belladonna to

the cervix uteri, while others contend that it has no real value. With this latter opinion we are in full accord.

A more hopeful class of drugs, which we do not know to have yet been used, are the local anaesthetics. Stovaine, we know, induces marked muscular paralysis when injected upon a motor nerve. Cocaine and eucaine would probably prove serviceable but must be used with caution, lest poisoning follow. These may prove highly important in combination with mechanical dilation.

The mechanical dilation of the canal is that to which final resort must be made. This frequently constitutes a very trying ordeal, which may require much labor and patience. For this purpose the vagina and vulva should be well disinfected and the hand rendered unctuous by means of an aseptic or antiseptic oil or fat or by keeping it well moistened by means of a warm lysol solution. By passing the hand through the vagina to the os uteri, one, two or more fingers are pressed through the os. As the os becomes somewhat dilated, the fingers are held in the form of a cone and, by a somewhat rotary motion, are forced further and further into the cervix, until finally the hand is pushed through into the uterine cavity, when a portion of the fetus may be grasped and secured, and the dilation completed from in front by drawing upon the fetus itself.

It should be constantly remembered that the most effective direction for the application of the force is from in front, as in normal parturition, and consequently, the earlier we can apply it from this direction the better, and the easier the task.

In one instance we were without mechanical appliances for dilating the canal, except obstetric instruments which were armed with olive-shaped handles tapering from the butt toward the point. After dilating the canal sufficiently to push one of these instruments through until the handle entered the uterus, we then introduced a second handle along the shank of the first instrument and forced it through also. Drawing simultaneously upon the two instruments brought the two handles together at the anterior opening of the cervix, and thus forced the cervical walls apart and dilated the canal far more effectively than we could have done by force applied from behind.

Uterine dilators are made, which in our experience possess high efficiency and greatly lighten the labor of the mechanical dilation

of the cervical canal. These instruments should be made very strong. Introduced through the canal closed, they are to be opened by means of a screw or other mechanism, and the cervical walls thus forced apart.

Since most of these instruments open to a greater extent at the apex than at the base, they imitate the natural method for bringing about the dilation. While some patterns of dilators have their jaws open along parallel lines, those which are divergent, so that they open wider at their apex than at their base, are to be preferred.

Some have suggested sponge-tents, in which a compressed piece of sponge is introduced into the narrow cervical canal, left there to absorb fluids, thus to become greatly enlarged and force the walls apart. Others have suggested rubber bags of various forms, which may be introduced through the cervical canal empty and then dilated by having warm water forced into their interior.

In our experience, however, it is best to rely upon the careful manual or instrumental dilation. This should be accomplished very gradually and with much care, since any violence may cause serious injury to the parts.

Induration and Atresia of the Cervix Uteri.

In the cow, and more rarely in other domestic animals, there occurs an induration of the cervix uteri, apparently the result of some injury or disease which has established a chronic inflammation of the part and led to its thickening and becoming sclerotic, with a consequent narrowing or even closure of the cervical canal. In dealing with the anatomy of the cervix uteri, we have already noted in ruminants, and especially in the cow, that the cervix is usually highly developed and contains numerous circular muscle fibers, commingled with a large amount of connective tissue, which gives to the part a preeminently rigid character.

This normal character of the cervix, with its slow response to the dilating influence of labor, tends constantly to induce injuries during parturition, which may later lead to a chronic inflammation and thickening of the part, to eventually end in induration and a loss of dilatability. It is generally presumed to occur chiefly in cows which have previously given birth, and suffered

from cervical lacerations, retained afterbirth or other forms of local irritation. In our experience it has been confined to heifers. In one heifer the cervix was so hard and unyielding that, in forcing the fetus through the narrowed cervical canal, the cervix was torn asunder, leaving a wide rent into the peritoneal cavity.

The induration may lead to a condition which will admit of a moderate degree of dilation, permitting the fetus to pass with more or less difficulty ; or to complete atresia of the canal. Between these two extremes there may be every possible variation.

The symptoms of induration and atresia of the cervix do not appear until parturition sets in and expulsive efforts have become established, when it soon becomes evident that there is some serious obstacle to birth. Although the expulsive efforts may be vigorous, and to all external appearances everything may seem normal, there is nevertheless little or no progress.

In the milder cases the fetal membranes may protrude and rupture, or even some portion of the fetus, especially one or two extremities, may advance along the vaginal canal and appear at the vulva ; but, regardless of the expulsive efforts, no substantial progress is made. The constriction continuing day after day unless relief is given, the placenta may finally come away, leaving the fetus behind, and the expulsive efforts may cease, while the fetus undergoes putrid decomposition. The cow may apparently recover her condition, or may succumb to septicaemia, with all the symptoms attendant thereon.

The diagnosis of induration and atresia of the cervix must depend primarily upon the revelation of the condition to the sense of touch upon manual exploration. When the veterinarian examines the genital canal he finds that the os is more or less completely closed, that the cervical canal is largely undilatible, and that the walls of the cervix are hard, tense and unyielding. In some cases the walls of the cervix are evidently greatly thickened for a considerable distance, while in others the diseased condition may be limited to the vaginal portion of the cervix.

Perhaps one or more fingers, or even the entire hand, may be passed through the cervical canal, but beyond this degree no dilation may seem practical, and the parts are exceedingly dense and rigid to the touch.

Induration or atresia is to be differentiated from spasm of the cervix, which is purely temporary in character and may yield with comparative promptness to mechanical dilation or somewhat later to the natural dilating forces of the expulsive powers. Induration is also to be distinguished from malignant or other new formations, such as carcinom, sarcom, actinomycosis or tuberculosis. These diseases usually reveal to the sense of touch a diseased state of the tissues, with a tendency to bleed upon being handled.

The prognosis of induration or atresia of the cervix uteri will depend very largely upon its location and extent. When confined to the vaginal portion of the cervix uteri, the prognosis is distinctly favorable, because this portion admits of the freest possible manipulation and operation without imperiling the integrity of the walls of the organ. When the induration is more extensive, and involves the anterior portion of the cervix or its entire length, the prognosis becomes more serious because any extensive operation or accidental tear during the extraction of the fetus may bring about a perforating wound communicating with the peritoneal cavity, and lead to the death of the animal.

Handling. Three courses of handling are open for consideration ; manual or mechanical dilation, followed by forced extraction of the fetus ; dilation by incision or vaginal hysterotomy; and gastro-hysterotomy or Cæsarian section.

Forced dilation of the cervical canal and extraction of the fetus should be attempted only in those instances where the veterinarian feels confident that it may be accomplished without serious mutilation of the cervix. If it appears that forcing the fetus through the canal would probably cause extensive tears, and perhaps penetrant wounds of the cervical walls, forced extraction should be abandoned. The os uteri and cervical canal are first to be gradually dilated with the hand or uterine dilator, until the operator may introduce his hand into the uterine cavity. The fetus may be secured by the presenting extremities, each carefully arranged in its proper position, and the cervical canal thoroughly lubricated, after which traction may be applied slowly and judiciously and the fetus forced away. The general directions for the application of traction have been given on page 586.

Vaginal Hysterectomy. The dilation of the cervix by incision, or vaginal hysterotomy, is usually to be preferred to forced

extraction or other means for bringing about delivery. If it is probable that forced extraction would cause more or less extensive ruptures in the cervix, the veterinarian may often guide and control these injuries by means of proper incisions. When the induration or atresia involves only the vaginal projection of the cervix, and the anterior portion is normal, the operation is simple and readily performed.

In such a case the operator introduces a scalpel or bistoury and makes one, two or three incisions in an upward or lateral direction, sufficient to bring about the required dilation of the part. The depth, number and direction of the incisions must be based upon the amount of dilation required and upon the thickness of the muscular walls. The direction of the incisions should usually be upward or to the right or left. It is better that they should be numerous rather than deep, because, if a certain degree of dilation is to be attained and but one incision is made and the fetus is then forced into the rigid cervix, the yielding will take place almost exclusively at the one point weakened by the incision, while the other portions remain undilated, thus leading to an extensive and dangerous rupture.

After the incisions have been completed, the presenting extremities of the fetus should be secured and properly placed, the cervical canal freely lubricated, and the fetus slowly and cautiously extracted.

After the extraction of the fetus, careful examination of the cervix should be made for perforating wounds into the peritoneal cavity. If the organ is intact and the fetus has been dead and has begun to decompose, it may be desirable to flush out the uterine cavity with an antiseptic solution. If there is a penetrant wound into the peritoneal cavity, the introduction of an antiseptic in a large volume is exceedingly dangerous and improper, and other means should be taken for cleansing the uterus. Any liquids present may be drawn off by means of a siphon. The fetal membranes should be removed as promptly as is practicable, and if they cannot be removed with safety they should be kept as nearly antiseptic or aseptic as is possible, by the introduction of liquid disinfectants, or dry antiseptics such as powdered boric acid or iodoform.

Cæsarian Section. Finally, if forced extraction and the surgical dilation of the cervix are each impracticable, Caesarian

section, as described on page 663, should be performed at a sufficiently early period to give the best opportunity for the saving of the lives of the mother and fetus. The operation leaves the animal worthless for breeding purposes, the common fate of induration or atresia of the cervix, however handled. It is only in exceptional instances that the veterinarian can properly advise an owner to again attempt breeding from an animal which has required surgical aid in parturition as a result of cervical atresia or induration.

Fleming cites a number of recorded instances of induration and atresia of the cervix uteri. We have met with two noteworthy instances, both in the cow. The first was in a two-year-old heifer, in which case the os uteri was opened sufficiently to admit the passage of the hand, by which means the two anterior feet and head were secured, and traction cautiously applied. The extraction of the fetus was very gradual, and the traction applied was not severe, consisting of the combined power of two men. The progress was very slow. The two anterior limbs were easily brought through the cervix into the vagina and pelvic canal. Later the head also passed through, but when the chest was reached there seemed to be a halt.

Finally during a vigorous expulsive effort, while traction was being applied, there was a loud tearing sound, the fetus advanced rapidly without severe traction and was quickly delivered. The calf was alive. Upon examining the uterine cavity, a great rent was found in the cervical canal, about 10 inches long, which penetrated the peritoneal cavity. Fortunately it was directly at the top of the canal and consequently was advantageously situated in reference to escape of uterine contents into the peritoneal cavity. The heifer recovered without incident.

The second case was also in a heifer, but in this instance a 3-year-old and of the Polled Angus breed. The pregnant heifer was kept at pasture in a place where she was not under close observation. At about the normal time for parturition, the owner noted the fetal membranes protruding from her vulva and assumed that she had given birth to a calf. The heifer showed some slight expulsive efforts, which he attributed to a retention of portions of the afterbirth.

In a general way she recovered from the ill-effects of fetal retention, and kept in good condition. She was taken from the pasture and was milked, yielding about two gallons per day. Her appetite and general health seemed to be good, except that at intervals she was affected with a fetid diarrhea, which soon passed off. Ten weeks later we were called in consultation, and upon exploration found the os uteri constricted, permitting the introduction of but two or three fingers, while through it protruded a portion of the tail of the fetus. The constriction was confined to the vaginal portion of the cervix, so that the finger or fingers entered the fully dilated cavity.

With an ordinary bistoury, the os uteri was sufficiently dilated, by cutting, to allow of the ready insertion of the hand. Introducing the hand into the uterus, we encountered the remains of the fetus there being recognizable the tail and a small fragment of the skin of the buttocks. Beyond lay an inextricable mass of fetal bones, which had separated into their basic parts, the shafts and epiphyses being separated from each other. Deep down in the anterior part of the uterus there was found an accumulation of whole grains of corn and other foods. Along the left side of the uterus there were two openings, which would admit of the passage of one or two fingers directed toward the rumen. Apparently the uterus had become adherent to the rumen, and portions of the fetus had sloughed into that organ and, passing out through the intestinal canal, had caused the fetid diarrhea which the owner had observed.

The walls of the uterus were hard, immensely thickened, and wholly devoid of contractile power. Judging from the sense of touch, the walls seemed to be more than one inch thick.

There was no unfavorable reaction to the operation, and the heifer continued her usual flow of milk. Later she was fatted and sent to market.

Malignant and Other Newgrowths Involving the Genital Passages.

Veterinary literature records occasional cases of malignant tumors or other diseased growths in the cervix uteri and other portions of the genital tract. They are very rare, and very diverse in character. The symptoms are frequently unlike those of induration or atresia of the cervix in that their presence may be revealed by symptoms before the end of gestation. Naturally, they probably develop chiefly after impregnation, because, were they present and had acquired any great development before breeding, they would probably prevent fertilization.

They may be of the nature of carcinom or sarcom and, more rarely, of actinomycosis or tuberculosis.

During pregnancy their presence may be revealed or suggested by the existence of a vaginal discharge, accompanied possibly by some constitutional symptoms of debility, especially in cases of malignant tumors.

If not revealed by the presence of discharge during gestation, they may be discovered because of their acting as an impediment to parturition. When the veterinarian is called because of dystokia, and examines the patient, he recognizes the tumor by touch.

The prognosis is highly unfavorable if the tumor is malignant because, although it may be possible to deliver the fetus, the life of the mother cannot usually be greatly prolonged, and the disease itself is generally beyond remedy. The disturbance of parturition is quite inclined to arouse the disease process to renewed activity.

Should the tumor be of a benign character, and its anatomical relations permit removal, the prognosis is favorable.

The handling of the dystokia is to be based upon the character of the tumor. If malignant, the chief aim should be the saving of the life of the fetus, if of value. Partial or complete removal of a malignant tumor of the genital canal may be warranted in order to remove the obstruction to birth, and the fetus may then be delivered through the birth canal. If the tumor is irremovable and offers serious obstacle to delivery, gastro-hysterotomy may be performed to save the life of the young.

Benign tumors interfering with parturition should be removed.

Numerous other minor impediments to parturition occur very rarely in the genital canal.

Adhesions and constrictions in the vulvo-vaginal canal offer at times more or less serious impediments to parturition, which may lead to important lacerations of the soft parts.

Persistent hymen is occasionally met with in cases of dystokia, but, so far as we have observed, consists of thin bands, stretching from floor to roof between vulva and vagina but taking no part in the causation of the dystokia. They are easily ruptured with the fingers.

DYSTOKIA DUE TO DISPLACEMENTS OF UTERUS.

a. **Hernia of the Uterus, or Hysterocele.** In considering the accidents and diseases of the pregnant female, we have already had occasion to refer on page 436 to the rupture of the prepubian tendon, and to other forms of uterine hernia by which the gravid uterus may escape through an opening in the muscular walls of the abdomen. In considering those accidents, we necessarily dealt with their causes, prevention, and method of handling.

b. **Deviation of the Uterus.** Various writers describe a displacement of the uterus obliquely downward, which they compare with ante-version of the gravid uterus of woman. The exact condition is not very clear. According to Fleming, when the hand is introduced into the vagina it reaches an imperforate culde-sac, which consists of the floor of the uterus pushed up against the floor of the vagina, thus projecting into the pelvic cavity, while the os uteri is situated high toward the sacrum and is not much dilated. The fetus lies beneath the vaginal floor and corresponds somewhat in its position to what we describe on page 715 as bi-cornual or transverse development of the fetus.

While considering the location and attitude of the fetus in pregnant animals, on page 379, we have recorded occasionally finding, during the later stages of gestation, an extremity of the fetus, usually the head and two anterior feet, projecting into the pelvis or immediately against the pelvic inlet, either above the vagina or alongside of it, but we did not consider that this was abnormal.

Fleming, citing Garreau, relates one case in which, in this deviation, the os uteri was closed and the cervix was thickened and indurated. Later it became necessary to perform Caesarian section, by which the life of the cow was saved. This seems rather to have been induration of the cervix.

In another case, described by Schaack, the fetus was in a normal position and was extracted, but the cow died almost immediately from an extensive rupture in the floor of the uterus, which led to a fatal hemorrhage, in a similar way, apparently, to what we record as a common consequence of forcible extraction in cases of bi-cornual development of the fetus.

It would appear, therefore, that under this head veterinary obstetrists include a group of diverse conditions.

The handling of such cases must be based upon the actual character of the obstacle to birth. When practicable, the fetus should be removed by traction.

c. TORSION OF THE UTERUS.

Torsion of the gravid uterus, or revolving of the organ upon its long axis, is an accident which belongs to quadrupedal animals. The displacement occurs most frequently in uniparous animals, and especially in ruminants. It is most frequently diagnosed in the cow. It is common in the ewe. In the cow it occurs chiefly in dairying districts where the animals are kept confined in stanchions and where, as a consequence, they are subjected to certain violent movements, especially of slipping in getting up on a wet floor or in making a misstep into a deep gutter. It is comparatively rare in the mare, and even more so in the small, multiparous domestic animals.

Historically, the accident has been recognized for more than a century, and has been well known and studied in every country where much attention is paid to dairying and the breeding of cattle.

The anatomical relations of the uterus largely determine the probability of torsion. The ovaries are formed, page 17, near the Wolffian bodies, and the broad ligaments extend from these backward to, and including, the vagina, maintaining the genital canal in its position in the abdominal cavity. In all animals the ovaries drop more or less into the abdominal cavity, and tend to move backward toward the inguinal ring. As the ovaries retreat backward, the broad ligaments tend to follow them, so that their most anterior attachments pass back toward the inguinal ring. Consequently, the fixation of the uterus becomes more and more posterior as the ovary moves backward.

This migration of the ovary, and the consequent moving backward of the broad ligament, is most marked in the ruminant, and consequently when the animal becomes pregnant the gravid uterus soon projects far anterior to its ligamentous attachments to the abdominal walls. There is little to prevent the projecting

portion of the gravid uterus from revolving upon its long axis, and once it has thus become displaced there are virtually no natural means for its replacement.

An additional factor in torsion of the uterus, which has perhaps been over-emphasized by some obstetrists, is that, in the uterus of the cow, the cornua curve downward, backward and then upward, instead of curving upward and forward as in the mare and most other animals, and that the broad ligament is attached at first to the inferior side of the uterine cornua. This in itself renders the organ unstable when it becomes gravid, and it tends to make a partial revolution upon its long axis before it can come to rest in a stable position upon the abdominal floor. Some writers look upon this peculiarity in the conformation of the organ itself as the chief factor in the frequency of torsion in the cow, but it probably plays a very minor part.

The accident, in the larger animals, consists of the revolution of the gravid uterus upon its long axis, in which process its broad ligaments must become involved. The torsion shows itself chiefly in the cervix and vagina. When the organ turns upon its long axis, the broad ligaments are necessarily carried along with it, and more or less incarcerate the organ, as if they were tense cords wound spirally about it.

In the smaller, multiparous animals, torsion usually involves one cornu only.

The gravid organ in torsion behaves very much the same as a stout bag filled with fluid contents. If such a bag is attached at one end, and we attempt to revolve the free extremity upon its long axis, the spiral constriction will occur, not in its middle but at the end where it is attached and constricted by its mouth being tied shut. In the distended uterus, when it revolves upon its long axis, the actual twist or spiral occurs ordinarily, not in the uterine body or in the cornua, but in the constricted neck or in the empty vagina just beyond. The method by which this torsion is brought about is well demonstrated in Figs. 114–116. The torsion may occur with equal facility to the right or to the left. If the upper portion of the uterus turns to the right, while the floor passes to the left, it is known as right torsion; if it revolves in the opposite direction, it is known as left torsion.

The torsion may be of any degree compatible with the integrity of the organ. As a general rule, it is scarcely recognizable

unless the revolution has reached the quadrant of a circle, 90°, or what some obstetrists know as quarter torsion. If the torsion continues until the uterus has made a complete revolution upon its long axis, it is known as complete torsion. Some writers would have us believe that the uterus may make four complete revolutions. This assumption or statement is open to question. It cannot well go very far beyond a complete revolution, until the strain upon the organ becomes too great, and it twists off or ruptures transversely and drops, an inert bag, into the abdominal cavity.

FIG. 114. THE MECHANISM OF TORSION OF THE UTERUS IN THE COW. GRAVID UTERUS IN NORMAL POSITION AT ABOUT THE 7TH MONTH OF PREGNANCY, SEEN FROM BELOW.

P, Pubis. B, Bladder. L, Broad ligament.
L′, Point of attachment of broad ligament to abdominal wall.
O, O, Ovaries. C, Right cornu. C′, Left (non-gravid) cornu.
A, Corpus luteum.

The causes of torsion have not been fully determined. Anything which may violently disturb the uterus may cause it to turn upon its long axis. We have noted the peculiar anatomical relations of the uterus of the cow. Another peculiarity is that when she gets up she rises first upon her hind feet, which causes the gravid uterus to hang half suspended by the vagina in the abdominal cavity. When thus partially suspended, any slipping upon a wet floor or misstep into a deep gutter may

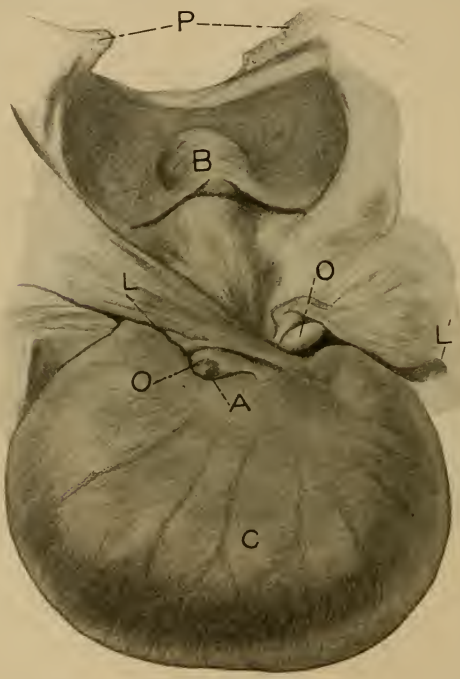


Fig. 115. The Mechanism of Torsion of the Uterus in the Cow. One-half Revolution of the Gravid Uterus on its Long Axis at about the 7th month of Pregnancy.

Lettering same as Fig. 114.

cause such a disturbance of the semi-pendulous organ as to cause it to revolve more or less completely upon its long axis.

Any movement of the animal which might cause a sudden impact upon the gravid uterus, such as a fall, a severe slip, running, jumping, or the jostling which animals get in transit upon railway trains, may accidentally cause the gravid uterus to revolve upon its long axis.

In one instance observed by us, a mare had the habit of climbing up the sides of a large stack of straw, and would then lie down in such a way that she was unable to get up except by rolling over backward. In several instances the owner was compelled to turn her over in this way and let her roll down the side of the straw stack before she could regain her feet. When foaling time came she died because of torsion of the uterus.

FIG. 116. THE MECHANISM OF TORSION OF THE UTERUS IN THE COW, COMPLETE REVOLUTION OF THE GRAVID UTERUS AT ABOUT THE 7TH MONTH OF PREGNANCY.

Lettering same as Fig. 114.

The belief that the rolling of the animal, or some similar movement, such as a slip, which causes the body to very quickly revolve to a slight degree, is the cause of torsion, is borne out by the results of our most common form of handling of this difficulty, the rolling of the animal.

Some believe that violent movements of the fetus exert an influence in the production of torsion, but this cannot be determined. The fetus may move violently because of partial asphyxia after the torsion has occurred, and this fact may be mistaken for the cause of the torsion.

Symptoms. The symptoms of torsion of the uterus are not diagnostic without the aid of an examination of the organ itself. Soon after the torsion occurs, there is more or less pain caused by the displacement of the organ, which may be expressed in a variety of ways, according to the degree of torsion and the period of gestation at which it occurs. In the simpler cases the pain is expressed by kicking at the belly, lying down and quickly getting up again, looking at the side, switching the tail, with other symptoms which might be regarded as those of colic. In addition to these colicky symptoms, there may be present more or less marked expulsive efforts, which may somewhat closely resemble normal labor pains, or may partake rather of the character of straining to defecate.

The general condition of the animal is variable. There may be a well marked loss of appetite, accompanied by more or less constipation of the bowels. When the torsion becomes more complete, and the blood supply to the uterus is largely or wholly interrupted, the fetus usually undergoes death and decomposition, followed by great weakness of the animal. There are then such symptoms as would be caused by the presence of an emphysematous fetus and an inflamed or gangrenous uterus, with the resulting extensive peritonitis combined with septicaemia. When the septicaemia and peritonitis do not result fatally, the contents of the uterus, undergoing putrid decomposition, act as an abscess, which eventually ruptures through the abdominal walls or into the digestive tract, and the fetal remains escape in this way. In other cases the fetus is said to undergo mummification, followed by recovery of the patient. This must be extremely rare. We have observed no such case, or authentic record of such.

Frequently the owner or caretaker fails to observe any signs

which would lead him to suspect serious accident. The animal simply becomes dull, or if colic is present it passes unobserved, and it is not until the torsion has existed for days or even weeks that it has caused a sufficient disturbance to finally attract his attention. This is especially true of those who keep but a few cows and are about them but little. Cows at pasture are often scarcely seen at all, or merely are noticed for a few minutes each day, so that, unless there are very evident symptoms of disease, they pass unseen. In this way, it has been our experience that torsion of the uterus frequently passes unnoticed for a week or two, except that the owner may have recognized the fact that there was something amiss with the animal, though not in his judgment of a sufficiently serious character to call for veterinary attendance. In some cases of uterine torsion, the vulva seems smaller and drawn inward.

The diagnosis of the accident in the larger animals is comparatively easy by either vaginal or rectal exploration. Examined per rectum, the anterior part of the vagina and the cervix of the uterus appear as a more or less tense, spiral cord, in which the spiral folds of the organ can be somewhat readily felt and the direction in which the torsion has taken place may be determined.

When the hand is introduced into the vulva, it does not advance far until it comes in contact with the spiral folds in the vaginal walls, which pass in a spiral manner, either to the right or left, obliquely toward the os uteri. In some cases these spiral folds are not very prominent and the vagina is not closed, so that the veterinarian may, without serious difficulty, advance his hand to the os uteri ; sometimes he may be able to pass the cervical canal and reach the cavity of the uterus.

In severe cases of torsion this cannot be done, but the hand, after following the folds of the vaginal wall in a spiral manner for a time, can be advanced no further. In some cases the hand can barely be introduced to the os uteri, and in others it stops before the mouth of the uterus is reached.

This condition of the vagina is sufficient in itself to clearly identify the torsion, and renders the diagnosis definite.

Pathology. The changes taking place in the uterus and its contents, in cases of torsion, must depend very largely upon the extent of the displacement of the organ. In mild cases, where

the torsion is but slight, it does not interfere seriously with the circulation of the uterus and the nutrition of the fetus. The contractile power of the uterine walls remains essentially intact, and the life of the fetus may not be threatened except by delay in its expulsion, caused by the narrowing of the birth canal, owing to the partial revolution of the organ. In such slight cases the torsion merely constitutes a mechanical impediment to parturition, which, if not relieved, may finally end in the death of the fetus, to be followed by the ordinary consequences of fetal death and decomposition. Such mild cases are recorded, but have not been seen by us.

When the torsion is extensive, it directly interferes with the circulation in the uterus, and secondarily with the nutrition of the fetus. As shown in Figs. 114–116, whenever the uterus revolves upon its long axis all the blood vessels become more or less incarcerated, so that the circulation is very promptly disturbed or may be completely cut off. This applies equally to vessels arising from the pudic or ovarian vessels. As soon as the circulation is disturbed, the effect upon the uterus is more or less

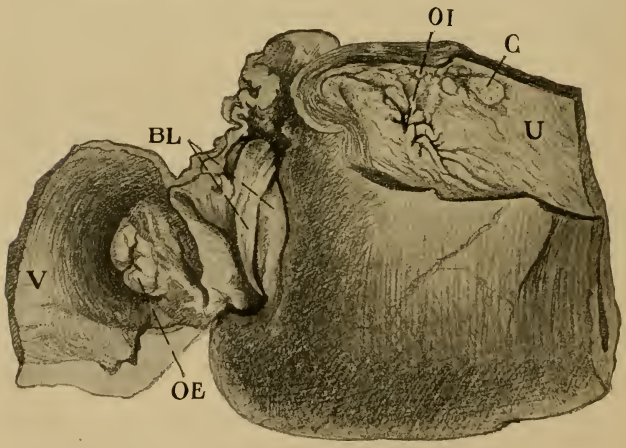


FIG. 117. TORSION OF UTERUS. COW.

V, Vagina. OE, Os uteri externum. OI, Os uteri internum.
BL, Broad ligament. C. Cotyledon. U, Uterine cavity.

profound, according to the degree of obstruction. Moderate obstruction to the circulation tends to cause congestion of the uterine walls and placenta, accompanied by pain and symptoms of colic, with possibly more or less evident expulsive efforts. This obstruction, affecting first the venous circulation, tends to cause asphyxiation of the fetus. As a result of this disturbance of the circulation, the fetus may show more or less violent movements, which may sometimes be misinterpreted and believed to be the cause of the displacement, whereas in fact they are the result of it. The disturbance in the circulation and the non-æration of the blood of the fetus tend finally to bring about its death, and this usually occurs after a comparatively short time if the torsion is at all extreme.

The interference with the circulation affects first the return of the venous blood from the placenta, and as a consequence there is a constant tendency to an extensive transudation of serum and blood, into the uterine cavity and the fetal membranes.

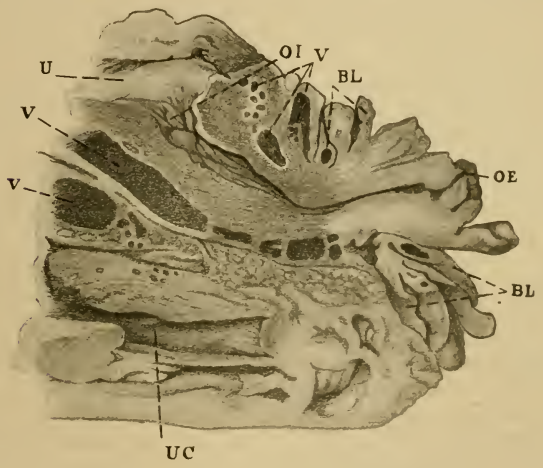


FIG. 118. SAGITTAL SECTION OF FIG. 117.

OE, Os uteri externum. OI, Os uteri internum.
BL, BL, Broad ligament.
V, V, V, Veins distended with coagulated blood.
U, Uterus. U, C, Uterine cornu.

The transudation involves the uterine walls also, causing them to become immensely thickened, injected and black ; the maternal and fetal placentæ undergo analogous changes; the fetal membranes become involved ; and extensive exudation of bloody serum occurs in the uterine, allantoic and amniotic cavities, increasing enormously the volume and weight of the gravid organ.

It is said that in some cases the fetus undergoes mummification, but if this occurs it must be very rare. The tendency is rather for infection of the uterus and its contents to take place and lead to putrid decomposition. Under normal conditions, the cervix uteri acts as an efficient guard against infection. The cervical canal is hermetically sealed with a mucous plug. When torsion occurs, the tissues of the vagina and cervix at once lose their normal function and, when the torsion is extreme and the vitality of the walls becomes depressed or destroyed, their bactericidal power declines or ceases, and they serve rather as a favorable culture ground for bacteria, which consequently advance to the uterus and its contents, either along the cervical canal or through the tissues, and thus cause fetal decomposition and septic metritis.

It has been stated by some veterinary obstetrists that the torsion of the uterus may take place at any point, or nearly so, in the entire organ in the vagina, the cervix or body of the uterus, or in the cornu. A study of the figures presented will answer this question. If we examine the gravid uterus, as shown in Figure 114, and revolve it upon its long axis, as has been done in 115 and 116, we find that we are dealing essentially with a large bag, containing solid (fetus) and liquid contents, in which the fundus of the uterus or the gravid cornu represents the bottom of the sac, while the cervix and vagina represent the closed mouth, which is fixed to the immovable vulva.

Attempting to revolve this bag upon its long axis, we at once find that it will twist only at or near its point of fixation, where its mouth has been closed. If the uterus were empty, it could admittedly twist at any point throughout its entire extent, but when completely filled this cannot occur. Instead, if it were forcibly revolved and forced to begin to twist in this part, it would be torn asunder because the contents do not permit of any decrease in volume. Therefore, in cases of uterine torsion

in unipara, the twist must occur in the cervix and vagina and not elsewhere.

The suggestion that the gravid cornu may possibly be the only part involved in a twist is untenable, in so far as it relates to uniparous animals, where a portion of the fetus has developed and lies within the uterine body. In multipara, like the sow, bitch and cat, torsion of one of the cornua may and does occur, and is more probable than the torsion of the entire uterus.

De Bruin suggests that, in a large proportion of the cases of torsion, the accident occurs after the os uteri has become dilated, and that it is favored by this fact. He bases his belief upon the clinical fact, that, in a large proportion of cases of uterine torsion, when it is reduced, the cervical canal is found dilated and ready for the passage of the fetus. We are not wholly ready to accept his conclusion. We have likened the gravid uterus to a bag filled with fluid. If we leave the mouth of the bag open, retaining its contents, attach it to an immovable object and attempt to turn it upon its long axis, we find this very difficult or even impossible.

De Bruin reasons that, because the uterus is contracted, there is more room for it to twist, but the uterus is certainly just as thoroughly filled, if not more so, than before it began to contract, unless the waters have escaped. The common clinical fact, that the cervical canal is found dilated in some cases immediately after torsion is reduced, may readily be explained by the torsion itself. In torsion, the cervix becomes very much stretched longitudinally, and this is one of the greatest elements in the dilation of the cervical canal. The torsion, by involving chiefly the cervix, would destroy first of all its contractile power, very greatly weaken its muscles and tend to favor dilation as soon as the torsion is reduced. De Bruin admits this weakness of the cervical walls, and cautions the obstetrist against applying great force upon the fetus after reduction of the torsion, lest the cervix rupture transversely, but this would scarcely occur except the muscles had been seriously damaged by over-tension.

When the fetus becomes emphysematous or undergoes putrid decomposition, and the uterine cavity becomes filled with transuded liquids, the disease processes are not confined to the inner surface of the uterus and to its contents, but extend to and beyond the peritoneal covering of the organ. The peritoneal covering

of the uterus becomes inflamed, and finally tends to adhere to other portions of the peritoneum with which it comes in contact, so that in one case observed by us, almost the entire peritoneal surface of the uterus was very firmly adherent to the intestines, rumen, bladder and abdominal walls. In addition to these adhesions, in severe cases, the peritoneal cavity contains an abnormal amount of a reddish-colored serum.

Not only does the uterus become adherent to surrounding organs and tissues, but one part of the organ becomes firmly adherent to another part of it or to its broad ligaments, especially about the cervix, so that even if the rest of the organ is free from adhesions it may be difficult to untwist it because of adhesions existing between the coils in the twisted portion itself.

When the torsion continues to an extreme degree, the organ and its broad ligaments give way, and the uterus, with its contents, becomes almost or wholly detached and lies free within

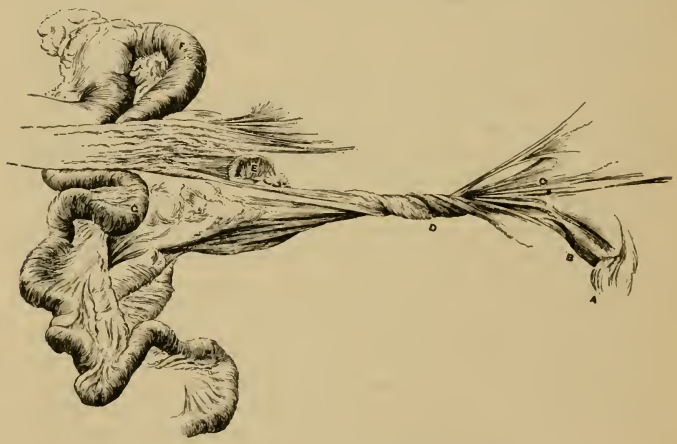


FIG. 119. TORSION OF THE UTERUS IN EWE.

Followed by transverse rupture of the vagina and sloughing of the putrid fetus through the abdominal floor.

A, Vulva.
B, Vaginal stump.
C, Broad ligament.
D, Cord-like cervix, entwined by broad ligament.
E, Ovary.
F, Uterine cornu.
G, Intestine.

the peritoneal cavity. Just how far uterine torsion can advance in the living animal is a question not readily determined. Fleming, in his Veterinary Obstetrics, Edition 1887, page 299, states that the uterus may make as many as four complete revolutions, but cites no cases which clearly demonstrate the correctness of such a conclusion. In our own experience, the constant tendency has been for the organ to rupture transversely whenever the torsion extends to an extreme degree. In Fig. 119, transverse rupture of the uterus in the ewe is shown. In this case the fetus and other uterine contents sloughed out through the abdominal floor in the region of the umbilicus. How many times this uterus had revolved before it had torn in two cannot be determined, but apparently not much, if any, beyond one complete revolution. We question very much if, under ordinary conditions, the pregnant uterus, when near the close of gestation, will turn more than once or once and a half around without serious danger of a transverse rupture.

In one instance, in the cow, which came under our observation, it would seem that the torsion did not exceed one complete turn because it was very promptly reduced by rolling the cow once over. Yet, when the fetus had been removed, a large transverse rupture was found, which later ended in the death of the animal. We do not believe that we caused this rupture in delivering the calf, as this was accomplished very gently and easily.

Some authors state that occasionally the broad ligaments of the uterus also become ruptured, and make their statement in such a way as to carry the impression that the ligaments rupture independently of the transverse rupture of the organ itself. How true this may be, is not quite clear to us. When the organ ruptures transversely, as in Fig. 119, it is very evident that the broad ligaments must give way also, as they are firmly incarcerated in the part which ruptures, and the immense weight of the gravid organ, after it has become detached from the vagina, is such that the ligaments must necessarily be torn. Yet, we do not understand, from a study of Figs. 114 and 115, how any serious rupture of these ligaments could take place without the organ itself having first given way.

Prognosis. The prognosis of torsion of the uterus must necessarily be grave. The probability of recovery must be based

largely upon the duration and extent of the lesion. When a recent torsion, to the extent of ¼ to ½ of a revolution, exists, it is ordinarily not to be regarded as serious, because it may not greatly imperil the life of the fetus, or render its extraction a formidable matter. It may not interfere very greatly with the circulation in the uterus or with the nutrition of the uterus and fetus. When, however, the torsion becomes complete, as in Fig. 116, or there is almost a complete turn upon its long axis, the circulation of the organ is at once seriously interrupted. Unless prompt relief is afforded, the fetus must perish, and almost certainly undergo decomposition with all its consequences, and the uterus must become seriously diseased. If the twist proceeds a step further, a rupture of the uterus results, which must almost inevitably lead to the death of the animal; or should she survive, her value is usually destroyed because of the very slow, uncertain, and imperfect recovery, by the sloughing of the fetus through the abdominal walls or into the alimentary canal.

The prognosis must therefore always be very cautiously made.

1. The torsion may be reducible or irreducible.

2. The fetus may be alive, or dead and emphysematous, according to the duration and extent of the torsion.

3. The putrid decomposition of the fetus and the serious disturbances in the circulation may have led to uterine paralysis, inflammation or gangrene from which it is impossible for the animal to recover.

4. The uterus may have suffered a fatal transverse rupture, which may not reveal itself until after the torsion has been reduced and the fetus extracted.

Treatment. The handling of torsion of the uterus must be based upon the extent and duration of the condition and the character of the pathologic changes which have occurred.

1. In slight torsion, where the uterus has not made a complete revolution upon its long axis, it may be possible to advance the hand through the vagina and cervical canal into the uterus, rupture the fetal membranes, seize the presenting limbs, and, by exerting force upon the fetus itself, cause the uterus to turn back to its normal position. In such a case the force is to be exerted in the direction opposite to the twist, turning the organ back to its original position. If the torsion has taken place to the right, the force, exerted indirectly

upon the uterus through the fetus, should be to the left. If the birth canal is sufficiently open to permit the feet to pass through and beyond the vulva, the correction of the position of the uterus is rendered much more simple, because greater power is given to effect rotation of the fetal body by grasping the limbs. Having flexed the foot at the fetlock, the pastern may be used as a lever to exert power. Various machines and appliances have been suggested to aid the operator in these cases, but, as a general rule, where the torsion is so slight its correction constitutes a rather simple procedure, and not much equipment is necessary for the purpose. In correcting this slight torsion, the animal should be in the standing position, if practicable, and with the hind-feet much higher than the fore-feet. We have not observed such slight torsion though it has been reported by others.

When the torsion has advanced to such a degree that the hand cannot be inserted into the uterine cavity, it is impossible to turn the uterus by the application of force to the vagina.

2. In severe torsion we may attempt either to turn the uterus within the abdomen of the patient or to turn the body of the patient and keep the uterus fixed.

The method most frequently employed for bringing about the reduction of the torsion is that of turning or rolling the patient. The operation is best performed in the open field if weather and other conditions permit. Otherwise a commodious room is selected. The patient is to be cast with her hind parts elevated, so that the uterus may tend to drop away from the pelvis and hang attached by the vagina, much like a bag freely suspended from a fixed support. If the torsion is to the right, the patient should be cast upon the right side. The two forefeet should be firmly bound to each other and the two hind feet to each other. The forefeet should not be attached to the hind feet, because this would exert compression upon the abdomen, which would interfere with the rotation of the uterus upon its long axis, and consequently with the replacement of the organ.

The operator should be careful to keep the posterior parts of the patient well elevated. He should kneel or lie behind the patient and insert his hand as far as possible, to hold the vagina or uterus as firmly as may be and also to determine the result of the operation of rolling. The operation proceeds upon the assumption that, in rolling the body of the animal, the gravid uterus shall

remain static, and consequently the normal relationship shall be restored by the patient's body revolving around the gravid uterus in the same direction in which the latter had previously turned. The operator remains in the position named, and assistants turn the animal upon her right side, thence upon her back and over onto her left side. Folding the feet beneath the patient's body, she is rolled up on her chest, over onto her right side, and the rolling continued as before.

In discussing the cause of torsion, we suggested that the accident probably results from a very sudden slip or turn of the animal. In attempting to overcome the displacement of the organ, it may be advisable to imitate those conditions which we assume to have caused the displacement. Consequently, the rolling process, at a critical point, should be more or less sudden, in the hope that the body of the patient, by being moved quickly, does not cause the gravid uterus to move with it, but leaves it standing still. To this end, then, when the rolling process is begun it may be done rather quickly, in order, if possible, to bring about the revolution of the body of the mother, without having the gravid uterus follow its motion.

3. Others favor a modified rolling process by causing a partial revolution of the body of the mother with an attempt to turn the gravid uterus in the opposite direction or to hold it from turning with the maternal body by means of external force applied to the fetus through the abdominal walls. The patient is turned slowly and gently upon her back, while the operator or an assistant identifies the fetus by palpating the abdominal floor. If the torsion is to the right, the operator pushes against the fetus from the right to the left and attempts to cause the gravid organ to revolve toward the left, or at least to aid materially in holding and preventing it from rotating to the right as the body of the patient is suddenly brought down on her left side.

This plan of operating is based upon the assumption that, when an animal suffering from uterine torsion is slowly and carefully rolled over, the gravid uterus revolves to the same degree, but that an abrupt roll of the maternal body may change the relations of the gravid organ. This influence can be aided by external manipulation.

Assuming that the operation has been successful, when the cow has been turned completely to her left side the ropes are removed

and she is allowed to stand. If the operation has been successful, the spiral folds of the vagina have disappeared, the hand can be advanced without difficulty to the os uteri, and, if the cervical canal is dilated, the hand may be passed on into the uterine cavity and the fetus grasped.

It is highly important, in this operation, that the veterinarian should constantly keep, or frequently insert his hand into the vagina in order to determine the progress which is being made. Sometimes the operator becomes confused in reference to the direction of the twist, and consequently in reference to the direction in which the animal should be rolled. If his hand is introduced into the birth canal and the rolling process is begun in the wrong direction, he at once recognizes the fact by the increased pressure upon his hand as the twist becomes aggravated. If the turning is in the right direction, and the torsion is reducible, the vagina becomes more open and commodious, and the hand can be advanced further into it.

In some instances the torsion is not promptly reduced, although it may eventually be accomplished by perseverance, so that, if turning the animal once does not completely accomplish the object, we should not despair, but should resort to several turns and watch closely the result.

4. When the rolling process, or the partial rolling with external manipulation, fails to bring about a reduction of the torsion, it has been recommended to perform laparotomy, reach into the abdominal cavity with the hand, grasp the gravid uterus, and reduce the torsion by acting directly upon the organ. In the cow it would be preferable to operate upon the standing animal, making the incision somewhat high in the right flank. If the torsion is to the right, the operator reaches down between the right abdominal wall and the gravid uterus; inserting the hand as far as possible alongside and beneath the organ, lifts upward; and, drawing somewhat to the right, attempts to cause it to revolve to the left. If the twist is to the left, the operator passes his hand over the top of the organ to the left side, and downward as far as possible, and, grasping some projecting portion, draws the organ upward and to the right. How often this process succeeds, where rolling or external palpation fails, we are unable to determine. Probably not often. The gravid

uterus is so voluminous and heavy, its exterior so even and smooth, and it is so closely imprisoned in the abdomen that grasping the organ with the hand and exerting efficient force is not so easy. The force must be largely exerted by placing the palm of the hand at a favorable point and pressing against the uterine walls in an advantageous direction to induce rotation. We have attempted the operation twice after rolling had failed, each time without result.

When the torsion has been reduced by one of the foregoing plans, the question of delivery arises. If the torsion has occurred early in pregnancy, and has been promptly discovered and remedied, it may not be advisable to encourage the immediate expulsion of the fetus. Cases have been recorded in the cow, six to seven months pregnant, in which the torsion has been reduced, the pregnancy continued to its normal close, and a living calf born. These constitute very exceptional instances. In many cases the torsion is not discovered at this period.

Torsion is liable to occur at any time during the last third of gestation, and consequently, when the veterinarian is called to attend a pregnant animal during this period, and finds it suffering from some disease, the character of which is not very clear upon external examination, he should not fail to investigate carefully the condition of the gravid uterus, in the course of which examination he would naturally discover uterine torsion if it existed.

When uterine torsion has been reduced, and has not caused pathologic changes which have destroyed the functions of the uterus, labor generally begins very shortly afterward, and the fetus is expelled. De Bruin and others recommend that we should as a rule leave the expulsion of the fetus to the natural forces of the mother, unless there are conditions present which suggest otherwise. If the cervical canal is not yet dilated, time should be allowed for this to occur normally. If the canal is dilated, it is usually observed that the fetus is quite promptly expelled, so that very little assistance, if any, is required. If it seems advisable to apply traction to the fetus, it should be done very cautiously, and abundant time should be given for the passage of the fetus through the birth canal. It is needless to state that, if the fetus presents abnormally, it should be adjusted.

Before applying traction or carrying out other manipulations, after the organ has been replaced, we would advise the practitioner to search carefully in every part for transverse rupture of the cervix uteri or other important injuries, because, if such rupture has occurred during the torsion of the organ, it should be discovered promptly and the owner of the animal advised of the conditions, that he may relieve the veterinarian from any responsibility which might rest upon him otherwise because of the later discovery of the condition.

De Bruin aptly remarks that, in these cases, examination should be made before any operation is begun, with a view to determining whether the case has already been handled by empirics or others, and in this way the outcome rendered more doubtful.

Torsion of the uterus is frequently irreducible. In one case which we attended, the torsion had apparently existed for about two weeks, and the spiral folds of the cervix and vagina had become so firmly adherent to each other, Figs. 117 and 118, that the organ could not very well have been untwisted.

Reduction was also made virtually impossible by the fact that the fetus was dead, emphysematous, and swollen to thrice its normal volume, and so great a volume of fluid had transuded into the uterine cavity as to increase the weight and volume of the organ to such a degree that there was neither room within the abdominal cavity to turn the organ nor power enough in the arms of a man to bring about its rotation. In addition, the uterus was so firmly adherent over its entire surface to the surrounding organs and abdominal walls that a replacement of it was impossible, until it had first been dissected loose.

In another of our cases, the organ was free from adhesions, the torsion had existed for some days, the emphysematous fetus and the transuded liquid had so thoroughly distended the uterus, and its walls were so voluminous, that it occupied virtually the whole abdominal cavity, and there was simply a want of room in which to turn the organ, and its weight was entirely too great for a man to lift.

In those cases where the torsion has ended in a complete transverse rupture through the cervix or vagina, reduction is evidently impossible. When gangrene of the uterus has occurred, reduction, if possible, is useless.

When torsion is irreducible, there is virtually no hope for

the life of the fetus, because in almost, if not all cases, it has perished before the condition has been realized, and consequently its life or value is excluded from consideration.

If irreducible torsion has occurred early in pregnancy, it is possible, according to some writers, that infection may not reach the uterus and its contents, and that as a result the fetus may undergo mummification, in which instance the animal, if a meat-producing one, may be fatted for the butcher and disposed of in that way.

In some instances, the fetus may undergo putrid decomposition and slough out through the abdominal floor or into the digestive tract, and by a long and tedious process the animal may eventually recover. But the economic loss is well-nigh total, because of the total loss of breeding power and the long time required for recovery.

5. Cæsarian Section. The chief hope in cases of irreducible torsion is Cæsarian section, and the value of this should always be judiciously considered. Usually there can be no hope for the life of the fetus, and the fertility of the mother is at an end. We have left for consideration the question of the economic value of the animal for meat, wool or labor; or the sentimental value of the saving of the life of the animal. Whether we operate or not should be determined after considering all these factors. The operation has already been described on page 663.

Should gastro-hysterotomy be performed in torsion of the uterus, it is to be remembered that the evacuated uterus must not be completely closed and returned into the peritoneal cavity unless the torsion has been reduced. If the torsion remains and the uterine incision is closed, the escape of uterine excretions is barred. The margins of the uterine incision may be securely sutured to the margins of the abdominal incision, thus providing an avenue for the escape of uterine discharges externally. Usually it would be preferable to amputate the diseased cornua and body of the organ, and secure the cervix to the margins of the abdominal incision. In other cases the entire organ may be amputated, with a portion of the vagina, the latter ligated and returned into the pelvic cavity, and the abdominal incision completely closed.

In the smaller animals, where one of the cornua undergoes torsion, reduction is practically out of the question, and only gastro-hysterotomy remains.

FETAL DYSTOKIA.

In veterinary obstetrics, abnormalities in the form or attitude of the fetus furnish by far the most numerous instances of dystokia. The ways in which the fetus may serve as an obstacle to its own expulsion from the uterus are exceedingly varied, and may be dependent upon something abnormal in the fetus itself, due to arrest in development, to disease during its intra-uterine life, or to its death and decomposition; or it may be due to some deviation in its attitude when approaching the birth canal, which may render its passage difficult or impossible.

It is convenient for the proper study of these difficulties that they be divided into groups dependent somewhat upon their character. These may be synoptically outlined as follows:

SYNOPSIS OF FETAL DYSTOKIA.

A. Development of the Fetus in an Abnormal Position in the Uterus. — Bi-cornual Pregnancy or Transverse Development of the Fetus.

B. Diseases of, or Abnormalities in the Development of the Fetus and its Annexes.

- *a.* Excess of Volume of the Fetus.
- *b.* Fetal Death. Emphysema.
- *c.* Diseases of Fetus causing Abnormal Size of Parts or of entire Body.
  1. Hydrocephalus or Dropsy of Lateral Ventricles.
  2. Ascites and Hydrothorax.
  3. Anasarca. (Wasserkalbe or Speck Kalbe.)
  4. Cysts or Cystic Degeneration of Fetal Parts.
     - *a.* Subcutaneous Cysts.
     - *b.* Cystic Guttural Pouches.
     - *c.* Cystic Kidney, Liver or other Viscera.
     - *d.* Fetal Tumors.
- *d.* Anomalies and Diseases of the Fetal Membranes and Umbilic Cord.
  1. Adhesions of Fetal Membranes
  2. Resistant Chorion.
  3. Hydramnios. Hydrallantois.
  4. Abnormal Umbilic Cord.
- *e.* Aberrations and Anomalies in Fetal Development.
  1. Campylorrachis.
  2. Schistocormus Contortus.
  3. Wry-Neck.
  4. Anchyloses of Articulations.
  5. Double Monstrosities.

C. Abnormal Presentations and Positions of the Fetus.

I. Anterior Presentation.

- *a.* Dorso-ilial or Dorso Pubic Positions.
- *b.* Deviations of the Extremities.
  1. Anterior Limbs.
     - (1) Feet crossed over the Head.
     - (2) Limbs Flexed at the Elbows.
     - (3) Limbs Flexed at the Carpus.
     - (4) Limbs completely Retained.
  2. Head and Neck.
     - (1) Head Deviated Laterally.
     - (2) Head Deviated Upward.
     - (3) Nose caught against Pubic Brim.
     - (4) Head Deviated Downward.
  3. Interlocking of Fetal and Maternal Pelves.
  4. Extension of Posterior Feet forward beneath the Body.

II. Posterior Presentation.

1. Dorso-ilial or Dorso-Pubic Positions.
2. Tarsal Flexion.
3. Complete Retention of Posterior Limbs.

III. Transverse.

1. Dorsal Presentation.
2. Ventral Presentation.

A. DEVELOPMENT OF THE FETUS IN AN ABNORMAL POSITION IN THE UTERUS. BICORNUAL PREGNANCY OR TRANSVERSE DEVELOPMENT OF THE FETUS.

The uteri of domestic animals are so definite and characteristic in their form that they usually admit of the development of the fetus in but one position, in which the long axes of the uterine cornu and the fetus must be parallel. In uniparous animals the two cornua usually leave the rather ample body at an acute angle, and the single fetus is almost inevitably developed in a longitudinal position, somewhat equally in one of the cornua and in the uterine body.

In multiparous animals the inconspicuous uterine body is usually empty, and the fetuses are developed almost wholly in the extensive cornu, in a longitudinal position.

In the mare, however, the form of the uterus is such that it may lead, as we have already stated on pages 28 and 379, to a bicornual or transverse development of the fetus.

The earliest account we have found of this abnormality is by Pauli, who, in Gurlt and Hertwig's Mag., 1842, Vol. 8, p. 196, records attending in 1837, with two colleagues, a mare which they could not deliver. Autopsy revealed a transverse fetus, dorsal presentation, head, neck and anterior limbs in right horn, hind feet in left horn, abdomen and chest occupying the uterine body.

So far as we are aware, definite attention was first drawn to this anomaly by us, in an article entitled "Transverse Development of the Fetus in the Uterus of the Mare" in the American Veterinary Review, Vol. 13, page 298. Later occurred a description of apparently the same anomaly by Anton Tapken, Official Veterinarian in Varel, in the Monatshefte für Praktische Tierheilkunde, Vol. 18, page 148, of which a translation by us appeared, with added comments, in the Veterinary Journal, Vol. XLIII, page 148.

Bicornual development of the fetus is made possible in the mare because of the unique direction in which the two uterine cornua are given off from its body. Instead of leaving the uterus at an acute angle, as in ruminants and carnivora, they

depart from the body at right angles, or slightly recurved so as to give the entire organ, consisting of the body and cornua, a crucial form. It thus becomes possible for the fetus to develop in such a position that the long axis of its body corresponds to the combined long axes of the two uterine cornua; that is, the fetus develops partly in each of the two cornua, with its body crossing the uterine body at its anterior extremity, so that the fetus fundamentally occupies a position with its long axis transverse to that of the mare.

How often this may occur in the mare, we do not know. In our contribution above quoted, we recorded four cases, to which we may add the four case reports of Tapken and one of Pauli.

It is a well known fact, to all who have had extensive obstetric practice in mares, that it is not rare for the foal to present transversely. This is in sharp contrast to cattle obstetrics, where transverse presentation is very rare. Among these presentations, except those cases which we now have definitely under consideration, it is impossible to determine how many of them may have developed transversely, and consequently at the time of birth presented transversely. While veterinary obstetrists may deny the posssibility of bicornual development, our cases, fully verified by post mortem examination, show that it actually occurs, and not very infrequently. The established facts do not forbid our assuming that some of the other fetuses which present transversely may have been developed in the transverse position.

In the cases now under consideration, the embryo apparently forms in each case in the transverse presentation, with its ventral surface presenting toward the os uteri, and later revolves upon its long axis, so that it finally rests in a dorsal transverse presentation instead.

In its earlier stages, the embryo curves very markedly ventralwards, and this ventral curvature continues to a considerable degree throughout gestation. Since the cornua of the uterus leave the body at right angles or slightly recurved, the embryo may well develop with either its dorsal or ventral surface facing the os uteri, although, so far as investigations upon this point carry us, only those cases have been recognized as bicornual development which have begun their development with their ventral surface presenting toward the pelvis.

If the embryo commences to form in the uterine cornua, with its ventral surface directed toward the os uteri, and the fetus curves ventrally, it would naturally follow that, as it attains weight, the central portion of its body would tend to drop downward, while its two extremities would point upward toward the oviducts. Later the fetus would tend to descend until the convex dorsal surface would come in contact with the abdominal floor and thereby assume an unstable position. Since the anatomical conditions prevent its revolving upon its long axis in the direction of the pelvis, it may acquire stability only by its extremities passing forward and downward to come to rest upon the abdominal floor. In accomplishing this movement, the fetus revolves upon its long axis; and in doing so its dorsal surface turns toward the birth canal, pushing the uterine floor backward beneath the vaginal floor, and stretching the roof of the vagina forward. In this transverse position, the fetus must necessarily drop well forward and remain wholly in front of the pubis, thus stretching and elongating the vagina to a remarkable degree. We have attempted to indicate this change in the position of the fetus in Figs. 120 and 121.

Symptoms. This anomaly in development naturally passes unobserved during the entire period of gestation, and is not discovered until an examination is made in order to determine the cause of dystokia. The symptoms are then unique and diagnostic. Before the obstetrist is called, the os uteri has become dilated, the water-bag has appeared and ruptured, and probably some of the fetal membranes lie in the vagina or protrude from the vulva. The labor pains are weak in character. The fact that no portion of the fetus, or at least no considerable portion of it, can usually be forced into the vagina, tends to inhibit any well marked expulsive efforts. Such would necessarily prove futile, and dangerous to the integrity of the uterus.

When the obstetrist inserts his hand, he is first struck by the extremely elongated and narrowed vaginal passage, which is nearly twice its ordinary length, although very much decreased in its transverse diameter. No os uteri or cervix is distinguishable as such. If the obstetrist follows the roof of the vagina, the hand glides along it almost as far as the arm can reach; or perhaps he cannot reach the anterior end of the roof, where it

finally turns down in a gradual curve, without any recognizable line of demarcation between it and the uterus.

If he follows the floor of the vagina and palpates carefully as his hand passes along, he will discover to his astonishment a hard body lying beneath it, which upon careful manipulation he may recognize as portions of the fetus, lying directly against the vaginal floor, and impressing him very strongly at first with the idea of extra-uterine pregnancy. If he will follow the uterine floor further, to the extent of nearly the entire length of his arm, his hand suddenly passes downward into the uterine cavity, and he finds that the floor which he has been following bends abruptly backward to constitute the roof of the uterus, immediately beneath which the fetus lies transversely with its dorsal surface presenting toward the pelvic inlet.

FIG. 120. TRANSVERSE OR BICORNUAL DEVELOPMENT OF THE FETUS IN THE MARE.

V, Vagina. U, Uterine cavity, which is later to blend with the vagina to constitute an elongated tube. UC, Uterine cornu.

In some cases the obstetrist may find one or more feet projecting from the uterus into the vagina, which may be readily reached and grasped. In a large proportion of cases, however, no portion of the fetus projects into the vagina, and before the operator can bring his hand into immediate contact with any portion of the fetus he must reach far forward and then, bending the hand downward and backward, touch the ventral portion of the fetus or some of the extremities which are folded along it. In order to accomplish this, he reaches clear over the body of the fetus, passes beyond its ventral line and then, after passing the point of version where the floor of the vagina ends, turns the hand downward, and more or less backward, into the uterine cavity. These peculiarities serve to differentiate this condition from any other known in veterinary obstetrics.

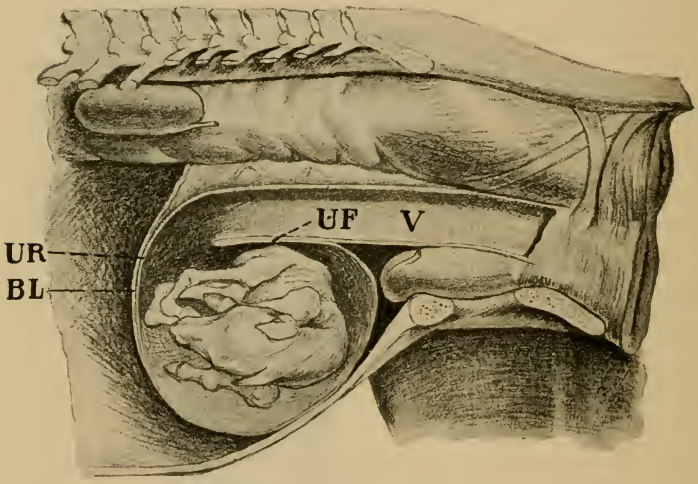


FIG. 121. BICORNUAL PREGNANCY. Second stage, the fetus having made one-half revolution on its long axis. (Schematic).

V, Elongated vagina and uterine body.
UF, Floor of uterine cornua, now become the roof.
UR, Roof of uterine cornua, now become anterior wall.
BL, Broad ligament.

Prognosis. The prognosis in this condition is always highly unfavorable. We have no record of any case in which the life of either mother or fetus has been saved. Tapken says, "Delivery is always difficult. If no part of the fetus can be reached, delivery is evidently impossible. In each of the four cases which I append, the result was fatal for both mother and foal, and such was also the result in another case, which, owing to oversight, was not included in the foregoing table. In the latter case of dystokia, two experienced colleagues had already tried in vain to deliver the mare before I had been called. It was barely possible to touch the metacarpus of one leg with the finger tips, when the arm had been introduced completely to the shoulder." The case of Pauli also ended fatally for both mare and foal, despite the efforts of three veterinarians.

In our own experience we have been equally unsuccessful, and have encountered great and even insurmountable difficulties in delivery. In one of our cases the mare survived the operation some days, but finally succumbed to metritis. In that one case it would seem possible that, had we had a better understanding of the conditions and given closer attention afterward, she might have been saved. We would not, therefore, advise the veterinary obstetrist to refrain from attempting to deliver a mare in this condition. However, in undertaking it, it would be well in our judgment to advise the owner of the highly unfavorable prognosis of the case, so that he may be forewarned of the probable outcome.

Method of Handling. Each case must be dealt with, in detail, according to circumstances. In general, it is well to secure any of the extremities which may lie within reach and cord them, so that force may be exerted upon them at any time that, it may become desirable. If all four feet can be reached, it is usually advisable to amputate the two anterior limbs, either subcutaneously or at the humero-radial articulation, and then attempt to convert the presentation into a posterior one by drawing carefully upon the hind legs.

The position of the animal is important. Fig. 121 suggests that, if we turn the mare upon her back, the version of the uterus will tend to disappear and the fetus will be brought nearer to the operator, so that parts which previously had not been in reach

may now be grasped. Placing the mare upon her back also relaxes the projecting floor of the vagina and, by tending to overcome the version of the organ, renders traction upon the fetus less dangerous to the floor of the vagina and the roof of the uterus.

Various positions of the mare may be tried in an effort to overcome the difficulty. It must be remembered that it is exceedingly exhausting to the mare to remain for a long period of time upon her back, and this position should not be continued beyond the absolute necessities of the case. If the work can be done nearly as well with her standing upon her feet, this position should be preferred until the critical time arrives for extracting the fetus by force, when we believe it would be best in all cases to turn the mare upon her back for this brief period and thereby relieve the vaginal floor and uterine roof.

The position of the fetus and its relation to the uterus render most forms of embryotomy exceedingly difficult or impossible. In our experience, we have been limited to the possibility of the amputation of the limbs. The decrease in the size of the fetus, were we able to bring about embryotomy, especially evisceration, would favor its delivery.

After the extraction of the fetus, if the obstetrist has been so fortunate as to accomplish this without fatally injuring the uterus, unusual care should be taken to guard against sepsis. Fig. 121 shows that the form of the uterine cavity is extremely unfavorable for adequate drainage, and suggests that this be overcome as far as possible by careful and repeated irrigation of the uterus and siphoning out of the contents.

In view of the fact that we have been unable to save the life of either mare or foal in any case, and, so far as we have been able to determine from recorded cases, no mare or foal has been saved by other practitioners, it would seem to us that the veterinary obstetrist is fully warranted in early resorting to gastro-hysterotomy in a way to possibly save the life of his patient. While we have not attempted this operation in the mare, we believe that it offers the greatest hope for success in these cases. Evidently there is nothing to lose. In one of my cases, as in one of those recorded by Tapken, delivery through the birth canal was wholly impossible, and under such conditions clearly the only plan remaining is hysterotomy.

Presumably there is never an opportunity to save the life of

the foal ; it is ordinarily dead before the obstetrist is called. We have outlined the technic of hysterotomy on page 663.

The following cases illustrate the variations and difficulties to be overcome, and suggest, more forcibly than anything else well can, the seriousness of the anomaly. Cases 1 to 3 are quoted from the contribution by Tapken ; cases 4 to 6 are from our personal experience.

1. An old mare, which had already foaled regularly a number of times, showed symptoms of colic in the evening after the normal duration of pregnancy. Later, mild labor pains appeared and some of the fetal waters were expelled. Upon examination, at 8:30 A. M., the mare was comfortable, ate some, no labor pains recognizable. At times there was a discharge of fetal fluids. The cervix uteri was dilated. Portions of the ruptured chorion extended into the vagina. The uterine walls were stretched and thrown into folds similar to torsion of the uterus, but nearer to the body of the uterus. The fetus could barely be reached with the finger tips, after the arm had been introduced up to the shoulder. During the exploration there were only feeble labor pains.

An attempt to modify the position of the uterus, by rolling the mare, failed. While in the recumbent position, however, strong labor pains appeared. As a consequence of these violent pains, the tightly stretched uterine wall was pressed into the pelvis to such an extent as to threaten rupture. The neck of the bladder was also dilated to such a degree that four fingers could be introduced into it. During the violent pains, the urinary bladder was from time to time forced out into the vulva, where it was visible as a whitish mass about the size of a man's fist.

A second veterinarian was called in consultation. At 4 P. M. the further handling of the case was undertaken by T., in company with his colleague K. After a prolonged effort, the lower end of the tibia was grasped, and a cord attached above the hock.

By means of a vigorous pull by four persons, the tarsus was brought to the pelvic inlet, and the tendo-Achilles divided, partly with a knife and partly with shears. Both arms were inserted in the genital canal, and finally the leg was drawn out so far that it could be amputated at the hock. The second leg could not be grasped. Traction was applied to the tibia of the amputated leg, and, with the force of six persons, the skin and muscles torn asunder without any incisions having been made, and the leg tore away at the hip joint and was drawn out. The other tarsus could then be grasped, and was handled in the same way. Upon the application of powerful traction by six persons, the fetus was extracted. It was large, but normally formed.

In the uterus, near the neck, there existed a perforation. The mare died a few hours later.

2. An eight-year-old mare, which had repeatedly foaled in a normal manner, showed, after eleven months pregnancy, weak labor pains and unrest for a period of two and one-half hours. An examination revealed one fore-leg, presenting in the normal position and direction, in the pelvis. Be-

neath the advanced limb, the uterus and vagina formed a projection, under which one could distinguish parts of the fetus, especially the head. These parts were time and again forced to the middle of the pelvic cavity during the labor pains. Beneath the presented foreleg one could feel, through the uterine wall, other parts of the foal, which later were found to be the second anterior limb flexed at the carpus.

After mounting a stool, so that the arm could be inserted as far as possible, he succeeded in reaching the point of flexure of the uterus. It was not possible to grasp any other part of the fetus. The anterior limb was corded and drawn out by three persons, until the forearm was visible. The other anterior limb was then released from the folds in the uterus and brought into the genital canal, but it could not be extended. In order to secure room, the extended limb was detached. The division of the skin was incomplete, and could only be extended to the elbow joint. As a result of this, it required the combined power of six or seven persons to draw the limb away.

The head, which was clearly recognizable at the beginning of the operation, became displaced in such a way that it could no longer be reached. There remained, consequently, no other recourse than a forcible extraction of the fetus, which was accomplished by the traction of six or seven persons.

The mare lay exhausted and listless. After half an hour the pulse was 60, strong and regular, which indicated that no great amount of internal hemorrhage was occuring. A small amount of blood flowed from the vulva. By a manual exploration of the uterus, no labor pains were induced. After three and one-half hours the mare arose, staggered somewhat at first, but soon partook of food. In the following days the appetite was fairly good, then failed.

Four days later the mare was again examined. The pulse was 70, the appetite poor, and now and then there were expulsive efforts. Upon examination of the parts, there was found a great gaping rent in the superior wall of the uterus, so that it was easy to introduce the hand directly into the peritoneal cavity. The animal died on the sixth day. The autopsy revealed a rent in the uterus about 25 cm. long, also diffuse peritonitis.

3. A young mare, at full term, had shown labor pains for several hours. Fetal waters had appeared. Upon inserting the hand as far as possible, only fetal membranes and the uterine wall could be felt; through these walls, however, in the reflexed uterus, parts of the fetus could be recognized. An empiric, with the consent of the owner, had made an examination and had torn through the wall of the uterus, which he had mistaken for the fetal membranes. The mare was destroyed.

4. In 1887 the writer was called to attend an imported Percheron mare, because the keeper believed her to be in labor, although in some way the symptoms appeared to him unusual.

Upon examination no expulsive efforts could be observed, and when manual exploration of the vagina was made there was marked narrowness of the passage at the usual location of the os uteri, which was mistaken for it. Lying beneath the vagina, a fetus was felt, apparently with all its membranes intact. Non-interference, with close watching, was advised.

The mare continued fairly well and quiet for about 48 hours, when we were recalled and, upon making a second examination, found the fetal membranes protruding from the vulva. Upon careful examination it was found that the part, which was previously supposed to be the os uteri, was merely the narrow vagina, beneath which the fetus lay. The presence of the membranes permitted us to follow them along their course until the opening into the uterus was reached, when it was found that nothing resembling the normal os uteri was present.

The vagina was extremely long and narrow. Far to the anterior, barely within reach, the canal opened abruptly downwards and backwards into the uterus. Posterior to this opening, and beneath the vagina, lay the body of the foal, in a transverse position, readily felt through the vaginal and uterine walls. Though beyond reach through the os uteri so long as the mare was standing, when she was recumbent the hind limbs could with difficulty be reached.

After patient and exhausting work, the hind legs were secured at the tarsus by means of cords, but it was impossible to bring them into the passage until the feet were amputated through the lower tarsal articulation. We then had the two hocks presenting with the ossa calces directed upwards, while beneath the vagina could still be felt the main volume of the fetus. Firm traction applied to the hind limbs finally brought the fetus into a posterior presentation, and accomplished its extraction after about five hours of very trying labor.

Examination immediately after delivery revealed an enormous rupture of the uterus and inferior wall of the vagina. The animal was destroyed, but no autopsy made.

5. A large French draft mare in excellent condition, which had previously bred successfully. The fetal membranes were found protruding, but no well-marked labor pains. Exploration revealed an exceedingly long, narrow vagina, which, at its anterior extremity, barely within reach, opened abruptly downwards and backwards. The usual conformation of the os uteri was wanting. While the mare was standing, no portion of the fetus could be touched by passing the hand into the uterus. There seemed to be a great cavity to the right and left and posteriorly. By following the superior walls of the vagina up to the uterus, we found this bent abruptly downward to become the anterior wall, which could be followed as far as the hand could reach without coming in contact with any portion of the foal. Posterior to this opening and beneath the floor of the vagina, the fetus could be plainly felt. By passing the hand through the uterine opening, drawing its posterior margin firmly backwards, and then reaching downward and backward as far as possible, a portion of the fetus could be barely touched, but not grasped.

After casting the mare and placing her upon her back, one hock was secured, corded, and with great difficulty brought into the passage. Then one anterior limb was secured and amputated. Later the other hind leg was secured, and with strong traction the fetus was brought away after eight hours of exhausting labor. The mare succumbed 24 hours later, and no autopsy was made.

6. The writer was called in consultation, in case of dystokia in a large

draft mare which had bred repeatedly before without difficulty. The vagina was abnormally elongated and narrow, and its anterior end opened abruptly downward and backward without resemblance to the usual os uteri. The fetus could be plainly felt through the floor of the vagina, posterior to the opening into the uterus. It lay with its back against the pubis of the mare. By passing the hand through the opening into the uterus, and then downwards and backwards, the elbow of one fore-leg could be touched with difficulty. After long and arduous labor this one limb was secured and brought into the passage, but we were wholly unable to secure any other limbs or parts of the foal, either by raising the abdomen with a sling or by casting the mare and turning her upon her back. Though my colleague was an experienced obstetrist and a large and powerful man with very long arms, it was impossible for either of us to secure other parts of the fetus. The one limb which we had succeeded in cording was in such a position, in relation to the uterus and vagina, that traction could not be applied with any safety or efficiency. After a long and fruitless effort, the mare was destroyed, and a post-mortem examination immediately made.

The foal, very large and well matured in every respect was lying upon its right side with its dorsum against the pubis of the mare. The head was located in the right uterine cornu, and the hind legs and buttocks in the left. The body lay in a thoroughly transverse position across the abdominal cavity, posterior to the opening between the vagina and uterus. One fore-leg was flexed at the carpus, and the other, which we had secured, was drawn backward over the neck of the fetus, into the vagina. The two cornua were developed equally, and their long axes were perpendicular to that of the mare. The vagina, because of the transverse position of the fetus and the peculiar version of the uterus, was much elongated and narrow. The opening from the vagina into the uterus was abruptly downwards, the superior vaginal wall suddenly losing itself by turning abruptly downwards to become the anterior uterine wall. Thus that portion of the uterus which had originally constituted the roof or superior wall had now become its anterior wall. The inferior wall of the vagina, or floor, terminated anteriorly abruptly, in a thin margin; what had previously been the *floor* of the uterus was turned abruptly backwards against the vagina, thus becoming the *superior* uterine wall.

* * * * * * *

While the bicornual development of the fetus seems to be naturally limited almost wholly to the mare, because of the peculiar conformation of her uterus, rare exceptions are recorded. Cuillé, Revue Vet. 1905, records a case of bicornual pregnancy in the bitch, which caused insurmountable dystokia. The autopsy showed a fetus, lying with its head and fore legs in the right horn and its croup and hind legs in the left. In another case of dystokia, in the bitch, C. extracted the fetus by traction on one fore foot, and believed that this also was a case of bicornual pregnancy.

B. ABNORMALITIES IN THE DEVELOPMENT, OR DISEASES OF THE FETUS.

a. Excess of Volume of the Fetus.

Excess in the volume of the fetus is a comparative term. It is the relation existing between the size of the fetus and the dimensions of the birth canal of th emother, rather than definite abnormality in volume. Such comparative excess in size is not rare in domestic animals, and is frequently a more or less serious obstacle to the expulsion of the fetus.

The causes of this comparative excess in fetal volume are not clear. The excess may be confined to one part of the body, or may apply to the entire body.

Prolonged gestation is sometimes believed to increase the volume of the fetus. In the cow and mare there are great variations in the duration of gestation, ranging from 30 to 90 days or even more. During this period the fetus is presumably constantly growing, and, if carried for 30 to 60 days beyond the briefest duration of pregnancy, it would be but reasonable to expect that it may be larger because of this longer period of intra-uterine development.

Nevertheless it has not been possible to verify this suggestion by clinical observation. Prolonged gestation does not commonly result in such a growth of the fetus as to cause any serious obstacle to its delivery. It is true that those fetuses which are born after a comparatively short duration of gestation, premature births, are usually very small, but they are also correspondingly immature. When they reach the average duration of intra-uterine development they seem to be as large as though carried for a much greater length of time. In one instance which we noted, where the duration of gestation in a mare exceeded 12 months, the foal to which she gave birth was a pigmy about half the size which would naturally have been expected in harmony with the size of the sire and dam.

Neuman (B. T. W., 1909, p.702) records delivering a cow, 413 days pregnant, of a putrid, emphysematous calf, weight 110 lbs. long hair, female, form of male. The impression is given that the large size was due to prolonged gestation. The fact

that the fetus was dead and emphysematous destroys all evidence of prolonged gestation. The fetus may have perished at 280 days. In 1908, Frost, instructor in the N. Y. State Veterinary College, delivered a Holstein-Fresian cow of a calf weighing 147 lbs. The duration of pregnancy was normal, the calf was normal, and was alive, but died during delivery. Calves weighing over 100 lbs. are not rare in this breed. It is consequently unwarranted to conclude that, because a fetus is unusually large, the duration of pregnancy has been excessive; or that, because pregnancy is being prolonged, dystokia from excessive volume of the fetus must occur. While rare exceptions may occur, according to our observations the largest fetuses are usually encountered in those cases where the full duration of what we regard as normal pregnancy has merely been reached.

It appears, from all that we can learn of the subject from a clinical standpoint, that the retention of the fetus in the uterus, beyond the average duration of time, is not dangerous from the standpoint of causing dystokia by excess of volume, but rather that other complications may arise which may be more or less dangerous for the well-being of the mother and fetus.

In multiparous animals, like the bitch and sow, it is frequently noted that when the number of fetuses is below the average they tend to grow larger because of the increased nutritive supply, and in this way tend to cause difficult labor.

Excessive size of the male animal, as compared with that of the female, has been alleged to cause an excessive size of the fetus, but this we have not been able to verify clinically. We have had occasion to observe the results of crossing small mares of 700 to 1000 pounds with large draft stallions weighing from 1800 to 2500 pounds, or approximately three times the weight of the mare. Yet we did not observe a case of dystokia, in such mares, attributable to excessive volume of the fetus.

Fleming cites several authors to show that such crosses do result in difficult labor, especially in the ewe and bitch. On the other hand, Saint-Cyr states, in harmony with our personal experience, that he has repeatedly seen large Percheron stallions crossed with small mares, without any resulting difficulty in foaling, because of size.

It appears from clinical observation that the size of the female, not that of the male, chiefly fixes the size of the fetus, and

that the variation in the size of animals because of cross-breeding occurs during extra-uterine life, and not during gestation.

On the other hand, our observations indicate that the male influences the form of the fetus and the comparative volume of certain portions of its body. This variation is noticed chiefly in the size of the head. It has been observed that the crossing of ewes with rams of certain breeds having larger heads may lead to dystokia because of the comparatively large size of the lambs' heads. In one instance we observed that many of the cows bred to a certain bull, which had a very heavy head and neck, required assistance because of the voluminous heads and necks of the calves.

When the domestic cow is crossed with the buffalo or American bison, with his very heavy head and neck, there is very liable to be difficulty in giving birth to the young, because of the large head and chest of the hybrid fetus.

The breeding of immature females constantly tends to produce dystokia because of the comparatively large size of the fetus. The fetus itself is actually smaller as a rule than the same female would produce later in life, but the birth canal, and especially the pelvis of the very young female, is not yet developed to a degree which will render birth easy or practicable. It is a common experience, therefore, that young heifers, which give birth to calves when only 1½ years old or even younger, may require some degree of assistance in order to expel the fetus. The same is noted in immature sows, and to some extent in other animals.

In one instance which we noted, the owner of a number of fillies allowed a stallion colt to run with them at pasture, and several yearlings became pregnant. Before the end of gestation contagious abortion broke out, so that they all aborted, and several of them required assistance in order to get rid of the very immature fetuses. Judging from these observations, it would seem probable that, had they carried their fetuses to the normal close of gestation, there might have been difficulty in expelling them.

Clinical observations apparently show that the fetuses are larger if the mother has been well fed. But this does not seem to interfere greatly with birth, because, while the fetus is comparatively larger, the expulsive powers of the mother are also greater and the birth as a rule is easier. If, however, an animal is very

fat, her young is not as a rule so large as the young of an animal which is simply well nourished.

Diagnosis. Excessive volume of the fetus is difficult of accurate determination, prior to its entrance into the pelvic canal. Various means have been suggested for determining this excess in volume, but they are necessarily unreliable. Some have suggested an unusual size of the abdomen, but this may depend upon twin pregnancy, an excessive number of fetuses, or hydramnios or other cystic disease. In many animals we note an enormous abdomen as the result of the character of the food or of individual peculiarity.

Along similar lines, some veterinarians have suggested that the excess in size may be anticipated owing to increased weight of the animal.

Its final determination must occur when, with a normally dilated cervix and normal genital canal, labor sets in and the expulsive efforts are vigorous, and, although the fetus is normal in form and position, little or no progress is made in its expulsion. If, under these conditions, the veterinarian examines the patient, he is enabled to judge that comparatively the size of the fetus is too great to pass readily through the birth canal. However, this opinion does not depend upon any definite measurement which he is able to make of the dimensions of the pelvis.

The principal obstacles to birth, in most of these cases, are the head and chest. The obstruction caused by the head is especially notable in the bitch and cow. In the bitch the difficulty most frequently occurs in those breeds, like the bull-dog, which have short muzzles and consequently present a blunt extremity to pass through the undilated canal.

In the mare, the head of the foal is small and elongated and rarely offers any serious obstacle to birth. Generally it is only when the chest or croup arrives at the pelvic inlet that serious difficulty arises because of volume.

We have already noted in the preceding pages that the dimensions of the chest of the foal are greater than those of the pelvis of the mother, and that it is only by some displacement of the parts, especially of the shoulders, that the chest of the foal is capable of passing through the birth canal. When the dimensions of the fetus are such that it is impracticable for the diminution by displacement to be sufficiently great to permit it to

pass through, we meet with a more or less serious obstacle to parturition.

Prognosis. The prognosis in case of excessive volume of the fetus must depend largely upon the degree of excess, and still more upon the duration of the dystokia.

In the mare the outlook for the foal is always bad, because the delivery cannot be greatly hurried with safety to the mother and cannot be delayed with safety to the fetus. In fact, as already repeatedly stated, the foal is usually dead when the obstetrist is called. The prospects for the mare may be said to be usually good, but it should be remarked that dystokia in the mare, referable to excess in the volume of a living fetus, is exceedingly rare and does not constitute a formidable question.

In the cow the outlook is usually good for the mother, and if the excess of volume of the fetus is not too great to permit of delivery by forced extraction the prognosis for the calf is also favorable. Unfortunately, however, we have met with cases in the cow where embryotomy was necessary because of the excess of volume.

The comparative excess in volume of the fetus in multiparous animals where embryotomy is possible, is in many respects more serious than in the larger species. In a large proportion of these the head of the fetus does not enter the pelvis, and consequently traction cannot be applied because the head cannot be secured. As a result, the veterinarian is forced to resort to Cæsarian section in order to bring about delivery, and this operation, while not necessarily fatal to either mother or fetus, must constantly be considered as grave.

Handling. 1. **Forced extraction** of the fetus should be carried out in all those cases where, in the judgment of the veterinarian, it can be accomplished with reasonable safety to the mother. Prior to its application, it should be determined that the fetus is in a correct position, after which the genital canal should be thoroughly lubricated with warm lysol solution or fat, and the traction then applied. In the mare and cow, and to a less extent in the ewe and goat, the traction may be exerted by means of cords applied to the presenting parts, as described on page 586.

In the sow, bitch and cat, traction is usually best applied by means of forceps such as Fig. 93 on page 585, or the obstetric noose such as f and g, Fig. 91, page 578. Very largely, forced

extraction is not possible or desirable in small animals, and Cæsarian section must be employed.

2. **Embryotomy.** In all instances, in the larger animals, where forced extraction is impossible or imprudent, the veterinarian should diminish the size of the fetus by embryotomy, unless the fetus is still living and possesses a very high value as compared with that of the mother. This operation is necessarily limited in practice to the larger species of animals, and is virtually excluded in the sow, bitch and cat because the size of the genital canal does not permit of carrying out the necessary operations.

In the ewe and goat embryotomy is at times practicable, depending chiefly upon the comparative dimensions of the genital canal of the patient and the hand of the operator.

In the cow we have occasionally found that the head presented the chief obstacle to labor, and it was only necessary to perform cephalotomy, as described on page 643, in order to accomplish delivery. If this does not suffice, the diminution in the size of the fetus may be continued to any further degree required, as suggested under d, page 645; g, page 649; and c, page 658.

3. **Cæsarian section** will be found necessary or advisable in many cases of dystokia in the sow and carnivora due to excessive volume of the fetus. Forced extraction is difficult because of the smallness of the genital passages, and frequently unwise because the force which would be required for the extraction of the fetus would produce injuries to the soft parts, of a more serious character than would result from gastro-hysterotomy. For the same reason embryotomy cannot be applied, and the obstetrist must turn to Cæsarian section as his last resort.

It is unfortunate in these cases to postpone the operation too long. The obstetrist should determine the necessity for Cæsarian section early, and carry it out as promptly as possible. If there is delay in operating, and one or more fetuses have perished and become emphysematous and putrid, the operation becomes very grave; whereas in these animals Cæsarian section, when carried out upon a uterus which has not suffered from any previous insult and in which the fetuses are yet alive, is not highly dangerous. The operation has already been discussed on page 663.

b. Death of the Fetus. Fetal Emphysema.

Simple death of the fetus prior to or during labor does not constitute a very important cause of dystokia, though the movements of the living fetus probably tend to favor easy labor by overcoming any tendency to a false presentation. The dead fetus may undergo *rigor mortis*, as in extra-uterine death, and this may tend to complicate its expulsion.

When the fetus has been long dead, and emphysema or gaseous distension of the tissues occurs as a result of its decomposition, the fetal cadaver becomes very greatly increased in volume, and this may render its expulsion exceedingly difficult or impossible. Not only is there an increased fetal volume in such instances, but the fluids escape and the hair of the fetus becomes dry and adheres closely to the uterine walls, so that it is difficult for the fetal cadaver to glide along the passages. The emphysema intensifies dystokia by distending the uterine cavity and causing paralysis of the uterine walls, from fatigue; or it leads to infection of the uterine walls, with paralysis of function. The advent of emphysema occurring during dystokia is very prompt. If the cervical canal is well dilated, and the membranes are ruptured, emphysema may be quite pronounced within 24 hours, the fetal cadaver greatly enlarged, and the hair and epidermis readily detached. Within 48 hours the skeleton may begin to lose its integrity, the epiphyses of the bones readily separating.

The diagnosis of emphysema of the fetus is readily made by the fetid odor, the enlarged puffy condition of the fetal cadaver, and the crepitus when the skin is pressed by the hand.

The cause of fetal emphysema, fundamentally, is the death of the fetus, followed by putrefaction dependent upon the presence of gas-producing organisms. It is essential, ordinarily, that the os uteri is open or the tissues of the cervix are seriously diseased, as in torsion, and hence incompetent to ward off the extension of the infection through the cervical canal to the fetus. Under other conditions, mummification of the fetus may occur instead.

Clinically, fetal emphysema may be divided into two classes—primary and secondary. In the first, the infection and death of the fetus in utero occurs prior to the advent of labor or expulsive

efforts. In some cases almost no labor pains are observed throughout their clinical history, and the presence of the emphysematous cadaver is made manifest chiefly by the protrusion of the putrid fetal membranes and the advent of fetid vaginal discharges.

In the second class, or secondary emphysema, are included those cases in which the fetus was alive, or at least not emphysematous, at the beginning of labor, and in which the emphysema follows the expulsive efforts because of some delay in the expulsion of the fetus as a consequence of dystokia. The first class might be termed the dystokia of emphysema; the second the emphysema of dystokia.

Whatever the cause of emphysema, in addition to the decomposition of the fetal cadaver, metritis, metro-peritonitis, pyaemia and septicæmia are more or less frequent and intense. The uterine walls become thickened, hard and unyielding. Sometimes the walls are one inch or more thick, dark colored, black, or necrotic-green. The uterine expulsive powers are absent or greatly enfeebled.

The prognosis is grave. In the cow, the extraction of the fetus after two or three days, or even its complete decomposition and sloughing out through the abdominal walls or into the alimentary tract, sometimes occurs. In fact, after emphysematous decomposition of the fetus has continued for a few days, the uterus and system acquire marked powers of resistance.

It is the recent case of emphysema which offers the grave prognosis. We have seen death from septicæmia and uterine gangrene, in the cow, within 24 hours after the owner had first observed signs of labor or disease. In these cases, apparently, the emphysema antedated any expulsive efforts, and the uterus quickly lost its expulsive powers.

Handling. 1. Forced Extraction. In many cases it is advisable to bring about delivery by forced extraction, pages 586 and 640. When forced extraction is to be attempted, we should first correct any deviation or abnormal condition of the presenting parts and then, lubricating the passages thoroughly with warm lysol solution or fat, apply traction, as already directed. The traction should be judiciously applied, but may be quite powerful, because, in the emphysematous state, the pressure is very evenly distributed over every part of the genital canal. It should be remembered also that the operation should not be hastened be-

cause the gases tend to become gradually forced out when pressure is applied to the cadaver, so that those parts which are under greatest pressure become slowly but markedly decreased in size, because of the shifting or escape of the emphysema, and thus favor extraction.

2. **Embryotomy**, page 641, should always be preferred to forced extraction if the latter involves any serious degree of force. Embryotomy is easier than in an undecomposed fetus, because the tissues are so soft and friable that they are very readily separated. In the performance of embryotomy it should be remembered that extensive punctures and incisions of the skin will allow the escape of large volumes of gas, by which the size may be reduced. A much greater reduction in size can be had by evisceration, p. 658, because not only do the viscera and the body cavity contain large quantities of gas, but also those gases which are in the tissues elsewhere may largely escape from the open body cavity, thus greatly reducing the volume.

Fleming cites Bosetto as having had a unique experience in one of these cases of emphysema, in which, upon withdrawing his hand after some manipulation, there was a rush of gas from the vulva of the cow, which was inflammable and, becoming ignited owing to the presence of a candle, caused a considerable flame, which burned for some time, but which produced no ill consequences.

3. **Cæsarian Section**, page 663, is usually indicated in the sow, bitch and cat; almost never, if ever, in the cow and mare. In many of these cases, in the sow, bitch and cat, the handling becomes safer if the more radical operation of *hysterectomy*, page 669, is substituted. The prognosis is unfavorable.

C. DISEASES OF THE FETUS.

During intra-uterine life the fetus is subject to various diseases, either of the entire body or of parts, which, at the time of parturition, may cause more or less serious dystokia. These consist largely of dropsy of cavities or organs, by which means a portion of the fetus becomes greatly increased in size; or a general dropsy of the entire body, anasarca, occurs.

1. Hydrocephalus.

Hydrocephalus consists essentially of a distension of the lateral ventricles of the brain with lymph. The fluid may be of any amount, and upon its volume depends the degree of dystokia

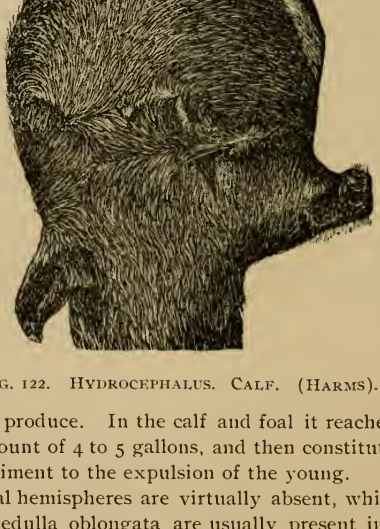


Fig. 122. Hydrocephalus. Calf. (Harms).

which it may produce. In the calf and foal it reaches, in many cases, the amount of 4 to 5 gallons, and then constitutes a rather serious impediment to the expulsion of the young.

The cerebral hemispheres are virtually absent, while the cerebellum and medulla oblongata are usually present in an apparently normal condition. The enormous distension of the lateral ventricles, with the prevention of the formation of cerebral

matter, leads ordinarily to the death of the fetus as soon as the umbilic circulation is suspended.

The effect upon the skull is interesting, and has an important relation to the question of delivery. The bony skull is usually incomplete, and the principal portion of the tumor or enlargement is wholly devoid of any osseous covering, and consists merely of the skin and vestiges of the meninges of the brain. At the base of the tumor, the bones of the skull spread outward and then upward to constitute a chalice-like cavity with irregular borders.

The cause of hodrocephalus in the fetus is unknown. It is observed in all animals, but is most frequently seen in the calf and somewhat rarely in the foal.

The diagnosis is comparatively easy when the fetus presents anteriorly, but may become somewhat difficult in the posterior presentation. When the fetus presents anteriorly, the obstetrist usually finds upon inserting his hand that the cranium is abnor-

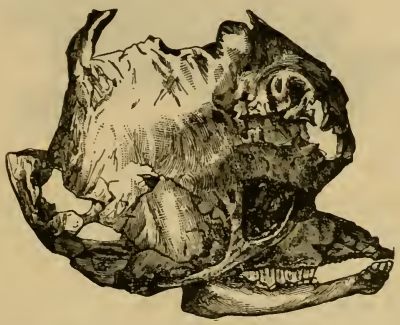


FIG. 123. HYDROCEPHALUS. CALF. SKULL FROM FIG. 122. (HARMS).

mally enlarged and soft or fluctuating. Somewhat rarely the hydrocephalic cranium is complete, the osseous walls completely enclosing the abnormal brain. At first there may be difficulty in identifying the head, because of the great disproportion and its soft, fluctuating character. The actual diagnosis can be made only by identifying some definite parts of the head, such as the mouth, nostrils, ears or eyes, and determining that the enlargement has a definite relation to these.

In the posterior presentation, the presence of hydrocephalus is not likely to be suspected until the entire fetus, except the head, has been extracted, when suddenly its progress is checked or completely stopped, and it becomes necessary to make an examination in order to determine the cause.

Handling. The indications in hydrocephalus are the destruction of the tumor by opening the sac and permitting the liquid to escape and then diminishing the size of the osseous portion by dividing the bone with the obstetric chisel. The incision into the tumor is easily made with the scalpel or ring knife, and the cranial bones are so thin and weak that they are easily broken down by means of the chisel, as described on page 643. In one case, in the mare, where the anterior limbs had not yet advanced into the canal, we opened the sac and allowed its con-

FIG. 124. HYDROCEPHALUS. CALF. (After photograph).

tents to escape, broke down the bones, drew the head through the birth canal and amputated it, after which we repelled the neck, secured the two anterior limbs and extracted the headless fetus.

When the fetus presents posteriorly, and hydrocephalus has been diagnosed, the handling is analogous to that for the anterior presentation.

As a general rule, it is not essential to decrease the size of the head very greatly, or, in some cases, to decrease it at all by artificial means. Fig. 124 represents a hydrocephalic calf, which was expelled without aid, the head-sac of which had a capacity of about 5 gallons. We had been called because of the dystokia, but, pending our arrival, the calf had been expelled. Upon examination, it appeared that the expulsive efforts had compressed the sac to such a degree that it ruptured through the

cribriform plates of the ethmoid bone, which allowed the escape of the fluid through the mouth, and the collapse of the pouch.

2. Ascites and Hydrothorax.

The peritoneal cavity of the fetus is occasionally the seat of very extensive effusions. It is said that in some rare cases the pleural cavity may suffer similarly. The causes of fetal ascites are unknown. Possibly some cases designated as ascites are due to cystic distension of the fetal kidneys, ovaries or other organs.

The symptoms of ascites, and similarly of hydrothorax, are confined to the resultant dystokia. It occurs almost wholly in the calf. Upon examination it may be found that the fetus is presenting normally, and the advancing parts are of normal form and volume. If presenting anteriorly, there is no apparent obstacle to expulsion until the head and neck have passed the vulva, when progress ceases, and, although considerable traction may be applied, the fetus appears immovable.

Upon examination the veterinarian finds that the abdomen is enormously enlarged, tense and fluctuating, and alone constitutes the obstacle to parturition.

When the fetus presents posteriorly the symptoms are quite analogous; the fetus in normal attitude advances until the hips enter the pelvic canal, where it stops. Inserting the hand alongside the fetal body, the distended abdomen may be felt and recognized.

The handling of the dystokia consists fundamentally of releasing the fluid from the abdominal cavity. This may be done in a variety of ways. The operator may carry a finger-knife or concealed scalpel into the uterine cavity, and incise the abdomen of the fetus from without, thus allowing the fluid to escape into the uterine cavity of the mother.

From the standpoint of safety to the mother and convenience to the operator, we prefer liberating the fluid through the chest cavity externally. The head and neck have already passed the vulva; it is the work of but a few minutes to remove one anterior limb subcutaneously, as described on page 645; after which one or two of the exposed fetal ribs may be severed. The operator can then eviscerate, page 658, pass his hand through the chest cavity, and rupture the diaphragm, when the ascitic

fluid promptly rushes out and escapes externally. Delivery readily follows.

In the posterior presentation the fluid may be caused to escape through the fetal pelvis by an incision through the perineum.

3. Anasarca.

Somewhat rarely in practice the veterinarian meets with a fetus, the entire body of which is edematous, so that its diameter is greatly increased and it appears as a somewhat rounded, soft mass with its tissues filled everywhere with fluid. Like ascites, anasarca is seen almost, if not quite exclusively, in the calf. In Germany this disease has acquired the designation *wasserkalbe* or *speckkalbe*. The fetus affected with anasarca usually perishes at the sixth to seventh month, and is expelled. Upon expulsion it appears as a rounded mass; the skin is hairless and looks somewhat leathery; the limbs and neck seem excessively short because of the increased transverse diameter of the fetus; and everywhere through its tissues there is a vast amount of liquid, which freely exudes when the parts are incised.

The causes of anasarca are not known, but some investigators have attributed the condition to an absence of the thoracic duct.

Anasarca rarely offers any serious obstacle to parturition, and when it does so the dystokia is referable solely to the excessive volume of the fetus, which we have already discussed on page 726, and should be handled in the same way.

4. Cysts and Cystic Degeneration of Fetal Organs.

Cysts in various internal organs or in the subcutaneous connective tissue, which may so increase the size of a particular region of the fetus as to induce dystokia, are very rarely recorded. Among the internal organs, the liver and kidneys have been found affected with cysts of such dimensions as to constitute an obstacle to the expulsion of the fetus. Naturally these cysts cannot be differentiated clinically from ascites, and it is only upon post partum examination that the character of the difficulty may be fully recognized. The method of handling is the same as we have already suggested for ascites.

Fleming, citing Ludke, records a cyst, in the subcutaneous connective tissue below the ear of a calf, which was more than a foot in diameter and contained 36 pounds of fluid. This had to

be punctured in order to permit the extraction of the fetus, but the exact nature of the disease was not determined. Was it a cystic thyroid or salivary gland ?

Fleming cites Pflug, who was called to attend a goat in difficult labor and found a large cyst upon each side of the head of the kid, in the region of the parotid gland, which offered considerable impediment to the extraction of the fetus, which, however, was finally accomplished without puncturing the cysts.

The same author describes the case of a foal with a cystic distension of the guttural pouch.

The indications in this rare group of anomalies will depend somewhat upon the location and volume of the cyst. When very large they may generally be easily destroyed by puncture, which allows the contents to escape; or the tumor may be so adjusted in position that the fetus may be extracted without the destruction of the cyst.

D. TUMORS OF THE FETUS.

It must be very rare that a fetus suffers from a tumor in the true meaning of that term. Fleming speaks of tumors of the fetus, but includes under this heading those which we have considered in the preceding section as cysts. Among his citations there is only one which might possibly be regarded as a tumor in the common acceptance of that term. Citing Rossignol, Fleming alludes to a fetus which had, in the neighborhood of the umbilicus, a tumor which weighed 11 pounds and was composed of fibro-adipose tissue. The description of the tumor is very incomplete, and its nature is not revealed.

E. ANOMALIES AND DISEASES OF THE FETAL MEMBRANES AND OF THE UMBILIC CORD.

1. **Dense Chorion.** It has been asserted that the fetal membranes may be abnormally thick and resistant in one case or abnormally thin and weak in another, and that these may result in more or less danger to the mother or fetus. As a source of dystokia, only the abnormally thick and resistant membranes, the chorion, can produce any serious results. How frequently these abnormalties occur in veterinary obstetrics cannot be determined. We have found no records of cases where such a condition was clearly proven. The toughness of the chorion or other membrane must be merely comparative, and its existence will largely depend upon the interpetration of the obstetrist in attendance. Should it occur, artificial rupture or incision is demanded.

2. **Adhesions of the Fetal Membranes to the Fetus.** Very rarely in veterinary obstetrics there are found adhesions between the fetal membranes and the fetus, which tend to interfere with birth. There is no part of the fetus upon which such adhesions may not occur. All the membranes may be involved—amnion, allantois and chorion—and cause more or less firm adhesions with the fetus, and may also extend to and involve the uterine walls. Fleming cites one instance where the adhesion took place upon the frontal region, and interfered with the expulsion of the calf. In other cases the adhesion has occurred upon the skin of the pastern and elsewhere. When such adhesions exist, and result in dystokia, they must be divided in order to bring about prompt delivery.

3. **Hydramnois and hydrallantois.** On page 424 we have already described the dropsies of the fetal membranes as causing more or less serious interference with the well-being of the mother during gestation, and have there discussed the action necessary to be taken in these cases.

4. **Abnormalities of the Umbilic Cord.** The umbilic cord of domestic animals is very rarely of an abnormal character, either in dimensions or in its tissue. It varies greatly, as we have already noted on page 364, in its length in various domestic animals, but we are unaware that these variations in length have any special significance to the obstetrist. If very short, it naturally must rupture very early, perhaps before the fetus is completely

expelled. In the cow, the umbilic cord habitually ruptures while the calf is passing through the pelvic canal, and yet it is born as safely as is the foal, in which the cord usually does not rupture until after the complete expulsion of the fetus.

As compared with the child, the umbilic cord in all domestic animals is short, and consequently does not tend to protrude through the vagina in advance of the fetus or to become entangled about the fetal neck or extremities. In very rare cases the cord has been found entangled about the neck, limbs or body of the fetus, but this has apparently never acquired any great significance.

Even if the cord should become entangled about the fetus, it usually offers no important impediment to parturition, because it is comparatively easily ruptured in any of the domestic animals, so that any powerful expulsive effort would quickly cause it to part. The chief danger is the strangling of the fetus through compression of the cord. When the cord is found encircling a part in a manner to cause its compression, the obstetrist should obviate the danger as far as possible, by disentangling it or hastening delivery, according to the circumstances.

F. ABERRATIONS AND ANOMALIES IN THE DEVELOPMENT OF THE FETUS.

1. Campylorrhachis.

We have met, in one case in the cow, a form of contracture, consisting of an abrupt lateral curvature of the spine in the dorsal region, by which the body was doubled upon itself in the middle in such a way that the two posterior feet lay with their ventral surfaces upward, alongside the two anterior feet, with their soles turned downward and the head resting upon them.

The symptoms of this anomaly are peculiar and confusing. The head end of the fetus offers in the typical anterior presentation, dorso-sacral position, the anterior feet extended and the nose resting upon them, while alongside them, to the right or left, are the two hind feet with their plantar surfaces turned upward and the hocks and buttocks readily reached. The condition at once gives the obstetrist the impression of twins, and the chief point in diagnosis is to determine whether the symptoms are due to twins or to deformity. In case of twins, one of the fetuses may be repelled while the other is advanced, but in this anomaly both the anterior and posterior portions must advance or recede simultaneously. It may be possible to reach and identify the spinal curvature.

The remedy is embryotomy. The most efficient plan is the subcutaneous removal of the two anterior limbs, by the method described on page 645, and evisceration of the fetus, as described on page 658, after which the head and neck are to be repelled, the now flaccid body of the fetus converted into a posterior presentation by traction upon the posterior limbs, and its extraction accomplished. The repulsion of the anterior portion of the fetus should be quite complete, and the operator should continue the process with his hand as long as it is possible to keep his arm in the vaginal canal alongside the advancing posterior portion.

2. Schistocormus Reflexus.

On page 351, while discussing the development of the embryo, we have stated that under certain conditions the amniotic fold contracts in such a manner that the spinal column is forced

down through the abnormally wide vitelline duct, and the somatopleur of the embryo is reflected so that it is virtually everted, as indicated in Figs. 71, 72 and 125. This anomaly occurs almost wholly in the cow, though a few cases have occurred in other ruminants. The viscera lie naked, in the absence of a fetal body cavity, while the other portions of the fetus constitute an irregular mass, presenting the pleuro-peritoneal membrane externally in the form of an inverted pouch, open at one end, through which all four limbs and the nose may more or less pro-

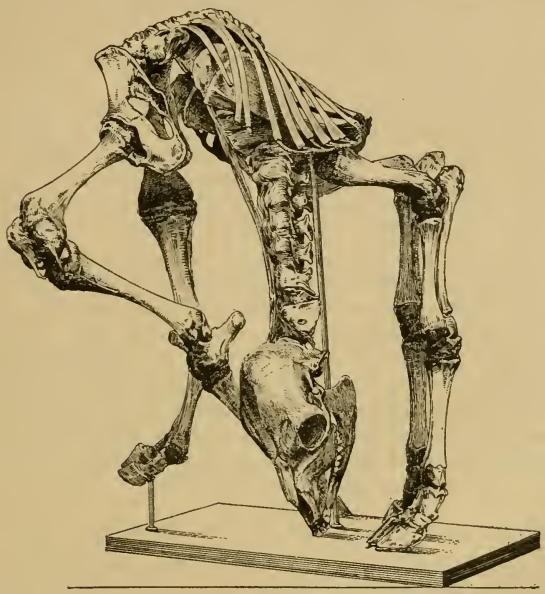


FIG. 125. SCHISTOCORMUS REFLEXUS. (DE BRUIN.)

trude. The four legs and the head and neck lie in an inextricable mass, as in a pouch of skin. The skin, with its coat of hair, constitutes the lining of the pouch, and lies in contact with the contained limbs and head and neck.

The diagnosis of this anomaly depends upon the anatomical relations above-mentioned. Usually the monster presents by its

four feet and head, and consequently the operator at once comes in contact with several, or all four feet and the head. Following along the fetal extremities, the hand passes into a closely enveloping pouch, lined with hair. Examining more externally, the operator's hand passes over the fetal mass and comes in contact with the fetal viscera lying loose within the uterine cavity.

If presenting by the reverse end, the operator should recognize the viscera lying free, and the exposed, bent spinal column and ribs, covered only by peritoneum.

Usually the condition offers rather serious dystokia. In the cases observed by us, fetal death, putrefaction and emphysema preceded the symptoms of dystokia, so that upon our arrival the fetus has been found putrid.

Forced extraction and embryotomy offer the chief suggestions in delivery. The conglomerate, irregular outline of the fetal mass, with projecting ribs and other bones, renders forced extraction too dangerous in most cases. Unless the pelvis of the cow is very roomy and the fetal mass very small, embryotomy is to be preferred.

In performing embryotomy, the operator should have in mind the anatomical relations of the parts, and should first of all make a longitudinal incision through the skin pouch, so as to lay it freely open and render the limbs available for operation. He should then proceed to diminish the mass to a sufficient degree, preferably first by the subcutaneous amputation of the two anterior limbs, page 645. This may be followed by the amputation of one or both hind limbs or of the head, as circumstances may suggest, until the remaining portion may be extracted without serious difficulty or injury to the soft parts.

3. Contractures of the Extremities. Wry-Neck.

Various fetal articulations undergo deformation during intrauterine life, and present at birth obstacles of a more or less important character. The campylorrhachis, mentioned on page 744, may be regarded as belonging to this class. Abnormal flexion of certain joints of the limbs is not rare. The indications, in case of dystokia due to flexures or contractures of the limbs, are to overcome such obstacles by forcible extension, or, if this fails, to amputate the offending part or relieve the con-

tracture by tenotomy or myotomy, and remove the fetus in an otherwise normal manner.

Wry-neck in the Foal. In the foal the abnormality known as "wry-neck" is comparatively common as a cause of dystokia. Wry-neck is usually described as a contracture, with the implication that the deformation is induced by contraction or abnormal shortening of fetal muscles, but the actual cause is unknown. Usually the bones themselves are bent. The anomaly is possibly due to the anterior feet occupying one horn, into which the head has failed to enter and becomes reflected back along the fetal body in the body of the uterus, there to be held firmly. If the neck of an equine fetus becomes accidentally caught in lateral deviation, and is so held, the muscles on the concave side naturally shorten as a result. This abnormality is most frequent, or practically confined to the foal, apparently because of the great length of its neck.

Wry-neck constitutes one of the most common and formidable obstacles to delivery in the foal. In these cases the neck is bent abruptly backward at its base, and the head lies in the flank of the foal. The deviation has existed throughout a long period of time, as is shown by the curvature of the head upon its long axis. If the neck is curved to the left side of the foal, so that the head rests in its left flank, then the left side of the head and face is concave and moulded to the surface of the body, while the right side is convex.

In our experience, wry-necked foals usually present either anteriorly, with the two forefeet more or less extended in the passage and the head out of reach, or transversely, with the ventral surface of the body toward the pelvic inlet and several or all four of the feet extended in the vaginal canal.

In the anterior presentation, the operator may not be able to reach the head because of its extreme deviation, favored by the great length of the neck. If he can reach the head, it will be found exceedingly difficult or impossible to bring it into the vagina, because when the fetus is repelled the head recedes, instead of tending to become extended as in case of a normally developed head and neck, where the head has recently become deviated. If the head is secured by means of hook or cord or other device, it is still found exceedingly difficult to bring about its extension in the genital passages, because of the contraction of the muscles

and the fact that the cervical spine has been long bent and is quite rigid.

When the fetus presents transversely, with all four feet in or near the pelvic inlet, the head is usually undiscoverable ; if it can be reached, it is difficult or impossible to bring it into the pelvic inlet. Fortunately we do not wish in these cases to advance it into the inlet or otherwise secure it.

The indications in instances of wry-neck vary according to conditions. These will be considered under Lateral Deviations of the Head in the Anterior Presentation, on page 765, and under Transverse Ventral Presentation on page 788.

4. Double and Triple Monstrosities.

Double monstrosities occur chiefly in the cow and somewhat rarely in the smaller ruminants and the sow, while in the mare

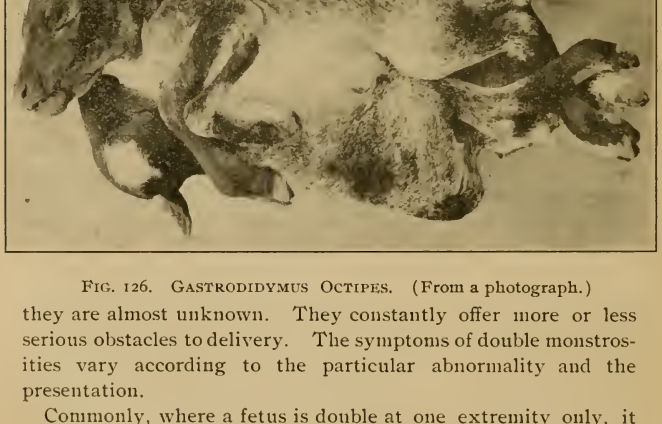


Fig. 126. Gastrodidymus Octipes. (From a photograph.)

they are almost unknown. They constantly offer more or less serious obstacles to delivery. The symptoms of double monstrosities vary according to the particular abnormality and the presentation.

Commonly, where a fetus is double at one extremity only, it presents by that extremity, and consequently the abnormal portion of the fetus is within reach and the diagnosis can be made by manual exploration. A double face, head, neck, or chest is

usually easy to differentiate by palpation. Double monstrosities in which the double condition affects the posterior extremity only, if presenting posteriorly, enable the operator to reach forward a sufficient distance to properly examine the point of bifurcation and diagnose the double character of the fetus.

In those cases where the single end of the fetus presents and enters the pelvic inlet, the dystokia is not apparent until the double portion reaches the pelvic inlet and its progress is stopped because of the abnormal size. Then the obstetrist, in making an

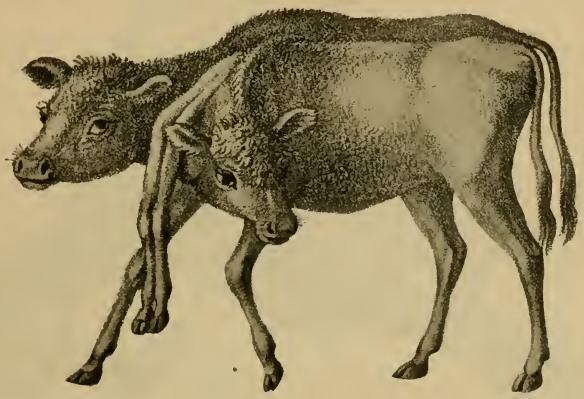


FIG. 127. TETRACHIRUS CHORISTOCEPHALUS. (GURLT).

examination, should be able to pass his hand alongside the single portion of the fetus until he reaches the double portion, the character of which, especially the spinal bifurcation, should be recognized by the sense of touch.

In the complete double monster, like the thoracopagus and others of similar type, Figs. 126 and 127, the obstetrist finds the two corresponding portions of the body advancing simultaneously, and cannot repel or advance the one without moving the other in a corresponding direction. Moreover, as a general rule he will be able to reach that portion of the two bodies where they are connected, and thus determine the character of the anomaly with which he has to deal.

In the very rare pigodidymus aversus, Fig. 129, it would be ex-

ceedingly difficult to diagnose the condition until the presenting portion of the monster, or we might say the presenting fetus, is completely withdrawn or at least its croup enters the pelvic inlet, when the breech of the second or posterior twin reaches the pelvic inlet, becomes impacted in it and stops further progress. If the operator will then examine carefully, he may be able to reach sufficiently far to determine the character of the monster with which he has to deal.

The indications in cases of double monsters vary. In many instances they are comparatively small, so that the double con-

FIG. 128. SCHISTOCEPHALUS. CALF.

dition does not prevent their extraction entire without serious difficulty. In other cases it is necessary to resort to embryotomy in order to bring about delivery with safety to the mother. There are no specific rules for the operation of embryotomy, but the reduction in the size of the monster is to be carried out according to the general suggestions already made on page 641.

It may be well to suggest that it is highly desirable, whenever possible, to divide the double monster into its two halves. That

is, if there exists a double head and neck, we should, if possible, amputate one of the necks with the chisel or by other means, and remove it, and then proceed to extract the remaining portion of the fetus. So we would handle a posterior presentation where

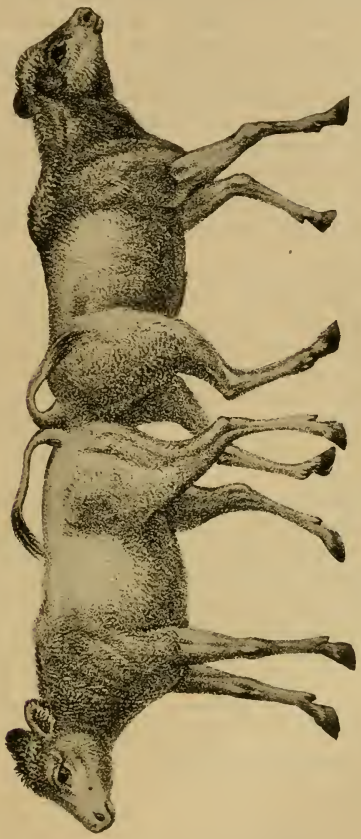


FIG. 129. PYGODIDYMUS AVERSUS. (GUILT).

the posterior extremity of the fetus is double. Or we may reduce the volume of the double body by evisceration, page 658, by the destruction of the pelvic girdles, or by amputation of the hind limbs, page 653.

5. The Dystokia of Twins.

Twins occasionally induce dystokia, and may at times cause confusion in diagnosis.

The diagnosis of twin or triplet pregnancy, when dystokia occurs, is usually not very difficult, especially if the fetuses have not become impacted in the pelvic canal, so that they are immovable. When they produce dystokia, it is usually because one or more extremities of each fetus has entered the pelvic canal.

A little carelessness may lead to an error. If one fetus is presenting posteriorly and the other anteriorly, there may be present in the passages the head and one forefoot of one fetus and one hind foot of the other fetus. This latter may be mistaken for a fore-foot of the former, or other similar error be made if proper care is not taken.

In other cases there may be such a deformity of a single fetus that it may be mistaken for twins. Especially is this the case in campylorrhachis, which we have already described on page 744.

The differentiation between twins and double monstrosities is usually not difficult. In case of double monstrosities the two parts necessarily move in harmony; they advance or retreat together, and each movement that one is caused to make is at once accompanied by a corresponding movement of the other. This is not true of twins.

The indications for handling dystokia due to multiparity are comparatively simple. The operator needs repel one fetus, or rather the presenting parts of one fetus, and advance the other.

It is essential that the one fetus shall be repelled entirely into the abdominal cavity, and kept there until the pelvic canal is fully occupied by the fetus which is being advanced, after which it is delivered. The other is then brought into position, and also extracted. Deviations of the extremities of twins are subject to the same rules as those of single pregnancies. Twins are usually smaller than single young, and permit of easier handling and correction of position.

C. ABNORMAL PRESENTATIONS OR POSITIONS OF THE FETUS.

I. ANTERIOR PRESENTATION.

a. Dorso-Ilial or Dorso-Pubic Positions.

In the larger domestic animals, where the fetus normally lies *en arc* or describes in its attitude the segment of a circle, the ventral surface concave and the dorsal convex, it is essential to the easiest delivery that the fetus should be in the dorso-sacral position. The body does not readily bend dorsalwards, because the inferior wall of the fetus is comparatively short and inextensible and, with the viscera in position, the rigidity of the fetal body is maintained. A further obstruction to its passage, in other position than the dorso-sacral, is that the greater diameter of its body does not correspond with the greater diameter of the pelvic canal. It is possible in some cases to bring about the extraction of the fetus in the dorso-ilial or dorso-pubic position, but this is chiefly in those cases where the fetus is comparatively small as related to the genital passages of the mother. When the fetus is so small that it can be brought out in this unfavorable position, its diminutive size permits the correction of the position to be made with very little labor.

The indications are usually to rotate the fetus upon its long axis, and convert the dorso-ilial or dorso-pubic into the dorso-sacral position. Under special conditions it may be advisable or practicable to resort to forced extraction. We have already dealt with the question of rotation on page 632, and of forced extraction on page 586. Both of these failing, it may be necessary to resort to embryotomy, consisting of the subcutaneous amputation of one anterior limb, page 645, and evisceration, page 658, followed by rotation.

b. Deviation of the Anterior Limbs.

The anterior limbs of the fetus are subject to greatly varying deviations. While these may sometimes be unimportant in the smaller species, they become of fundamental value in the larger animals, such as the foal and calf. The long and rigid limbs and neck of these make it essential that each extremity should be fully extended in order to pass readily through the pelvic

canal. Any deviation from this normal attitude is liable to result in more or less serious difficulty in the expulsion of the young animal..

1. Flexion of the Anterior Limbs at the Elbow. Anterior Limbs Incompletely Extended in the Pelvis.

It is not very rare to meet with instances in the calf and foal in which the two anterior feet present in their normal position and appear at the vulva, accompanied generally by the nose, which is advanced to nearly the same degree as the feet themselves. At first glance the position seems to be essentially normal,

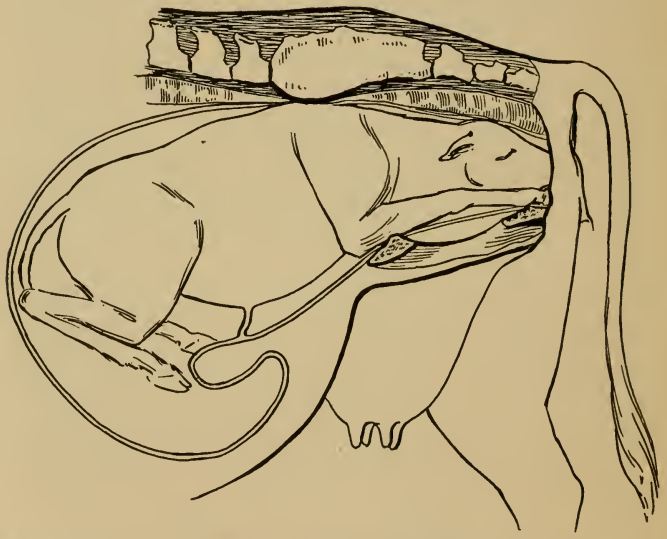


Fig. 130. Incomplete Extension of Anterior Limbs.

but, when the fetus has reached the point where the feet and nose are visible, its advance becomes checked and the expulsive efforts of the mother are quite unavailing to cause any further progress.

The interpretation of this condition varies somewhat with different writers. Fleming says : "It is usually due to the shoulders not being closely applied to the chest of the fetus, and the elbows,

consequently, thrown widely apart, coming in contact with the brim of the pelvis, thus proving an obstacle to the progress of the young creature."

We interpret it as purely a flexion of the humero-radial articulation, the consequent or coincident pushing of the shoulders backward upon the sides of the chest, and the impaction of the olecranon against the pubic brim. In this position, the transverse diameter of the chest of the fetus is greatly increased by the retention upon its sides of the entire volume of the fetal shoulders, including the scapula and scapular muscles, the humerus and the bulky anconean group of muscles. The perpendicular diameter of the fetus is also greatly increased, because it must represent the distance from the top of the spinous processes of the dorsal vertebræ down to and including the olecranon, the latter projecting downward to constitute an unyielding obstacle which becomes lodged against the pubic brim. The condition naturally belongs to the dorso-sacral position.

The diagnosis depends fundamentally upon two facts. While the two forefeet present normally and the nose is resting on top of them in a normal position, so far as it is independently concerned, there is an abnormal relation between the degree of advancement of the feet and the nose. While normally the nose of the fetus rests about the middle of the metacarpus, in these cases it is advanced to the fetlock or even further. Under these conditions, if the obstetrist will introduce his hand along the anterior limbs until he reaches the brim of the pubis, he will find the olecranon tightly impacted against the pubic brim.

The indications are simple and obvious, and consist merely in releasing the olecranon from its incarceration in front of the pubis and the proper extension of the limb in the birth canal. Little, if any repulsion is required. When both limbs are retained, each should be handled separately. The operator should insert his hand along the inferior surface of the limb, with the palm turned upward, until it has been forced between the pubis and the olecranon, so that the latter rests in the hollow of the hand. An assistant is then to exert traction sharply upward and backward, while the operator causes the olecranon to glide over the pubic brim and the anterior limb to become extended in the pelvic canal. The same operation is carried out upon the other limb, after which the fetus is delivered under ordinary precautions in the dorso-sacral position.

2. The Fore-limbs Crossed Over the Neck.

It is very rare that an anterior limb of the fetus becomes crossed over its head while passing through the birth canal in other animals than the mare, and even here it is not very common. Such displacement in the foal offers a considerable obstacle to parturition, partly owing to the obstruction of the carpus lying on top the fetal poll or neck, largely because it induces the same position of the shoulder and elbow as we have already described in the previous section. By this displacement the diameter of the chest is greatly increased and the olecranon, instead of being in a horizontal position, projects downward almost perpendicularly, and thus constitutes a very serious obstacle to the advancement of the fetus along the birth canal.

There is the further very important danger that, when a foot is so misdirected, it is liable to become engaged in the roof of vagina and, perforating it, cause a rupture of the rectum or of the perineum.

The false position of the deviated foot or feet is readily recognized upon examination.

Handling. It is not difficult ordinarily to seize the misdirected foot with the hand and, while exerting some traction upon it, push it toward the side where it belongs, first somewhat upward to cause it to glide over the poll, thence in a lateral direction and downward, and finally toward the central line to bring it beneath the head and neck. If both feet are crossed over the head, as it is alleged occurs in rare instances, that one which is uppermost, the one which is crossed over the other foot as well as over the head, should first be brought into position, after which the other is to be similarly handled. It is not essential to repel the fetus, unless the fore-foot has become engaged in the roof of the vagina and has pushed its way into it so far that the repulsion is necessary to its disengagement. In such cases the repulsion should be merely sufficient to enable the operator to bring about the necessary replacement of the foot.

Should the replacement of the limb prove difficult, it is advisable to cord the foot and have an assistant exert traction upon it in such direction as the operator may indicate, while he guides and aids the reposition directly with his hand. After completing the replacement of the foot into its normal position,

the operator should take the further precaution to see that the elbow is completely extended, before any traction is applied to other portions of the fetus, because, until this is done, the position remains such that expulsion cannot readily occur.

3. Flexion of the Anterior Limbs at the Carpus.

This obstacle to birth occurs chiefly in the calf and foal, and to a lesser extent in the lamb and kid, but in these cases it is very rare and of less significance. In carnivora and the sow the condition is not present, or not of moment as a cause of dystokia, because the limbs are short and may readily fold backward and permit the head to present alone.

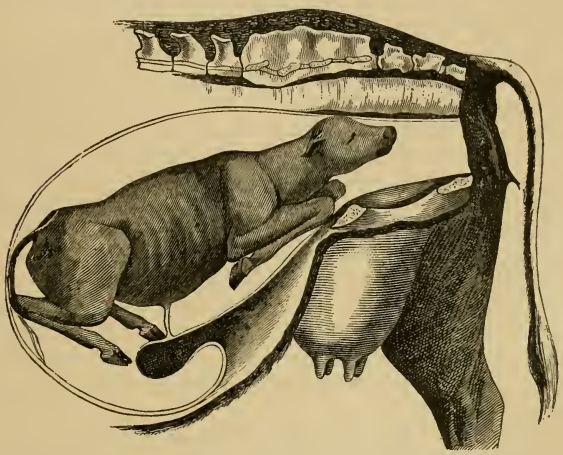


Fig. 131. Flexure of the Anterior Limbs at the Carpus. (St. Cyr.)

In such cases the metacarpus is flexed upon the radius, the radius upon the humerus, and the humerus upon the scapula, so that the entire limb is folded and the shoulders are pushed back upon the chest, thus greatly increasing the perpendicular and transverse diameters of the fetal body in the region of the chest, and offering a very great obstacle to its expulsion, which is greatly heightened by the impaction of the carpus in the pelvic canal, or in front of or beneath the pubic brim.

Normally the fetus, until just prior to birth, lies somewhat upon its side with all the limbs flexed along the ventral surface of its body, the radius upon the humerus and the metacarpus upon the radius in such a way that the very long limbs of the foal and calf occupy the least possible space in the uterus. When expulsive efforts set in, should the fetus be dead, the limbs may remain flexed during parturition, just as they were prior to the beginning of that act. Should the fetus be alive, it is quite possible that, because of close investment by the fetal membranes, its feet may not become extended upon the carpus. Consequently the fetus approaches the pelvic inlet with the limbs still flexed, in which case they almost inevitably become impacted in the pelvic cavity, or beneath or against the pubic brim, to constitute a more or less serious obstacle to delivery.

Some obstetrists hold that the displacement may occur otherwise. They claim that at the moment when the limbs of the fetus enter the pelvic inlet they may not be fully extended, and the toes may become caught against the border of the pubis. As the fetus advances the limbs become flexed at the carpus, and later the metacarpus and phalanges become directed backward, and the folded limbs thus applied against the neck. If we study carefully the mechanism here proposed, we find it probable that, if it came about in this manner, when the parts became folded the carpus would be far advanced in the pelvis along the side of the neck of the fetus. This, as every obstetrist well knows, is very rarely the case, but instead the flexed carpus is engaged against or beneath the pubic brim, a position which it could acquire only with the greatest possible difficulty, by the method which has been suggested.

Another objection to the theory of the flexion of the carpus during parturition may be realized by the obstetrist when he attempts to extend the flexed member so as to bring about the extraction of the fetus. He finds at once that the length of the metacarpus exceeds the perpendicular diameter of the pelvis and that the limb has to be pushed completely back into the abdomen in order to be extended. If the mechanism of this flexion, as found in dystokia, is of the character here alleged, when the flexion is coming about it would tend to become stopped by the carpus abutting against the sacrum and becoming lodged in a perpendicular position across the pelvic inlet.

We consequently regard this deviation as being usually a persistence of the pre-parturient attitude of the limb of the fetus, and not as an acquired deviation of the part. Consequently we may well find both anterior limbs flexed at the carpus, and the head of the fetus flexed ventralward, with its chin resting upon the sternum. This attitude of the fetus is especially frequent in cases of abortion in the mare, where the dead fetus quite frequently presents by the poll and the two carpal joints.

Sometimes one foot presents normally, along with the head; sometimes the head only; and sometimes one anterior foot only. Any one of these suggests at once that there is either a flexion of the carpus which checks delivery, or else that the anterior limb has been completely retained. It is thus essential to diagnosis that a manual examination be made.

In the mare and cow the retention of the anterior limbs at the carpus usually constitutes an insurmountable obstacle to parturition, except artificial assistance is given. Saint-Cyr properly suggests that the dystokia does not result so much from the flexion of the carpus itself as it does because all the long bones of the anterior limb are flexed upon each other and the entire mass of the shoulder and limb is pushed backward upon the chest walls, to abnormally increase the transverse and perpendicular diameters of this portion of the body and render it so gross that it cannot pass through the birth canal without the deviation being first corrected.

The indications are to secure the deviated limb or limbs and to bring them into their normal position. The position of the fetus is usually dorso-sacral, but, should it be dorso-pubic or dorso-ilial, the same general rules for the correction of the deviation apply in the main, and in many respects are actually easier than though the fetus were in the normal or dorso-sacral position.

1. **Mutation.** In order to bring about the extension of the limb or limbs, repulsion of the fetus is necessary. If the head of the fetus, with or without one anterior limb, has advanced only a short distance along the pelvic canal, it may be quite practicable to push it back into the uterus and acquire room for the correction of the deviation in the abdominal cavity. If the fetus is very small, or the pelvis of the mother quite roomy, it may be possible to repel the fetus after its head has passed completely beyond the vulva, but this generally proves very difficult, and frequently impossible. If the fetus is dead, which is generally the case with the foal, and

the head has passed beyond the vulva or can readily be brought beyond it, the most desirable method of procedure is to resort at once to decapitation, as described on page 642, and then repel. The decapitation is a very simple procedure under these conditions, decreases very greatly the amount of labor required for repulsion and the time neccessary for the correction of the deviation, and thereby very largely increases the favorable outlook for the mother.

When the head of the calf has passed beyond the vulva, its prominent and blunt poll makes its repulsion more difficult than that of the foal. Hence, if the head has protruded beyond the vulva and the calf is dead or is of little or no value to the owner, or if the conditions are such that the life of the mother will be greatly jeopardized by tedious repulsion, the obstetrist, as in the foal, should at once proceed with decapitation.

Pronounced elevation of the posterior parts of the body greatly facilitates repulsion. In the ewe and other small animals, the patient may be almost or quite suspended by the hind legs in order to favor repulsion. Tepid unctuous fluids may then be introduced through the vulva into the vagina by gravity. The fluid lubricates the walls, rendering fetal movements more easy, and the weight of the liquid contributes toward repulsion. The repulsion may be aided by manual force.

Having accomplished repulsion, with or without decapitation, as described on page 595, the obstetrist should first secure the anterior limb, or limbs, with the hand or by means of cords. First, if practicable, lift the bent carpus from beneath the pubis and carry it up into the pelvic canal. Then place a cord upon the pastern as described on page 579. When this has been secured, the operator proceeds to extend the limb as described on page 636.

As soon as the toe has been brought into the birth canal, the foot is quickly extended, and the entire anterior limb is brought into complete extension by traction. The other forefoot, if retained, is handled in the same manner.

If the head is also deviated, it is to be handled according to the directions given under C on page 765. After proper adjustment of the relations between the two anterior limbs and the head, the delivery is proceeded with in the usual manner.

When this deviation occurs in the dorso-ilial or dorso-pubic

position, its correction is usually easier than when the fetus presents dorso-sacrally, and is to be brought about in a corresponding manner. If the fetus is presenting in a dorso-pubic position, it will be necessary to press the carpus downward in the front of the pubis and bring the toe of the foot along beneath the sacrum in order to extend it. In the dorso-ilial position, the retained carpus is pushed outwards in front of the shaft of one of the ilia, while the toe is carried over the ilium of the other side and extended in the birth canal. After the limbs have been properly extended in the birth canal, the fetus is to be rotated upon its long axis, page 632, and brought into the dorso-sacral position.

2. **Forced Extraction.** Under certain conditions forced extraction may be advisable. Some obstetrists highly recommend it, especially in the case of a living foal. Naturally, it is only practicable in those cases where the bent carpus is already advanced in the pelvic canal, or is in a position where it may be readily secured and brought into the pelvic canal in its state of flexion. In these cases, especially when a foal is living and prompt delivery is essential to the preservation of its life, the flexed carpus may be grasped by the hand, or a cord may be applied to it. By exerting firm traction, the shoulder, arm and forearm are normally extended, the flexed carpus advanced, the entire body then advanced by the application of force, and the fetus delivered.

3. **Embryotomy** is rarely demanded except to the extent of the preliminary decapitation, which is desirable in order to facilitate repulsion. It is rarely, if ever, essential or advisable to amputate the anterior limbs at the carpus.

3. Complete Retention of the Anterior Limbs.

Instead of the limb being flexd at the carpus, as in the preceding instance, we meet with cases in which one or both anterior limbs are completely retained, and assume the position shown in Fig. 132. Under these conditions one or both carpal articulations project down deeply into the uterine cavity in front of the pubis of the mother, with the radius fully extended upon the humerus, so that those two bones constitute one elongated, rigid column. In this position of the fetus there can be no yielding in a posterior direction from the scalpulo-humeral articulation to the carpus. As a consequence of this deviation, the shoulders of

the fetus are pushed back upon the sides of the chest so as to greatly increase its transeverse diameter, while the perpendicular diameter is still more profoundly increased by the rigidity of the limb, and now equals the distance from the fetal withers or back, to the carpus.

The causes of this deviation may be two. When a fetus presents at the pelvic inlet with one or both carpal joints flexed, these become impacted against the pubis, and, as the fetus con-

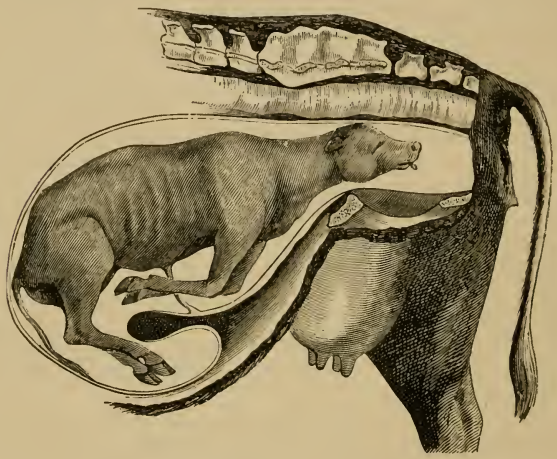


FIG. 132. COMPLETE RETENTION OF THE ANTERIOR LIMBS.

tinues to be advanced by the expulsive efforts of the mother or by traction, they tend to glide downward and finally backward in a way to convert the flexed carpus into complete retention of the anterior limb.

It is quite possible that in many instances the fetus approaches the pelvic inlet with the limbs extended backwards, due to an arrest in their forward extension. With the anterior limbs of the fetus folded against the ventral surface of its body, a small amount of force, applied to the lower end of the radius, pushes it backward, and causes the fetus to offer at the inlet with the entire forelimb retained.

The position is not abnormal for the smaller domestic animals.

For the carnivora the position is more favorable for easy delivery than though the anterior limbs were extended beneath the head. It is only in the larger domestic animals that this position becomes abnormal and interferes seriously with parturition.

The diagnosis is comparatively easy. The condition permits the advancement of the head and neck to a further degree than when the limbs are flexed at the carpus. Consequently, as a rule, when the veterinarian is called the head has passed beyond the vulva. Upon examining with the hand, the differentiation between the complete retention of the anterior limbs and their flexion at the carpus is easily made.

Handling. 1. **Mutation.** The indications are to correct the deviation of the anterior limb or limbs. The fetus must almost always be repelled, page 595. Before this can be accomplished it is best, unless the fetus is living, to decapitate, as described on page 642. With or without decapitation, the repulsion should be made backward and upward, assuming that the fetus has presented in the dorso-sacral position. As the fetus is repelled, the forearm tends to come within reach, so that it may be grasped.

The beginner especially should bear in mind that, the further upward and backward the fetus is repelled, the nearer the radius approaches to the pubis, and consequently the more readily it is reached. Without repulsion it is frequently quite impossible to reach the radius at all. As repulsion progresses and the radius comes within reach, a cord should be passed around it and a running noose applied as low down toward the carpus as is possible. Drawing from time to time upon the cord with which the limb is secured, the operator should continue the repulsion and, with the aid of the cord and the operator's hand, bring the limb into the position of carpal flexion described in the preceding section. From this point the operation is the same as described under that head.

2. **Forced Extraction** has been suggested by some. It is frequently practicable in the sheep and goat. In the mare and cow we consider it wholly unwarranted. It is said that some veterinary obstetrists have succeeded in the forced extraction of the foal or calf in this position, but the records in the cases are not sufficiently lucid to enable the reader to determine whether they were dealing with an average sized fetus or with an abortion at a comparatively early period in gestation. When a fetus is not

fully developed, its limbs are comparatively much shorter and far more pliable, and consequently it may be forced through the passage in almost any conceivable position, dependent upon its size. When the fetus has reached its normal dimensions and attained the degree of rigidity regularly shown at the time of birth, the question of the correct position of each extremity becomes one of fundamental importance, and whenever we attempt to bring about forced extraction under these conditions we must assume an extraordinary risk. If a fetus can be drawn away by forced extraction when an anterior limb is completely retained, it must be because it is a very small fetus, in which instance there is no necessity for forced extraction, because the deviation is easily corrected.

3. **Embryotomy.** Except the amputation of the head, which we always advise, embryotomy is rarely demanded in this deviation. Fleming states: "Amputation of the head will not always prove advantageous in retropulsion; indeed, it will often be found to be a disadvantage." Upon what clinical facts such an opinion is based we are not aware, and cannot readily understand how amputation of the head could in any case prove disadvantageous in bringing about repulsion of the fetus. It is possible that sometimes further embryotomy may prove desirable. If the head has been removed, and, after repulsion, it is still impossible or impracticable to correct the deviation, especially in cases of emphysema of the fetus, it may become desirable to remove one or both of the shoulders. This cannot be done by subcutaneous amputation, described on page 645; but it would be necessary to divide and detach the skin over the region of the shoulder and follow this by a division of the muscles which attach the scapula to the chest.

These are chiefly the trapezius and rhomboideus, which would free the superior end of the scapula and permit it to be secured by means of a cord with a running noose. Then should follow the division of the latissimus dorsi and the pectoral muscles, after which the limb may be drawn out from the skin covering it, in an inverted manner. After the one limb has been removed, the chest of the fetus may be opened and evisceration, page 658, employed. Further diminution in size of the fetus may be prosecuted to any desired extent, and the remnant finally drawn away.

c. Deviations of the Head and Neck.

In domestic animals, the tendency for the head to become more or less deviated at the time of birth varies greatly because of the differences in the length of the neck as compared to its transverse diameter. In the pig, where the neck is thicker than its length, it is very difficult for the head to become deviated, in marked contrast to the foal, with the very long and slender neck, in which these deviations are among the most common and serious forms of dystokia. Not only is the head of the foal very liable to deviation at the time of birth, but frequently the head and neck have become bent laterally at a very early date in gestation and have remained so throughout the development of the fetus, constituting a serious deformity—wry-neck.

1. Lateral Deviation of the Head.

The most common form of deviation of the head is the lateral, as it is in this direction that the neck is most flexible and the head most readily displaced. The deviation may occur with equal facility to the right or the left.

The causes of lateral deviation of the head are two. In the foal the deviation frequently occurs during an early period of gestation, to constitute wry-neck, so that when the end of gestation arrives the head and neck have already been doubled back along the side of the foal for weeks or months, the parts have become thoroughly adapted to this position, and the head lies in the flank of the foal, where it is moulded to the convex surface of its body. That side of the head in contact with the body of the foal is concave, and the opposite side convex.

The second, and except in the foal, perhaps the only cause of deviation, and the one which is most subject to remedy, is an accidental misdirection of the head at the time of the parturition. As the fetus, in an anterior presentation, is being forced along the genital canal, the nose or other portion of the head becomes somewhat deflected to the right or the left, and, becoming impacted against some projecting portion of the pelvis or genital canal or entangled in some way in the fetal membranes, is drawn farther to one side, until it becomes caught between the side of its body and the wall of the uterus or vagina. When this occurs it is highly improbable that delivery can proceed spontaneously, but instead the head tends to become farther and farther

deviated as the body of the fetus is pushed more and more forward. Finally the neck is doubled directly backward as far as possible from the shoulder, and the head lies far back in the flank.

The diagnosis of this deviation usually offers little difficulty. It generally needs to be differentiated from only the two succeeding forms of deviation, the downward and upward displacements.

First, the operator must identify the two anterior limbs, one or both of which are ordinarily in the passages. Having accomplished this, he is yet to determine whether the head is deviating upward or downward, or, if laterally, whether it be to the right or to the left.

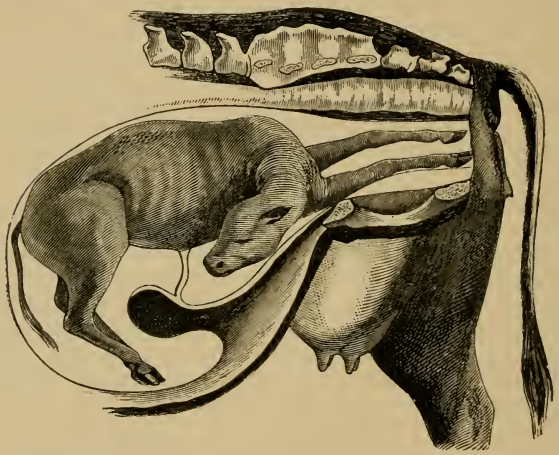


FIG. 133. LATERAL DEVIATION OF THE HEAD. (ST. CYR.)

The determination of the direction is not always easy. If the head can be reached, that decides the question. When the head cannot be reached with the hand, the diagnosis becomes more difficult. As a general rule it is only in the foal that the head cannot be reached and examined with the hand, and in the foal we are aided by the presence of the somewhat prominent mane. If the head is bent laterally and the operator passes his hand as far as possible along the presenting portion of the fetus, he will usually be able to identify the withers. From this point, turning

either to the left or the right and then backwards, he may trace the top of the neck, bearing the mane. At the lower margin of the neck, the operator will usually be able to identify the trachea. In one direction he can trace this to its point of disappearance within the fetal chest between the two anterior limbs, and in the other may follow it across the right or left anterior limb to later turn backward toward the patient's head.

In the upward and downward deviations of the head, the relations of the trachea and the superior border of the neck or mane are wholly different, and serve to distinguish these displacements. In the upward deviation of the head, the top of the neck or the mane is out of reach, whereas the lower margin of the neck or the trachea is quite fully exposed, and curves upward and then backward above the withers and disappears. When the deviation is downward, the trachea cannot be discovered, but the superior portion of the neck or the mane disappears downward between the two anterior limbs.

The indications in lateral deviations of the head will vary greatly according to species and individual cases.

1. **Mutation.** In those cases where the deviation is recent, where wry-neck is not present, where the fetus is not emphysematous or there are no other evidences of insurmountable obstacles to the correction of the deviation, this is the conservative and proper course. The cow or mare should be operated upon in the standing position, with the hind parts elevated, or, if recumbent, should be placed in lateral recumbency on the side opposite to the fetal head, with her hind-quarters elevated.

The operation consists, first, of repulsion, as described on page 595, which is to be applied to the chest of the fetus, directed obliquely backward and away from the misdirected head. If the head is deviated to the right side of the mother, the repulsion should be obliquely toward her left side, so as to tend to release the head and cause it to advance toward the pelvic inlet.

After repulsion has been accomplished, the operator should secure and extend the head of the fetus by those means most available in the particular case, under the rules laid down on page 636. In many instances it is merely necessary to grasp some portion of the head with the hand or fingers, and give it a sharp pull, by which it is brought into its normal position. When the nose is pointing backward, that is, toward the anterior part of

the mother, the nostrils and commissure of the lips offer a secure hold for the finger of the operator or for the insertion of a blunt hook, and this hold may prove of value until the head has turned somewhat.

In the correction of this deviation it will often prove highly advantageous to place a repeller securely against the chest of the fetus and have an assistant maintain constant repulsion, thus keeping the body of the fetus pushed away from the pelvic inlet in a manner to insure to the operator the greatest amount of room for manipulating the head.

In the bitch, cat and ewe, the patient may be more or less suspended by the hind legs, the vagina filled with a warm, unctuous fluid, and the fetus repelled, partly by gravity, partly by the pressure of the fluids, aided by shaking the animal, by pushing upon the fetal limbs or by means of a finger-tip placed against the chest. When repulsion has been accomplished, the operator may locate the fetal head through the abdominal wall, and by external manipulation push it upward (the patient being suspended by the hind feet) toward the vulva, while a finger or fingers inserted in the vulva aid in adjusting the head in proper position, after which traction may be applied.

2. **Forced extraction** has been advised in the mare by some veterinary obstetrists, and a few of them have reported good results by this method. It has been suggested by some that by this means it is possible to save a foal, though we have been unable to find a record of so fortunate an occurrence.

The plan of forced extraction has already been described on page 640. We have not had occasion to apply this method of delivery in the mare or other animal, but we have observed a considerable number of instances in which others have done so, and have learned definitely of but one instance in this country where the life of the mare has been saved, and none where the fetus has not perished. In European countries there are a number of records of successful deliveries of mares, in these cases of dystokia, by forced extraction.

There was entered in our clinic a mare from which a fetus in this position had been extracted by force. Her perineum was completely ruptured, the afterbirth was retained, she was very weak and exhausted, and presented a repulsive and pitiable sight. The afterbirth was removed, and the ruptured perineum was dis-

infected. In a few days she succumbed, and upon *post-mortem* examination there was found a small perforation upon the floor of the cervix uteri, which had caused a septic peritonitis.

We consider forced extraction in this position in the mare as unnecessary, unsurgical and brutal. There is one possible exception to this condemnation—if the foal is known to be alive, cannot be promptly extracted otherwise and its life preserved, and there is a possibility of saving its life by forced extraction. Under all other conditions we hold that embryotomy is far safer for the mare, requires little labor upon the part of the obstetrist, is on the whole one of the easiest forms of embryotomy with which the veterinary obstetrist is acquainted, and offers to him the most favorable prognosis. If a fetus is so small that it can be safely extracted by force, without correction of the deviation or embryotomy, then it is so small that it need not be extracted by force, because the deviation can be easily corrected or embryotomy can be very readily performed. We consequently see no good reason for forced extraction, and consider that such a plan should be constantly and vigorously condemned. As the calf has a very blunt poll and a thick head, forced extraction becomes highly dangerous in the cow and should not be considered.

3. **Embryotomy** constitutes one of the most practical and favorable methods for overcoming dystokia due to the lateral deviation of the head in the mare and cow, if the displacement cannot be readily corrected. Nowhere in obstetrics has embryotomy a more favorable application than in this deviation, especially in those cases of foals where wry-neck is present, which renders it extremely difficult, if not impossible, to bring about a correction of the vicious position. In all those cases where the fetus is dead and the head is deviated laterally to so great an extent that it cannot be readily adjusted, or even if the fetus is alive and of comparatively little value or if it is evident that its life cannot be saved, embryotomy should be proceeded with at once.

While the veterinarian should not undertake embryotomy when the deviation can readily be corrected, he should be equally careful not to exhaust his physical powers in a vain endeavor to bring about a correction of the deviation before he resorts to embryotomy. The operation consists of the subcutaneous removal of one anterior limb, as described on page 645. The limb away

from which the head is bent, and which is thereby fully exposed, is the one to be selected for amputation. After the removal of the anterior limb, the chest should be opened at the exposed point and evisceration carried out, as described on page 658. When this has been accomplished, and the fetal ribs have been severed, the size of the presenting portion of the fetus is reduced to such a degree that it is now no greater with the head turned back than it would have been had it presented normally. It may then be drawn away with the head deviated, or what is usually better, the fetus has now become very flaccid and much room is gained, so that it may usually be very readily repelled and the head brought into position, so that the extraction may finally take place in a somewhat normal manner.

Some operators advise, instead of subcutaneous amputation of the limb, the amputation of the head and neck, which we have described on page 644. We regard the amputation of the limb as an easier, quicker and safer operation. Should the fetus be emphysematous, it is also more efficient. If the fetal body is normal, the accomplishment of either operation is efficient.

4. **Hysterotomy, or Cæsarian section,** is uncalled for in the larger domestic animals, and usually in the sheep and goat. In the smaller animals, where the correction of the deviation fails, and embryotomy is not available because of the narrowness of the passages, Cæsarian section, as described on page 663, is the only recourse, and offers a fair prognosis if undertaken at the proper time and under proper conditions.

2. Downward Deviation of the Head Between the Anterior Limbs.

In describing the lateral deviation of the head, we did not state the very evident fact that such a deviation may not be direct but may be variably oblique upward or downward. Such deviations from the direct lateral line are not materially important, and offer nothing unusual for our consideration. In other instances there is a downward deviation, in which the head passes downwards between the two anterior limbs.

We have stated, in considering the normal attitude of the fetus in the uterus, that it rests with its head and neck bent ventralwards, with its chin in close proximity to or resting upon the sternum. It is easy to understand that in some cases the head may remain in this position, and the two anterior limbs become extended and enter the pelvic canal. The head, passing down between the anterior limbs, is tightly held in that position, because the limbs are firmly pressed together over the back of the neck.

There occur variations in the degree of the deviation, as in other cases, but they largely arrange themselves into two groups. The first group includes those of a minor character, in which, when the fetus advances along the birth canal, its nose catches against the pubic brim. As the fetus is pushed along, there is a constant tendency for the nose to turn more and more downward and backward, while the head becomes sharply flexed upon the neck and the poll passes into the pelvis, to constitute what is sometimes known as the poll presentation.

From this position it has been assumed by some that the deviation may become more and more accentuated until it reaches that degree where the head passes completely downward between the legs. A study of the circumstances under which the deviation occurs tends to throw serious doubt upon this view. When the limbs are advanced in the pelvic canal, they are necessarily confined quite closely to each other, and it is only during the early stages of advancement, before the feet have yet approached the vulva, that the muzzle of the foal or calf can well drop down between the two anterior feet and become jammed against the pubic brim. As the two limbs advance further and further, they become applied more and more closely to each other, so that it would be highly improbable for the head of the fetus to pass completely down between them to occupy a position beneath them. We hold, therefore, that the two positions are not differences of degree, but are fundamentally different in origin, and that one does not pass into the other by imperceptible gradations.

The diagnosis by manual exploration is comparatively easy. In the first instance the head is found lying upon the anterior limbs, with the poll directed more or less upwards and forwards, while the nose projects down between the limbs and is caught against the pubic brim. In the second instance the head at first cannot be felt, but the limbs seem to be pushed somewhat apart as they near the chest. Careful manipulation will reveal the fact that the top of the neck or the mane disappears almost straight downward from the top of the withers, to finally recurve backward. By reaching around underneath the anterior limbs and fetal chest, some portion of the head will most likely be reached and identified.

The handling of the downward deviation of the head offers some variations according to type.

1. **Mutation** is usually applicable in those milder cases where the nose is caught against the pubic brim, and the correction of the deviation constitutes the most rational and economic procedure. In such cases it is not difficult to repel, as described on page 595. The operator should correct the deviation by inserting his hand between the pubic brim and the muzzle of the fetus, and, grasping the latter in the palm of his hand, lift it over the pubic brim and extend it in the pelvis. The case is then to be proceeded with in the ordinary manner of normal parturition. When the head has passed completely down between the legs, correction of the deviation may prove highly difficult or impossible. It is essential to so far repel the fetus that the carpal joints pass into the abdomen and permit the limbs to part sufficiently to allow the head to pass up between them and resume its normal position.

When the fetus has been sufficiently repelled to permit the carpal joints to be flexed and parted, the lower jaw may be corded as described on page 637, grasped with the hand or secured by a hook in the orbit, and lifted upwards between the legs.

In the smaller animals the correction of the displacement is to be undertaken in the same manner as we have just related for the lateral deviation.

2. **Forced extraction.** Tapken strongly advises forced extraction in those cases in the mare where the nose of the foal is caught against the pubic brim, if there is any hope that the fetus is alive. He believes that he thereby greatly advances the interests of the foal without materially injuring those of the mother. However, it is very rare that the foal is alive when the veterinarian reaches the case, and there is rarely, if ever, any reason for precipitancy.

3. **Embryotomy.** Where the head is completely deviated downward and the two anterior limbs are closed over above it, and a reasonable effort demonstrates that the replacement of the head is improbable, or if it will apparently prove very difficult and the fetus is dead or comparatively valueless, we should proceed at once with embryotomy. We prefer to remove one anterior limb subcutaneously, according to the technic on page 645, by which process we relieve the incarceration of the head and permit it to be readily brought into position, after which the extraction occurs in the ordinary way.

3. Upward Deviation of the Head.

The upward deviation of the head is exceedingly rare in practice, and is due to some accidental misdirection while the fetus is passing along the birth canal. In most animals, and especially in the foal, a primary upward deviation is so unstable that the head is very liable to drop off to one side and, revolving somewhat upon its long axis, assume a more or less lateral displacement. Owing to the anatomical peculiarities of the head and neck, this displacement is perhaps most frequently observed in carnivora, where it may constitute a very serious obstruction to birth.

The diagnosis is not readily made in the smaller domestic animals. In the larger ones, where manipulation is practicable, the obstetrist finds upon the insertion of his hand that, though the position is dorso-sacral, the head is not readily grasped or touched, and that the trachea of the fetus, freely exposed and presenting toward the pelvic inlet, emerges from the chest and turns upward and then backward to disappear along the sacrum of the mother.

The indications are analogous to those already related under lateral deviation. First we should consider the question of repulsion and correction of the deviation by methods already described. Second, before exhausting the strength of the operator or of the patient, if the replacement is difficult, or threatens to be futile, embryotomy is to be recommended, and should be carried out upon the same basis as in the lateral deviation.

Cæsarian section, page 663, necessarily constitutes a valuable and available method for handling this deviation in the carnivora, where the hand of the operator cannot be inserted along the genital passages to correct the vicious position. As in other cases of hysterotomy, the operation should here be undertaken early, before the patient has become exhausted or the fetuses have perished and become emphysematous, and especially before the genital passages have been lacerated and infected in a vain effort to bring about extraction by other means.

d. Dystokia in the Anterior Presentation, Due to the Hips.

Interlocking of the Maternal and Fetal Pelves.

It not infrequently occurs, especially in the cow, that birth has proceeded with more or less facility, with the fetus in an ap-

parently normal position, until the anterior portions have passed beyond the vulva and the hips of the fetus have reached the pelvic inlet, when the progress is interrupted and the fetus refuses to move, even under vigorous traction. The interpretation of this condition varies with different obstetrists.

Some hold that the dystokia occurs because the two stifles are in a state of abduction and thus, standing apart, catch upon the pelvic margin and stop the progress of the fetus. It is difficult to conceive of the possibility of such a condition, because there is nothing to maintain such abduction, but all the expulsive forces tend to promptly and effectively overcome it.

According to our interpetation of this difficulty, the conditions are as we have depicted in Fig. 109, page 650, and consist essentially of the interlocking of the pelves of the fetus and mother in such a way that, if the traction is applied in a somewhat unfavorable upward direction, the incarceration is emphasized instead of being overcome.

During its development the embryo lies in the form of the segment of a circle, and the ventral surface of the body is maintained in a somewhat concave form. When the fetus begins its passage through the birth canal, it maintains this curved form until it has been completely expelled from the vulva. If this direction becomes interrupted, according to our observation, the pelvis of the fetus may become interlocked with that of the mother.

If, when the chest of the fetus is passing through, or has passed beyond the vulva, traction is directed upward instead of downward, the external tuberosities of the fetal ilia are thrown upward, and the prepubian tendon of the fetus, being rendered tense, draws the fetal pubis forward, flexes the fetal pubis upon the sacrum and increases the transverse diameter between the supero-external tuberosities of the fetal ilia.

The tension upon the prepubic tendon, by advancing the fetal pubis, increases greatly and dangerously the perpendicular diameter of the fetal pelvis. Normally the fetal pelvis leaves the spinal column at an acute angle, and, if traction is exerted on the spine, this angle is increased, the ilial tuberosities are lowered, and the ischia and pubis pass backwards and upwards. If the traction is instead applied to the pubis through the prepubian tendon, the angle is reduced and the ilial shafts approach

the perpendicular to the fetal spine. The error in the direction of traction causes the fetal ilia to become firmly lodged against the anterior border of the maternal ilia, and the more violent the traction, the firmer the interlocking.

When the fetal pelvis is large and the external ilial tuberosities prominent, the hips may offer serious resistance in passing the pelvic inlet, even without the complication of misdirected traction.

With misdirected traction we have twice seen cows tied firmly by the head to a post, with one or two horses hitched to the fetus and pulling their utmost in an attempt to bring away the calf, but without avail.

The symptoms and diagnosis of this form of dystokia require but little consideration. The fetus, possibly rather large, generally offers in the normal anterior presentation, and advances somewhat slowly until the hips have reached the pelvic inlet, when the progress is stopped and the fetus cannot be advanced by traction so long as it is applied in a direct line, parallel to the long axis of the body of the mother or somewhat upwards. If the operator can succeed in inserting his hand along the fetus into the uterus, he will find that everything is apparently normal, except that the pelvis of the fetus is firmly wedged against that of the mother and seems immovable. We know of but one condition from which we need to differentiate it, and that is the double monstrosity known as pigodidymus aversus, Fig. 129.

The indications in this form of dystokia are :

1. **The Application of Traction in the Proper** Direction. When a fetus is advanced without serious difficulty until it has reached the hips, and is in every way normal, there is no good reason why its extraction should not be readily completed, if care is taken to apply the traction directly downward toward the feet of the mother, according to the technic given on pages 586 and 640. Some suggest release by partial rotation.

2. **Embryotomy**. Failing to bring about extraction under moderate force, the obstetrist should at once resort to embryotomy, consisting of the destruction of the pelvic girdle, as already described on page 649.

e. Dystokia in the Anterior Presentation due to the Forward Extension of the Hind Limbs Beneath the Fetal Body.

In the mare, and possibly in other animals, we occasionally encounter a fetus presenting anteriorly, with the anterior limbs and head in an approximately normal position, and the two posterior limbs thrust forward in extreme extension beneath the body of the fetus, so that the two hind feet are lodged just in front of the maternal pubic brim, or have passed some distance along the pelvic canal. This places the fetal body in such a position that its progress becomes blocked when the neck or chest has appeared at the vulva.

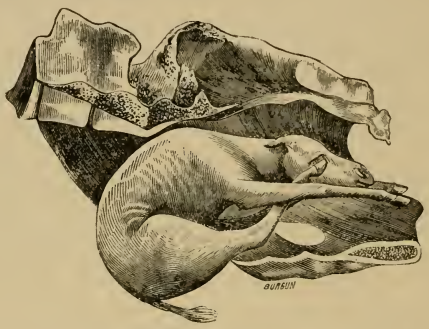


Fig. 134. Forward Deviation of Posterior Limbs in Anterior Presentation. (St. Cyr.)

The nature of this presentation suggests to one that of the ventral transverse presentation, in which all four feet are present, but the head is wanting, whereas in this case all four feet and the head offer at the inlet, and become more or less engaged in it.

The fetus is ordinarily in the dorso-sacral position, with the proper relations existing between the two anterior limbs and the head and neck. However, when it has advanced sufficiently for the fore feet and nose to show at the vulva, its further progress becomes blocked. Inserting the hand beneath the body of the fetus, the operator encounters one or both posterior feet, either in the pelvic canal or just anterior to the brim of the pubis, where they are easily recognized, their soles directed downwards. The spinal column is jammed hard against the maternal sacrum.

The prognosis is extremely unfavorable. Next to bi-cornual pregnancy, this is one of the most dangerous positions of the fetus encountered in the mare. The fetus is doubled up in such a manner as to cause very severe pain and violent straining, constantly threatening serious or fatal injury to the mother. The position offers unusual opportunity for damage by empirics, and invites violent traction by laymen without knowledge of the serious results which are almost sure to follow. When the two posterior feet are lodged against the brim of the pubis, the danger is perhaps greater than when the hind feet are well advanced in the pelvis, because the expulsive efforts of the mare, or traction applied by attendants, tend to force the two posterior feet through the floor of the uterus. It is also a position in which the layman and empiric may undertake embryotomy, and in one case attended by us they had performed detruncation through the dorsal region, but had failed to protect the genital organs from the sharp bones which they had left. As a consequence, the vagina was very badly lacerated and a chronic vagino-cystitis followed, from which the mare never recovered, although she survived.

The method of handling varies greatly in the hands of different obstetrists.

1. **Mutation.** Some advise the adjustment of the misplaced members, but we find no data to show in what proportion of cases such a plan may succeed. The directions given are to repel the two hind feet as far as possible into the uterine cavity and abdomen, and then by traction to bring the fetus away. It must be evident that it is only in very favorable cases that such an operation can succeed in the mare. With the anterior portion of the fetus and its body impacted firmly in the pelvic canal, the operator cannot reach very far into the abdominal cavity, and cannot expect to repel the two posterior feet to any very great degree.

The character of the position generally excludes all possibility of repelling the head and body of the fetus, and if the hind limbs are very far advanced in the pelvic canal it would seem impossible to effectively repel them. Even when repulsion has succeeded to a degree, it is impossible for the operator to know if the two hind feet rest in a safe position where they may turn backward as the fetus moves forward, or not. It seems to us, from our clinical observation, that there would be constant danger

of the hind feet being thrust through the floor of the uterus while traction is being applied to the anterior portion and the hips are advancing and passing over the bent limbs.

We do not consider adjustment of the deviated posterior limbs safe, practicable or advisable in the mare. Such an operation may be wholly feasible in the cow, but dystokia of this form has not been observed by us in this animal. The deviation is generally observed in the mare.

2. **Forced Extraction.** Other obstetrists advise forced extraction. What success they have attained we cannot determine from the literature before us, but it would appear that the position is one which renders this operation specially dangerous. The plan of forced extraction is to secure the two hind feet with cords, advance them well under the body of the fetus, and then, applying powerful traction simultaneously upon the two hind limbs and the head, bring it away entire. Such a plan of delivery necessarily draws the pubis forward and forces the pelvis into that unfavorable position we have already described as "Interlocking of the Fetal and Maternal Pelves."

3. **Embryotomy** constitutes, according to our view, the most desirable and rational method for handling these cases in the mare. In performing embryotomy, our chief operation would be that of detruncation, page 648, repulsion of the hips, and conversion of the fragment into the posterior presentation.

In all cases of dystokia in this position, an unfavorable prognosis should be given, whatever the method of handling. Before beginning his operation, the veterinarian should determine as far as possible if any rupture of the uterus has been caused by the two posterior feet, or if they have wounded the large uterine vessels of this part, causing serious hemorrhage.

In our practice, one mare died from uterine hemorrhage while we were preparing to attempt delivery, although the case was a very recent one and had not been greatly tampered with.

In another case, to which we have already alluded, the owner and his neighbors had bisected the fetus through the thorax and left the vertebrae and ribs freely exposed, and had lacerated and torn the vulva and vagina in a very repulsive manner, so that, although we succeeded in detruncation at the proper point and the removal of the remnant of the fetus, the lacerations which had been caused by the owner were followed by a severe and chronic infection, which not only involved the vagina and vulva, but extended into the bladder, causing a severe chronic purulent cystitis, from which recovery was very tardy and incomplete.

We were called to attend a vigorous young mare suffering from this form of dystokia. The case was recent and had not been meddled with. Delivery by detruncation was prompt and easy. The mare died two days later from gangrene of the vulva and vagina.

In a fourth case a foal was found one morning incarcerated in this position. Apparently the dystokia had existed much of the night. The delivery was easy. Gangrene of the vulva with sloughing occurred, followed by vulvar constriction of such a degree that copulation was not possible.

We have not had a satisfactory recovery in this form of dystokia.

II. DYSTOKIA OF THE POSTERIOR PRESENTATION.

1. Dorso-ilial and Dorso-pubic Positions.

When considering the normal course of birth we had occasion to observe that a fetus presenting posteriorly, especially in the larger domestic animals, may pass quite readily through the pelvic canal, so long as it is in the dorso-sacral position ; but, whenever it deviates to any great extent from this, its passage becomes more or less difficult or impossible, depending largely upon the size of the fetus as related to the dimensions of the channel through which it must pass.

The dorso-pubic position is the most unfavorable, because, owing to the curvature of the body of the fetus, the hind feet project upward against the roof of the vagina, so that they may readily become engaged in the vaginal walls and cause more or less obstruction to the progress of the fetus, and at the same time greatly imperil the integrity of the soft parts of the mother. When the fetus is lying upon its back, its buttocks drop down in front of the pubic brim in such a position that it is exceedingly difficult for the contraction of the uterus and abdominal walls to lift it up over the pubis and cause it to enter the pelvic canal.

The indications in these positions are to bring about an adjustment by rotating the fetus upon its long axis, as described on page 632.

Some obstetrists hold that the fetus may pass through the canal somewhat easily when in the dorso-ilial or dorso-pubic position, and that, in either of these positions, it may often be forcibly extracted without serious peril to the mother, but according to general experience such positions offer more or less serious obstacles to delivery, especially in the calf and the foal.

If the fetus is very large, the amount of traction necessary to bring it away passes the limit of safety ; if the amount of force required is not great it is usually very easy to bring about rotation and delivery by the more natural method. Thus, forced extraction has a very limited application in this form of dystokia.

Embryotomy might be demanded in very rare cases, where, owing to firm impaction in the pelvic canal, rotation becomes impossible and forced extraction unsafe.

2. Flexion of the Hind Limbs at the Tarsus.

We meet occasionally, especially in the mare and cow, with dystokia due to the tarsal articulations becoming flexed and either entering the pelvic canal or becoming caught just in front of the pubis. This displacement constitutes a formidable obstacle to the expulsion of the fetus, because it necessarily involves the flexion of all the articulations of the limb, and consequently greatly increases the diameter as measured from the fetal sacrum down through the folded limb. The femur is flexed upon the pelvis, the tibia upon the femur, the metatarsus upon the tibia,

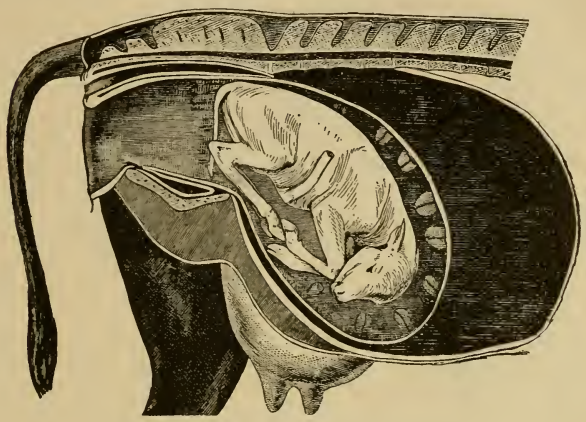


Fig. 135. Retention of Posterior Limbs at the Tarsus. (Franck).

and the phalanges upon the metarsus. We cannot extend one of these articulations completely until the others are ready to be simultaneously extended, and the folding of the limbs in this manner quite effectively prevents the passage of a fetus of normal dimensions through the pelvic canal.

The diagnosis is comparatively easy. Upon inserting the hand, the operator may first touch the tail, or the ischiatic tuberosities. Lying just beneath and in front of the pubic border, there is recognized the summit of one or both hocks. In some cases the flexed hocks extend into the pelvic canal. The fetus

is thus lying in the position of ordinary sternal recumbency, with the hind feet closely doubled immediately beneath the body.

The cause of this displacement is not far to seek. In discussing the normal position of the fetus in the uterus, we have noted that it usually lies with its hind legs folded beneath its abdomen. When parturition occurs, the limbs should, under normal conditions, become extended, so that in a posterior presentation the most advanced part should be the two hind feet. When this extension fails to take place, and the fetus is forced toward the pelvic inlet in the position in which it has previously lain, the points of the ossa calces naturally become caught against the pubic brim, or advance for a short distance in the pelvic canal, and stop further progress in the expulsion of the fetus.

Handling. 1. **The correction of the deviation** should in all cases be undertaken if, in the judgment of the obstetrist, it can be properly accomplished. The overcoming of the deviation consists first in the repulsion of the fetus obliquely forward and upward, as described on page 595. The mother should preferably be in the standing position, with the hind parts elevated. If unable to rise, she should be placed in lateral recumbency, or sometimes still better, in the dorsal position, still applying the rule of keeping the posterior portions of the mother higher. When the repulsion has been accomplished, the extension of the limbs is to be carried out as described on page 636.

2. **Forced extraction** has been suggested by some operators, although neither its advantages nor safety have been clearly demonstrated. As a general rule the so-called forced extraction in this position really involves partial embryotomy by the severing of the tendo-Achilles, which, by permitting dorsal flexion at the fetlock, ameliorates the dystokia. In our judgment forced extraction is never necessary, and rarely if ever justifiable, even with the severing of the tendo-Achilles.

3. **Embryotomy** occasionally becomes necessary or desirable. In case of a very large foal, or when the foal or calf is dead and emphysematous, and especially in those cases where the patient is unable or unwilling to stand, it may be impossible, or at least impracticable, to adjust the position, and consequently embryotomy must be performed.

Embryotomy in these cases is very simple, consisting merely of the amputation of the foot with the chisel, through the lower portion of the tarsus, as described on page 651.

4. **Cæsarian section**, page 663, may become necessary in the

smaller domestic animals, where the adjustment of the deviated limbs or embryotomy is not available.

3. Complete Retention of the Posterior Limbs. Breech Presentation.

The breech presentation may be met with in any of the domestic animals, and probably acquires its greatest significance in the mare, where it constitues a very formidable cause of dystokia. It differs from the preceding deviation in that, instead of being

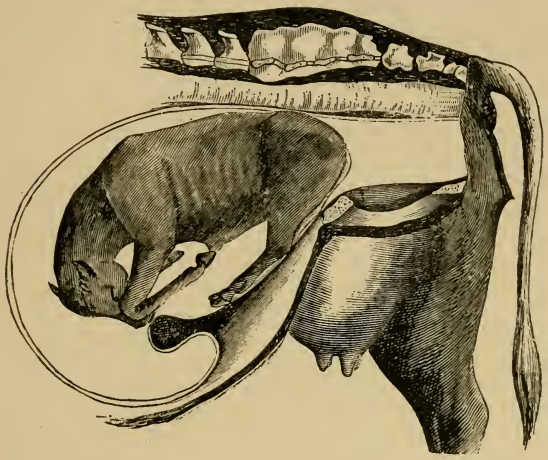


Fig. 136. Breech Presentation. (St. Cyr.)

flexed at the hocks, the posterior limbs are flexed upon the pelvis, beyond which each joint is in rigid extension and the limbs are thrust forward beneath the abdomen and chest of the fetus. The causes are identical with those of the preceding, and probably in many cases complete retention follows flexion at the tarsus. The flexed tarsus becomes caught against the brim of the pubis, and the expulsive efforts of the mother, pushing the fetal body along, cause the ossa calces to glide downward and then forward, and the tarsus to become extended, until finally the entire limb is pushed forward beneath the body. The operator, upon examining the case, usually meets first with the tail or buttocks

of the fetus, and in many cases can only touch the tibia or other portion of the limb with very great difficulty. Sometimes no part of the hind limb can be grasped or recognized until after repulsion has taken place.

1. **The adjustment of the deviated limbs** is first of all indicated. The fetus should be repelled, as described on page 595, after which the tibia or metatarsus, as may be available, should be secured by means of cords, as described on page 579. By continuing repulsion, the position is to be converted into a hock presentation, after which the further handling of the case is identical with that position which has already been described.

2. **Forced extraction** has been advised by some operators in these cases. As to how successful they have been our veterinary literature is not very clear. They suggest a variety of ways for bringing about forced extraction. Some recommend that a cord with a running noose be passed around the loins of the fetus and secured, or rather that the cord be passed around each of the thighs and then passed through the noose at the top of the back, so that the loins of the fetus are secured and the operator is enabled to apply any degree of traction which may be desired.

Others would apply traction by means of sharp hooks deeply imbedded in the flanks, like the flank hooks of Harms. Yet other obstetrists would incise the perineum of the fetus and, inserting the hook through the fetal pelvis, engage it in the obturator foramen or in front of the pelvis, and exert traction in this way.

While forced extraction may be somewhat easier for the obstetrist, we do not consider it warranted by modern surgical principles. We have at no time found any need for applying forced extraction.

3. **Embryotomy** offers the most valuable method for overcoming this form of dystokia, especially in the mare, in all those cases where adjustment is impossible or difficult. Whenever the fetus is comparatively large or is dry or emphysematous, or for any other reason it is exceedingly difficult or impracticable to bring about an adjustment of the position, embryotomy is highly commended, and should be undertaken promptly, before the operator and patient have become exhausted in fruitless endeavors. Various forms of embryotomy have been recommended by different writers, but we greatly prefer the intra-fetal amputation of the two posterior limbs, as described on page 653. Others prefer

to amputate the limbs extra-fetally, with the knife, Persson's saw, or the Pflanz embrytom.

4. **Cæsarian section**, as described on page 663, is sometimes necessary in the smaller animals, like the sow and bitch, but is uncalled for in the cow and mare because embryotomy is always readily available.

III. TRANSVERSE PRESENTATIONS.

a. Dorsal Transverse Presentation.

Transverse presentations are virtually confined to the uniparous animals, and among these the overwhelming majority occur in the mare. The fetus usually presents ventrally, except in those cases we have already described as Bi-cornual Pregnancy on page 716.

When the dorsum of the fetus offers at the pelvic inlet in the right or left cephalo-ilial position, the position is usually uncomplicated by any further deviation, so that, when the operator inserts his hand, it comes at once into contact with the dorsal surface of the fetus, which is easily recognized. By extending the hand to the right or left, he may palpate and recognize the hips or the shoulders and neck. As a general rule the operator does not come in contact with the head or any of the feet, but only with the body, although in rare cases one or more of the feet may be more or less misplaced in their general relation to the body of the fetus, and project in such a manner that they may be felt or grasped by the operator. In one case in our experience, one hind leg passed backward over the fetus into the pelvic canal.

The causes of transverse presentations are not well defined. Most obstetrists hold that they are acquired positions, occurring during labor; but, as we have related, page 716, the fetus of the mare occasionally develops equally in the two uterine cornua; in a transverse position. In the anomalous development which we have described, the fetal body revolves upon its long axis in order to attain a stable position.

We do not know that all fetuses developing transversely in the mare undergo this rotation, and we can readily conceive it as being wholly possible that no rotation should occur, in many cases, and consequently that the fetus may develop transversely and, without rotation, present transversely at the time of parturition.

Handling. Version, as described on page 634, is usually the best and most effective method of handling. In almost every case it succeeds well. Should this fail, it may be necessary to perform detruncation in the lumbar region. The detruncation is to be accomplished chiefly with the chisel, severing first the

spinal column. The soft parts may be most conveniently severed with the finger knife. Evisceration, page 648, should follow. The posterior half may be secured by means of a rope noose about the lumbar vertebræ, or by hooks or cords applied inside the pelvis.

It may prove necessary to extend the embryotomy to include the destruction of the pelvic girdle, pages 661 and 649. In other cases, the posterior half of the fetal body may be repelled, and converted into a posterior presentation.

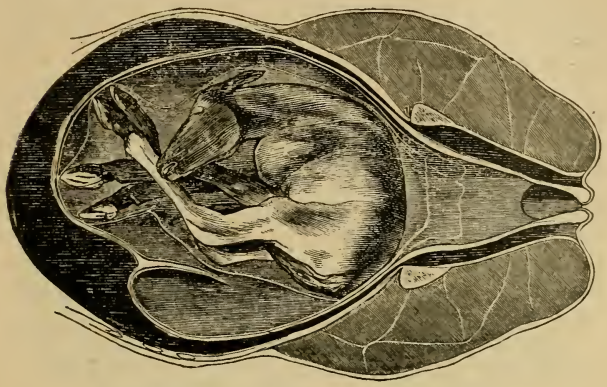


FIG. 137. DORSAL PRESENTATION. (FRANCK).

The anterior half is to be managed in a similar manner. After evisceration it may be desirable to sever the ribs, page 656, so as to permit the fetal chest to collapse. The remnant may now be extracted by securing the dorsal vertebræ by means of a cord and exerting traction upon it.

In some cases it may be practicable or preferable to convert the anterior half into the anterior presentation.

In one instance occurring in our practice, due to abortion in a mare, the fetus was in the dorsal transverse presentation, with its upper hind leg extended over its back into the pelvic canal. The leg could not be returned into the uterine cavity, and consequently detruncation was effected, after which it was easy to convert the posterior half into a posterior presentation, and the two pieces were readily removed.

b. Ventral Transverse Presentation.

Most fetuses in the transverse presentation offer at the pelvic inlet by their ventral surfaces. The head of the fetus is retained, all the feet offer in, or are somewhere near to, the pelvic inlet, and the fetus lies upon its side, more or less transverse to the spinal axis of the mother, with the fetal head resting in the region of one or the other of the maternal ilia—right or left cephalo-ilial position.

Symptoms. In most instances some or all feet appear at or near the vulva, but no essential progress is made in the expulsion of the fetus, although the animal may make violent expulsive efforts, and neighbors and empirics may apply force.

In a large proportion of the cases in the mare, wry-neck is present. If the wry-neck is to the right the fetus usually lies upon its right side, and if to the left upon its left side, so that the head in a large proportion of cases is entirely out of reach, which in many respects is fortunate. Upon inserting the hand, the obstetrist usually meets with, and can identify, all four of the limbs. In some cases it may be exceedingly difficult for him to differentiate between the different members, so badly are they entangled with each other, and so tightly impacted in the pelvic canal.

This form of dystokia is quite favorable for the mare, because the owner or empiric is usually balked at once in any effort to meddle with the case, and must consequently await the arrival of the veterinarian. Even more or less violent traction upon the fetus, as a general rule, produces little harm, because its position is such that any moderate force applied to the feet cannot wedge the fetal body in the pelvic inlet or force any projecting portion of the fetus against the soft parts of the mother.

Handling. 1. **Version.** In the cow it may be practical and advisable to attempt adjustment without embryotomy, because the feet and legs are shorter and more pliable than those of the foal. If it is decided to perform version of the fetus, the two posterior limbs are to be corded at the pastern, and the two anterior limbs pushed away forward as far as the operator can reach, while an assistant advances the posterior limbs by exerting traction upon the cords, as described on page 634. The operator thus converts a transverse into a posterior presentation, after which the delivery is completed as such.

2. **Embryotomy.** In the mare we regard embryotomy as being simpler and safer than version, without generally involving any great amount of labor upon the part of the obstetrist. Embryotomy in these cases consists of the subcutaneous removal of the two anterior limbs, as described on page 645, followed by version of the fetal remnant, which is to be brought about by repelling the chest and applying traction to the two posterior limbs, in order to convert the transverse into a posterior presentation.

This position is subject to a variety of complications, which may tax the skill and endurance of the operator. In the typical case in the mare, which we have described above, it requires only about one hour or one and a half hours to perform embryotomy

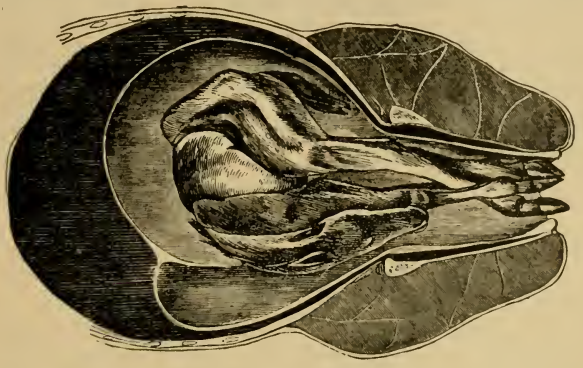


FIG. 138. VENTRAL PRESENTATION. (FRANCK).

and deliver the fetus as outlined. An expert operator may even accomplish the task in much less time, but in the presence of certain complications it may require very much more time.

In one of my cases all four feet of the fetus had already passed through the vulva, and the four large, bony limbs were tightly impacted in the pelvic canal, completely filling it, so that it was only with difficulty that the arm could be inserted alongside or between them. I could reach neither of the shoulders to amputate subcutaneously, but was forced to amputate one at the elbow joint, and the other with difficulty at the scapulo-humeral articulation, but these amputations served my purpose, and permitted delivery after some five or six hours of fatiguing labor. The case was further complicated by the viciousness of the mare, which persistently fought by kicking, striking or biting at any one within her reach, so that it became necessary to cast her and securely tie all four feet. The recumbency, with the

cramped position of all four feet, induced extraordinary pressure upon the abdomen and greatly restricted the room for the work. Nevertheless she made a good recovery.

In another instance the two anterior limbs were well advanced in the pelvis, with the feet protruding beyond the vulva, while the two hind feet were jammed across the pelvic inlet. The upper hind foot crossed above the upper forefoot in front of the pelvic inlet, and the toe was firmly caught in front of the shaft of the maternal ilium, while the hock lay immovably fixed against the iliac shaft on the other side. The lower hind foot passed between the two anterior limbs, and was otherwise engaged in the same way as the upper hind foot.

It was impossible to repel the fetus, and equally impossible to reach the uppermost shoulder to amputate the anterior limb, because of its being crossed by the metatarsus. With the chisel, we therefore amputated the upper hind foot through the lower part of the tarsus, removed the foot, and secured the stump above the os calcis with a cord. The upper fore-leg was then removed subcutaneously. Next the lower hind foot was amputated at the tarsus, in the same manner as the first one, and the stump was secured with a cord. Finally the lower anterior limb was amputated subcutaneously, after which the chest was repelled, while traction was applied to the stumps of the amputated hind limbs, and the remnant of the fetus was converted into a posterior presentation.

PATHOLOGY OF THE PARTURIENT OR PUERPERAL STATE.

Grouped about the act of parturition, there is a highly interesting and important series of accidents and diseases of the mother, which require close study upon the part of the veterinary obstetrist. They occur in all animals, although one or another disease or accident may be far more frequent in one species than in another. These diseases, injuries or infections usually have some definite time at which their foundation is chiefly laid, but there are wide variations as to the exact time of the advent of the symptoms. In some instances they may occur before parturition; in others, during or after that act. Many of them pass by imperceptible gradations from one into another, which tends to render their classification somewhat difficult, and subjects any plan which may be suggested to certain objections. For convenience, this group of affections may be divided into five classes: Pathology of the Placenta; Wounds and Injuries of the Genital and Neighboring Organs; Puerperal Infections; Parturient Eclamptic Diseases; and Diseases of the Mammæ.

I. PATHOLOGY OF THE PLACENTA.

Retention of the fetal Envelopes. Retained Afterbirth.

In dealing with the question of birth, we have already had occasion to allude on page 516 to extra resistance of the chorion, which, it has been claimed, sometimes imperils the life of the fetus; on page 742, to adhesions between the fetal membranes and the fetus as a cause of difficult labor; and on page 525, to the rupture of the chorion and its expulsion with the other membranes, in advance of the fetus, leading thereby to fetal death. These conditions are rare, and relatively unimportant from an economic standpoint.

Retained placenta constitutes one of the most common and serious maladies among the diseases of the puerperal state, especially in the cow. In considering normal birth, we have noted that, as a consequence of that act and following closely upon the expulsion of the fetus itself, there should normally occur a separation of the fetal placenta from that of the mother and an

expulsion of the fetal membranes from the uterus. If they remain, they inevitably undergo decomposition and cause more or less serious disease. When the fetus has been removed or has ceased to live, and the passage of blood through the umbilic cord has ceased, these membranes become essentially foreign bodies, highly subject to infection, which more or less seriously involves the uterus and the animal system as a whole.

A study of the placentæ of the domestic animals shows that the intimacy of contact between fetal and maternal placentæ varies greatly in the different species. The placental tufts are very much longer and more complex in ruminants than in other domestic animals. In ruminants the placental attachments are not uniform over a large area, as in the mare and sow, but they are concentrated upon certain well-defined areas, where their attachment is all the more complex. It would at once be suspected, after a study of the anatomy of the placentæ of various domestic animals, that ruminants, with their highly complex cotyledonous placentæ and very complex placental villi, would be far more subject to retention of the fetal membranes than is any other animal. This suggestion, however, holds true for but one member of the group, the cow. Retained placenta may almost be said to be a disease of the cow, so far as the domestic animals are concerned. While the condition is met with in all domestic animals, and acquires importance in mares, there is no such number of instances in any other domestic animal, or in all others combined, as in the cow. See Fig. 97, p. 361 and Fig. 139, p. 802.

It is difficult to define in exact terms what constitutes retained placenta. The line between the normal and abnormal duration of retention of the placenta, after the expulsion of the fetus, constantly vacillates according to species and individual, so that the term is largely a comparative one. In the mare the chorion usually separates from the uterus within 10 to 15 minutes after the expulsion of the fetus, and if it remains over 30 minutes it might be very properly considered abnormal, although in all probability it may yet separate and come away spontaneously after a further trifling delay, and the case pursue an apparently normal course.

In cows the fetal membranes usually do not become detached so quickly. In a large proportion of cases they still remain attached to the cotyledons after one-half to one hour, and, not at

all rarely, in cases which are apparently normal, they remain from 4 to 12 hours or even more, before becoming detached and dropping away. However, if they remain for a longer period than 10 to 12 hours after the expulsion of the fetus, especially if the latter has been carried for the full term, most obstetrists would regard the further retention as abnormal.

In the smaller ruminants, the ewe and goat, the placenta is usually expelled with more promptness and uniformity than in the cow.

In multiparous animals it is the rule, if not a necessity, that the placenta of each fetus shall become expelled prior to the expulsion of the next fetus from the same cornu, and the last fetus is almost immediately followed by the expulsion of its membranes.

1. Retained Placenta in the Cow.

Although, among all the domestic animals, the cow is by far the most subject to retained fetal membranes, the causes of such retention have not been made wholly clear by veterinary writers, and in fact comparatively little investigation has been made, with a view to a scientific explanation of the pathologic condition.

By many it has been regarded as a disease of the membranes, by which they adhere with abnormal tenacity to the maternal placenta. While the tufts of the chorion are very long and numerously branched, and sink into the recesses in the cotyledons of the mother, they have no power within themselves of holding fast to the maternal tissues. It has already been stated that, at no time during fetal life, is there any direct communication between the maternal placenta and the placental tufts of the chorion, but they are always normally separated by two layers of epithelial cells, the one maternal, the other fetal.

It has long been believed and taught that, under certain diseased conditions, adhesions take place between the tufts of the fetal chorion and the corresponding septa of the maternal placenta, but no such adhesions have as yet been observed by histologic examination. While we are not in a position to deny the possibility of such adhesions, it is certain that, if they occur at all, they are so rare as to constitute no important element in the question as a whole.

Retention of the fetal membranes in the cow is due primarily to the incarceration of the tufts of the chorion within the crypts of the maternal cotyledons.

Recently Pomayer,[1] in a very extended study, has quite well shown the principal causes of retained afterbirth by histologic research, and his findings and conclusions are in full accord with clinical experience. Pomayer holds that retained fetal membranes are due to inflammation and swelling of the maternal placenta, that is, placentitis or cotyledonitis. The lesions within the cotyledons may be of two classes, aseptic and septic.

During pregnancy an animal may receive a blow, be gored by a cow, or meet with some other external injury which may more or less detach some portion of the chorion from the maternal placenta. Hemorrhage may take place to a limited degree, followed by a more or less extensive inflammation, with new formation of connective tissue between the mucous membrane of the placenta and the epithelial tufts of the chorion. Should the hemorrhage between the two parts become very great, it may cause so extensive a separation as to induce the death and expulsion of the fetus. If the hemorrhage is not so great, and the inflammatory processes already mentioned take place, the fetal membranes may become more or less incarcerated and held over a limited area, but there would be no general retention of the entire fetal membranes, or rather we would say that, in the cow, the fetal membranes would become readily detached from all the cotyledons save one or two which had been implicated in the injury during pregnancy. With this group of cases, we have little to do, and clinically it is virtually negligible.

The important group, from the practitioner's standpoint, consists of those cases in which infection plays the chief role and the retention of the afterbirth is finally maintained by the inflammation of the maternal placenta. By observing Figs. 79 and 139, it will be seen how intimate is the relation between the chorion and the cotyledons in the cow, and it will be readily understood that, when the cotyledons become inflamed and swell, the very complex chorionic tufts may become more or less immovably fixed and held.

[1] Das Zurückhalten der Nachgeburt beim Rind, by Dr. Phil. C. Pomayer.

The advent of cotyledonitis may vary in different cases. In many instances, the disease of the placenta precedes the expulsion of the fetus, and consequently, at the time of the expulsion of the calf, the pathologic conditions which must result in retention of the fetal membranes are already present, and fully developed. This is especially true in contagious abortion, in which there is frequently more or less infection of the cotyledons, prior to the expulsion of the uterine contents. If the abortion occurs early in pregnancy, before the chorionic tufts have become developed, the fetal membranes are regularly expelled along with the aborted fetus. Later in pregnancy, after the chorionic tufts have become more developed, with corresponding complexity of the maternal placenta, retained afterbirth becomes very common, and is referable to the existence, at the time of the expulsion of the fetus, of a distinct inflammation of the maternal placenta, which incarcerates and holds the chorionic tufts of the fetal placenta. In other cases, also, inflammation has already advanced into the uterus, and brought about an inflammation of the cotyledons, prior to the expulsion of the fetus. In the granular venereal disease of cows, where the granular inflammation extends into the uterus, if the death of the fetus fails to be brought about, but instead its premature expulsion is caused, the cotyledons readily suffer, and the expulsion of the immature fetus may be followed by the retention of the membranes.

When a pregnant animal has suffered for a long period of time from prolapse of the vagina and of the vaginal portion of the uterus, the uterine cavity is very prone to become infected, since the chief barrier to uterine infection, the healthy vagina, has been replaced by a diseased and infected organ.

Similar conditions prevail when torsion of the uterus has occurred, because compression and stretching of the tissues have greatly decreased their power of resisting infection and permitted the infection to extend into the uterine cavity and involve the placenta. Any cause which may operate in such a way as to permit the access of disease-producing organisms into the uterine cavity may at any time cause infection of the maternal placenta and bring about a degree of inflammation and swelling which will eventually cause a retention of the fetal membranes.

In the other important group of cases, those in which the diseased condition occurs after the completion of birth, infection

is favored in a quite different manner. The observations of Pomayer upon this point are very exact and convincing. If birth has been difficult, if the animal is weak and debilitated, or if the uterus is in a debilitated state from the expulsion of the fetus, retention of the fetal membranes is very probable. The expulsion of the fetus has exhausted, in these cases, the contractile powers of both the uterus and the abdominal walls. In most cases of parturition, there is a definite and well-marked exhaustion at the completion of the act, and a period of rest at once follows. Later, when the animal system and the uterus have recovered from the exhaustion of parturition, contractions of the uterine and of the abdominal walls normally occur, and serve to press out any remaining fetal fluids, and the afterbirth, and close the uterine cavity.

If, for any reason, the exhaustion is abnormal and the contractions of the uterine walls do not recur promptly, infection takes place very quickly. As soon as the navel cord is ruptured, the fetal membranes at once cease to live, and assume the significance of a foreign body. The entire mass of membranes is dead tissue, filled with fluid and containing portions of the fetal fluids which have not been thrown out. Taken together, the membranes and the fluids constitute a highly favorable breeding ground for disease-producing organisms. Usually the broken end of the navel cord hangs from the vulva, comes in contact with bedding, feces, urine and other substances reeking in micro-organismal life, and furnishes an excellent avenue along which the organisms may pass into the uterine cavity.

Still more important, in many cases, micro-organisms of the most dangerous kind are introduced directly into the uterine cavity on the hands of laymen, or other persons who have interfered in cases of dystokia or have inserted their hands into the uterus immediately after the expulsion of the fetus. Thus there is abundant opportunity for infection of many kinds to gain access to the uterine cavity and, having reached that organ, find the conditions of heat, moisture, nutritive material and exclusion of air ideal for their rapid and efficient multiplication. If the exhaustion of the uterus continues for 10, 12 or more hours, the infection of the cotyledons has probably occurred, and within 24-48 hours the disease processes in the cotyledons may have so far advanced as to firmly incarcerate and hold the chorionic tufts.

The pathology of the retention of the fetal membranes is necessarily somewhat foreshadowed by the causes which have been related above. Inflammation of the cotyledons in the cow, or of the placenta in other animals, naturally follows the general course of inflammation of tissues, resulting from infection. It may abate in the course of a few days, and the swelling of the cotyledons may decrease and result in the release of the incarcerated placental tufts, so that the chorion may finally come away, accompanied by contraction of the uterus and prompt recovery from the disease. If, however, the infection is more extensive and virulent, the cotyledon may undergo total necrosis and slough away, still holding firmly incarcerated the section of chorion to which it is attached. We have observed this result in the cow repeatedly, and sometimes it has involved the necrosis and sloughing away of all or nearly all the cotyledons in the entire uterine cavity.

The ravages of the disease do not always cease with the necrosis of the cotyledons, but may extend to the walls of the uterus, involving the mucous, muscular and peritoneal coats more or less in their order, and extending beyond the peritoneal covering of the uterus, to involve the peritoneum in general.

The fetal membranes undergo more or less rapid decomposition, so that in 48 hours, as a rule, they become quite putrid and give off a very fetid odor. The inflammation of the uterine mucosa, endometritis, causes a more or less abundant excretion into the uterine cavity, which is usually very fetid and consists of a dirty, grayish, flocculent, semi-fluid or fluid mass, which may vary greatly in amount. Naturally it is mixed with shreds of afterbirth and placenta, and sometimes contains cotyledons which have sloughed away from their pedicles. In some cases, the uterine mucosa is covered over with diphtheritic membranes.

Depending upon the degree of infection, the uterine mucosa or the entire uterine walls may be more or less thickened and changed in consistency. Sometimes the uterine walls are very firm and hard, as a result of an exudative inflammation, especially if the disease is of somewhat long standing. At other times, the walls are very thick and soft, as a result of gangrene.

When the inflammation of the uterine walls is virulent, and the pathologic changes serious, the uterus quickly loses all contractile power and lies as an inert organ. The pathologic secre-

tions accumulate within the organ, until sometimes it may contain four or five gallons. Any expulsion of the contents of the uterus must now be brought about by the contraction of the abdominal walls, including the diaphragm, and even these forces are too frequently in abeyance, so that the uterine contents increase more or less rapidly, and in many cases flow away spontaneously, especially when the animal is lying down, simply as a result of passive pressure upon the abdominal walls.

The constitutional symptoms are usually parallel to the local changes in the organ. The systemic disturbances will vary, however, according to the vitality of the patient and her power of resistance to bacterial products. Usually, when the inflammation of the uterus has extended to any considerable degree, there are more or less well-marked symptoms of septicaemia or pyaemia. These include inappetence, irregularity of the bowels, either in the form of diarrhea or of constipation, cardiac debility with a very weak or imperceptible pulse, great depression of the animal, cold extremities, rapid, shallow respiration, and any other of the long train of symptoms which may accompany septicaemia.

The symptoms of retained placenta, in the cow, are variable, and include the symptoms of all the pathologic lesions which may result from the disease. Generally they are self-evident, and consist of the navel cord and portions of the chorion hanging from the vulva, while other portions are retained within the uterus. This is not always true. Sometimes the major portion of the chorion, and the navel cord, have dropped away, and the owner believes that the expulsion of the fetal membranes has been complete, but within the uterus there remain imprisoned more or less extensive portions of the afterbirth, which soon become infected and undergo decomposition. In other cases, the entire mass of fetal membranes, or essentially all, is retained within the uterine cavity, the os uteri has contracted, and no portions of the membranes protrude from the vulva, to reveal in that very apparent way the condition which exists.

In addition to these usual visible signs, there are present symptoms of the pathologic changes which we have enumerated above. These may not be very marked, but the animal, soon after parturition, loses her normal vigor, and there are generally symptoms of ill health of a more or less serious character. In many cases, the retention of the membranes may be suspected

from the presence of a vaginal discharge, with the general appearances of ill-health. In other cases, there occurs a more or less evident prolapse of the vagina.

When retention of the placenta is neglected, the membranes and cotyledons may slowly slough away, the os uteri contract, chronic metritis and pyometra become established, marasmus and emaciation follow, and the disease continue month after month, to finally terminate in death, or in recovery with sterility.

Under such conditions, following within a few days or a few weeks upon parturition, it behooves the veterinarian, when called to attend the animal, to make a careful search of the uterus. If the os uteri is open, he may profitably make this examination direct through the vagina, but, if the os be closed, the examination needs be made per rectum, when the enlarged uterus will be discovered and the nature of the disease understood.

The handling of retained placenta in the cow calls for careful study, and the display of great judgment. Mostly the work has been undertaken in a haphazard way by the layman or the dairyman, and these methods have been largely copied by the veterinary practitioner. No practice in connection with our professional duties could be more unfortunate. As a general rule, the layman or the veterinarian removes the afterbirth by manual force, more or less completely, at a time which is arbitrarily fixed, or when it may suit the convenience of the parties concerned. As a result of this haphazard and unscientific method of handling this very serious disease, the lives of many valuable cows are annually sacrificed, and many more are rendered useless for dairying or other purposes. In order to handle retained placenta successfully, the veterinarian must first understand the physiologic expulsion of these membranes and the pathologic conditions which occur in the course of the disease. Three different courses present themselves for consideration in the handling of each case of retained placenta in the cow, and the veterinarian must use good judgment in determining which of these three courses he should pursue.

1. **The manual removal of the placenta.** As early as 24 hours after parturition, the veterinarian should examine the retained membranes and determine whether or not they may be safely and completely detached by manual force, and, if practicable, should remove them. The precise time for this examina-

tion cannot be definitely fixed. If the veterinarian attends a case of dystokia, and finds, after the removal of the fetus, that he can follow with the removal of the placenta, without tearing the cotyledons and without causing hemorrhage, this should be accomplished immediately. If there are any wounds in the uterus or vagina, there is greater need for the removal of the membranes, in order to prevent wound infection and injury to the parts. If the fetus has been dead and emphysematous, it is quite important to remove the afterbirth immediately following the removal of the fetus, and in such cases it is generally quite practicable to do so.

The operation of the manual removal of the placenta should be accomplished in a careful and thorough manner. During parturition, the chorion has become separated from some of the cotyledons about the cervical canal, and the farther toward the horns we proceed the more intimate do we usually find the attachments of the membranes to the cotyledons. The veterinarian should begin by detaching those cotyledons which are first recognizable posteriorly, along the top of the uterus, and then, gradually working forward, eventually detach those from the bottom of the uterus and from the horns.

The method of detachment should aim at the complete removal of all the chorionic tufts, without injury to the cotyledon or to its pedicle. The operator grasps the cotyledon with his thumb resting upon one side at the margin of the attachment of the chorion to the cotyledon and his index and middle fingers resting upon the opposite border of the organ. By pressing upon the chorion, between the thumb and fingers, the chorionic tufts are gradually detached and forced out of the crypts in the cotyledons, while no force is exerted upon the stalk of the cotyledon, and consequently it escapes injury. After the fetal placenta has begun to be detached on the side where the thumb is located, the detached margin may be grasped between the thumb and index finger, while the other fingers rest upon the opposite side of the cotyledon, and the detachment of the chorion gradually completed. This process is to be repeated upon one after another of the cotyledons, until all are finally detached.

The operator usually has difficulty in reaching the most distant cotyledons located in the two horns, especially those in the gravid horn. This horn turns downward, and then backward, and is

longer than the reach of a man's arm. The operator may bring these cotyledons somewhat nearer to him by having assistants lift upon the floor of the abdomen with a blanket or board, or in some cases, by gradually pulling backward on the curved horn, and thus drawing it toward the pelvis. If the uterine walls are not paretic, one may also cause a decrease in the size of the organ by filling the uterus with warm water and causing it to contract and expel the liquid. This causes a diminution in the size of the organ, and brings the most distant cotyledons more nearly within reach.

Before beginning the operation, the veterinarian should wash and disinfect the vulva and tail carefully, and should irrigate the vagina. The operator should take precautions against infection of his arms and hands. For this purpose, we recommend the repeated immersion of the arms and hands in a reliable antiseptic fluid, and would especially recommend lysol, because of its unctuous character. Some, like Pomayer, condemn antiseptics for this purpose, and recommend oils or fats instead, but our experience has been that oils and fats are almost instantly dissolved by the fluids present and washed away.

We also practice and recommend the irrigation of the uterine cavity prior to the beginning of the removal of the afterbirth. We would not use, for this purpose, a powerful disinfectant, which would tend to cause abnormal expulsive efforts, but would use instead soft warm water, with a small amount of disinfectant, like ¼% carbolic acid, which, we find, tends to soothe rather than irritate the diseased uterus. If the uterus is too feeble to cause the expulsion of this liquid, and it is not accomplished by the abdominal walls, it should be siphoned out.

For making the injections we prefer to use a rubber tube, especially the pure gum horse stomach tube, which, to our mind, makes an ideal apparatus for the irrigation of the uterine cavity. To the distal end of this, we may attach either an aseptible enema pump or a funnel. The funnel is cheaper, lighter to carry, and is highly efficient.

If the operation of the manual removal cannot be carried to completion, or cannot be performed without injury to the cotyledons or causing hemorrhage, it should not, for the time being, be persisted in.

The membranes should not be divided, but should be removed completely or left together attached to the uterus. One important element in the normal detachment of the membranes is the weight and volume of the chorion and umbilic cord. If the principal volume and weight of these is removed, the tendency for the

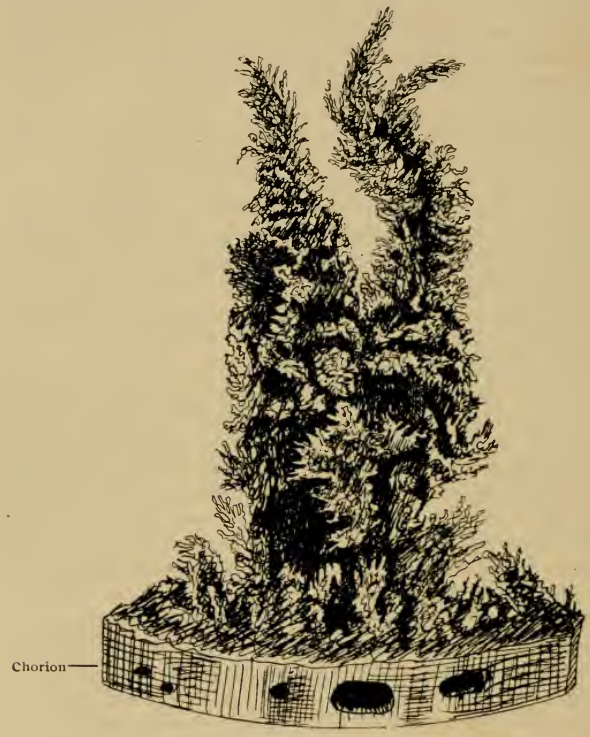


FIG. 139. PLACENTAL TUFTS FROM THE CHORION OF THE COW. (Pomayer.)

remnant to continue to be retained is intensified. If the main body of the chorion is torn away, and the placental tufts remain imbedded in the cotyledons, the incarcerated portions lose the influence of traction, which is so necessary to their eventual re-

moval. It is the dead and putrefying placental tufts imprisoned in the cotyledons, and not the other portions of the chorion, which constitute the element of danger in the disease. If we cannot remove these tissues, which constitute the fundamental danger in retained placenta, then we should not, under any conditions, remove those harmless portions, which may later serve a highly necessary and useful purpose in withdrawing the imprisoned placental tufts.

2. **Expectant Handling.** When it is impracticable to manually remove the entire mass of the chorion, including the tufts, the afterbirth should be allowed to remain in the uterine cavity with the detached portions hanging from the vulva. The attending veterinarian should attempt to control and alleviate the infection in the organ, and to retard, as far as possible, the putrid decomposition of the retained membranes by irrigating the uterine cavity with warm water, to which he may add a small amount of disinfectant, being careful not to use sufficient to cause any irritation of the uterus. One may use from ¼ to ½% carbolic acid, or an equal amount of lysol. If the animal does not throw out the injected liquid, along with the accumulated discharges in the uterine cavity, it should be siphoned out by means of a tube.

It is wrong to leave this fluid in the uterine cavity, where it can work no good. We cannot disinfect the diseased tissues, because any disinfectant sufficiently powerful to pass into the tissues and destroy the micro-organisms must destroy the tissues before the micro-organisms are reached. It is of great use, however, to remove from the uterine cavity the accumulated disease discharges or bacterial products. The washing should be repeated at least once a day, and should be continued each time until the fluid, when expelled or siphoned out, is comparatively clear and free from odor. When this has been siphoned out, there should be deposited within the uterus some antiseptic which will tend to obviate any increase of the infection, without inducing any marked irritation of the diseased organ. In our judgment, the most reliable drug for this purpose is iodoform, which may be introduced into the uterine cavity in the powdered form, enclosed in a gelatine capsule, which the operator may leave to dissolve or may open and scatter the powder about in the various parts of the uterus. This plan has been carried out by

us, and some of our colleagues, with very satisfactory results. Possibly other antiseptics, such as powdered boric acid, would prove of similar value, introduced in the same manner.

The patient should be examined daily. If it is found that the inflammation in the cotyledons has abated, so that the chorion may be effectively detached, the manual removal of the membranes should be proceeded with. If they are still firmly held, the treatment should be repeated, and so, day by day, the case should be carefully watched, until finally it is possible to remove the chorion complete, including all the placental tufts.

3. **Removal of the Cotyledons.** The preceding plans may fail and the disease proceed rapidly to the necrosis of the cotyledons. Sometimes this necrosis is very acute, and calls for prompt recognition and handling. We observed especially, in one case, where apparently infection had been carried into the uterine cavity by the operator, while overcoming dystokia, that placental gangrene was well established in about 24 hours. The cotyledons were enormously enlarged, very firm and tense. They were about four times their normal volume. The fetal placentæ could not be detached from the cotyledons, but it was found that the cotyledons themselves were very easily detached from the uterus, and this was not followed by hemorrhage or by any apparent pain.

The cotyledons were, one after another, detached and withdrawn, with the chorion still firmly attached to them. No material hemorrhage followed. The uterus was immediately irrigated with warm water, to which about ¼% of carbolic acid had been added. The cow, which had previously shown all the cardinal symptoms of septicaemia, accompanied by a very high temperature, improved immediately after the operation, and within 24 hours her temperature, appetite, and general condition were normal. She made an uneventful recovery, and in due time again became pregnant.

In other cases of retained placenta in the cow, we have frequently found many or all of the cotyledons lying free within the uterine cavity, still attached to the chorion. Sometimes we have been able to distinguish these enlarged necrotic cotyledons when they were almost ready to drop off, and have removed them with good results. In one case, in a valuable cow which had been neglected, we found the os uteri rather firmly closed. In the uterine cavity lay the entire chorion, with the cotyledons still

firmly attached to it, but sloughed away from the uterine walls. The removal of the cotyledons and chorion, with irrigation of the uterus, was followed by uneventful recovery, without destroying the fertility of the cow.

Because of these experiences with necrosis of the cotyledons, we hold in all those cases where the uterine walls are comparatively sound and the cotyledons have undergone necrosis, that the veterinarian is not only warranted in removing them, but that their removal is clearly indicated as the proper surgical procedure.

Such removal of the cotyledons in the cow is somewhat analogous to the curetting of the placenta in woman. It produces, in proper cases, the same results. It removes the decaying fragments of the fetal membranes and the irrecoverably diseased maternal placenta.

While the decomposing chorionic tufts are incarcerated within the crypts of the cotyledons, and the cotyledons are yet alive but diseased, the diseased surface, from which bacterial poisons may be absorbed, is the superficial area of the mucosa of all the placental crypts. When the cotyledon has been removed, the receptive surface is reduced to the area of the cross section of the cotyledonal stalk—probably less than 1000th part of the area of the placental epithelium.

The collateral handling will vary greatly, according to circumstances. If the patient is not seriously depressed, if she is not straining abnormally, if her temperature and appetite are good, there is no call for general medication. When there are evidences of serious constitutional disturbances, such as fever and weakness, the patient should be supported and strengthened by easily-digested, nutritive foods, if she will take them, to which may be added stimulants and tonics. Alcohol is especially useful, and may be given in large and frequent doses. When symptoms of septicaemia appear, it has been our practice to administer large doses of quinine, and in our experience the results have been good.

Some have practiced and advised the administration of ecbolics such as ergot, savin and rue, but this is opposed by many and the clinical evidence of the value of this group of drugs is not clear.

Others, and with more reason, advise and use carminatives and aromatics internally, such as anise seed, fenugrec, gentian, and camomile, or the gum-resins like camphor and others. They are probably of distinct value as adjuncts to the local handling.

In many cases, great good may come from prompt catharsis, and for this purpose we prefer one of the hypodermic cathartics, such as eserine or arecoline. Owing to the feebleness of the heart, we would administer it in small and repeated doses, combined with strychnine, and continue it until the desired evacuation of the bowels has been brought about. This in itself frequently causes a great reduction of the temperature, and marked improvement of the general symptoms.

The food should be easily digestible. Such highly nutritious food as linseed meal serves an excellent purpose, while roots are also valuable, because of their keeping the bowels more or less freely open.

The prevention of retained afterbirth in the cow is an important problem, which offers hope for success in numerous cases. It is highly important, from the standpoint of prevention, that, in all cases of dystokia attended by a veterinarian, the afterbirth should be removed, if possible, immediately after the removal of the fetus, followed by irrigation of the uterus, bringing about its firm contraction. It is also important that the owners of pregnant animals should keep them in vigorous condition, allowing plenty of exercise, air and light, with an abundance of good digestible food, for some weeks at least prior to parturition.

A very important element in the prevention of retained placenta, and for which the veterinarian is directly responsible, is the question of handling in cases of dystokia. In discussing the general handling of dystokia on page 620, we have already emphasized the value of aseptic precautions in all these operations. It is well to repeat here the duty of the veterinarian to take every possible precaution against carrying infection into the uterine cavity while he is dealing with a case of dystokia. To this end, he needs to follow out carefully the rules which we have already laid down regarding sterilization or disinfection of his clothing, his hands and arms, his instruments, and the exposed parts of the patient.

As soon as fears of placental retention are entertained, the veterinarian can, and should, do much to obviate the disease.

Copious irrigation of the uterine cavity, within a few hours after calving, washes away placental debris, fetal fluids and retained blood clots, stimulates uterine involution, and greatly favors the spontaneous expulsion of the membranes.

The irrigating fluid should be at least as warm as the uterine cavity, but not of appreciably higher temperature, and should be of soft water or softened by the addition of soda bi-carbonate, to which may be added 0.6% of salt.

The irrigation should be begun as early as convenient after calving, and may be repeated every 4 to 6 hours. The irrigation is to be carried out under antiseptic precautions, and very gently. When the horse stomach tube we have advised is used for irrigation, the properly lubricated end can be pushed forward gently, and with some rotary motion, through the vagina and into the uterine cavity, usually without inserting the hand, thus avoiding the manual introduction of infection. The tube is rigid enough to be reasonably subject to external direction, and pliable enough to obviate any danger of wounding the genital tract.

The prognosis of retained placenta is exceedingly variable, but must always be cautious. Whenever the afterbirth can be completely removed manually within 24-48 hours after calving, the prognosis is highly favorable. It must, however, depend upon the state of the uterus itself, and upon the general vigor of the animal. If the uterus is highly inflamed and paretic, the outlook is always serious.

In our experience, the most serious cases have usually been those where some party has unsuccessfully attempted to remove the membranes, and has merely succeeded in tearing away the major portion of the chorion, leaving many of the fetal placentæ still firmly attached to the cotyledons, and naturally leaving many of the cotyledons themselves more or less seriously injured. When this has been done, and severe straining follows, accompanied by a high temperature and loss of appetite, we have found the disease highly fatal. On the other hand, the uterine walls may be very intensely inflamed, firm, paretic, and yet recovery occur. Pomayer has emphasized the value, in this disease, of the degree of leucocytosis in the uterine walls. It is, he says, the number of leucocytes which exist in the uterine walls, or

which may be attracted to them, which brings about recovery. If the infection of the cotyledons and of the uterine walls is of such a character as to destroy the leucocytes, recovery cannot occur.

2. Retained Placenta in the Mare.

Retention of the placenta is much less frequent in the mare than in the cow. Clinically, retention of the placenta in the mare is divisible into two separate forms, total and fragmentary.

Total retention of the fetal membranes in the mare corresponds in a measure to the disease in the cow. It is, however, very rare, not only as related to placental retention in other animals, but also as compared with the fragmental retention in this animal.

The rarity of placental retention in the mare is explained upon various hypotheses. Most significant, perhaps, is the comparative simplicity of the chorionic tufts, so that any swelling of the uterine mucosa does not tend materially to incarcerate them and hold the chorion. It bears another important difference when compared with ruminants; the placenta is diffuse. The chorion is thick, rigid, not readily compressible. When involution of the uterus occurs, the area of attachment in the uterine mucosa rapidly decreases, while the opposing chorionic attachments are not subject to like diminution in area and are consequently detached. The placentæ of sheep and goats are essentially as intriate as those of the cow, and are upon the same general plan, but retention of the fetal membranes in these is very rare as compared with the cow. According to our observations also the disease is less common in the ewe than in the mare. Hence the arrangement of the placental structures does not wholly control the probability of retention.

The causes of total placental retention in the mare are analogous to those already mentioned in the cow, such as placentitis as an accompaniment of contagious abortion, and fatigue of the uterine walls during difficult labor, followed by infection.

The symptoms of total placental retention in the mare usually consist merely of the visible protrusion from the vulva of the umbilic cord and portions of the chorion. There is rarely any straining. If neglected, and infection occurs, as it does very quickly, a diffuse endometritis quickly follows, the chorion usu-

ally sloughs away, the uterine walls become paretic, voluminous excretions into the uterine cavity occur, and the cavity of the organ is soon occupied by two to five or more gallons of a dirty grayish, flocculent, stinking semi-fluid mass. Following closely upon these changes, perhaps even noted first, parturient laminitis occurs.

The handling of total retained placenta in the mare consists of the manual removal, and should be undertaken at the earliest convenient time subsequent to parturition. In cases of dystokia, the veterinarian should remove the membranes as soon after delivery has been completed as possible, allowing merely a few minutes for the animal to recover from her exhaustion.

In removing the afterbirth of the mare it is to be remembered that ordinarily the chorion comes away everted, but when we desire to remove it artificially it should be done right side out. First the veterinarian needs locate the margins of the rupture in the chorion through which the fetus has been expelled. Necessarily this margin is detached for some distance from the torn border.

Secure the torn border and carefully draw it out through the vulva. Insert the open hand or clenched fist between the chorion and uterine wall, and, while exerting enough traction upon the ruptured margins to keep the chorion tense, gently and cautiously push the hand along between the chorion and uterine wall. The process should be carried out almost equally around the entire circumference of the uterus, and the chorion gradually detached until the coruna are reached and included.

In many cases of retention in the mare, it is not actually needful to insert the hand into the uterus. If the protruding chorion be carefully grasped, folds of it picked up first here and then there, and gentle traction exerted upon each area by turn, it will soon be found that drawing upon a given part of the chorionic sac causes dehiscence of the placenta and distinct advance is made. Section after section is cautiously tested, and gradually the entire chorion comes away with the placental side outward.

If there has been no infection, if the operator has not inserted his hand, nothing further is demanded.

If there is infection in the uterus or if the operator has inserted his hand, the uterus should be well irrigated with tepid water to which 0.5% carbolic acid may be added. This should be repeated as frequently as conditions demand.

Fragmentary placental retention is in a way peculiar to the mare. It consists in the accidental transverse rupture of the chorion of the non-gravid cornu, followed by the chorionic mass from the gravid cornu and uterine body coming away, and leaving behind the small isolated fragment in the non-gravid horn.

This fragment is usually 8 to 12 inches in length, and its lumen sufficiently large to admit of the insertion of a man's hand into its cavity.

The cause of this retention is not far to seek. The chorionic mass of the mare is very heavy, and she usually stands while the membranes are being expelled. The non-gravid cornu is last to expel its membranes, so that, before the chorion in the non-gravid cornu becomes detached, it must support the weight of the remainder of the membranous mass. At this time the greater mass of the chorion hangs outside the vulva, and the umbilic cord drags upon the ground, where it may be stepped upon and the attached area of chorion torn off. Possibly the cord is still intact and the foal, in trying to rise, may partly do so and fall, giving a violent pull upon the cord, which is promptly transmitted to the still attached strip of chorion in the non-gravid cornu, and causes it to give way.

Once this fragment becomes separated, the narrow horn has little or no expulsive power and the mechanical assistance ordinarily afforded through the weight of the other portions of the chorion is wanting.

Infection of the isolated fragment quickly follows. In two to five days the chorionic fragment has become well decomposed, the uterine wall has become inflamed, the abdomen is very tender upon pressure, the infection has spread throughout the uterus (purulent endometritis), extensive purulent collections have occurred in the uterine cavity, the uterine walls are thick, hard and paretic, and parturient laminitis is present.

At about this time, if the veterinarian will carefully explore the uterine cavity he will be able to recognize by touch the retained segment of chorion, somewhat loosened and readily detached, putrid, fragile and extremely fetid. He will not always find the piece as it may have sloughed away and passed out. In one such case, as we approached the recumbent patient, she suddenly sprang to her feet. As she did so, there came a gush of pus from the vulva, in which was the tell-tale fragment of chorion.

The handling consists fundamentally of a careful search for, and removal of, the retained chorionic fragment, followed by the proper handling of the resulting endometritis and laminitis. These we shall discuss later.

This type of retention is subject to preventive measures. The veterinarian, when attending a mare in labor, or removing the fetal membranes when completely retained, should always carefully note whether the two horns of the chorion are complete. If not, the missing apex should at once be removed and the uterine cavity well irrigated.

3. Retained Placenta in the Smaller Animals.

The smaller domestic animals do not suffer so frequently from retained placenta as do the cow and mare. The ewe and goat with cotyledonal placenta suffer occasionally. The sow and carnivora suffer but rarely from retention. De Bruin records tetanus infection in the ewe as a result of placental retention. Generally the disease in the ewe has about the same danger as in the cow. The sow withstands the disease well.

The handling is somewhat similar to that in the cow. If the genital canal is large enough to admit of the insertion of the operator's hand, manual removal may be carried out as in the cow. Otherwise the uterine cavity is to be irrigated with warm normal salt solution, thus mechanically cleansing the organ, stimulating normal involution of the uterus and increasing presumably the number of leucocytes in the uterine walls. De Bruin condemns the use of antiseptics in these cases.

Should chronic metritis, with chronic vaginal discharge or with vaginal prolapse, follow, hysterectomy, page 669, may be indicated in the sow and carnivora.

II. WOUNDS AND INJURIES TO THE GENITAL AND NEIGHBORING ORGANS.

Post-partum Hemorrhage.

Post-partum hemorrhage is comparatively rare in domestic animals, and occurs chiefly in the larger species. In woman hemorrhage following childbirth is very common as a result of the highly developed and vascular placenta, but in domestic animals, in which there are generally more or less diffuse placentæ of the disseminated or cotyledonous form, the conditions are such that we rarely observe spontaneous placental hemorrhage. In fact we have no definite records to show that serious placental hemorrhage proper, occurs in animals, although slight hemorrhage from the placenta is quite commonly observed in the mare and cow, and to a lesser degree in other domestic animals.

The hemorrhages which occur during or immediately subsequent to parturition in domestic animals are generally due to traumatic injury which is more or less independent of the placenta, although it may naturally involve that structure. We have already had occasion to mention, on page 457, that in rare instances uterine hemorrhage occurs during gestation and may with extreme rarity prove serious.

During the act of giving birth to young, serious and fatal hemorrhage is not exceedingly rare, especially in the mare, as a result of a rupture of the uterine walls involving some of the great vessels of the organ. Necessarily in the mare it involves in the lesion the placenta itself, since this is distributed over the entire organ. After the expulsion of the fetus, whether in the mare or the cow, there frequently follows immediately a considerable discharge of blood, which may be placental in origin, but which is more probably due to the rupture of uterine vessels of considerable size. The point of origin and the exact character of such a hemorrhage is very rarely determined.

After the fetus has been expelled, the rude removal of the fetal membranes by laymen or empirics frequently induces profuse hemorrhage, which may even end fatally. In the mare, if the chorion is very firmly adherent to the uterus and violence is used to bring about separation, the mucosa may be wounded to such a degree as to cause profuse hemorrhage. In some cases of re-

tention it is impracticable to separate the envelopes at once because of hemorrhage due to the uterine injuries. In the cow, when the placenta is retained and involution of the uterus has not yet occurred, and the layman or empiric attempts to detach the membrane, profuse and fatal hemorrhage is liable to result, which is greatly accentuated when the cotyledons are rudely torn away from the uterus.

In one instance observed by us, an empiric attempted to remove the membranes from a cow immediately after calving, and, by tearing them away, brought on a hemorrhage which proved fatal to the patient in the course of a few hours. When we were called, the entire uterine cavity was filled with a great mass of blood ; much blood had already escaped from the vulva ; the cow was down, and unable to rise ; the mucous membranes were blanched ; the animal was pulseless, and in a dying condition. In the mare we have observed fatal hemorrhage as a result of ruptures during difficult labor.

Hemorrhage from the uterus occurs also in cases of prolapse or inversion, and usually of two types. There may be a general capillary hemorrhage from the entire mucous surface, or rather from the placental surfaces of the uterus, and there may also occur hemorrhage from wounds of the uterine walls or placentæ involving large vessels.

Symptoms. Generally there is an escape of blood from the vulva. The blood may, however, be largely retained within the uterus, and coagulate promptly. In case of rupture of the uterine walls, and especially of the uterine floor, when involving large vessels, a profuse and even fatal hemorrhage may occur into the peritoneal cavity, without any appreciable amount of blood escaping from the vulva. In these instances of intra-uterine or intra-peritoneal hemorrhage, the symptoms, in general, are those of internal hemorrhage, such as the blanching of the mucous membranes, weakness of the animal, pain, anxiety and sweating. Death frequently follows quickly. The diagnosis must be made by these symptoms, in conjunction with a manual exploration of the uterine cavity.

The indications in uterine hemmorrhage will depend largely upon the cause and origin. When due to extensive wounds of the uterine walls, involving the large vessels, and the uterus is in position, it is well-nigh beyond the obstetrist's control, though

it might be possible in some cases to secure the wounded vessel if it could be identified. In the milder forms of hemorrhage, where the quantity of blood is not great, it may not be necessary or even advisable to interfere, especially if the uterine cavity is in an aseptic condition. When the hemorrhage is dependent upon a want of involution, contraction should be encouraged by such means as we have at command.

If the organ is intact, we may hasten involution by the injection into it of a tepid solution of an antiseptic or a normal salt solution, or we may attempt to favor involution by the administration of ergot or of stimulants. It may be also that the involution can be hastened in some cases by the introduction of cold water or of ice into the uterine cavity, and at the same time the hemorrhage somewhat checked by the cold.

In hemorrhage from the prolapsed uterus, we can not hope to check that of a capillary character except by the reposition of the organ; while that from any torn vessels of importance can be readily controlled with the aid of forceps or by ligation or other means in common use. Digital compression, applied for some time, may bring success.

When a quantity of blood has accumulated in the uterus and coagulated, it should be promptly removed and means applied to cause uterine involution.

2. Rupture of the Uterus and Vagina.

In all domestic animals, rupture of the uterus or vagina is liable to occur at any time during labor, and especially toward the close of the act, as the fetus is being forced along the genital passages. The organs are again subject to rupture because of their prolapse or eversion of the organs.

The accident occurs in a great variety of ways. Frequently it occurs through the projection of some part or extremity of the fetus in an improper direction, so that it is forced through the wall of the organ because of a concentration of pressure upon a small area. Ruptures from this cause naturally occur most frequently in the mare and cow, where the fetus has long and rigid extremities, which are capable of inducing great injury when they become misdirected.

In transverse presentations in the mare, when version is attempted without embryotomy, there is always danger of an

extremity becoming so misdirected that, during the expulsive efforts of the mother, it may be forced through the uterine wall and bring about a perforating wound of the peritoneal cavity.

In the anterior presentation, with the two posterior limbs extended beneath the body of the fetus and lodged just in front of the pubic brim upon the uterine floor, the forcing of the fetus into the passage brings about a great concentration of pressure upon the uterine floor by the feet. The croup and thighs are rigidly and firmly pressed against the sacrum and lumbar vertebræ, while the extended limbs are forced, under enormous pressure, downward and forward against the floor of the uterus. Such pressure is constantly liable to cause the toes of the fetus to force their way through the uterine floor.

When the fetus presents anteriorly in the dorso-sacral position, with a foot crossed over the head, or a foot misdirected upward from other causes, the misplaced extremity tends constantly to push upward and force its way through the roof of the vagina. So with other misdirections of the anterior or posterior extremities.

In the bicornual development of the fetus, as already described on page 716, extensive and fatal rupture of the uterus is very liable to occur when traction is applied in order to bring about delivery.

In torsion of the uterus, as already related on page 704, transverse rupture is a common result of the displacement, and follows regularly when the torsion has acquired an extreme degree.

A further and not rare cause of uterine rupture is the attempt of the veterinarian to force a fetus through a constricted passage, or a fetus which is too large or presents improperly through a normal passage. In discussing the question of atresia or induration of the cervex uteri, we related an experience in which, in a heifer, we attempted to force the fetus, normal in size and position, through a very narrow cervical canal, with the result that we ruptured the cervix for its entire length.

Another, and highly important, way by which rupture of the uterus may be caused during traction consists in tearing and rupturing the walls of the organ by forcing it against some projecting portion of the pelvis, as already described on page 676. We meet occasionally in the mare and cow with projections or eminences upon the pelvic inlet, which assume such a form that, if

the uterine wall is forced against them, it is liable to become seriously injured or even punctured. In some instances there occurs, first, severe maiming or contusion of the organ, of such a character that its vitality is destroyed over a small area, the devitalized area becomes infected, and eventually a small slough takes place, which establishes a communication between the uterine and peritoneal cavities.

In other cases, when forced extraction is attempted with a fetus in an improper position, such as a deviation of the head, the uterine wall may be caught by some projecting portion of the fetus, and dragged along in such a way that it doubles upon itself and thus tends to bring about its rupture.

Of all the ruptures of the uterus, the most embarrassing and unfortunate are those which are brought about by improper manipulation or accident upon the part of the obstetrist himself or through the meddling of laymen or empirics. In discussing the general subject of obstetric work upon page 623, we have already suggested that it is to the professional and legal interests of the veterinary obstetrist to examine very carefully each case of dystokia to which he is called, and determine whether or not the animal has been subjected to injurious meddling before his arrival, and discover, if possible, any important injuries which may have taken place, before he attempts to handle the case.

Again, in discussing the method or plan for overcoming dystokia or accomplishing obstetric work, we have urged on page 630 that the veterinarian should always use care and judgment and that he should especially husband his strength to conserve his efficiency. In one instance, in our own practice, we had labored long and ineffectively to correct a lateral deviation of the head, in a case of wry-neck, when we should at once have resorted to embryotomy. Finally, after becoming exhausted, we made an attempt to secure the head by means of a long, blunt hook, and in our exhausted condition failed to properly control the direction of the instrument, caught it in the uterine wall and tore a large opening, which at once demanded the destruction of the patient.

Sometimes, in cases of prolapse of the uterus, the animal gets the prolapsed organ caught upon obstacles of various kinds and, dragging upon it, brings about a more or less serious rupture. It is not very rare for the prolapsed uterus to be torn and lace-

rated by other animals. Especially is this true of the cow when she suffers from eversion of the uterus in an enclosure where swine can get to her, as these animals at once pounce upon the prolapsed organ and begin to devour it, if it is within reach. In one case cited by Fleming, almost the entire organ had been devoured. Just as the condition was discovered the cow got up, and the remnant of the organ suddenly returned to its place. The animal recovered.

At the normal time for parturition, or when abortion occurs, the uterus may become ruptured from emphysema of the fetus, or rupture may follow dropsy of the amnion.

The symptoms of rupture of the uterus are perfectly obvious in the prolapsed organ. When the organ in its normal position becomes ruptured, the symptoms will vary according to the position and extent of the rupture, the degree of hemorrhage, and the character and volume of substances which may escape from the uterine, into the peritoneal cavity. If the rupture is very extensive, and a large amount of liquids, especially if infected, escape into the peritoneal cavity, there is at once a profound collapse, under which the animal is liable to die very suddenly. If the rupture is extensive, and immediately after the extraction of the fetus the veterinarian is so unfortunate as to inject into the uterine cavity a large volume of antiseptics for the purpose of irrigating the organ, and these escape instead into the peritoneal cavity, the collapse is sudden and death may ensue in the course of an hour or two.

When the rupture involves the division of voluminous blood vessels, the chief symptoms may be due to the hemorrhage, as already described in the preceding chapter. If the rupture occurs in the roof of the organ, or so high along the sides that it does not cause the escape of large volumes of liquids into the peritoneal cavity, there may be no symptoms presented at first, and it may pass undiscovered except through the medium of manual exploration. Later, infection may gain admission into the peritoneal cavity, through the rupture, and bring about a septic peritonitis, with all the symptoms of that disease.

When the rupture is very small and amounts to a mere perforation, or when a small area of the organ is so contused that it looses its vitality to later become necrotic, and the peritoneal cavity becomes secondarily opened, the definite symptoms, septic

peritonitis and its accompaniments, are slow to become established. It may be several days after parturition before they become apparent, and the definite diagnosis may be made only upon post-mortem examination.

In one instance occurring in our clinic, the owner of a mare had inhumanly drawn away a foal while the head was completely deviated to the side, and, in doing so, had caused a complete rupture of the perineum. When the mare was presented at our clinic because of this injury, the afterbirth was still retained. This was removed, and the ruptured perineum was regularly cleansed and disinfected. Although we had examined the uterus carefully, we had failed to find any injury of its walls, and concluded that we had only to deal with the retained placenta and the ruptured perineum, but we were in error. The mare perished three days after entrance into our clinic, under symptoms of septic peritonitis. Upon post-mortem examination there was revealed a small rupture of the uterus along the floor, just anterior to the pubic brim and located upon the median line. The opening was barely sufficient to admit the passage of a pencil; its edges were necrotic; and it could not be determined from its appearance whether the rupture had been direct or complete at the time of the dystokia or whether it had first consisted of a contusion, which had been later followed by gangrene and a sloughing of the uterine floor. Most probably it had at first consisted of a contusion, the result of impingement of a uterine fold between the fetus and a bony prominence of the maternal pelvis, during the inhuman forced extraction.

In another instance occuring in our clinic, some stablemen had delivered a cow without any antiseptic or other reasonable precautions, and the delivery was followed by retention of the placenta. Though we removed this carefully and, as we believed, judiciously, the cow exhibited the general symptoms of peritonitis, to which she succumbed. A post-mortem examination revealed a small perforation of the uterine floor, just in front of the pubic brim, in the same position essentially as in the preceding case of the mare.

Again it was impossible to determine if the perforation was immediate or secondary. In each case we were criticised because of the death of the patient.

These cases suggest the importance of care in examining the

uterus in all instances where there has possibly been tampering before the veterinarian has been called, and should clearly impress the practitioner with the importance of using all due precautions in any manipulations which he undertakes. It must be evident to him that, when he is attempting to adjust a retained foot, he should be very careful not to bring excessive pressure upon this point of danger at the pubic brim, because of the constant possibility of causing a small perforation of the uterine floor. We have suggested that, in the extension of a foot which has been retained, the operator should always grasp the toe in the palm of his hand, and cause it to glide over the pubic brim without coming in contact with the uterine floor. This point is highly important, not only because it actually facilitates the operation, but also because it affords a highly necessary security against serious or fatal injury to the organ.

The handling of rupture of the uterus must be adapted to each individual case. When the uterus is in position, it is rarely possible to close a rupture by means of sutures or otherwise. It should always be remembered that the involution of the uterus brings about a great decrease in the size of a rupture in its walls.

When the organ is prolapsed and ruptured, it is comparatively simple to close the opening by means of sutures under proper aseptic precautions. The sutures should be of silk, and of the intestinal type, that is, the peritoneal surfaces should be brought in contact with each other while the wound margins project into the uterine cavity. When the rupture is in the roof of the uterus or well up on its side, there is always a possibility of spontaneous recovery, and every opportunity should be allowed for its occurrence.

In all cases of uterine rupture it is clearly inadvisable to inject liquid antiseptics or other fluids into the uterus, and take the risk of their escaping into the peritoneal cavity. If it is essential to remove blood clots, fetal envelopes or disease excretions, this should be accomplished without irrigating the organ. The operator may largely remove these with the hand, which can be used somewhat as a scoop, and the cleansing may be completed by means of a piece of gauze saturated with an antiseptic.

Rarely it may be practicable to grasp a ruptured uterus, and by traction, with the patient under general anaesthesia, draw

the ruptured part out through the vulva, where the injury may be properly sutured.

When the ruptured organ is prolapsed, and the rupture is so extensive that recovery is very doubtful, the organ should be amputated, which operation is described under "Eversion of the Uterus."

3. Rupture of the Bladder.

Rupture of the bladder during parturition is a very rare accident. Fleming cites two cases, one by Furnivall (Veterinarian, Vol. 33, page 377), in which a mare died very quickly after the expulsion of the fetus, and a post-mortem examination revealed nothing pathologic except rupture of the bladder. In the other, recorded by Overed, the mare was not seriously unwell after foaling, but it was noted that she urinated more frequently than usual and the act was accompanied by pain. However, she was well enough that she was bred to a stallion on the 9th day, and it was only after four weeks had elapsed that Overed was called to examine the animal. She later died under symptoms of peritonitis, and, upon opening the abdomen, a large quantity of fluid, said to be about 12 gallons, escaped, which was supposed to be urine. Diffuse peritonitis was present, and a rupture existed in the bladder, which communicated with the peritoneal cavity. It was assumed that the fundus of the bladder was injured during parturition, and that it later sloughed through.

4. Rupture of Intestines.

In rare instances, rupture of the intestines may occur during parturition, either because they are over-filled or weakened at the time, or because an intestinal loop becomes engaged between the pelvic inlet and an unyielding portion of the fetus as it advances along the birth canal. Fleming cites Schaack as having observed one instance of a rupture of the intestine by its becoming compressed between the fetus and the pelvic bones.

The symptoms of such an injury, especially in the mare, would be those common to rupture of the intestine, and would consist chiefly of collapse, with very feeble or indistinguishable pulse, trembling, and cold sweats. It is well-nigh impossible to make a positive diagnosis of this condition during the life of the animal, and it can merely be suspected from the general symptoms. It is not possible to apply any effective method of treatment.

5. Rupture of the Diaphragm.

It has been claimed that rupture of the diaphragm occurs rarely as a complication or accident of parturition, in some cases of dropsy of the amnion or allantois, or from other causes which may induce extraordinary weight or volume of the gravid uterus. The few cases which are recorded are not very significant, and exhibit no definite symptoms by which the accident is to be diagnosed.

The diagnosis has been made post-mortem. It is quite possible that some of the cases diagnosed as rupture of the diaphragm as a parturient accident may have been post-mortem lesions, such as frequently occur an hour or two after death.

7. Rupture of the Sacro-Sciatic Ligaments.

Fleming cites one case of rupture of the sacro-sciatic ligaments in the mare, during the expulsion of the fetus, but the symptoms which he relates are very vague in so far as establishing the character of the alleged injury is concerned. A filly was unable to rise after parturition, and an examination led the attending veterinarian, Naylor, to conclude that the sacro-sciatic ligament had been ruptured. We fail to see how a rupture of the sacro-sciatic ligaments could prevent an animal from rising or standing, or why the rupture should have caused an extreme atrophy of the muscles of the affected hip, as was recorded in this case. The symptoms recorded point rather to an injury of the gluteal nerves, to which we shall refer later.

8. Prolapse of the Intestine through the Ruptured Walls of the Uterus or Vagina.

When a perforating wound or rupture of the walls of the uterus or vagina occurs at any point, it is possible for a protrusion of the intestines to follow. This prolapse, however, does not ordinarily follow when a wound is made through the walls of the vagina or uterus in the non-pregnant animal. The prolapse is probable only in those cases where there is violent straining, as seen in parturition or immediately following it. In spaying the mare or cow through the vagina, though the veterinarian habitually makes a more or less extensive wound, large enough in the mare to admit the entire hand, there is virtually no danger of

the protrusion of the intestine. In uterine or vaginal rupture in difficult parturition, where the intra-abdominal pressure is enormously increased by the straining, a portion of the intestine frequently passes into the uterus or vagina, and finally beyond the vulva.

We have already noted that in some cases a rupture of the uterus is caused by the meddling of empirics, by whom some rude instrument is used, and that through this rupture the intestines protrude, if the fetus is prevented from escaping. In one instance which we observed, an effort had been made to catch some portion of the fetus by means of a hooked stick, and in so doing a large rent had been caused in the wall of the vagina. The fetus was retained within the uterine cavity because of bad position. The expulsive efforts of the mare forced the floating colon through the rent in the vagina, so that upon my arrival the intestine had protruded beyond the vulva so far that it dragged upon the ground.

The indications usually are to at once destroy the patient, since the prognosis must necessarily be extremely bad. The protrusion generally occurs before the expulsion of the fetus, and it then becomes almost impossible to extract the fetus without incidental injury to the intestine and infection of the peritoneal cavity. If it be possible to return the intestines with hope of saving the life of the patient, this should be done, and measures taken to keep the intestines out of the way until the fetus has passed beyond the point of injury. After the fetus has been removed, it may in some cases be possible to suture the wound in the uterus or vagina in order to guard against further prolapse and decrease the danger of infection.

9. Prolapse of the Bladder through a Rupture in the Floor of the Vagina.

When the floor of the vagina becomes ruptured during parturition, there is a somewhat remote possibility that the urinary bladder may be forced out through this rupture and extend into the vagina or vulva. Necessarily such a prolapse involves the bending of the organ upon itself to an extent which tends to cause an obstruction to the passage of urine through the urethra, and thereby favors an accumulation of urine in the bladder. The accident is an exceedingly rare one, and has occurred only with sufficient frequency to establish the possibility.

The symptoms consist of the presence of the prolapsed organ in the vagina or vulva, with its fundus turned backward toward the vulvar opening, or protruding through it, according to the degree of distension. The organ is right side out, and shows the peritoneum upon its surface. A careful examination of the floor of the vagina will reveal the presence of a rupture, through which the organ protrudes. In the mare or cow, a further test of the character of the injury may be made by inserting a finger into the urethra and passing it along that canal until it turns upward, to reappear again in the vagina inside the prolapsed organ.

The indications in such cases are to return the bladder to its proper position, under aseptic precautions, and suture the wound in the floor of the vagina, bringing the peritoneal surfaces of the vagina in contact. If the bladder should be so greatly distended that it is exceedingly difficult or impossible to return it through the rupture, the urine may be drawn off by passing a small trocar or hypodermic needle into the distended organ and allowing the urine to escape.

10. Eversion of the Uterus. Inversion of the Uterus. Uterine Prolapse.

Eversion or prolapse of the uterus is a common and formidable obstetric accident, especially liable to occur in cows, chiefly in those which are largely confined in stables for dairying purposes. It is possible in any domestic animal, though not common in the smaller species.

The accident consists at first of an invagination of the anterior extremity of a cornu into the succeeding portion, essentially in the same manner as intussusception of an intestine. Should the invagination continue, the invaginated portion finally appears at the vulva, and, passing beyond, constitutes a prolapse or evagination. When the eversion becomes complete, there is necessarily involved with it a prolapse of the vagina as well. In the incomplete forms, and in the beginning of the displacement, there exists merely an intussusception or invagination of one of the horns to a limited degree, and it is only by the extension of this that the accident becomes complete. In uniparious animals, only the gravid cornu becomes everted, but the non-gravid cornu is prolapsed along with the everted gravid one, hidden from view and recognizable only as a diverticulum extending inwards.

In multipara but one horn is usually involved, because its prolapse through the body of the uterus prevents the other horn from becoming everted.

Symptoms. The inversion usually begins in one of the cornua, whether in a uniparous or a multiparous animal. When the displacement has proceeded to only a very limited degree, the chief symptom observed is that of expulsive efforts, which differ very little, except in intensity, from those of parturition. There is more or less uneasiness on the part of the animal, with some symptoms of colic, as shown by kicking at the belly and looking toward the side. These, combined with expulsive efforts, should direct attention at once to the uterus.

In the larger domestic animals, where the uterus can be readily examined with the hand, a careful search at this stage will reveal the gravid cornu occluded at some point in its length by a rather hard projection into its canal. Upon examining this projection it will be found that there is an opening in its center, and also that the fingers may be passed around between the tumor and the direct wall of the cornu. A further study of the conditions present will show the obstetrist that he is dealing with a beginning inversion of the cornu.

If measures are not at once taken to remedy the displacement, the constant tendency is for the intussusception to extend toward and involve the body of the uterus and the vagina, and later appear at the vulva, to soon pass beyond and project as a large bleeding mass. The prolapsed uterus is characteristic in appearance, and should not be mistaken for any other organ. It may still be covered by retained fetal membranes, which should be readily distinguished. In ruminants the cotyledons are very conspicuous, and serve to fully reveal the character of the accident.

In the mare the mucous surface of the uterus has a dark red, velvety appearance, and is studded thickly over with the placental villi. To the inexperienced, the appearance of the chorion may cause confusion between this membrane and the mucous surface of the uterus. They are well-nigh identical in their general appearance, and can be distinguished only by a careful examination. Especially is this true when the chorion is being expelled right side out, instead of being everted, as usual, during its expulsion.

In all cases, a careful examination reveals the exact character of the accident, by the fact that the protruding organ is continuous with the vulva and vagina. When the eversion is extensive and complete, it forms a characteristic tumor, varying in its appearance somewhat according to species. In the mare and cow it constitutes an immense pear-shaped tumor, which, when the animal is standing, hangs down to the neighborhood of the tarsus. The mucous surface has become external, and capillary hemorrhage occurs upon its surface. Litter and other foreign substances may be adherent to its exterior.

If the eversion has existed for a considerable period of time, the organ becomes dark, and occasionally covered with an exudate, or, if it is of very long standing, with pus. It may be badly torn and abraded, or even gangrenous.

The position of the uterus causes an intense mechanical congestion and an enormous increase in size.

The general symptoms are by no means uniform, and one will occasionally observe a cow, with her uterus quite completely prolapsed, grazing or ruminating almost as though nothing had occurred. In some instances the condition produces such debility that the animal is unable to rise ; or perhaps in more cases it might be said that prolapse of the uterus frequently occurs in animals which are so weak that this additional disturbance weakens them to such a degree that they can no longer rise. In other cases the animal is recumbent because the displacement constitutes one of the symptoms of parturient paresis, and not because of the presence of the prolapsed organ. When gangrene of the organ occurs, the extreme debility and collapse from the septicaemia may bring about a paralysis which prevents the animal from standing.

The symptoms may be modified and complicated by the relations of neighboring organs, which tend also to become displaced. The vagina has necessarily been involved in each case of complete prolapse, and even the vulva is involved to a degree because of the great weight of the protruding organ dragging upon it, so that in many cases in the mare or cow, if the hand is inserted into the vulva, it can scarcely reach the boundary line of the vagina until it comes in contact with the recurved wall of the prolapsed organ. Naturally the bladder and rectum are more

or less displaced, and tend to be drawn into the pelvic canal, to occupy a position somewhat in the center of that cavity, and the urethra becomes doubled upon itself in such a way as to interfere with the escape of urine, while inside the uterus one or more loops of the intestine may extend down to the fundus of the prolapsed organ.

We have already referred, on page 816, to the danger of rupture of the prolapsed uterus in various ways.

The interference with the circulation in the organ, and the irritation of the atmospheric air, constantly accentuate the tendency to congestion and inflammation of the organ, while its denuded surface offers an excellent avenue for the introduction of infection. Thus we may observe uterine prolapse ending in gangrene, abscesses or tetanus. The usual form of infection which supervenes upon this exposure is that of metritis. Fleming, citing Funk, records an instance where, in the bitch, the prolapse of one cornu prevented the expulsion of fetuses which still remained in the other horn, necessitating Caesarian section for their removal.

The prognosis of prolapse of the uterus is exceedingly variable, and must always be highly unfavorable except artificial assistance is given, since there is no possibility of spontaneous reduction. Fleming cites one case in a cow in which the organ was devoured by pigs, after which she recovered. Generally speaking, death is inevitable, unless the case has judicious attention. Even then the mortality is high. The rapidity with which death occurs will vary according to circumstances and complications. In ordinary cases the animal may live for several days, while in special instances, as in parturient paresis in the cow, death may ensue within a very few hours, rather because of the paresis than of the prolapse.

The prognosis depends very largely upon the promptness with which competent assistance is given. It is always unfavorable in neglected cases, and very much more favorable where prompt attention is given.

The prognosis is very greatly influenced by species, being very much more favorable in the cow than in the mare. Fleming, citing Deneubourg, states that in an extensive experience he had not lost a case; and the same author cites Moens as having had 27 cases without a fatality. Other writers have lost

as high as 25 to 30% of cases in the cow. The statistics regarding fatalities in this accident are not reliable because, like in too many other instances, there is a tendency for veterinarians to record their successful experiences and remain silent regarding those where the termination has proven fatal. In the mare the accident is highly fatal. Saint-Cyr, from statistics given, records a mortality of 74%, and Zundel of 50%. These figures are probably misleading, due to the fact that the successful and not the fatal cases have been recorded.

In our own experience, prolapse of the uterus in the mare has been very rare. One or two instances occurred where the prolapse appeared immediately upon the expulsion of the fetus, when the mare was in a dying condition, and where death followed within a few minutes. In only one instance, in the mare, did prolapse of the uterus occur in such a way as to call for definite treatment, and this animal survived. She was unable to stand after the reduction of the prolapse, and required slings. Before she had become strong enough to warrant our removing these, tetanus set in, and the slings were retained until she recovered from that disease.

Repeatedly after dystokia we have recognized a beginning inversion of the gravid cornu in the mare. Having given it immediate attention, we have been able to promptly correct the position of the organ, and the animal remained well. However we cannot count these as cases of prolapse, but simply as beginning cases, in which a certain degree of inversion had occurred.

In the cow our experience on the whole has been unfavorable, because we have encountered a number of cases of this accident as a complication of parturient paresis, in which it has proven universally fatal. In other instances the results have been more satisfactory, with recovery in more than 80% of cases. In the smaller animals, inversion of the uterus is highly unfavorable, in so far as replacement is concerned, but they very largely recover after amputation of the organ.

The relation of prolapse of the uterus to the breeding of the animal has not been very carefully studied. As a general rule, if the organ is promptly returned it seems to have little or no influence upon the fecundity of the patient so far as has been observed.

Once the accident has occurred, its recurrence is probable at the next parturition, and when such animals are rebred they should be watched the next time they give birth to young.

Causes. Prolapse of the uterus has been attributed to a variety of causes. The accident necessarily demands the presence of a freely dilated os uteri, and consequently occurs very soon after parturition. It frequently appears immediately after the expulsion of the fetus, in both the cow and the mare. In some instances in the mare, the organ has followed the fetus, and has required immediate replacement. In these instances it seems that the closely investing uterine walls adhere more or less to the fetal body, and tend to be dragged out with it, so that, as the last portion of the fetus escapes from the vulva, the uterus, apparently adherent to it, follows immediately. In other cases in our experience, the foundation for the later prolapse is apparently laid at the time of the act of birth, by the apex of the gravid cornua becoming inverted. We suspect that many of the cases of inversion of the uterus have their foundation in such accident at the time of the expulsion of the fetus, and that, if the uterus were carefully examined at the time, the beginning of what is later to constitute a prolapse would be found, though the prolapse itself may not be complete until after one or more days. Exhaustion of the contractile powers of the uterus, and the expulsion of the fetus wholly through contraction of the abdominal walls, or with traction, tend to produce the prolapse.

Aside from a derangement in the contractile power of the organ, by which a partial intussusception occurs in the gravid cornu, a very prominent cause is tardy involution of the uterus, with failure of the cervix to contract, consequently leaving the organ more or less open and flaccid.

A further cause of prolapse of the uterus is the presence of an irritant in the body of the organ, such as infection or retained placenta, each of which may cause expulsive efforts, and at the same time may delay a proper involution of the organ.

Closely allied to tardy involution is the question of the comparative amplitude of the genital passages in the so-called roomy animal, and especially one of a more or less phlegmatic temperament. In this relation we find general influences at work, such as close confinement with overfeeding, which is so often seen in

dairy stables, where the accident is far more common than in the field. In our experience, among cows which are kept for raising beef cattle and constantly run at large, the accident is almost never seen.

Anatomical peculiarities exert some influence upon the probability of inversion of the uterus. We have already related, on page 29, that the broad ligaments of the uterus of the cow are attached to the abdominal walls more posteriorly than those of the mare, and hence the uterus is not held so far forward in the peritoneal cavity. When pregnancy occurs, the broad ligaments become greatly amplified, and when parturition occurs these bands are so greatly elongated that the uterus can readily become prolapsed, so far as these attachments are concerned, without their becoming ruptured or even very greatly stretched. In spaying the non-pregnant cow we can draw the ovary very nearly to the vulva. From this standpoint, the cow is more liable to prolapse than is the mare. On the other hand, the cervix of the uterus in the cow is more narrow and contracts more promptly than that of the mare, so that, if the contraction takes place normally in each, the mare would be more subject to the accident from this standpoint than the cow.

We must constantly recognize, as a contributory cause of prolapse, anything which greatly debilitates the animal. Difficult and prolonged labor is so frequently followed by prolapse of the organ that it must be regarded as one of the causes of the accident, although it by no means follows that dystokia should directly cause this displacement. We repeatedly see cases where powerful traction has been employed without inducing any displacement of the uterus. On the other hand, we meet with cases of prolapse of the organ where the parturition has been natural and easy.

When the fetal membranes are abnormally retained, and cause irritation and expulsive efforts, they are liable to cause a prolapse of the organ. Eversion is further facilitated by the fact that, in the presence of the membranes, the cervix of the uterus does not undergo its normal constriction. Very naturally, any injudicious traction upon retained membranes tends to cause prolapse of the organ. For example, when the chorion of the mare is separated from all parts except the apex of the gravid cornu, severe traction upon the membranes is liable to cause the beginning

of an inversion of the horn, and the irritation causes a continuation of the displacement until the prolapse results.

Parturient paresis acts as a distinct and not very rare cause of prolapse of the uterus. Apparently this cause has been overlooked by many veterinary obstetrists. In these instances we have the ordinary symptoms of parturient paresis, such as coma, coupled with a sub-normal temperature, and a general state of unconsciousness in the recumbent animal. In the cases which we have observed, three in all, we could not determine from their history whether the ordinary symptoms of paresis occurred first or the prolapse was the initial symptom. Naturally, when uterine prolapse complicates parturient paresis the animal is found in recumbency, usually lying prone upon her side. This induces tympany, by which the paresis is complicated and the replacement of the prolapsed organ is prevented.

Handling. In all cases of dystokia, the obstetrist should examine the uterus after the extraction of the fetus, in order to determine if the organ has assumed its proper position and relations, and especially to determine if any inversion of the organ has begun. If such beginning inversion is present, as has repeatedly been observed by the writer, the obstetrist should reduce the intussusception at once, by applying pressure upon the advancing portion of the organ, either with the clenched fist or with the ventral surface of the fingers of the open hand, taking care at all times not to wound or otherwise injure the organ. After the replacement of the organ, unless there are reasons to the contrary, such as a rupture of the uterus, the obstetrist should inject into the uterine cavity a large volume of normal salt solution or a very weak disinfecting solution, by which means the uterus is cleansed from any irritants which may be present. The expulsion of the liquids also causes energetic contractions of the muscular walls of the organ, which lead to a prompt and normal involution, after which the danger from prolapse is usually, if not always, eliminated. The same rules should be applied when the veterinarian is called to attend an animal because of retention of the fetal envelopes, and great care should be taken not to leave the organ partly everted after the removal of the membranes.

In these cases, the position of the patient is not highly essential; but it is very desirable that she should be in the standing position, with the hind parts higher than the fore parts.

The handling of complete prolapse or inversion of the uterus offers two different plans—replacement and amputation.

The replacement of the organ, and its retention in position, is always the most conservative and desirable, and should be applied in the vast majority of cases, including all those in which it is possible to replace and retain it, and in which the state of the uterus is such that the veterinarian may reasonably hope that it may recover from any injury or disease existing at the time of its prolapse or acquired as a result of the accident.

For the replacement of the organ it is important that the animal should be placed in the most favorable position possible. In the larger domestic animals, where the prolapse has not existed for a very great period of time, the standing position of the animal is frequently preferred. Whether the animal is standing or lying, it is always to the advantage of the obstetrist that its body should be more or less sharply inclined from behind downwards and forwards, so as to throw the weight of the abdominal viscera against the diaphragm and away from the pelvis, in such a way as to favor a spontaneous reduction of the prolapsed organ.

When the prolapse is complete, the position of the body of the patient becomes of the very greatest importance. Though many veterinarians prefer to have the animal standing, those who have had extensive experience in very severe and difficult cases are very much inclined to prefer that the animal be placed in the recumbent position, but never in sternal recumbency. If the animal is to be handled in the recumbent position, it is desirable that it be placed upon its side. Some hold that it is even better to place the animal upon her back.

The attitude of the patient should be borne in mind, in every case of uterine prolapse, because it modifies the difficulties to be overcome, to a degree which almost surpasses belief. We might well illustrate this fact by an occurrence in our practice, where we had worked long and hard to return the prolapsed organ in a cow. We had worked with the patient in the standing position, and several times had progressed far enough that almost the entire organ had been returned through the vulva. Then violent expulsive efforts would come on, and the cow would throw herself to the ground and undo all our work. When this had occurred several times, and we had worked more than an

hour, we had once more almost completely returned the organ, when the cow again threw herself violently to the ground. This time, by accident, she fell into an excavation, and lay with her head down hill upon as steep a bank as would permit her to retain her position without sliding downward. When we grasped the uterus and again attempted to return it, it fairly fell back into place after one or two minutes of work, and the operation, at which we had worked in vain for an hour or two, was completed. The smaller animals, when suffering from prolapse of the uterus, are regularly to be more or less completely suspended by the hind legs. Where extreme difficulty is encountered in the mare or cow, she too may be partially suspended with ropes and pulleys from a beam.

Having secured the animal in a proper position for the return of the organ, or having made the necessary arrangements for placing the patient in the proper position, the obstetrist should proceed to put the organ in proper condition for its return into the normal position.

If the placenta remains attached, this should be removed if at all practicable. In this everted state, the operation of the removal of the placenta is undertaken under the very best possible conditions, so that it is nearly, if not always, perfectly practicable and easy to remove it. It is needless to say that this should be done with very great caution, since any abrasions or lacerations of the uterus in this prolapsed state tends to produce very profuse hemorrhage.

In almost all cases of prolapse of the uterus, the organ has become more or less befouled with dirt of various kinds, and especially with manure and bedding, bearing abundant and serious infection, which it is the province of the veterinarian to overcome as far as possible.

In order to properly cleanse the uterus, the organ must first be protected from further contamination by being placed upon a clean sheet, tray, or other suitable apparatus. Having provided ample protection, the operator should next proceed to cleanse the organ, chiefly by irrigating it with a tepid saline solution, so as to remove most of the dirt by mechanical washing, without irritating the organ. We may use in this solution a very small quantity of carbolic acid, not to exceed 0.5%. The washing with this solution should be very abundant, and

should be accompanied by gentle massage, which will tend to overcome the congestion of the organ, thereby decreasing its volume.

It should be constantly borne in mind by the obstetrist that the position of the organ, as related to the body of the patient, affects its size, and that, if the organ can be held somewhat above the level of the vulva, or at least as high as that organ, the blood tends to pass back into the body, thus relieving to an appreciable degree the engorgement of the organ, and rendering its replacement more practicable.

If the uterus has been torn or abraded, the wounds should be given proper attention. If any perforations have occurred in the organ, they should be closed by means of sutures, in such a manner that the two peritoneal surfaces of the organ are brought in contact. Should any blood vessels be wounded, they should be ligated or twisted, or the hemorrhage should be otherwise controlled before it is attempted to return the organ to its position.

In some cases it may become necessary or desirable, before attempting replacement, to reduce the volume of the organ by removing a portion of the blood from it. Two plans for decreasing the volume of blood in the organ, and thereby lessening its size, have been proposed.

The most direct and radical of these is scarification of the mucous surface of the organ. While some writers upon veterinary obstetrics recommend this, they do not seem to speak from the standpoint of experience, but rather theoretically. There can be no question but that these scarifications will reduce the volume of the congested organ, but the safety of the operation does not seem so clear. Saint-Cyr relates that early in his experience he applied scarification in a case of uterine prolapse in a mare, and she died from bleeding. This would seem to be a very natural consequence of such an operation. It would be well-nigh impossible to perform very extensive scarification without injuring vessels of large size, and when this is done in an organ which has become weakened by displacement the control of the hemorrhage would become difficult, if not impossible. Aside from the question of hemorrhage, however, scarification opens up an extensive avenue for the entrance of infection, and the conservative obstetrist would avoid making these wounds. The extraction of the blood

may not be advisable either, because if a very large amount escapes, even though it does not result fatally, it tends to seriously weaken the animal. The scarification of the prolapsed organ is inadvisable.

A second method of reducing the volume of the organ is by causing the blood to return into the vessels of the body. This may be accomplished by a variety of means. We have already suggested that the elevation of the organ above the level of the vulva, accompanied by massage during the cleansing of the organ, tends to distinctly reduce its volume. Others suggest that they get most excellent effects from immersing the organ in cold water, and still others advise the use of ice. While cold may reduce the volume of the organ more than the application of a tepid solution, it also renders it somewhat more hard and firm, while the tepid solution makes it soft and pliable.

Others recommend the application of pressure by means of a bandage, beginning at the fundus of the organ and continuing toward the vulva. The plan suggested below for reducing the prolapse also efficiently reduces the congestion and volume.

The reduction or replacement of the uterus is next to be undertaken. We have already suggested that, when the inversion is incomplete, and consists merely of an intussesception of the apex of the gravid cornu into the succeeding portion, the operation is very simple and consists merely in placing the clinched fist or open hand against the advancing or central portion of the displaced mass, and pushing toward the apex of the horn, causing it to become unfolded and to resume its normal position.

When the inversion is complete, and prolapse has occurred, the operation becomes far more complicated and difficult. If possible, there should always be an abundance of help at hand to give any necessary aid to the operator. Fleming suggests that at least four assistants are necessary, but in our experience we have usually succeeded with two or three persons, though admittedly in severe cases it is very much better if more persons are at hand in case of emergency. If the animal can stand, and will do so, and it is practicable to return the organ with the patient in this position, it is not essential to have very many assistants, but even then it is usually convenient to have as many as Fleming suggests. Fleming would place one attendant at the animal's

head to hold it firmly, and in case of the cow to pinch the nasal septum in order to control the movements of the animal and diminish the straining. One man would stand upon each side of the animal and, with a sheet or other cloth, hold and elevate the organ while it is being returned. The fourth man would hold the tail away, and at the same time pinch the back of the cow so as to prevent her straining.

Great assistance can be rendered by two to four assistants, in exerting pressure upon the prolapsed uterus. A piece of sterile muslin or other suitable tunic is passed beneath the tumor, and one or two assistants grasp each end as near to the organ as will permit the operator to work. They then lift the organ at least as high as the vulva, and press it firmly against the vulvar opening, thus tending at the same time to push the prolapse back into the vulva and to reduce the congestion and size by forcing the blood back into the body vessels.

Different operators suggest different methods for returning the organ. The plan which we have uniformly followed is that of exerting pressure upon the extremity of the prolapsed organ, or as some would say, against its fundus. The pressure is thus made against that part of the organ which first began to evert, so that in replacing it the operator simply reverses the process by which the prolapse took place. In this operation the obstetrist seeks that point in the gravid cornu where it has ceased to evert, a point which is recognized at the fundus or extremity of the mass, in the center of which there is an excavation or passage representing the apex of the gravid cornu, which has not become everted, but has prolapsed within the everted portion.

Placing the clinched fist or open hand against this portion, the operator gradually and carefully pushes his hand forward, toward and into the vulva, as far as he can readily reach. Holding the advanced hand in this position, with the other he grasps the portion of the organ immediately surrounding the inserted arm and holds the uterus, while he withdraws the arm which has been advanced, and prevents the replaced portion from following his arm out. He now carries the other arm up to and through the vulva, pressing with it a succeeding portion of the prolapsed mass. He continues in this way to pass first one hand and then the other into the mass of the organ, and thence through the vulva, carrying with it the distal or ovarian end

of the cornu, until finally the entire horn and body have been pushed in, and have thus become replaced in the order of the original displacement.

It is essential in this operation that great care be taken not to lacerate or abrade the organ with the finger nails, push a projecting finger through the walls of the organ, or otherwise injure it. Throughout the operation the prolapsed organ should be kept soft and pliable by frequent irrigation with warm water or saline solution.

Some have suggested that, instead of returning the apex of the gravid or everted horn first, the obstetrist should begin at that part of the organ which is nearest the vulva, and by this means press the uterus back through the vulvar opening. By this method the assistants hold the organ in the same position as the preceding, and the operator, acting upon the proximal portion of the prolapsed mass, presses his hands on either side of the tumor, between it and the lips of the vulva, and thus acts first upon the vagina, then upon the cervix and body of the uterus, and finally upon the everted cornu, until the replacement becomes complete.

A third method is that of Coquelet, although it apparently does not merit the designation of being distinct from the two preceding. It consists essentially of applying a pressure bandage of a peculiar form until the organ is considerably reduced in size, when one of the two preceding methods is applied for replacing the mass. C takes a clean piece of cloth about one yard in length and 28 to 30 inches in width, and passes this beneath the prolapsed organ up close to the vulva. Its lower border is carried up over the distal end of the organ, and the ends are then carried up over the sides of the organ, until all are folded together on top of the uterus, completely enveloping it. While tepid water is kept constantly applied to the bandage, it is gradually tightened by pressing upon the mass underneath and pulling the corners of the bandage tighter and tighter until the desired amount of reduction has been brought about. The prolapsed organ is then replaced by the method described above, or otherwise. Other methods for reducing the size of the organ, due to some peculiar way of applying a bandage, have been described.

After the uterus has been returned through the vulva, it is essential that the operation should immediately be continued

until the replacement is fully completed, since otherwise expulsive efforts recur and the organ is almost certain to again become everted and prolapsed. When the uterus returns into the vagina, the operator's hand should follow it and should trace out each part of the cavity. Especially should he clearly distinguish the two cornua of the organ and make a careful search of the gravid horn to see that the invagination of that part has been completely overcome. As a rule it will be found that some invagination still exists, and this must be overcome by placing the clinched fist or the open hand against the invaginating mass and pushing upon it until the intussusception has been completely overcome.

When the complete replacement has been accomplished, it is well to keep the hand in the cavity of the organ for a few minutes, until straining and uneasiness cease, and the organ has undergone some contraction and begins to recover its tone. Sometimes severe straining continues, with the probability of a recurrence of the prolapse. The most efficient means for overcoming these expulsive efforts is the introduction into the uterine cavity of a large volume of a warm ¼% solution of carbolic acid, which not only completes the replacement but also soothes the organ, washes away any blood clots or extraneous matter, and favors a normal involution of the organ. As soon as the uterine cavity is well filled, the fluid excites expulsive efforts, by which the solution is thrown out, and the contractions aroused in the uterine walls cause each part to become properly replaced.

If the straining is very persistent, after the organ has been replaced as well as possible, and the measures above suggested have been carried out, it may be necessary to resort to the use of narcotics or anaesthetics. Among the various remedies to overcome the straining, we should not forget those which may act locally. The tepid saline solution or the very weak solution of carbolic acid acts as a local soothing agent, and tends to decrease the irritation and overcome the straining. Iodoform also acts well as a local anaesthetic, and at the same time tends to guard against infection of the uterus, and consequently becomes of very great importance in retaining the organ in position. The powdered iodoform should be introduced into the uterine cavity in a gelatin capsule, the capsule opened and the powder scattered thoroughly.

Among the remedies which have a powerful influence in controlling the straining, chloral hydrate occupies an important place. It may be administered in a variety of ways ; in draught, in enema, or intra-peritoneally. Some obstetrists have advised the use of ether as a general anaesthetic, while others have advised the use of opium as a narcotic. Morphine and opium are not reliable agents, however, in ruminants and solipeds, and may excite rather than soothe. Others advise large doses of alcohol to the point of inducing narcosis, and this we would believe useful, even though given only as a stimulant, thus arousing the contractile powers of the organ.

In the smaller animals, where the uterus is so small that the hand cannot be introduced, the reposition of the prolapsed organ is rendered difficult and somewhat dangerous, and very frequently fails. To a certain degree, the finger may be used to replace the organ in small animals, but cannot follow it to assure complete replacement. In order to bring this about, it may be necessary to use a sound, which needs be of large size and well rounded at the end in order to guard against puncture of the organ. For this purpose a large instrument, like a horse catheter, may be used to push the organ into its position ; or, as Fleming suggests, one might use a candle, properly rounded at one end, for pushing the organ back into its place. If the small animal is suspended by its hind legs, and warm water poured into the vagina through a funnel, the weight of the water, with the position of the patient, tends to complete the replacement of the organ.

In most cases when the prolapsed uterus has been promptly reduced and properly replaced, the animal becomes calm and ceases to strain, and a recurrence of the prolapse is not probable. This especially holds true in all cases where the animal can stand. Many obstetrists deem it essential, nevertheless, that some mechanical appliance should be used to prevent a recurrence of the eversion. However advisable this may be, it should not tend in any way to decrease the attention of the obstetrist to the measures which we have already suggested for bringing about a thorough replacement of the organ in every detail, its proper cleansing and soothing by irrigation, and the stimulation of the uterus to normal involution. When these are done, and thoroughly done, it is only in a minority of cases that any mechanical appliances are essential for the retention of the organ. Admit-

tedly, however, it is very unfortunate to leave an animal without adequate protection, and permit the recurrence of the prolapse after the obstetrist has left the premises. A variety of appliances for the retention of the uterus in position have been devised and applied, and are recommended or condemned by this or that veterinary obstetrist, largely according to his personal experience or prejudice.

1. **Pessaries** have long been used for the purpose of retaining in position a uterus which has once been prolapsed or threatens to become so. They consist essentially of an elongated and rigid shaft, which may be passed through the vulva and vagina into the uterus, and retained there by some form of external bandage or other mechanism, thus preventing the uterus from becoming everted. The uterine end needs be large and smooth in order to avoid possible injury to the uterus. They are constructed of a great variety of materials, and upon different models.

The pad pessary is made of a stick of wood 20 or 25 inches in length, with a pad of as large a size as can readily be introduced through the vulva, fixed to the uterine end. This is firmly secured to the wooden stem, so that it cannot become dislodged, while through the other end of the shaft a cord is passed by which it can be fastened to a bandage, so that the instrument cannot be forced out of the organ.

Others construct a pessary of metal, with a small ring upon the uterine end. This is introduced and retained in the same way as the pad pessary. A rude pessary is sometimes made by attaching a pig's bladder, filled with water, to a round stick, thus producing an instrument similar to the pad pessary. Others have suggested a rubber bag, attached to a tube to act as the stem of the pessary, and inflated by air forced through the tube into it and retained by means of a stop-cock. Still others take a large wine or beer bottle, fasten a stick in its mouth, introduce the large end of the bottle into the uterus and retain it there with a bandage.

The value of the pessary in veterinary obstetrics is very questionable. It almost inevitably causes discomfort to the patient, and tends to induce expulsive efforts. If for any reason the pessary becomes disconnected, such as the pad slipping off the end of the shaft, the naked stem is liable to be forced through the uterine wall and cause serious injury. The most formidable objection to

the pessary is from the standpoint of inducing uterine infection. It exerts a concentrated pressure upon a small area of the organ, which weakens the tissues and renders them more susceptible to infection, while the stalk of the instrument constitutes a highway from the exterior to the cavity of the organ, along which bacteria may freely pass. It is no longer much used in any country, so far as we can determine, and has never acquired an extensive foothold in American practice.

From the standpoint of efficiency in preventing the recurrence of the prolapse, the pessary naturally occupies a prominent place, but it seems that the dangers which surround its use tend to completely outweigh this one advantage.

Sutures in a variety of forms have been recommended by veterinary obstetrists, and are generally preferred to the pessary.

The sutures may consist of silk, linen, hemp or other vegetable fiber, or of metal. The metallic sutures may be in the form of wire, or special metal bands may be used. The sutures are usually passed directly through the lips of the vulva, but they may be inserted through the skin near the point of the hip, thus avoiding the wounding of the vulvar mucosa itself. They must necessarily be strong and deeply inserted, in order to afford that amount of security which the obstetrist desires. The number of sutures to be inserted need not be great. Usually a single suture will suffice, if placed sufficiently deep in the vulva, and in no case need there be more than two deep sutures.

Veterinary obstetrists are by no means agreed as to the comparative merits of the sutures placed directly through the vulvar lips and of those passing over the vulva and through the skin of the hips. The former are known as labial sutures, and the latter as hip sutures. Some practitioners claim that the labial suture is painful ; that the tissues, being infiltrated and swollen, may readily yield to expulsive efforts, tear out, and the prolapse recur; and that consequently the hip suture is preferable. The latter is applied by lifting up a piece of skin near the tuberosity of the ischium, passing the suture through this fold, carrying it across the vulva to the opposite side, and passing it through another skin fold at a corresponding point. Four to six of these sutures are advised, in sufficiently close proximity to prevent any portion of the uterus from passing out between them.

The efficiency of sutures in preventing a recurrence of prolapse of the uterus is high, but not perfect. In our experience, if the straining of the animal is very violent, the sutures are ineffective and are promptly torn out by the great force applied by the animal. When there is little or no straining, they remain in position, and are effective; at least the prolapse does not recur. Perhaps this is partly because the sutures do not readily permit it, but largely because the animal does not strain. This especially applies to the sutures through the lips of the vulva, which we have seen torn out very promptly, especially in the mare, under violent straining. The labial sutures have the further disad-

FIG. 139b. ROPE TRUSS OF RAINARD. (de Bruin.)

vantage that they produce wounds in the birth canal at a time when it is highly susceptible to infection, which may readily extend deeper and constitute a menace to the uterus itself.

It is claimed that the hip sutures have a much higher efficiency in preventing the prolapse of the organ, and they certainly are highly superior from the standpoint of danger of causing infection to the uterus. The sutures necessarily cause pain, and suture infection inevitably ensues. It must consequently be confessed that sutures, like the pessary, have objections, although not the same in each case.

The bandage or truss constitutes a third method for retaining the uterus. These appliances consist essentially of some apparatus

which can be held firmly against the vulva of the patient, in a way to compress the opening and to offer thereby a more or less effective obstacle against the protrusion of the uterus or vagina. They are made in a great variety of patterns, and of various materials. Usually they are constructed of cord. For this purpose two pieces of cord about ½ inch in diameter and 12 to 15 feet in length are used. Each is double in the center, and the two are united by a loop in their middle, in a way to leave an oval space somewhat in the form of a ring, which will surround and include the vulvar opening, but not completely close it. The two free ends of one of these cords are then passed downward between the hind legs, on either side of the udder, and thence forward to be attached to a collar placed about the neck. The free ends of the other cord are carried upward, one on either side of the tail, and then forward along the back, and secured to the collar at the top of the neck. The cords are then drawn sufficiently tight to exert compression upon the vulva.

Such a truss will remain in position better if another cord be passed around the loins, firmly attached to each of the longitudinal cords at the point of crossing, and then tied tightly around the body.

Such a cord not only retains the others in position, but when drawn tight about the loins tends to stop straining. A second cord, passed around the chest in a similar manner, further aids in keeping the truss in position.

Other forms of the rope truss are suggested in great variety by different obstetrists. Some construct a truss from a band of leather, in which they make openings corresponding approximately to the anus and vulva. The appliance is retained in position in a similar manner to the rope truss. Other obstetrists prefer a metallic loop, through which compression is to be exerted upon the vulva. This apparatus is maintained in position by cords somewhat similar to the rope truss.

With most veterinary obstetrists the truss holds first place as a means for retaining the uterus, after it has once been prolapsed. Its efficiency is somewhat questionable in so far as its direct influence is concerned. If the cord about the loins is kept quite tight, it may prevent the animal from straining, and consequently tend to obviate the prolapse of the organ. In our experience, if an animal strains severely the truss is wanting

in efficiency, and the prolapsed organ may push it aside and escape. According to our observations, trusses generally become relaxed and loosened when the patient arches her back in order to strain. Should we desire to prevent this relaxation, it is advisable in our judgment to carry the two inferior cords upward and forward over the flanks, and cross them over the loins of the animal, from whence they are to be carried downward and forward along the sides of the chest to pass between the fore-legs, and attached in such a manner that, if the animal arches her back in order to make an expulsive effort, the tension upon these cords is increased rather than decreased.

In any event, however, the most important point is to have the truss very carefully adjusted, and then to watch it very closely. The truss cannot prevent the inversion of the organ and its passage into the vagina and vulva, but can only tend to prevent its prolapse through the vulvar opening. This is equally true of sutures. While this truss is recommended by one and that truss by another, the best one always is that one which is best applied. The actual value of the truss is not so great as many suppose, but after all it has an important influence from a sentimental standpoint, and has none or few of the objections which can be raised against sutures and pessaries. Since the owner of an animal which has suffered from prolapse of the uterus is constantly afraid of its recurrence, it is good practice to apply the truss in the majority of cases simply to allay his fears, if it accomplishes nothing else. Should the truss become displaced somewhat, and the prolapse recur, the owner still considers that the veterinarian has at least attempted the retention of the organ.

We prefer to show the owner how to apply the truss, should it become necessary, then have him watch the patient and so care for her that the truss will not be needed. We have in mind here the patient which is able to stand. If the patient is recumbent, the case is graver, and retention apparatus usually imperative. She should be kept with her hind parts elevated and abdominal pressure reduced to a minimum.

The handling of prolapse of the uterus, after the organ has been replaced and the precautions against a recurrence taken as suggested, demands little except to care for the general well-being of the animal. It is well to bear in mind that any increase of

the intra-abdominal pressure tends constantly to force the organ backward. This may be largely avoided by unloading the alimentary canal with one of the prompt-acting hypodermic cathartics like eserine and arecoline. The abdomen should be kept somewhat empty, by allowing a concentrated and laxative diet and avoiding bulky foods.

If the weather is suitable, the animal will be more quiet, and will not show the same tendency to strain, if given its freedom in the pasture, where it can constantly move about in search of food. In many cases when the animal seems to be very much irritated and shows a great tendency to straining, if it is led about gently for a time and its attention attracted, the irritation may soon abate. This movement may further tend to bring about a more thorough adjustment of the organ, while it stimulates normal circulation and involution of the uterus.

It is needless to say that any food which may tend to cause tympany should be carefully avoided, or that constipation should not be permitted to occur. If an animal becomes tympanic, that alone may suffice to bring about the prolapse of the organ, simply as a result of the increased intra-abdominal pressure.

When there is reason to fear metritis following prolapse, its avoidance should be attempted by frequent antiseptic irrigations and the liberal application of powered iodoform in the uterine cavity. When metritis follows replacement and retention of the prolapsed organ, it should be handled according to the directions for handling that malady.

The truss or sutures may be retained in position for one to three days, according to conditions, or, if straining continues, possibly for even a longer period of time.

Amputation of the Uterus. When it becomes impracticable or impossible to return the prolapsed uterus or, after reduction, to retain it in position, the question of its amputation arises with a view of saving the life of the patient, minus its power of breeding. The reasons for resorting to amputation of the uterus are chiefly three.

1. The impossibility of bringing about a reposition of the organ. In practically all cases of eversion and prolapse of the uterus in large animals, it is possible to return the organ into its former position and retain it in place. It is claimed, however, that cases do occur in which reposition cannot be attained, and

this is especially true in the smaller domestic animals with very long uterine horns.

2. In some cases of prolapse of the uterus, when the organ has remained extruded for a considerable period of time and has become more or less necrotic and seriously infected, its return into its usual position is followed by serious and even fatal consequences to the patient. If the uterus has been prolapsed for a few hours only, it is not gangrenous as a rule, because the eversion of the organ does not wholly cut off the circulation in it, but only interferes somewhat by doubling the vessels in their course, so that the blood supply may be maintained for a long time, and in some cases almost indefinitely. As soon as the organ hangs down from the vulva in a complete state of prolapse, the interruption to the circulation is important, since in addition to the doubling of the vessels there is also the impediment of gravity, which causes the organ to become greatly engorged with blood and interferes in an important manner with its circulation. If the organ has been seriously injured by rough handling during dystokia, has been prolapsed for a number of hours and has been bruised or crushed against the floor or wall, or has for a long time been greatly soiled by highly infectious manure, gangrene is frequently inevitable. It is inadvisable to return such a uterus into position. The condition may cause a recurrence of the prolapse, in spite of any precautions to the contrary; or, if the organ is retained in its position, it may undergo gangrene, and cause the death of the animal.

3. Wounds of the uterus of large extent usually call for amputation, especially when complicated with extensive infection of the peritoneal surface. When only a small wound, or even a large one which is moderately clean, occurs, amputation is not necessary. It is by no means essential that the entire uterus should be amputated because a small portion or even half of it has been more or less damaged. It is presumably just as safe to amputate ¼ or ½ as to amputate all of the organ, and it may at times be of fundamental importance that we should save a portion of it, if by so doing we may retain the power of breeding. Consequently, when a wound is present and we can close it accurately by means of sutures, we have performed an operation which is quite as safe as the ablation of the organ. The principal objection to this is the fact that some infection will probably

occur at the seat of the sutures, which may readily involve the general surface of the uterus.

The prognosis of amputation of the uterus varies in different animals, and under different conditions. In the mare it is usually unsuccessful. In the cow it is a fairly successful operation, if undertaken in due season and carried out with proper care. In the smaller domestic animals it is usually quite successful, especially in the sow and carnivora.

Technic. Before proceeding with amputation, the entire prolapsed organ is to be carefully cleansed and disinfected, and placed upon a sheet of sterile gauze or other material, where it may be well protected during the operation. As far as possible, the blood accumulated in the organ should be forced back into the circulatory system by compression with the bandage of Coquelet as, described on page 836, or by other means.

Great care should also be taken that other viscera are not included in the operation. The bladder may extend out into the prolapsed organ, and be caught or damaged in the operation. Very frequently a loop of intestine projects out into the peritoneal sac of the prolapsed organ, and numerous instances have occurred where veterinarians have carelessly ligated the organ and included the intestine, causing the death of the patient. In order to safely determine whether any viscera extend into the cavity of the prolapsed organ, the veterinarian should incise the uterine wall under aseptic precautions, and insert a finger or his hand into its peritoneal cavity.

Amputation is to be carried out by the ligation or suturing of the entire organ. Some operators advise that it be ligated in parts, while others strongly insist that the organ should be ligated in toto. The latter is the usual custom, and probably the best. The material for the ligature may vary according to availability in a given case. One of the best and most satisfactory materials is silk tape, which is soft and very strong, so that it will admit of being drawn very tight. Others use a heavy cord of almost any character, and some veterinary obstetrists advise the use of a moderately thick and strong pure-gum tubing.

In the larger domestic animals, the ligature should usually be placed about the cervix of the uterus, near to the external os, while in the smaller multiparious animals, in which generally

but one horn is involved, it may be placed as close as possible to the point of bifurcation. The ligature must be applied very tightly, and for this purpose powerful traction is required. The ligated portion necessarily becomes sharply plicated, and unless the ligature is drawn very tightly there will be an open avenue for infection to pass through the amputated stump into the peritoneal cavity. Unless very tightly ligated also, the partial disappearance of the engorgement loosens the ligature and permits the stump of the organ to slip away.

The principle of the application of the ligature should be to apply it so tight that the nutrition of the portion of the stump beyond the ligature shall be completely cut off, so as to cause immediate necrosis and prompt sloughing away.

The elastic ligature is highly efficient, because it continues to contract as the tissues of the organ give way, and so tends to continue tight instead of becoming loosened by the yielding of the tissues. In applying this ligature, a piece of stout cord should be placed lengthwise upon the uterus, and the ligature applied tightly around the uterus and over the cord. The cord is then tied over the ligature to hold it. The ligature may be passed two or more times around the organ, according to its strength in comparison to the size of the uterus.

When the ligature has been securely applied, the uterus may be cut off at a safe distance beyond it—in the cow usually about 3 to 4 inches. Care should be taken to leave a sufficiently large stump to insure the ligature against slipping when the vagina returns into its position. On the other hand, it is inadvisable to leave an unnecessary amount of tissue, which must inevitably undergo decomposition and consequently prove a danger from the standpoint of infection.

The ligature should come away ordinarily after 5 to 10 days, along with the necrotic stump of the uterus. Pending this time, the vagina should be irrigated daily with antiseptics.

In the amputation of the organ, the veterinarian should aim, in all cases where practicable, to include the ovaries in order to obliterate estrum along with the power of breeding.

Closing the amputation wound by means of sutures is more surgical, and safer than the ligature. After thorough cleansing of the prolapsed organ, it should be grasped and extended by an assistant. A piece of heavy braided silk, about one yard long,

should be armed at each end with a heavy straight needle. The suturing should begin at the top, that is, opposite the superior vulvar commissure, and the two needles inserted at approximately opposite points, about ½ in. from the superior border of the organ, each needle emerging at the point where the other entered. By drawing firmly upon the ends of the ligature, the included portion of the uterus is strangulated. The needles are then turned back, and reïnserted at a point about ½ in. farther down, and the process repeated until the inferior wall or floor of the prolapsed organ is reached and included, when the ends of the suture are firmly tied together. In this manner the circulation in the organ to be amputated is completely cut off, and hemorrhage rendered impossible.

The uterus may now be excised at a point 2 or 3 in. beyond the suture line, but the incision should not be at once completed. The incision may be begun at either end of the suture and extended for a short distance, followed by the application of a second ordinary continuous suture, closing the margins of the new-made wounds. When the suture has reached the point to which the excision has been carried, the cut may be extended, the attachments of the organ serving merely as a means for holding the stump while it is being sutured. The excision could be completed at once, and the stump held with forceps. The same precautions are to be taken in this operation as in ligation, to not wound or include the urinary bladder, intestine, or other viscera.

When the operation is completed, and all blood clots have been removed, the stump may be permitted to return into the vagina. Whether amputated by ligature or suture, the vagina should be kept as nearly aseptic or antiseptic as possible during the healing of the wound. It should be irrigated daily and dressed with powdered iodoform.

Eversion of the Vagina. Vaginal Prolapse.

Prolapse or eversion of the vagina may occur in any domestic animal after parturition. We have already dealt with prolapse of the vagina, as related to sterility, on page 199, and as occurring during pregnancy, on page 449. The character of prolapse of the vagina after birth, in a large proportion of cases, is essentially different from that seen before or during pregnancy. Prolapse of the vagina consists of the displacement of some por-

tion or the entire circumference of the vaginal wall, backward into or through the vulva. According to some authors, the prolapse consists chiefly or wholly of a displacement of the upper or lateral walls of the vagina, but this does not always hold true. In many cases the entire circumference of the vagina is prolapsed in a way closely analogous to the eversion of the uterus. Occasionally the vaginal prolapse includes also the prolapse of the vaginal portion of the uterus, exposing to view the os uteri externum.

In other cases we have observed in the mare, cow and bitch the displacement of the floor of the vagina upward and backward until it protrudes through and beyond the vulva and carries along with it the urinary bladder, which becomes turned upon its transverse axis so that its fundus is directed upward and backward instead of downward and forward, to constitute vesico-vaginocele.

Prolapse of the vagina occurs chiefly in ruminants, and largely because of anatomical peculiarities. The uterus of the cow is more readily pushed backward than that of any other animal, because its broad ligaments are attached more posteriorly, which permit a ready posterior displacement of the vagina.

Prolapse of the vagina in ruminants is further favored by the fact that the organ is not so closely attached by means of the pelvic connective tissue, and especially by the fact that the prolongations of the peritoneum constituting the vesico-vaginal and recto-vaginal excavations extend more posteriorly in these animals than in others, so that a greater part of the vagina is covered with peritoneum, and it is consequently more free to move in any direction. In addition to these causes, the other essential conditions which tend to determine the prolapse of the organ exist more frequently in ruminants than in other animals.

Etiology. Various causes have been assigned to account for prolapse of the vagina. One of the very common and fundamental causes is a relaxation of the parts, which must be attributed partly to the manner in which the animal is kept, very largely to the debilitating influences of long-continued and close confinement, with high feeding. The disease is far more common in closely-housed dairy cows and in closely-housed ewes than in any other domestic animals.

In addition to these predisposing causes, there may occur infiltration of the walls of the vagina and surrounding connective tissue, at the time of birth, which causes the vagina to become more readily displaced. The tendency is further heightened by increased intra-abdominal pressure, and especially by increased intra-pelvic pressure. Animals which are highly fed, especially upon bulky food, must inevitably suffer to some degree from the consequences of exalted intra-abdominal pressure, and if we add to this a floor sloping backward, upon which the animal is constantly kept, the pressure becomes most effective upon the pelvic organs, tending constantly to press them backward toward the vulva, and finally to cause their prolapse.

A very fruitful cause of prolapse of the vagina following parturition consists of some form of chronic irritation, either in the vagina itself or in the uterine cavity.

The most important and common cause of post-parturient prolapse of the vagina is a chronic metritis, caused by retained placenta. Such irritation will cause expulsive efforts, which may produce prolapse of the vagina or uterus, or both.

Symptoms. Sometimes the prolapse appears as a reddish, somewhat spherical tumor, between the lips of the vulva, which may be visible only when the animal is lying down or when, for any reason, she is making expulsive efforts. In other instances the prolapse is much greater, and the everted organ appears beyond the lips of the vulva. In the larger animals, the prolapsed mass may be as great as 8 or 10 inches in diameter. The external covering consists of mucous membrane, which may be more or less disguised by the adherence of dirt or of blood clots. Its surface may be blackened as a result of long exposure, or ulceration, suppuration or gangrene may be present.

As the case progresses, the tendency is for the prolapse to become more and more constant, so that finally the displacement of the organ is continuous. The tumefaction and enlargement of the prolapsed organ may become so great that its replacement is difficult. The inflammation and swelling render the prolapsed organ more friable and easily torn, and contact with the tail, floor or walls tends to cause abrasions and lacerations.

The patient may eat well and her general condition remain good, or there may be difficulty in defecation and urination, with more or less persistent straining. If the prolapse is de-

pendent upon disease of the uterine cavity, the symptoms of general disease will depend upon the uterine affection rather than upon the prolapse of the vagina. In vesico-vaginocele, the irritation is very great, and the difficulty in urinating tends to further complicate the course of the disease, leading as a general rule to more or less continuous and violent expulsive efforts.

A manual exploration should be made by the veterinarian to determine the condition of the vagina, uterus and neighboring organs.

Referring to differential diagnosis, de Bruin suggests the possibility of confusion between prolapse of the vagina, vaginal tumors, retention cysts of Bartholini's glands, and inversion of the bladder. A careful examination, however, will reveal the characters of each in such a way as to bring about a differentiation. Tumors of the vagina are necessarily attached to some portion of the wall.

Bartholini's glands lie upon the lateral portions of the floor of the vestibule, and, when they become distended with retained contents, appear as fluctuating tumors. The prolapsed bladder may readily be recognized by its point of attachment, the dribbling of urine from its surface at the point of opening of the ureters, and the absence of the urethral opening.

The prognosis of the disease is largely dependent upon the cause. As a general rule it is not dangerous for the life of the animal, but when caused by chronic inflammation of the uterus, complicated by retained afterbirth, it should be regarded as serious. The condition has the further danger of consequent sterility.

In some cases the patient may suffer from prolapse of the vagina for days and even weeks, with great swelling and ulceration or necrosis of the mucous membrane, though with little danger for the life of the animal. One of the most unfavorable features of the disease is its tendency to recur.

Handling. The first aim is the replacement of the organ, which should always be preceded by thorough cleansing and disinfection. In bringing about the cleansing of the prolapsed organ, care should be taken to decrease rather than increase the irritation present, in order that when it is returned the method of handling shall not cause pain, and thereby expulsive efforts. De Bruin advises the use of a 2 to 3% creolin solution or a 2% carbolic acid or alum solution, placing special emphasis upon the

latter because of its cheapness and great astringency. In our experience so strong a solution of creolin or carbolic acid as suggested by this author tends to excite straining, and thereby to defeat the object in view.

The replacement of the organ is to be brought about in a way somewhat analogous to the reduction of prolapse of the uterus. The position of the animal should be the same. Great advantage may be gained by having the posterior parts more or less elevated. The smaller animals may be suspended by the posterior limbs. After having properly secured the animal and cleansed the organ, the protruded mass may be replaced by pressure with the open hands.

The finger nails should be well trimmed in order to avoid abrading the organ, and the hands carefully placed in a manner to insure the parts against injury. After the return of the organ into place, the hand should be introduced into the cavity, and the walls straightened out and replaced carefully in detail.

De Bruin recommends, in cases of long-standing prolapse of the vagina, after cleansing the organ, that a 2% alum solution should be applied to it for 10 or 15 minutes, after which a piece of cloth about 1½ by 2 feet should be applied to the prolapsed organ and wound about it as a bandage. This is to be kept saturated with the alum solution, while firm and careful pressure is applied to the outside of the mass with both hands, until finally the prolapsed organ is replaced. During reposition the animal often strains violently, and renders the operation far more difficult. It may be necessary or advisable to take measures to overcome the expulsive efforts. An assistant can do much by attracting the animal's attention or by pinching the back so as to prevent the expulsive efforts. In the mare the straining may be overcome to some extent by the application of the twitch. After the replacement of the organ it is sometimes of importance to move the animal gently for a time in order to attract its attention and to overcome the tendency to straining.

Where the prolapse is referable to irritation in the uterine cavity, our efforts must be directed to overcoming it. The uterus should be thoroughly examined, and no intra-uterine infection or disease overlooked. After the reposition of the va gina, the

cervical canal should be dilated, and the uterus irrigated with antiseptics.

Hess recommends in these cases in the cow that we search for and press out any persistent yellow bodies from the ovaries, and then apply massage per rectum to the uterus . By this method he reports excellent results.

In other instances the prolapse is directly referable to some irritation in the walls of the vagina, and, before one may reasonably hope to overcome the straining and recurrence of the prolapse the irritation must be removed. On page 267 we have related a case of vaginal prolapse due to vaginal adhesions which could not be mechanically controlled but was cured by chloral narcosis.

All the various means that have been advised for preventing recurrence of uterine prolapse have alike been suggested for that of the vagina. The pessary is ineffectual, constantly irritates the organ, and tends to increase rather than decrease the straining.

Many veterinarians recommend vulvar sutures as already described for prolapse of the uterus.

It is inadvisable to apply sutures until after the cause of the prolapse has been removed, since such a closure of the vulva can only result in harm in those instances where ovarian, intra-uterine or intra-vaginal disease is the cause.

The application of the bandage, such as advised for prolapse of the uterus, has a very low efficiency in prolapse of the vagina, because the organ can readily be pushed out beneath the bandage whenever severe straining occurs.

Whatever value any retention apparatus may possess, it is more important to overcome the cause of the prolapse than it is to force the organ back in its position and hold it there by mechanical means. If infection is the cause, and it usually is, then disinfection must constitute the basis of handling, and should be applied with that thoroughness which will secure efficiency. The alum solution so strongly recommended by de Bruin and others is commendable, because it has high value as an antiseptic, is very astringent, and induces but little irritation.

Iodoform is a valuable remedy in such cases, because it possesses high efficiency as a disinfectant, along with a distinct local anaesthetic effect. Where the straining is very violent, because of great irritation in the vagina, it may be temporarily

controlled by the aid of cocaine, eucaine or other local anaesthetics.

Where the irritation is acute and exceedingly difficult of control, we may secure excellent results by complete chloral narcosis, extending over several hours. During this period of respite from severe straining, the organ may resume its normal condition.

12. Prolapse of the Rectum.

Prolapse of the rectum occurs rarely as a result of expulsive efforts during or immediately after the act of parturition. In the horse the anus becomes somewhat everted normally with each defecation, but returns at once to its position when the act has been completed. This peculiarity is regarded as a predisposing cause of prolapse.

In dystokia in the mare, the rectum tends to become everted on account of the violent expulsive efforts. In some cases, where difficulty in parturition has occurred and the animal is not constantly attended, the eversion or prolapse of the rectum may become very great, and seriously imperil the animal's existence.

In one case occurring in our practice, a valuable mare, suffering from dystokia, was found with the rectum prolapsed to the extent of 3 feet, involving about 6 feet of the organ. With some difficulty it was replaced in position, and the extraction of the foal accomplished without material delay or visible injury to the rectum or genital organs, but the patient perished a few hours later. Extreme prolapse of the rectum is sometimes observed in the sow during parturition.

During labor the obstetrist should take note of any threatened eversion of the rectum, especially in the mare, and should take all necessary precautions against its occurrence. This may be best accomplished by having an assistant press upon the anus with a towel or other cloth saturated with disinfectant. When the organ has already become prolapsed, it should be replaced as promptly as possible, and retained in position. It should be carefully cleansed, but does not call for very thorough disinfection, since it must again become infected as soon as feces pass back into the portion which has been prolapsed. It should, however, be quite well cleansed, and preferably bathed in a normal salt or soda solution, and then returned into its place, followed

by the hand to make sure that all parts of the walls are straightened out.

The prognosis of prolapse of the rectum in the mare during parturition is highly unfavorable. In other animals the prognosis is more favorable.

13. Prolapse or Eversion of the Bladder.

Eversion of the bladder may occur in any animal, but has been noted chiefly in the mare, though it has also been recorded in the cow and sow. The very wide urethral opening of the bladder of the mare tends to make the eversion of the organ in that animal more probable, because more room is afforded through which the organ may pass.

The eversion of the bladder may occur at any time immediately prior to, during, or following labor. When prolapse occurs prior to the expulsion of the fetus, the integrity of the organ may be endangered during the passage of the fetus through the vulva. The accident does not constitute any great impediment to the expulsion of the fetus, but greatly imperils the integrity of the organ and the life of the patient if the fetus passes over the prolapsed organ. When eversion occurs after the passage of the fetus, the danger to the patient is less.

The causes of eversion of the bladder are chiefly the exalted intra-abdominal pressure due to expulsive efforts, the relaxed and weakened state of the circular muscles of the urethra, and in the mare, the very large urethral opening.

The symptoms of eversion of the bladder are of such a character as to render diagnosis easy and clear in the majority of cases. A tumor appears, which is somewhat pear-shaped and has its attachment on the median line of the floor of the vulva, at the point where the urethra normally exists. In eversion the urethral opening has disappeared, and its place has been taken by the everted organ. The tumor varies in size, according to its degree of congestion, which is largely dependent upon the duration of the eversion. If the eversion is recent, or if it has not protruded beyond the vulva to any great extent, or has not been seriously abraded or injured, it presents a fresh mucous surface, and upon either side near the neck of the tumor may be observed the two uretral openings, from which urine escapes drop by drop, or sometimes in small jets during an expulsive

effort. If not much swollen, the bladder may remain almost or completely hidden, especially when the animal is standing, to become exposed when the patient is lying down or straining.

It is to be differentiated chiefly from *hernia* of the bladder through a rent in the vaginal floor, and from hematoma or tumors in the vagina or vulva. In rupture of the vaginal floor with *hernia* of the bladder, the *peritoneal* surface of the bladder remains external, and the ureters, still emptying inside the organ, may cause it to become distended with urine. The rupture in the vaginal floor is recognizable. The urethra is present in its normal position on the vulvar floor, and through it the finger or a catheter may be passed into the herniated organ. The *mucous* surface of the *everted* bladder, is external, and the ureters open upon the external surface. The viscus does not become dilated with urine, and the meatus urinarius is absent.

In the handling of eversion of the bladder, the organ should first, be thoroughly cleansed by washing with a non-irritant fluid, such as a normal saline solution. The organ should be examined and proper attention given to any injuries. If any perforations of the walls of the organ exist, these should be carefully closed by means of sutures, so applied that the peritoneal surfaces of the lips of the wounds are brought into contact. If a portion of the wall of the organ has been severely lacerated or contused or has become so badly infected or otherwise damaged that its recovery cannot well be expected, the damaged portion should be removed and the edges of the wound brought together, thus amputating as much of the organ as may be necessary. In such an operation it is essential to preserve the outlet of each ureter.

After due preparation the organ is to be returned into its normal position, through the urethral opening. The operation is usually not difficult, especially if the organ has not been long everted. Grasping the organ in the hollow of one or both hands, the operator should press firmly and evenly over the entire mass until it gradually returns into its position. The operation cannot generally be carried out hastily. Firm and evenly applied pressure with the hands gradually forces the blood out of the organ, and reduces its volume, until finally, when the engorgement has largely disappeared, the organ is usually returnable through the urethal opening.

After replacement, any irritation present may be ameliorated to some extent by irrigating the cavity with a warm saline solution. If this does not suffice, local anaesthetics may be applied, such as cocaine with adrenalin chloride. General anaesthetics or narcotics, like chloral and morphine, may also be used in order to overcome the expulsive efforts, by which the replacement or retention of the organ is made difficult.

The prognosis in prolapse of the bladder is usually favorable, if it is handled early and properly.

14. Rupture of the Perineum.

Ruptures of the perineal tissues may consist of a rupture of the vulvo-vaginal roof and ano-rectal floor in front of the sphincter muscles of these two openings, to constitute recto-vaginal or ano-vulvar fistula. The lesion may extend backward from this opening and involve a complete division of all the tissues comprised between the floor of the anus and the superior commissure of the vulva, so that the two openings are converted into one cavity, into which the rectum, the vagina and the bladder empty in a common cloaca. In other cases it may consist of a more or less extensive rupture at the superior commissure or other part of the vulva, without involving the anus.

The symptoms of a rupture extending from the vulva or vagina into the anus or rectum, without involving the sphincter muscles, are not well marked externally at first, but may be followed soon by swelling. At the time of the accident the obstetrist or attendant may observe that some portion of the fetus has passed from the vulva or vagina upward into the anus or rectum. Later feces occasionally drop from the vulva. The relative amounts of feces which may escape from the vulva and anus respectively will depend upon the size of the opening between the two passages. There is frequently an involuntary passage of flatus, especially when the animal is driven at a trot.

When the rupture of the perineum is complete, and involves the floor of the anus and roof of the vulva, the symptoms are well defined and very evident. At first there is more or less hemorrhage from the lacerated tissues. The tissues are greatly lacerated and befouled with feces, which drop into the wound, and thence into the vulva. There is intense infection, followed by extensive swelling and suppuration, accompanied by necrosis

of the lacerated tissues. After a time the lacerated wounds heal, with cicatricial deformity. There is no reunion of the divided parts, but each portion separately granulates and heals, leaving the perineum divided. The feces constantly fall into the vulva, from which they drop in an involuntary manner, after causing a chronic irritation and thickening of the mucous membrane. If the animal is moved at a rapid pace, there is an involuntary passage of air in and out of the cloaca, which causes a repulsive sound, and as the air is involuntarily forced out it usually carries with it particles of fecal matter.

The causes of rupture of the perineum may be divided into three important groups.

1. The misdirection of a fetal extremity, by which it becomes deviated upward and is forced through the roof of the vagina into the rectum, to eventually appear in most cases through the anal opening. The other fetal extremities pass through the vulva, and thus, as the fetus is forced along by the expulsive efforts, the complete rupture of all tissues between the vulva and anus posterior to the perforation inevitably follows. When the owner or obstetrist is present, and notes the threatened injury in time, the diverging foot or head may be pushed back into the vagina from the rectum, and the delivery brought about in the usual way, leaving a more or less extensive tear in the recto-vaginal partition. Cases are recorded in which the entire fetus has passed into the rectum and been expelled through the anus, thus leaving a very wide and extensive rent between the rectum and vagina. The mare is far more liable to this accident because of her spacious rectum, often filled with large, hard fecal masses, and the tendency for the long and rigid feet of the foal or its long and pointed nose to become displaced upward toward the rectum, to be forced through the recto-vaginal wall. The mare is further rendered liable to this injury because of the stormy character of her labor pains and the rapidity of the passage of the fetus through the birth canal. The rupture of the perineum in this manner is therefore essentially an accident of the mare, and is rarely, if ever, observed in other domestic animals.

2. Rupture of the perineum may be caused in any animal by overstretching of the parts as the result of forcing through the birth canal a fetus of too large dimensions, and especially a fetus with one or more extremities displaced, forming a projection and

abrupt increase of diameter, which may cause an increased tension to bear upon some portion, especially the superior commissure of the vulva. We have seen complete rupture of the perineum in the mare, where the foal had been torn away by powerful traction exerted upon the two anterior limbs, while the head and neck of the foal were completely deviated to the side.

The prognosis of rupture of the perineum depends chiefly upon the character and degree of the lesion. When the rupture results in a recto-vaginal fistula, the prognosis is favorable for the life of the animal, and moderately favorable as to her usefulness, but as a general rule the animal makes an objectionable noise when being trotted, owing to the involuntary escape of flatus from the rectum through the vulva. It is possible for such animals to breed, providing the fistula is of such a character that the penis of the stallion will not become engaged in the opening during coition.

The probability of bringing about a recovery in such cases, that is a complete recovery by obliteration of the fistula, is remote. We have made repeated efforts to bring about a closure of the fistula in two cases in the mare, and in each instance not only failed absolutely in our object, but left the fistula rather larger than smaller. A few cases of complete recovery from this injury appear to be recorded, but the failures are apparently left unpublished.

When the rupture involves the complete destruction of the sphincters of the anus and vulva, and includes the floor of the rectum and roof of the vagina for some inches forward, the prognosis is again highly favorable in respect to the life of the animal. As in the preceding condition, there have appeared from time to time records of complete recovery following sutures, but here again there has been ominous silence in reference to the failures. How great the proportion of failures we do not know, but it must certainly be very, very high, probably more than 90%. Personally we have neither obtained a recovery nor had the privilege of observing one in the hands of other veterinarians.

In almost all cases the wounds granulate and finally cicatrize, but the lips of the wound do not unite, and the anal and vulvar cavities remain one, with the feces dropping into the vulva. An animal with complete perineal rupture which has failed to unite, is usually sterile. The conditions are such that successful

copulation cannot readily occur, because the penis of the stallion becomes deflected upward into the rectum. As work animals they are wholly worthless for purposes of pleasure, because of the repulsive sound of the involuntary passages of air in and out of the cloaca and the fragments of feces accompanying the expelled air, which scatter in every direction. Unless complete recovery can be obtained, the value of the animal is virtually ruined except for the temporary purpose of nursing the foal should it be born alive. After this service has been rendered the mare usually passes into the hands of low dealers. Unless complete recovery can be attained, it is usually better for sentimental and humane reasons to destroy the animal.

3. The third group of lesions, which consists chiefly of the tearing of the lips of the vulva at or near the superior commissure or elsewhere, without involving extensively the sphincter of the anus, the prognosis is highly favorable. Under proper surgical attention, the animal should be completely restored to usefulness in the vast majority of cases.

The handling of these very serious accidents calls for judgment and patience upon the part of the veterinarian. In the two first groups, in spite of the very unfavorable prognosis, attempts should be made to bring about complete recovery, always giving to the owner an unfavorable prognosis, and thus placing the operator in a proper position before the handling is undertaken. There is nothing to lose, and if success follows the effort, the gain is the value of the recovered animal.

Views vary as to the most opportune time at which an operation should be undertaken. Some recommend operating immediately after the injury, while others counsel delay until the lacerated tissues have sloughed away and granulation is established over the entire wound surface. In this the operator should be guided somewhat by circumstances. If called immediately, before a serious infection of the wound accompanied by great swelling has taken place, we consider it preferable to operate at once.

If the operation has been delayed until the wound margins have healed, it becomes necessary to entirely denude them of epithelium.

Prior to undertaking the operation, the alimentary tract should be thoroughly and completely evacuated, so that there

may be no necessity for the passage of feces over the freshly closed wound. Such unloading is best accomplished with repeated small doses of eserine or arecoline. A mare of medium size may take 0.75 to 1 grain of either alkaloid, which should be repeated every 45 to 60 minutes until the intestines are apparently completely empty.

The vulva, anus, perineum, buttocks and tail should be thoroughly scrubbed with hot water, soap and brush for half an hour or more and bathed thoroughly with ether to dissolve the fats in the skin. The parts should then be thoroughly scrubbed with a hot 1–1000 corrosive sublimate solution for 15 to 30 minutes. This should be completed before casting the patient or placing her on the table.

The animal is to be placed in lateral recumbency, for which purpose the operating table furnishes by far the best means and places the patient in the best possible position for the convenience and efficiency of the operator. If a table is not available, the patient may be secured upon an improvised platform of boards or straw, and sufficient elevation acquired to render the operation field available.

The patient is then to be placed under complete general anaesthesia with chloroform or chloral. Local anaesthesia does not fully answer, because the animal will resist the confinement and interfere with the operation even in the absence of surgical pain.

The vagina and rectum are to be thoroughly washed and disinfected. The rectal and vaginal mucosa will not withstand concentrated disinfectants, without inducing an irritation which will later cause swelling and straining. The operator should accordingly do much of the cleansing by means of irrigations with warm normal salt solution, followed by copious irrigations with a 1% solution of carbolic acid, creolin or lysol. The weakness of the disinfecting solution needs be counterbalanced by careful and extended application.

The tail should be completely enclosed in an antiseptic bandage, and securely tied out of the operator's way. Antiseptic towels or cloths should be spread in abundance over the buttocks and thighs, and secured in position by means of safety-pins. The table or floor just beneath the field of operation should also be carefully covered with antiseptic towels or gauze.

These precautions having been taken, the vagina and rectum

are to be carefully wiped dry with sterile gauze. If the operation is upon a fresh case, any necrotic or maimed tissue fragments are to be carefully excised with scissors. If the case is an old one and the wound margins are covered with epithelium, this must be carefully and completely removed.

The recto-vaginal cloaca is to be widely dilated by means of retractors, and the recto-vaginal walls upon either side of the wound grasped with double tenaculum forceps and drawn backwards as far as possible, bringing them essentially external to the vulvar lips.

The sutures may be applied by any reliable method. A good plan is to take heavy braided silk sutures about two feet in length, armed at either end with a full-curved needle. Carry one of the needles into the rectum and, if the operator is right handed, insert the needle into the right side of the recto-vaginal partition about ¼ inch from the anterior end of the wound and an equal distance from its lateral margin. Pass the needle down to but not through the vaginal mucosa, carry it across, insert it in the opposite margin of the wound between the vaginal mucosa and muscular tissue, carry it up through into the rectum at a point opposite the entrance on the left side, and remove the needle. Insert the other needle in the same manner about ¼ inch posterior to the first, and pass through the tissues and back into the rectum in the same way. Tie the extreme ends of the suture together, and have an assistant hold it upward out of the way.

Apply a second suture in the same manner, and repeat until the posterior or external end of the wound is reached. Drop all the sutures along the floor of the rectum, or have an assistant hold them aside. Divide the first suture by clipping away the knot, and then close the engaged portion of the wound by drawing the sutures gently and tying. Do not draw the sutures too tightly, lest they cause necrosis, infection, swelling and tearing out. Repeat the process with each succeeding suture.

After the sutures have all been tied, and the ends clipped away, begin at the anterior end of the wound, and apply a continuous suture close to the margins to secure accurate apposition. The wound margins on the vaginal side should be closed by accurate continuous sutures in the same manner as the second suture in the rectum.

The external wounds are then to be closed by appropriate deep interrupted sutures. Because of the great danger from suture infection in this part, the sutures, before introduction, should be thoroughly saturated with a disinfectant, preferably by immersion of the sutures for a day in tincture of iodine. The external sutures may be rendered safer by applying to each, after insertion, a drop of the tincture of iodine.

When the suturing has been completed, the rectum and vagina should be carefully wiped with sterile cotton or gauze, and the wound line, especially in the rectum, liberally sprinkled with iodoform.

When recto-vaginal fistula exists, the operation is analogous. The sutures are to be made in the same manner. The anus should be widely dilated with retractors, and the margins of the fistula grasped and drawn out through the anus.

The after-handling of the wound is highly important. The chief concern of the operator is the prevention of the befouling of the wound by means of contact with the fecal matter, followed by swelling, infection and tearing out of the sutures. The animal should not be allowed any solid food, but may have gruels or liquid foods, especially milk. The bowels may be largely blocked up, and the passage of feces into the rectum decreased, by small doses, ½ to 1 gr. of morphia repeated every 3 or 4 hours. The expulsion of such feces as may gain the rectum should be facilitated by injections of warm antiseptic solutions, especially of weak solutions of lysol or of a weak carbolized oil warmed to the temperature of the body.

The handling of the third group of injuries to the perineum, the external lacerations which do not divide the sphincters, offers nothing special, and consists in the closure of the wound by means of sutures, in accordance with general surgical principles.

15. Vesico-Vaginal Fistula.

Fleming, citing Dupont, records an instance of vesico-vaginal fistula, but fails to give exact data in regard to it. Rupture of the bladder in an ordinary case of birth, due to the passage of the fetus over it, is improbable, since normally the bladder is completely emptied before the fetus enters the birth canal, and the empty organ lies in a depressed and smooth area upon the pelvic floor, covered over by the floor of the vagina. Should

there be present, within the bladder, a calculus or tumor, the danger to the viscus would be very great. Should the floor of the vagina and the upper wall of the bladder become very severely contused, and the two adhere, there might well occur a sloughing of the injured portions, and eventually an artificial communication between the bladder and the vagina. Chronic purulent cystitis, see page 900, which is not a very rare disease in the mare, following vaginitis and other maladies, should not be mistaken for vesico-vaginal fistula.

The handling of vesico-vaginal fistula should be based upon general surgical principles, adjusted to each individual case. The fistula cannot be overcome unless the urethra remains open. In such a lesion, as a general rule, there would be, in addition, a chronic, purulent cystitis, with an accompanying precipitation of the urinary salts upon the walls of the bladder, causing the latter to become very greatly thickened and paretic, while they give to the finger the sensation of being covered with fine sand which has formed into crusts. This condition needs be overcome by repeated irrigations with warm water, with possibly very mild antiseptics as recommended on page 900.

16. Hematoma of the Vulva.

During or about the period of parturition, there occasionally appear in the vulva more or less extensive hematoma, due to the rupture of blood vessels, causing a hemorrhage beneath the mucous membrane in the loose connective tissue.

The date of their appearance varies. In one instance we noted a hematom of considerable size in a mare, following parturition, in which no dystokia had occurred so far as was known. In a second instance we noted the development of a hematom which contained about ½ pound of coagulated blood, in a mare not yet due to foal. In this animal there had been a somewhat severe colic, which had continued for 18 or 20 hours with some tympany, but she had not rolled violently and it was not known that she had received any injury. The owner had made a manual exploration of the vagina, but apparently had done nothing which might cause the hematom to form. The great vascularity of the part just prior to parturition tends to favor such lesions upon very slight provocation. In one of these cases the hematom oc-

curred along the floor of the vulva near the median line ; in the other it was well up along the side of the organ.

The symptoms are very characteristic when the blood has become collected in a large mass, because it pushes the mucous membrane outward into the cavity of the vulva, so that the volume of the tumor projects beyond the surface of the surrounding tissues and may become pedunculated or pear-shaped. It may project quite beyond the lips of the vulva, especially when the animal is lying down, and may usually be seen very well by parting the lips of the vulva with the hands. Upon palpation the tumor is comparatively soft and painless. When so situated that it can be seen, it is observed to be of very dark color, which indicates its character.

It is important to make a clear differential diagnosis of hematoma. In one of our cases the tumor was distinctly pedunculated, and so extensive that it protruded beyond the lips of the vulva whenever the animal was lying down, and it was so near to the median line and immediately in the neighborhood of the meatus urinarius that it was at first mistaken for the everted bladder. Further examination revealed the meatus, and established the fact that the bladder was in its normal position.

In some cases there may be a very general extravasation of the blood into the tissues, over a large area. This we frequently meet with in practice, where dystokia has existed, especially if rudely handled by laymen or empirics, and the vulva and vagina greatly abraded and irritated by rough hands and apparatus, or with hard, rough cords. Such extravasations are not of a character generally to cause serious trouble, but are after a time absorbed.

The handling of hematoma usually consists merely of making a free opening through the mucous membrane and pressing out the blood clots, after which the vulva should be cleansed with an antiseptic solution. In our experience it is easy to thrust a finger through the mucous membrane, and thus produce an extensive opening, which will not adhere and retain discharges later. This method of evacuating the blood coagula has an element of safety in it, because there is no danger of wounding any blood vessels which by chance may be displaced because of the lesion.

Fleming advises scarifications in cases of extensive extravasations, though he admits that Cartwright had an unfortunate experience through the wounding of a large vein. Apparently in this instance he was dealing with a general extravasation of blood in the connective tissue, and here of course a single puncture or division of the mucous membrane would not permit the escape of the blood. As a general rule, in these cases, the extravasated blood will be safely resorbed by the tissues, if they are given that opportunity. Scarifications, on the other hand, open an inviting avenue for serious infection. They had best be omitted and, in their stead, careful cleansing and disinfection maintained until resorption occurs.

17. Relaxation of the Pelvic Symphysis.

Fleming, citing Gillis, records one instance of what was diagnosed as relaxation of the symphysis of the pelvis, as a consequence of parturition, but the diagnosis was not verified by post-mortem examination or by other conclusive evidence. In this case a cow had some difficulty in expelling a calf, after which she could scarcely rise when down, or walk when upon her feet, and her hind quarters swayed from side to side. The sacro-iliac articulations appeared to be tender. When the animal was moved, there seemed to be some motion in the ischio-pubic symphysis. The condition remained permanent, and the animal was prepared for the butcher.

18. Contusions of the Lumbo-Sacral Nerves.

The lumbo-sacral plexus of nerves is so disposed, in domestic animals, that certain trunks are somewhat subject to impingment between the bony walls of the pelvis and prominent, unyielding portions of the fetus, by which they may become more or less seriously contused and their functions interrupted. The probability of these nerves becoming injured during parturition is not alike for all the trunks, the gluteal and obturator nerves being especially exposed, where they pass over the articular eminence between the last lumbar and the first sacral vertebræ, while the obturator nerve again becomes exposed to injury as it rounds the margin of the obturator foramen. See Fig. 1, page 4.

a. Contusion of the Gluteal Nerves. Gluteal Paralysis.

We have observed, in two cases in draft mares, paralysis of the gluteal muscles, followed by atrophy consequent upon parturition. In our observations neither case was referable to dystokia, in the ordinary acceptation of the term, since birth took place without aid and, so far as known, without observable difficulty. The mares were in prime condition ; no injury or infection was externally visible ; there was no fever or loss of appetite or flesh. Yet, when the mare was down it was difficult for her to get up, and when up she walked with an unsteady gait. In one case the paralysis was unilateral, and consequently the difficulty experienced in rising was not great. When moved she had a very distinct paralytic limp in the affected limb. After a few days the muscles of the gluteal region commenced to atrophy rapidly, which continued to an extreme degree, but the paralysis soon subsided, although there was a certain deficiency in the strength of the part. After the lapse of several weeks the muscles began to recover their volume, but the recovery was very slow, and nearly a year elapsed before the parts resumed their normal appearance.

In the second case the paralysis was very profound and notable, because both hind limbs were involved and it was necessary for a time to aid the mare somewhat when she attempted to get up, although once she had gained her feet she could walk about with some difficulty. The paralytic symptoms subsided in the course of two or three weeks, while the atrophy was extreme and the restoration of the muscles was very slow, though eventually complete.

The handling of contusion of the gluteal nerves must depend fundamentally upon the general care of the animal, since there is nothing very direct to be accomplished, nor is it probably necessary as a rule that anything definite should be done. The animal should not be permitted to struggle in getting up, or otherwise exert herself violently in a manner to increase the injury to the nerves and muscles, but should be watched rather closely and guarded against further injury. To this end she should have comfortable quarters, and her stall should be so managed that she will have the best footing possible in order to avoid any

slipping in attempting to rise. Furthermore, it is desirable, as far as practicable, to aid the animal by lifting upon the tail whenever she wishes to get up, unless she can accomplish the act unaided with comparative ease and safety. Slings may be applied should conditions require, but it is preferable to avoid them. Should indications warrant it, the veterinarian may apply electricity by placing one of the poles of the battery over the lumbar region and moving the other over the surface of the atrophied gluteal muscles.

According to our observations, the prognosis is highly favorable. The paralysis disappears in the course of a few days to two or three weeks. At the same time the atrophy is increasing, but from this the animal tends to recover completely in from 6 to 18 months, and in the meantime may do light work if desired.

b. Contusion of the Obturator Nerves. Obturator Paralysis.

The obturator nerve is subject to injury from the fetus, at its point of passage over the eminence of the lumbo-sacral articulation and again at the point where it rounds the lip of the obturator foramen.

The symptoms of this accident are acute and unique. They consist essentially of a loss of power in the obturator group of muscles, which include all of the adductors of the limb—the obturator externus, the adductors of the thigh, the pectineus and the short adductor of the leg.

It matters not, so far as symptoms are concerned, if the nerve is injured at its point of emergence from the spinal canal or of its disappearance through the obturator foramen. If one nerve only is contused, the animal is able to progress with some difficulty, but the affected limb is held in extreme abduction, though the power of bearing weight or of advancement is not interrupted. In advancing the limb, it is brought forward in extreme abduction, and is placed upon the ground some inches laterally to the normal point of bearing.

If both obturators are simultaneously injured, the symptoms assume an entirely different phase. Both limbs now become sharply abducted, the animal is unable to support its weight, the two hind feet slip apart, and the animal drops upon its pubis. If assisted to its feet, and the hind limbs are held in adduction, the

animal can stand without difficulty, but the moment it raises one foot the two slip apart again and the animal falls.

In one case occurring in the clinic of the New York State Veterinary College, a mare had foaled apparently naturally, but immediately afterward it was seen that in walking she carried the leg in extreme abduction, so that it was exceedingly difficult for her to walk. The condition had existed for about a year before she was presented at our clinic. We promptly diagnosed injury to the obturator nerve upon the affected side. She still walked with the affected limb in extreme abduction, while the muscles of the inside of the thigh were greatly atrophied. As we believed her incurable after so long a duration, she was destroyed, and a post-mortem examination revealed all the muscles supplied by the injured obturator nerve, very pale and greatly atrophied, so that their volume was only about $\frac{1}{3}$ that of the corresponding muscles of the opposite side. The other muscles of the limb were normal. The obturator nerve was apparently normal, except at its point of disappearance in the obturator foramen, where there existed a very distinct enlargement, consisting chiefly of connective tissue, as shown in Fig. 140.

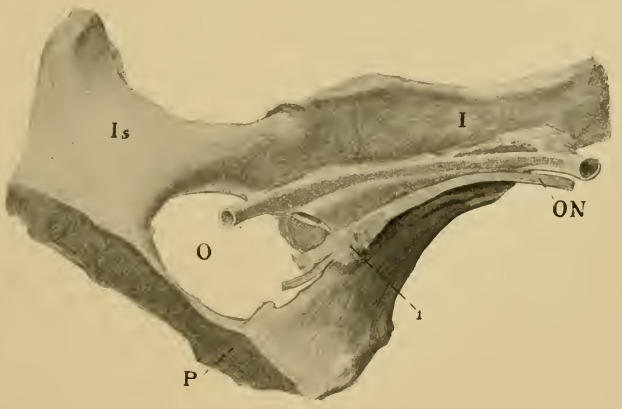


FIG. 140. CONTUSION OF OBTURATOR NERVE.

I, Ilium. Is, Ischium. P, Pubis. ON, Obturator nerve.
O, Obturator foramen. 1, Inflammatory induration of obturator nerve.

In a second case, observed in our private practice, an imported French draft mare, aged four years, had given birth to her first foal without difficulty, but was unable to get up. Having been called, we placed slings under the patient and helped her to her feet, but she could not stand on the hind limbs because they immediately parted and she tended to drop upon her pubis. If a man would hold the feet in adduction, she could stand without difficulty. The slings were properly adjusted and the two hind feet tied together, after which she stood comfortably and without difficulty. After three days, upon the removal of the slings, it was found that she could walk with but little difficulty. She made a rapid and complete recovery.

The handling of contusions of the obturator nerve should consist of the application of slings, and the feet should be tied together to prevent abduction. Later, electricity may prove useful, one electrode being applied over the loins, the other to the inside of the thigh.

PUERPERAL INFECTIONS.

During the puerperal state, the great vascularity of the entire genital system, combined with the denudation of all that portion of the uterus occupied by the placenta, and the almost inevitable abrasions and lacerations of some of the parts, tends very strongly to lead to infections of a more or less serious character. The detachment of the fetal from the maternal placenta leaves a vast denuded surface, which, in relation to infection, is somewhat comparable to a wound. If to this is added wounds, contusions and abrasions, of a more or less extensive character, the tendency to infection is still more increased.

In the separation of the placenta there is inevitably some escape of blood and other fluids into the uterine cavity, which, if not promptly expelled, act as foreign bodies and invite infection in the part. If the placenta for any reason fails to become detached and expelled at the proper time, it inevitably undergoes decomposition and leads with certainty to a greater or less degree of infection of the uterus and vagina, with possible involvement of distant parts and the general system. Added to all this, when dystokia occurs and the animal is weakened, the genital organs are debilitated, do not contract and close as they should, and infection is directly carried into the uterus by the ignorant or careless operator, upon the hands, instruments or apparatus.

It is consequently not so much to be wondered that infection frequently occurs during the puerperal state, but rather that such infection does not occur with greater frequency. Infections referable to the puerperal state are consequently of the greatest possible variety in intensity, location, character and symptoms. It is difficult to draw definite lines between the various forms, nor is it possible to describe all forms of infection. We shall endeavor to describe only those of leading importance, which offer some special train of symptoms, and permit of classification. They all trace to the one common source—the entrance of infection into some part of the genital tract during the highly susceptible puerperal state. From the genital tract the infection may extend to neighboring or distant parts, or involve the entire system in more or less grave disease.

1. Acute Metritis.

Foremost among the puerperal infections, from the standpoint of frequency and seriousness, stand the acute infections of the uterus. The infection may involve simply the mucous membrane of the uterus, to constitute endometritis. When involving only the mucosa of the organ, it may be largely or wholly confined to the placenta. In the mare, so long as the infection is confined to the mucosa, it is also limited to the placenta, and might therefore be called placentitis with equal propriety. In endometritis of the cow, with her multiple placentæ, the infection may be confined chiefly or wholly to the placentæ or that part of the mucosa which goes to elaborate the placentæ. Here again we might justly apply the term placentitis, but in this instance it is probable also that those portions of the mucosa between the cotyledons may become involved to some extent, constituting more strictly an endometritis.

If the infection is of such virulence that it passes beyond the mucosa and, penetrating the muscular walls, involves the peritoneal surface of the uterus, thus including the entire uterine wall, we designate it as metro-peritonitis. The difference in designation is consequently one intended to indicate the degree of extension and the consequent difference in the gravity of the disease.

The causes of acute metritis consist of any of those elements which may favor the introduction into the uterine cavity, and the growth there, of disease-producing bacteria.

Standing at the head of causes of metritis, is the retention of the fetal envelopes. Whenever the normal period at which these should become separated and expelled has passed by, without such expulsion, they immediately constitute a source of danger for the well-being of the animal. They promptly cease to constitute a part of the living tissues, the circulation of blood within them ceases, and they furnish a favorable medium in which bacteria may multiply. In most cases the membranes extend from the uterus out through the vagina and vulva, where they become soiled with feces and other highly infected material, and constitute an open highway, along which the bacteria may rapidly travel as well as multiply, until they reach the uterine cavity. The presence of the membranes keeps open the cervix of the

uterus, and prevents to a large degree the normal involution of the organ. Added to this, the interference with the retained membranes, with a view to their removal, by laymen, empirics or other incompetent persons, serves to intensify the danger of infection by wounding and abrading the organ.

In the mare, where endometritis is by far the most common form of puerperal infection, the disease is generally attributable to the fragmental retained placenta, already described on page 810.

Another very fruitful cause of metritis is the introduction of infection into the cavity of the organ, upon the hands, instruments or apparatus of the veterinary obstetrist during the overcoming of dystokia or other manipulations of the organ. The frequency with which metritis following dystokia occurs in animals constitutes a severe criticism upon the usual methods employed by veterinary obstetrists.

Wounds of the organ during manipulations of any kind greatly facilitate the entrance into the tissues of any infection which may gain admission to the uterine cavity.

The presence of a dead fetus, which is undergoing putrid decomposition in the uterus, inevitably causes a more or less serious metritis. In some instances, where the death of the fetus is comparatively recent and the putrid decomposition has not progressed far, the degree of metritis may be comparatively unimportant, or may even pass unnoticed. In other cases, where the putrid fetus has remained in the uterus for a longer period of time and the decomposition has become quite complete, the inflammation of the organ is correspondingly great and serious. After a long period of fetal decomposition, the uterine walls may finally assume the characters and functions of abscess walls.

When the fetus dies in the uterus and does not become decomposed, but undergoes mummification instead, it does not tend to induce inflammation of the organ.

Tardy involution of the uterus constantly tends to invite infection. When the uterus does not promptly close, and its walls fail to quickly come in contact with each other, there is probably a similar tardiness in the contraction of the vagina and vulva, so that the entire tract remains somewhat freely open, inviting infection. The debility of the organ, of which the tardy involution is but a symptom, decreases its power of resisting the infec-

tion. When the organ undergoes normal involution and contracts vigorously, that vigor in itself acts largely to prevent or overcome infection.

Exposure to cold or wet has also been claimed to act as a causative agent in metritis. It no doubt occupies an important, though indirect place. Any sudden chill, or disturbance of the body in general, weakens and depresses the highly sensitive genital tract, and renders infection far more probable than though the animal were kept under more favorable conditions.

For convenience the various types of metritis may be considered separately.

a. Acute Endometritis in the Mare.

Inflammation of the mucosa of the uterus may develop in the mare very promptly after giving birth to a foal. Should the foal perish and be retained in the uterus to undergo rapid putrid decomposition, there may be present within 24 hours a well-marked endometritis, which seriously complicates the handling of the dystokia.

Many cases of endometritis in the mare, do not follow dystokia, but result from the retention of a fragment of the fetal placenta in the non-gravid horn, as already described on page 810. In such cases infection quickly takes place, and, within 24 to 48 hours or slightly longer after the expulsion of the fetus and of the principal volume of the fetal membranes, there appears first of all a well-marked stiffness in the gait of the animal, with some disinclination to move and very marked tenderness of the abdomen upon pressure. The pulse may be normal or somewhat quickened ; the temperature is slightly elevated ; and the respiration is somewhat impeded because of the abdominal tenderness. The mare may assume the recumbent position much of the time, or she may persistently stand. The appetite is variable, and sometimes remains fairly good, but is usually depressed.

The lips of the vulva are usually swollen, and from the genital tract there issues a somewhat thin, reddish-gray, dirty, flocculent discharge, which may be more or less fetid. If the lips of the vulva are parted, the mucous membrane is seen to be injected and irritated. If the obstetrist will introduce his hand into the uterine cavity, he will usually find it filled with a dirty,

flocculent discharge of the same character as that which is observed flowing from the vulva. The amount of the accumulation in the uterus is extremely variable ; there may be but two or three quarts, or there may be 4 or 5 gallons. The walls of the uterus are paretic, so that they are unable to force the accumulated discharge out of the uterine cavity, and thus permit the great accumulation. Upon palpation, the walls are found to be dense, swollen and very thick, giving the examiner the impression of a diameter of ½ inch or more.

Examining the non-gravid cornu carefully, the obstetrist will frequently identify in it a retained piece of the chorion ; or this retained membrane may have become detached from the cornu and passed out into the body of the uterus, where it lies free in the accumulated pus ; or it may have escaped through the vulva and disappeared.

In almost all cases of acute endometritis in the mare, there coëxists parturient laminitis. The occurrence of this disease as a complication is so uniform that it might well be regarded as a part of the malady, but since it is usually described separately we shall follow that custom and take up its consideration later.

As the disease progresses, and becomes more intense, the pulse, temperature and respiration become more markedly involved, and the discharge from the uterus increases in volume and becomes more fetid. As the laminitis increases, the animal becomes more and more unable to move, assumes either the recumbent or the standing position, according to individual temperament, and persistently maintains such position.

The handling of acute endo-metritis in the mare consists essentially of the removal from the uterine cavity of any placental fragments and accumulated uterine discharges. Special search is to be made for the fragment of retained chorion so common in the non-gravid horn.

The accumulated fluids are to be removed from the uterine cavity by copious irrigations with warm water, to which a small amount of antiseptics, like 0.25% carbolic acid, lysol or bacillol or 0.1% permaganate of potash may be added. This will not disinfect the uterine contents or uterus, but may serve the purpose of partially disinfecting the irrigating solution. Two, three or more gallons of the solution may be introduced at one time, allowed to escape, and a like quantity again injected. The process

should be continued until the water is expelled clear and odorless. This may require a total of six to ten gallons.

The plan outlined is mechanical cleansing, in contradistinction to chemical disinfection. The enormous volume of virulently infective discharges is quite beyond the power of any ordinary disinfectant to overcome. If the discharges can be mechanically removed, the aim of the surgeon is fully accomplished in so far as that is concerned. The walls are still infected and inflamed, and will quickly secrete more discharges. We cannot disinfect the walls; any antiseptic capable of doing this would likewise irritate, injure or destroy the uterine tissues.

The paretic uterine walls do not contract, and the fluid must either be forced out by the contraction of the abdominal walls or must be siphoned out through the irrigation tube. The uterine cavity should be left empty, except that ½ oz. of powdered iodoform may be introduced in a gelatine capsule, the capsule opened, and the powder scattered over the surface.

The irrigation should be repeated one to three times daily, according to indications. Improvement is indicated by decreased discharge, disappearance of fetor, and a gradual change from the dirty-grayish, flocculent, semi-fluid mass to a transparent, odorless mucus. At the same time the hard, thickened walls of the uterus soften and become thinner, the mucosa recovers its normal consistence, the walls contract, the uterine cavity decreases and the walls come in contact. These changes mark convalescence, and warrant the gradual cessation of irrigation.

The strength of the patient may be advantageously supported by a free allowance of alcohol or nitrous ether in the drinking water. An ordinary sized mare may take two to four ounces of either drug, and the dose may be repeated frequently. She may take either of them at the rate ½ to 1 oz. per hour for 24 consecutive hours. Quinine may also be administered in large (ounce) doses, once or twice daily if fever is present.

The handling of the concurrent laminitis will be discussed while dealing separately with that affection.

The prognosis of acute endo-metritis is highly favorable. Properly handled, over 90% recover promptly and completely. The mare usually remains fertile.

b. Acute Metro-peritonitis in the Mare.

Acute metro-peritonitis in the mare is most frequently due to a perforation of the uterine walls during parturition, or to lacerations or contusions of the uterine walls, which soon lead to necrosis of an area, through which an avenue is afforded for the passage of infection from the uterine cavity to the peritoneum.

The wounds which invite the infection and afford an avenue for the entrance of the organisms into the deeper tissues frequently occur just in front of the pubic brim along the utero-vaginal floor, and are apparently often due to the presence of a conical bony projection on the symphysis pubis, as indicated in Fig. 113b, page 677. The perforation may be direct, but probably more frequently consists of an irrecoverable contusion and maiming of the uterine tissues between an unyielding portion of the fetus and the conical projection of the pelvis. The contusions may also be due to a portion of the fetus becoming impacted against the pubic brim and crushing the intervening uterine floor, especially during forced extraction with important deviations, as already related on page 818.

It also results frequently from the intensity of infection of the uterine walls, from rough handling during dystokia, from the introduction of virulent organisms into the uterine cavity upon the hands of obstetrists or others, the putrid decomposition of the fetus in the uterus, and other similar causes.

The symptoms may be preceded by, or include in a measure, those of endometritis, already described. Laminitis, which is so often observed in endometritis, is not a common symptom. The patient is stiff and disinclined to move. Pressure upon the abdominal walls induces severe pain. Fever and loss of appetite are marked. The vulva and perineum are usually swollen. As a general rule, vaginal discharge is present, soiling the tail and neighboring parts. Manual exploration of the genital tract reveals its walls swollen, more or less paretic, thickened and painful to the touch. The uterine cavity may contain a variable amount of disease discharges, thick, flocculent and fetid, as already described in endometritis.

The prognosis is extremely grave. Few mares recover from the disease, but usually succumb from gangrene and septicaemia in from three to ten days.

Treatment is of little avail. Locally it should consist of irrigations, as already recommended for endometritis on page 876. To the warm water may be added 0.5% carbolic acid, creolin or lysol. After thorough irrigation, iodoform powder may be scattered over the uterine floor.

Internally, quinine, one ounce once or twice daily, or potassium iodide in ounce doses, two or three times daily, may be used; or the two drugs may be given simultaneously or alternately.

The strength of the patient should be supported by large and repeated doses of alcohol or nitrous ether, and by repeated moderate doses of strychnine. If the patient will eat, ample food should be allowed of such variety as is usually indicated in serious febrile infections.

c. Acute Metritis and Metro-Peritonitis in the Cow.

Metritis in the cow is most frequently dependent upon retained placenta, especially when such retention is neglected, or still worse, when improperly handled, as has already been discussed when considering the treatment of retained placenta on page 799. The infection is also frequently dependent upon perforating wounds, or ruptures, of the uterus due to accidents during parturition such as have already been related on page 818 while considering rupture of the uterus. It varies greatly in acuteness. In one instance, where an acute placentitis occurred within 24 hours after dystokia, apparently due to infection carried into the uterine cavity by the obstetrist, there was a sudden elevation of temperature to 106F., with the general symptoms of acute septicaemia, the cotyledons were enormously enlarged, tense and necrotic. This represents an exceedingly virulent type of metritis, more severe than the usual form of the disease. As usually observed there is elevation of temperature, loss of appetite, absence of milk secretion, torpidity of the bowels, dullness, and the general symptoms of septicaemia.

Locally there is observed swelling of the vulva, and upon introducing the hand, the vulva and vagina are found very hot to the touch and tender, and the mucous membrane swollen. There is frequent and severe straining, during which usually small quantities of a grayish-red flocculent pus are discharged.

Mixed with the discharge from the uterus, there are frequently observed shreds of the fetal membranes, or necrotic cotyledons which have sloughed off. The straining is usually very intense, and in some cases well-nigh constant. The cow stands with her back arched and the abdomen compressed. She frequently grinds her teeth, and in almost all cases shows very great prostration. When the hand is introduced into the uterus, the straining is usually aggravated, and becomes very violent.

As the disease progresses, the discharge may vary greatly in character. Always somewhat muco-purulent, it shows a constant variation of the proportion of pus to mucus and of the degree of admixture of blood, which induces a change in color and consistence. In some cases the discharge becomes diptheritic, and is expelled in large, tough grayish-white masses. As the disease progresses, the cow tends to assume the recumbent position, and ere long is unable to get up, as a result of the profound septicaemia. The rumen may become distended with gas.

Terminations. The course of acute metritis in the cow is usually very rapid, and terminates in recovery or death within from two to six or eight days. In some cases the disease gradually passes into the chronic state, and continues for weeks, months or years unless properly handled.

The mortality is high, exceeding 50%. In the placental metritis or placentitis, where necrosis of the cotyledons is followed by their prompt removal and the thorough disinfection of the organ, the prognosis in our experience is highly favorable. When, however, we have to deal with the usual type of metritis or metro-peritonitis, the prognosis is always exceedingly grave.

The symptoms upon which our prognosis is to be based resolve themselves into two principal groups, general and local.

The temperature of the animal is not always a reliable index as to the state of disease, since when there is extensive septicaemia the body temperature is somewhat erratic and at times deceptive, so that, while a high temperature may always be regarded as indicative of a serious state, a low temperature is not to be relied upon as indicating a favorable course. In cases of very profound septicaemia in the cow, mare and other animals, the temperature may be normal or subnormal, but when such is the case there is a general depression, coma, or collapse, which should place the veterinarian upon his guard and prevent him

from misinterpreting the gravity of the disease by the body temperature. The general appearance of the animal is of more importance in determining the probable outcome than is the question of temperature. If the animal looks somewhat bright and maintains a fair appetite, or the appetite, having been lost, shows a tendency to return, such may be regarded as a favorable omen.

Locally we usually can determine more exactly the course of the disease and its probable termination, by comparing the conditions from day to day. The tumefaction of the vulva and vagina, if it increases, indicates an unfavorable course of the disease, which is heightened to a degree if the mucous membrane of these passages becomes darker in color and necrotic. If, on the other hand, the swelling of the vulva tends to disappear and the mucous membrane to assume its normal color, the indications are favorable.

Within the uterus itself we meet with still more definite signs as to the course of the disease. If the case is progressing favorably, the uterine walls are less firm and become thinner; the mucous membrane gradually resumes its normal consistency and loses its hard and smooth character, to become soft and velvety. When the patient is improving satisfactorily, the uterine walls gradually regain their contractile power, and the uterine cavity consequently becomes smaller. The accumulation of disease products in the uterine cavity decreases in volume; the discharge loses its fetor and tends to become more and more mucous in character, until finally all appearances of pus cease, and the discharge is entirely of mucus, so far as the naked eye can observe.

On the other hand, if the disease is progressing toward a fatal termination, the uterine walls become more swollen and paretic, while the discharge into the uterine cavity tends to increase and become more purulent and fetid, and perhaps darker in color, owing to a larger admixture of blood.

Pathology. When metritis progresses to a fatal termination, the post-mortem examination usually shows the chief lesions to be in the genital tract, very largely in the uterus itself. Accompanying these changes there are general appearances throughout the body of a profound septicaemia, followed by very rapid decomposition of the body. In fact the decomposition has progressed to an unusual degree before death, so that, if an autopsy is made

immediately after the animal succumbs, the decomposition of the genital tract has already advanced to a very marked degree, and involves its peritoneal covering.

The uterus is usually much thickened, dark colored, and more or less necrotic. The necrosis involves not only the mucous membrane, but the muscular and peritoneal coats, and even adjacent organs in the abdominal cavity, which have been in immediate contact with the diseased organ. In the vulva and vagina there are frequently encountered necrotic patches of a dark, dirty, or greenish color, and the entire tract and its contents are usually very fetid. The quantity of fluid in the uterus may be comparatively small, or may reach several gallons.

The greatly thickened walls of the uterus are frequently highly emphysematous and very friable. Sometimes shreds of the fetal membranes are still retained, the cotyledons may be necrotic, and portions of the uterus may be covered with extensive diptheritic membranes.

The peritoneal covering of the uterus being involved, permitting the disease to extend thereby to other portions of the peritoneum, causes a more or less voluminous exudate into the peritoneal cavity. Abscesses may exist in the uterine walls, or in the surrounding pelvic connective tissue.

Whenever metritis is highly virulent, thrombosis of the neighboring vessels is probable, as a result of the infection extending to and involving the veins and lymphatics. Such a condition is greatly favored in metritis, because of the fact that, only a few hours before, the vessels were very large and contained a great volume of blood. The large vessels, which no longer have their previous function to perform, become inactive and vulnerable to infection. The thrombi, breaking down and passing along the blood vessels, tend to cause embolisms in distant parts of the body, such as the lungs and the joints. In the latter position they may produce pyaemic arthritis.

The general post-mortem appearances of the tissue and organs, other than the genital tract, are those of septicaemia or pyaemia. The blood is dark colored, and does not readily coagulate. The muscles are pale, friable and soft. The liver and kidneys are engorged and soft. The general appearances of the body do not offer any special differences from those observed in death from

wound infection; in fact we are essentially dealing with wound infection of a particularly virulent type.

The infection is usually mixed in character, and offers no distinction from that usually found in acute wound infection.

Handling. The veterinarian should first of all observe carefully those general rules which tend to prevent the infection. As in other operations of a surgical character, accompanied by wounds or destruction of the protective epithelium, we know that they may be caused without being followed by infection, if certain precautions can be, or are, properly applied. We have already urged, on page 620, that the veterinary obstetrist should rigidly apply the rules of aseptic and antiseptic surgery, and have there fully discussed the proper course to pursue. He should remember that the introduction of his hand into the genital passages of a breeding female, just before, during or after parturition, is always accompanied by more or less grave possibilities of infection, and consequently that such manual exploration should not take place unless there is ample reason for it.

A retained and decomposing fetus should be removed from the uterus as early and carefully as possible, because it must otherwise eventually induce metritis. If the fetal envelopes are retained, they should be carefully handled along the lines which we have suggested on page 793, in order that their decomposition in the uterus, and the infection of the organ therefrom, may be avoided.

When metritis and parturient fever have become established, the gravity of the disease calls for prompt, vigorous and intelligent handling. The first duty is the cleansing of the uterine and vaginal cavities. If there is a large accumulation of purulent material in the uterine cavity, its prompt removal is demanded. The septic material may be flushed out by overfilling the uterus with warm water, as described on page 875.

It is not essential what antiseptic is used, but highly important how it is used. Generally speaking, we desire the highest efficiency with the least irritation. With the uterus in a highly inflamed state, the irritation from antiseptics is not so great as in the normal organ, and consequently a comparatively strong solution may be used. However, we must constantly rely far more upon the mechanical flushing out of the organ and the washing away of the micro-organisms and their poisons than upon de-

stroying them in the uterine cavity or in the tissues of the uterus. Large volumes of weak antiseptic solutions are therefore preferable to smaller concentrated ones. During the entire process of irrigation, the operator may add small quantities of antiseptics, and thus exert some influence upon the septic condition. In our experience we have preferred less than a 1% solution of carbolic acid. We have likewise used a 0.1% solution of permanganate of potash, with good results.

After the irrigation of the uterine cavity has been completed and the liquid has been expelled or siphoned out, there may be deposited in the uterine cavity a liberal amount of powdered iodoform.

The flushing of the uterus should be continued until the walls have recovered their contractile power and the purulent discharge has been replaced by mucus.

Internally the treatment should consist chiefly of those remedies which support the strength of the animal, and tend to bring about either the destruction of the micro-organisms and their products, or their prompt excretion from the system. The general rules of systemic medication in acute metritis in the mare apply also to the cow. Potassium iodide, being highly toxic for the cow, should be omitted or given in small doses.

In metro-peritonitis, and other puerperal infections, various anti-streptococcic and other sera have been used and highly lauded by some veterinarians, but so far as we have been able to determine, the evidence of their value has been what we may term circumstantial.

The rapid elimination of poisonous products may be greatly favored, when necessary, by prompt catharsis, but as a general rule this should be avoided except in very acute cases, and instead the excretion by the bowels should be favored by a light, laxative diet so long as the patient will eat. If, however, it is felt that prompt excretion is essential, our preference is decidedly toward the hypodermic cathartics, which will act within an hour, and thus not induce a prolonged depression or threaten to cause superpurgation. Among these remedies we favor moderate or small doses of eserine or arecoline, of such amount as to not cause great depression of the animal.

d. Acute Metritis in the Smaller Animals.

In the smaller animals the causes and symptoms of acute metritis are in the main parallel to those observed in the cow and mare, varying of course in their expression, according to species. Most small animals, when suffering from acute metritis, tend to remain in the recumbent position. There is extreme prostration, with fever, tenderness of the abdomen and a purulent discharge from the vulva. The patient shows a disinclination to move, and usually gives an outcry of pain when pressure is applied to the abdomen.

Since in the smaller domestic animals the uterus is not so readily cleansed by flushing, considerable care is necessary in order to bring about disinfection, and even then the operation will not succeed so well as in the larger domestic animals. In the smaller animals, like the cat and bitch, we may insert far into the uterine horn, a rubber human catheter, and through this inject the fluid; or possibly a slightly bent metallic catheter might be used with even greater advantage, because of the possibility of directing it first into one and then into the other horn, and gently flushing these out with antiseptic fluids.

In these animals, if the uterus cannot be disinfected by irrigation, it may be necessary to resort to hysterectomy, as described on page 669.

2. CHRONIC METRITIS. PYOMETRA.

Allied to acute metritis, and frequently following it as a sequel, there occurs a chronic inflammation of the uterus, which is characterized by suppuration of the uterine cavity, with more or less accumulation of pus, constituting pyometra, or in case the cervical canal of the uterus becomes completely occluded a large volume of pus may be confined within the uterine cavity, to constitute abscess of the uterus.

Chronic metritis or pyometra may occur in any domestic animal, but has been observed chiefly in the mare, cow and bitch. It may appear at almost any period in the life of the animal, and its relation to parturition is variable. It occurs almost always in females which have previously bred, but the duration of time elapsing between the last birth and the appearance of the disease is not constant. In some cases, pyometra or chronic metritis follows parturition after an interval of a few weeks, or there may be a more or less definite acute metritis, which partially recovers, to be continued somewhat indefinitely as a chronic, purulent inflammation.

Anything which may lead to an infection of the uterus, and permit it to continue for a long period of time, suffices to establish the disease. Anything, therefore, which would debilitate the organ or the general system, or which would favor or lead to the introduction of micro-organisms into the uterus, would act as a cause of the malady. Prominent among the recognizable causes of this malady, are retained fetal membranes and any of those causes which operate to bring about acute metritis, as described in the preceding article.

In many cases manipulations during dystokia appear to be the essential source of an infection, which, though not sufficiently virulent to bring about an acute metritis, nevertheless induces a chronic suppurative disease of the organ.

a. Chronic Metritis in the Mare. Pyometra.

Chronic metritis in the mare has not received that attention, from writers upon veterinary obstetrics or gynæcology, which its importance deserves. The affection is not at all rare in the mare, and often proves very obstinate when handled by the

methods which have been in vogue. This affection is by far most frequently seen in those mares which have at some previous time been bred, and have then been allowed to go without further attempts at breeding. It is consequently more common, according to our observations, in localities where few horses are raised, than in those districts where most mares are regularly used for breeding purposes.

In addition to the general causes of chronic metritis, indicated above, it is not rare to observe chronic metritis in the mare, in cases where, because of apparent sterility, the stallion groom has attempted to "open" the uterus with a view to inducing the mare to conceive. The groom has forced his dirty hand through the cervix of the uterus in a rough manner, wounding the organ more or less seriously and depositing in the lacerations or abrasions, abundant infection from his dirty hand.

The symptoms of chronic metritis in the mare consist usually of a general appearance of indifferent or poor health, with some emaciation and want of power of endurance. Accompanying these systemic disturbances, there usually appears from time to time a discharge of pus from the vulva. This discharge is sometimes constant, and dribbles away, especially when the mare is moved rapidly upon the road or when she is lying down. If it is at all constant, the tail and thighs will generally be found soiled. In many cases the discharge occurs only at very wide intervals, and apparently proceeds from the over-distension of the uterus, which causes the cervix uteri to dilate and brings about the escape of a large portion of the contents. In these cases the disease behaves somewhat as an abscess. The uterine cavity becomes filled with pus, the cervical canal opens and permits the escape of the pus, then closes, and the abscess cavity again becomes distended. Sometimes the evacuation of pus is preceded by symptoms of colic, and expulsive efforts.

The amount of pus which may be discharged at one time varies between a few pints and four or five gallons. The contents usually present the ordinary appearances of pus from an abscess, with the admixture of more or less mucus. In many cases it is comparatively free from odor, while in others it is quite fetid. It is usually yellowish or bluish-white, or may be of a dirty, grayish color, and in one case was black, somewhat flocculent,

and presented to the naked eye the appearance of a disintegrated melanotic tumor.

Upon vaginal exploration, the vagina is usually found to be normal, though possibly the mucosa is somewhat irritated because of the presence of the pus from the uterus. When the os uteri is reached, it is usually found closed, and it may prove exceedingly difficult or impossible to insert a finger. If the cervical canal can be passed, the uterine cavity is found filled with pus, and the uterine walls paretic and denuded of their epithelial covering. Exploring per rectum, the operator finds the uterus very greatly distended, lying inert, and containing from one to several gallons of liquid, which fluctuates upon palpation.

There are few affections which may be confounded in reference to diagnosis with chronic metritis. Occasionally we meet with a similar discharge from the vulva in case of a very large calculus in the bladder, accompanied by purulent cystitis. Other forms of purulent cystitis may cause like symptoms, as may also a malignant tumor of the bladder when breaking down. Chronic vaginitis may also be mistaken for this affection, until manual ex-

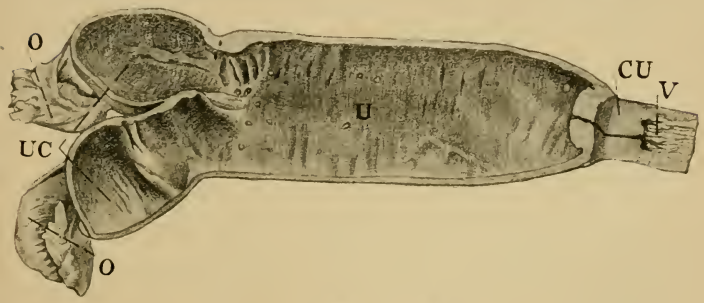


Fig. 141. Pyometra in Mare.

O, O, Ovaries. UC, Uterine cornu. U, Uterus.
CU, Indurated cervix uteri. V, Vagina.

ploration is made. In Case 3 we record below an instance of teratologic development of the uterus, which induced symptoms of chronic metritis.

The changes observed in the uterus consist chiefly of a thickened and sclerotic condition of the cervix uteri, with extreme

narrowing of the os. The mucous membrane completely loses its ordinary character; ulcerating patches appear; and, as shown in Fig. 141, the cornua become displaced from their normal position at right angles to the uterine body, and push forward somewhat in the direction assumed by the cornua of the uterus of the cow. The normal longitudinal folds in the mucous membrane are entirely obliterated, and in their place there appear numerous transverse ridges in the muscular walls.

The handling of chronic metritis in the mare must be based upon the problem of local disinfection, the principal obstacles to which are the sclerotic condition of the cervix uteri and the paretic state of the uterine walls. The fundamental duty of the practitioner is to bring about a thorough dilation of the os uteri to such a degree as to permit the insertion of the operator's hand into the suppurating cavity. This requires much patience and hard work in many cases, but is of such great importance that it should be persevered in until fully accomplished. In some cases it requires patient endeavor, extending over several hours, to dilate the os sufficiently to insert a finger. When this has been attained, the uterus can be irrigated somewhat ineffectively by passing a tube through the os, injecting a large volume of antiseptic fluid, and then siphoning it out by means of the tube through which it entered. But the further dilation of the os uteri must be completed before recovery can be assured. This may be accomplished with the finger and hand of the operator, by repeated efforts upon succeeding days.

The partially dilated os may also be tamponed with antiseptic gauze or other material, which, remaining in place for twenty-four hours, tends to cause a dilation or softening of the parts. A large and powerful uterine dilator may be of great service in forcibly dilating the os, rendering it very much easier for the operator.

Once the os uteri is sufficiently dilated to admit freely the operator's hand, he is in a position to proceed with the final problem of disinfection. With good drainage, the question of a choice of disinfectants is not supremely important. Any reliable disinfectant will accomplish the end, but it needs be intelligently applied, and by the veterinarian himself. It is needless to say that the disinfecting solution should be sufficiently voluminous to fill the uterus two or three times successively, so as to in-

sure the thorough cleansing of the cavity at each operation. The flushing of the uterus should occur regularly as often as once a day, and should be persevered with until success is obtained.

Among disinfectants, 1–1000 permanganate of potash solution is highly efficient. We have had good results with a solution consisting of carbolic acid, tannin, glycerine and water. We have varied the strength of this solution according to circumstances, as related in the cases given below. It is important to make the solution as strong as will be borne without irritating the organ. It is well to remember that most disinfectants are quickly absorbed, and their action ceases. In this respect iodoform offers special advantages. After cleansing the suppurating cavity thoroughly with one of the foregoing disinfectants, a gelatine capsule containing 5 or 10 grammes or more of powdered iodoform may be carried with the hand into the cavity, opened, and the powder scattered over the uterine floor. The specific gravity of the iodoform causes it to drop into the folds and irregularities of the mucosa, and prevents its being thrown out, while its feeble solubility causes a continued action for a day or more. At the same time it acts somewhat as a local anæsthetic, and tends to prevent straining.

When local treatment is begun, there frequently occurs an increased systemic disturbance, due apparently to an accelerated absorption of septic material. In order to counteract this it is well to administer tonics and antiseptics, such as nux vomica and iron, potassium iodide, hydrastis Canadensis, or other agents. Still more important perhaps, especially if the pus seems more fetid and abundant, the irrigations should be increased to two, three or more times daily if essential to cleanliness.

When the disinfection becomes effective there is decreased suppuration, any odor which may have been present disappears, the discharge becomes more and more mixed with mucus, the mucosa of the uterus becomes normal in consistency, the uterine walls become active and approach each other so that they lie in contact.

The mare should be kept directly under the supervision of the veterinarian from the beginning of the treatment to its successful termination, and the handling should on no account be entrusted to an ordinary layman. The treatment should not be stopped or relaxed until the recovery is complete. By following

these lines of handling we have not met with an unsuccessful case, while we do not recall an instance where the treatment has proven successful when the application of the remedies has been entrusted to a layman.

Upon the question of breeding after recovery we have no definite data, but there is the danger that the oviducts may occasionally become occluded during the course of the disease, and cause sterility.

The following cases are illustrative :

CASE 1.—A mare, aged 15, entered our clinic March 11, 1899, because of a vaginal discharge. An examination revealed a copious discharge of dirty, whitish pus from the uterus. The os uteri was constricted. The uterine cavity was first injected with warm water, and later with 1-5000 corrosive sublimate solution. On March 12, a horse catheter was introduced through the constricted os, and 1 gallon of pus siphoned out, after which the cavity was injected with 1-5000 corrosive sublimate solution.

This line of treatment was continued until the 16th, when the os and uterine cavity were tightly packed with gauze saturated with creolin solution. On March 23 the os had become dilated, and the uterus had regained its power, so that the pack of gauze was expelled. There was no longer an appreciable amount of pus in the uterus. On March 25 the packing of the uterus was discontinued, and creolin solution was substituted for the corrosive sublimate for irrigating. The suppuration had ceased, and the mare was discharged. The treatment had occupied a period of two weeks.

CASE 2.—The patient was a mare aged 9 yrs., weighing about 1,100 lbs. She was entered on January 9, 1900, with the history of a vaginal discharge since June, 1899, or a period of seven months. She had been served in June, 1899, without result. Exploration per rectum revealed the uterus greatly distended with fluid. A rubber hose was passed into the uterus, and 5 gallons of pus were siphoned out. A weak solution of creolin was then injected into the uterus by gravity, and allowed to escape. The uterine cavity was then packed with three yards of cheese-cloth saturated with 2% creolin solution.

On January 10 the same treatment was applied, and 5 yards of cheese-cloth were used in packing. The same course was pursued on January 11. On January 12 the uterus was washed with creoline solution, and packed with gauze saturated with carbolic acid solution, which was left in place until January 14, when it was re-dressed. On January 15 the patient seemed worse. In order to bring about a more complete dilation of the constricted os, a new plan of packing was adopted. A bag was made of sufficiently strong cloth, with a diameter of about 4 or 5 inches and a length of 3 feet. It was saturated with creolin solution, sprinkled with iodoform, and then oiled, and the closed end passed into the uterus. Through the open end there were then passed 3 yards of cheese cloth, partly into the uterus but largely in the canal of the cervix.

There was given internally for the five following days 1 dram of powdered nux vomica and one-half dram sulphate of copper twice daily. A manual examination of the uterine cavity showed that the cornua, in their paretic state, tended to become reflexed upon themselves in a way to prevent good drainage. This difficulty slowly disappeared as the case progressed. On January 17 the creoline injection was displaced by 1-2500 corrosive sublimate solution, and, in addition, iodoform powder was introduced into the uterus on January 20, 22 and 23. She now improved very rapidly. The internal treatment was continued. The mare was discharged on the 23rd, convalescent, after fourteen days of treatment.

CASE 3.—A mare, aged 4, weighing about 1,050 lbs., was entered on January 7, 1901, with the history that she had suffered from a vaginal discharge since one year old. The discharge was of a light color, and was dropping away continuously, keeping the tail and thighs badly soiled. She had not been bred, and had never shown signs of estrum. Upon making a manual exploration, it was found that the os uteri was open and the hand could be passed through it readily. The right cornu appeared normal, while the uterine body, with the left cornu formed a remarkably large, elongated cavity. The uterus and cornu had the peculiar property of ballooning, like the vagina, under the movement of the hand.

The case is inserted here because of its unique character. It offered the general external appearances of chronic metritis, except that the discharge was mucoid in character instead of purulent. The difficulty was evidently teratologic in character, and the uterus had developed like the vagina, and should physiologically have been considered a part of that organ.

CASE 4.—An imported French draft mare, aged 23, and weighing about 1,350 lbs., was entered in the clinic on February 13, 1902, for chronic metritis. She had a copious discharge of a thick, fetid pus from the vulva. The tail had a number of small melanotic tumors. The uterus was washed with a weak solution of carbolic acid. On February 14 the discharge seemed somewhat decreased, and potassium permanganate solution was used for irrigating. The same was repeated on the 15th. On the 17th the uterus was packed with cheese-cloth saturated with iodoform and vaseline. On the 18th the pack was omitted, and the uterus was washed with a solution of carbolic acid and bi-carbonate of soda, which was continued on the 19th and 20th. On the latter date there was but a small amount of discharge.

On the 21st the discharge seemed worse. The uterus was washed as before. Following the washing, a suppository of iodoform, tannin, vaseline and beef tallow was introduced into the uterus. On the 22nd the uterus was washed with carbolic solution, and after it had been expelled there was inserted into the uterine cavity, and allowed to remain, a solution consisting of tannin 1 oz., carbolic acid 1 dram, glycerine 4 oz., tepid water 1 pint. This treatment was continued daily until March 3, when the patient was discharged practically convalescent, with directions for the owner to continue the disinfection of the uterus for seven or eight days.

CASE 5.—A farm mare, aged 11, was entered in the clinic on April 25, 1904. She had been owned by the party who presented her for three years. Elev-

en months prior to entrance she had been taken to a stallion for breeding, and when the stallion groom examined her he thought that the os uteri was much constricted. After using considerable force he succeeded in passing one finger through the os. Immediately afterwards she was served, but did not conceive. Since that time she had regularly shown signs of estrum. Six months prior to entrance in our clinic, the owner observed intermittent discharges from the vulva, of a thick, white, muco-purulent character. At times while at work, she would discharge a large amount of pus, and then for several days the discharge would virtually cease. Examination revealed the os uteri rigidly contracted. After repeated and laborious attempts we succeeded in passing two fingers into the uterus. We introduced a piece of rubber hose into the uterus, and withdrew seven quarts of a thick, grayish-white viscid pus. We then washed the cavity of the uterus repeatedly with 1-1000 corrosive sublimate solution, after which we introduced some two quarts of the solution into the cavity, and allowed it to remain. We then packed the os uteri firmly with gauze.

Internally we prescribed copper sulphate 1—1½ oz., nux vomica 3 oz., potassium iodide 5 oz., mixed and divided into twenty-four powders, of which two were directed to be given daily in the food.

During the forcible dilation of the os, the mare strained violently and offered considerable resistance. On April 26 the mare was straining a great deal, though not very violently. After removing the pack, it was found that the os had dilated but little. The rubber hose was again introduced into the uterus, and the cavity thoroughly washed out with a solution of lysol. After repeated injections until the siphoned fluid came away clear, we introduced into the uterus a solution consisting of tannin 1 oz., carbolic acid 1 dram, glycerine 4 oz., water 1 pint. We then packed the os as tightly as possible, after which she strained very violently. She was given one ounce each of chloral and powdered ginger, which gave relief.

On April 27 there seemed to be little progress in dilating the os by means of the pack. After thorough disinfection of the parts, the os was forcibly dilated until the hand could be passed into the uterus. The uterus and horns were found greatly dilated, with thickened, paralysed walls. After thoroughly irrigating the cavity with lysol solution, we deposited about 1 dram of powdered iodoform in each cornu, and injected, and allowed to remain in the uterus, the solution used upon the preceding day. We then inserted into the os a gauze bag, which had been smeared with iodoform and lard, and followed this by packing the bag as full as possible of surgeon's cotton, saturated with corrosive sublimate solution.

On the 28th we removed the pack, and found no accumulation of pus. The cavity was washed with lysol, after which the solution of carbolic acid, tannin and glycerine of the preceding days was repeated. On April 29 examination showed that the uterine walls were resuming their normal condition and contractile power. The treatment of the previous day was repeated. The same treatment was applied on the 30th, and the case was left without interruption on May 1. Examination on May 2 showed a small amount of mucus in the uterus. The treatment of the previous days was repeated.

Recovery was now rapid, and she was discharged fully convalescent on May 7, or thirteen days after the beginning of the treatment.

CASE 6.—A mare aged 14, weighing about 1,050 lbs., was entered in the clinic on October 6, 1904, for poll-evil. During the operation for poll-evil, under chloroform, there was a constant discharge of a very fetid black pus from the vulva. A rubber hose was inserted into the uterus, and 4 gallons of pus siphoned away. Upon the following day one and a half gallons of pus were removed, and the uterus was washed with a solution of potassium permanganate 1-500. Three of these injections were employed consecutively, each consisting of 2½ gallons of the fluid. On the third day the amount of pus collected in the uterus had decreased to one quart. The treatment of the previous days was repeated.

The accumulation of pus in the uterus gradually decreased from day to day, and became lighter in color. On October 12 the pus had assumed the ordinary muco-purulent character in colour and consistence, and was free from odor.

On the first day there appeared to be some blood clots in the discharge, and the highly fetid pus had the appearance of broken-down melanotic tissue. Microscopical examination of the pus revealed streptococci, and a peculiar fungus which was apparently responsible for the color.

From the beginning of our treatment the mare had received daily in her feed ½ oz. of iodide of potash and ¼ oz. powdered nux vomica. On October 18 the administration of potassium iodide and nux vomica was decreased one-half; the discharge was constantly growing lighter in color; and the pus was being replaced by mucus.

During the entire course of treatment the os had been very much constricted, and each day forcible dilation was attempted, but it was not until the 20th that it was practicable to insert the entire hand into the uterus. On the 22nd, the potassium permanganate injection was replaced by the carbolic acid, tannin and glycerine solution described in the previous cases. On October 24 the same treatment was repeated, with the addition of one ounce of powdered iodoform deposited in the uterus before the injection of the disinfecting solution. On October 26 the os was well dilated, there was a small amount of mucus present, the uterine walls were contracting, and and the patient was convalescent. She was discharged on October 27, after twenty-one days' treatment.

CASE 7.—A mare. aged 7, weighing about 1,000 lbs. was entered in the clinic on October 13, 1904, for chronic metritis. The owner related that she had had a very pendulous abdomen for some time and had shown an intermittent vaginal discharge. She had expelled a considerable quantity of pus on the day of entrance. A rubber tube was inserted into the uterus, and 5 gallons of thick, whitish pus withdrawn. The cervix uteri was hard and unyielding, and the os much constricted. The mucosa of the uterus felt much thickened. Only two fingers could be passed through the os into the uterus. The uterus was washed daily, up to October 20, with a solution of permanganate of potash. On October 20 the permanganate of potash was discontinued, and in its stead we injected into the cavity a solution consist-

ing of tannin one ounce, carbolic acid one ounce, glycerine three ounces, and water one gallon. This line of treatment was continued until October 25.

Throughout the course of the treatment, attempts had been made to dilate the os uteri, but had not succeeded, and consequently on October 25 we inserted a uterine dilator, and forcibly dilated the os uteri until the hand could almost be passed into it. The os was packed with gauze saturated with 2 per cent. lysol. On the following day there was a considerable accumulation of fetid pus, and the os uteri was much swollen. The uterus was washed with 0.5 per cent. potassium permanganate solution, and the os was packed with gauze saturated with lysol® solution. On October 27 we succeeded in inserting the hand into the uterus. The treatment of the previous day was repeated, and continued until November 3, when the cavity was injected with corrosive sublimate solution, after which we deposited in the uterus half an ounce of iodoform and two ounces of olive oil. This line of treatment was now continued, and the case improved rapidly until November 16, when the patient was discharged convalescent.

Case 8.—A farm mare, aged 21, was entered in the clinic on May 3, 1905, for chronic metritis, The owner related that a whitish vaginal discharge had been present to some extent for three years. She had given birth to a foal in the spring of 1904, since which time the discharge had been much increased. The os uteri was dilated so that the hand was readily passed into the cavity. The uterine walls were flaccid and thickened. The uterus contained a collection of fetid pus. The uterus was washed with a 1-2,000 corrosive sublimate solution.

Owing to the paretic condition of the uterine walls, there was difficulty in expelling the fluid. She was given internally nux vomica and sulphate of copper. The case was discharged on the day of entrance, and the owner was directed to wash the uterus daily with 1-2,000 corrosive sublimate solution. It was later reported that in the hands of the owner the treatment proved unsatisfactory and the animal was destroyed.

b. Chronic Metritis in the Cow.

Chronic metritis in the cow occurs chiefly in those animals which are closely housed, used for dairying purposes, and regularly bred.

The causes appear to be chiefly retained fetal membranes or improper manipulations during dystokia. It appears to be especially common in the granular venereal disease, or granular vaginitis. Whether in these cases it results indirectly from retained placenta as a consequence of the disease, or directly from the extension of the disease into the uterine cavity, is not clear.

The symptoms in the cow consist mainly of a chronic purulent discharge, of a dirty gray color, accompanied sometimes by indifferent health, with loss of condition and decrease of milk. In many cases, in addition to these general signs, there is, in the

cow, a tendency to prolapse of the vagina. Usually the discharge occurs while the cow is in the recumbent position, and the dirty reddish-gray accumulation is found lying behind the patient in the gutter. In cases where prolapse of the vagina occurs, the discharge from the uterus may largely pass unnoticed. In many cases of chronic metritis in the cow, the discharge from the uterus is intermittent, may be comparatively insignificant in volume, and therefore not readily observed.

When such a discharge appears at the vulva, or the animal seems to be in indifferent health, or is sterile, it is well for the veterinarian to make a manual exploration of the uterus and determine its condition. If chronic metritis exists, the uterus will be found enlarged, according to the amount of pus retained within its cavity. The amount of liquid within the uterus may vary between one pint and 4 or 5 gallons. The os uteri is firmly closed; otherwise the imprisonment of the pus would not be so marked. Chronic metritis in the cow constitutes an important cause of sterility.

Handling. The handling of chronic metritis or pyometra in the cow must be based upon the same general principles as already related in detail for the mare. In the disinfection of the organ one may follow the method already suggested for the mare, dilating the os uteri and injecting disinfectants into the uterine cavity. The problem of dilating the cervical canal in the cow is far more difficult than in the mare, because of anatomical conditions. The treatment consequently requires more time and effort than in the mare.

A second plan for dealing with chronic metritis or pyometra in the cow has been proposed by Hess, and already described while discussing the subject of sterility on page 224. According to Hess, his plan of handling pyometra by pressing out the persistent yellow body of the ovary, and then applying massage to the uterus from before backward, has been followed by gratifying results. This plan has proven effective in our hands.

c. Pyometra in the Bitch and Cat.

In the bitch and cat, pyometra seems most common in those animals which have been bred and later excluded from breeding, but may occur in animals which have not been bred at all.

The symptoms are very similar to those already noted in the

mare and cow, and include a general weakness and emaciation of the patient, combined with a grayish-red discharge from the vulva, which stains the bedding. When the uterus becomes much distended, the size of the abdomen may be augmented, and the enlarged, fluctuating uterus may be recognized by abdominal palpation.

The handling of the disease in these animals is to be based upon the same general principles as in the preceding cases, modified by differences in the size of the patient and the form of the uterus.

Owing to the smallness of the uterus, and its form, it is well-nigh impossible to effectively irrigate and disinfect its cavity. A catheter or other tube may be pushed along through the vagina into one of the horns, but it can scarcely advance to the apex or be introduced at will into the right or left cornu ; nor can the veterinarian determine, after it has entered one of the cornua, which one it occupies. The irrigation with antiseptics is consequently indefinite and unsatisfactory.

Hobday (Vet. Jour., Jan., 1907, page 30) relates that he has had favorable results in rare instances by the administration of the extract of hydrastic Canadensis, while a solution of the same was used as an injection into the vagina.

Hobday recommends, instead of antiseptic irrigations or internal medication, the operation of hysterectomy, because as a general rule the more conservative measures ultimately fail to bring about recovery, while hysterectomy in his experience has been safe and efficient. The technic of this operation has been described on page 669.

It is essential to carry out the operation under the strictest aseptic precautions, and to this end it is well that the operation be performed under general anaesthesia.

3. Uterine Abscess.

When chronic purulent metritis is complicated with atresia of the os uteri, there ensues a condition which may be best described as uterine abscess. The line of demarcation between chronic metritis or pyometra, described in the preceding article, and uterine abscess is not clear. In the former the evacuation of the uterine contents is sometimes constant and sometimes intermittent. The intermittent character may be due to a

temporary atresia of the os or the cervical canal, and the final discharge of the accumulated fluid may be the result of a breaking down of the adhesions in the canal, in a way which might be compared to the rupture of an abscess. In some cases, however, the atresia or closure of the os is more persistent, and brings about a state which cannot be better designated than as abscess.

The causes of abscess of the uterus are similar to those of chronic metritis, and are very largely referable to infection following manipulations during dystokia or to retention of the fetal membranes.

The symptoms of uterine abscess differ from those which are typical of chronic metritis. The disease is observed chiefly in the mare. The principal symptoms observed are those of general debility accompanied by some emaciation and general appearances of ill-health, with evidences of abdominal pain, which may be described as colic. Later, expulsive efforts appear. The uterine walls serve as abscess walls, and the tension within the cavity constantly increases, until finally the walls rupture in the direction of least resistance, and the contents escape. So far as we have observed, the abscess ruptures into the vagina, apparently through the occluded os uteri.

Under these conditions a manual exploration per rectum reveals an enormously enlarged uterus, very tense and fluctuating. The uterus may contain as much as 4 or 5 gallons of pus. The organ loses its usual form, and becomes more or less spherical.

Manual exploration per vaginam reveals a normal vulva and vagina ; but the os uteri is absent, and that portion of the uterus which normally projects into the cavity of the vagina has become wholly effaced. The anterior wall of the vagina appears as a tense partition, without any opening toward the uterus. Through this wall the distended organ may be readily felt, or rather we might say that the anterior vaginal wall, with which the hand comes in immediate contact, constitutes the posterior wall of the abscess cavity.

In one mare we had considerable difficulty in overcoming dystokia. After the fetus was removed by means of embryotomy, the mare did not recover with that promptness and completeness which should be expected, and finally began to decline. Later

she was presented for examination because of frequent colicky pains and expulsive efforts. Upon manual exploration per rectum, the uterus appeared as an immense spherical sac containing 5 or 6 gallons of liquid. Upon introducing the hand into the vagina, the os uteri could not be definitely recognized, and there was no opening extending forward into the uterine cavity.

The owner hesitated about an operation, and after a few days, upon going to the stable in the morning, he found lying in the stall behind the mare some 5 or 6 gallons of thick and extremely fetid pus.

Handling. The treatment of uterine abscess shoud be essentially the same as that for other abscesses. The abscess cavity should be freely opened, and its contents evacuated, followed by thorough disinfection. The point for opening the abscess is through the occluded os uteri. The opening may be made with a scalpel, or a finger may be thrust through the wall, if not too dense. The opening should be sufficiently dilated that the hand may be passed through into the abscess cavity. The later treatment is the same as for chronic metritis.

The prognosis in uterine abscess should be guarded. The life of the patient may usually be saved. The abscess tends to cause occlusion of the oviducts and consequent sterility.

4. Vaginitis and Vulvitis.

Inflammation of the vagina and vulva almost inevitably accompany acute metritis, because the passage of infected and irritant discharges from the uterine cavity must contaminate the mucous membrane of these organs in escaping externally. In such cases the vaginitis and vulvitis normally disappear when the metritis recovers. Aside from this we sometimes meet with inflammation of the vagina and vulva without the uterus becoming involved.

Causes. Anything which may cause contusions, lacerations or abrasions of the vaginal and vulvar mucosa tends to cause the disease, if added to this there is favorable opportunity for infection. In dystokia, the manipulations of a careless obstetrist may do much to lacerate and abrade the vagina and bring about infection of the wounds. Laymen and empirics, as well as some veterinarians, frequently use old, dirty cords or ropes, made of very coarse, harsh material, for carrying out obstetric operations.

These lacerate and abrade the genital passages in a highly repulsive manner, and simultaneously deposit the infection in the maimed tissues. Add to these, dirty hands of careless operators and the virulent infection from a putrid fetus or fetal membranes, and a highly dangerous infection of the vagina or vulva is almost inevitable.

Necessarily no differentiation can usually be made between inflammation of the vagina and of the vulva, since these two canals are continuous at the time of parturition, and the vagina cannot well be involved without the vulva sharing in the disease to a greater or less extent, and vice versa.

Inflammation of the vagina or vulva may lead to suppuration, ulceration or gangrene. Necrosis of the lips of the vulva, or of the walls of the vagina, may lead to a rapidly fatal termination ; or, should the patient survive, the vulvar lips may slough away, and more or less atresia of the vulva or vagina result. While dealing with dystokia in the anterior presentation, due to the extension of the posterior limbs beneath the fetal body, we related, on page 778, three cases in which serious vulvitis, vaginitis or cystitis followed, one case ending fatally.

The lips of the vulva, and the mucous membrane of the vulva and vagina, become inflamed and swollen. If the lips of the vulva are parted, the mucosa is observed to be of a deep red or dark blue, or a necrotic greenish-black. Usually there are also visible lacerations or abrasions of the mucous membrane, with more or less suppuration. The swelling and pain in the parts may cause difficulty in defecation or urination.

The prognosis of vaginitis and vulvitis must be based upon the extent and virulence of the infection. Where the necrosis of the tissues is not extensive, the prognosis is usually good; but when there is extensive gangrene, accompanied by general septicaemia, a fatal issue may be expected. In cases of more or less extensive ulceration or gangrene, without marked septicaemia, there may be highly important adhesions or constrictions, which may serve to prevent thereafter the breeding of the animal.

The treatment of vaginitis consists essentially of disinfection, which needs be vigorous and thorough. The attending veterinarian should guard with all possible care against septicaemia in cases of gangrene, by the administration internally of quinine,

potassium iodide or other similar remedies in large doses, in addition to vigorous local disinfection.

In all cases of dystokia where the obstetrist has reason to fear vulvo-vaginitis, he should apply strict prophylactic measures, in the form of careful and repeated irrigations with warm antiseptics, and the washing of the tail, vulva, anus and surrounding parts frequently with reliable antiseptics like 2.5% carbolic acid solution.

5. Cystitis.

Septic inflammation of the bladder, as a result of puerperal infection, is not a very common malady in domestic animals. We have observed one case in the mare, which we have already briefly related at the bottom of page 778.

After overcoming the dystokia, the vagina and vulva were cleansed as well as practicable, but the case was neglected and not seen by us again for some weeks, when we found severe vaginitis, vulvitis and cystitis. The cystitis was the most formidable of the lesions. The meatus was open, and the index finger could readily be passed into the cavity of the bladder. The walls of the bladder were thickened, and the mucosa was thrown into extensive folds, which were covered over by crusts of urinary salts, mixed with pus. The purulent urine had a very fetid odor. The cavity of the bladder was small, and the thickened walls paretic and inextensible, so that the urine flowed from the bladder involuntarily, producing an intense irritation of the vulva. Dribbling down constantly over the thighs, the urine kept these parts repulsively soiled and excoriated, and the tail constantly wet and filthy.

The treatment of purulent cystitis consists essentially of the disinfection of the vagina, vulva and bladder. Somewhat mild and efficient antiseptic fluids, such as a 0.5% solution of carbolic acid, or, perhaps better, 0.1% permanganate of potash, should be injected into the cavity of the bladder. On account of the precipitation of the urinary salts on the walls of the bladder, it might be well to slightly acidulate the fluids injected into the viscus, in order that the urinary salts may be dissolved, and hence the irritation caused by their presence overcome. The disinfection of the vagina, vulva and bladder should be frequently repeated, at least once a day, and persisted in until complete recovery is assured.

6. Peri-vaginal Abscesses.

In difficult labor, much of the violence to the genital tract is concentrated upon the vagina and the pelvic portion of the uterus. These parts may be caught between unyielding portions of the fetus and the bony walls of the pelvis, and become more or less seriously contused, abraded or lacerated. In addition to these injuries, the obstetrist may irritate the parts in some measure with his hands and arms, and with instruments and apparatus, especially with coarse cords or straps for the exertion of traction. Under these conditions the walls of the vagina are liable to become seriously infected. The septic material, finding its way deeply into the tissues, eventually induces the formation of abscesses in the walls of the vagina itself or outside in the pelvic connective tissue. More anteriorly, the infection of the vaginal walls may cause adhesions between the vaginal or uterine peritoneum and the walls of the pelvis, and lead to the formation of abscesses between these two layers of adherent peritoneum or in the adjacent connective tissues.

The abscesses occur with greatest frequency, according to our observations, along the floor of the vagina in the region of the bladder, and, when very extensive, press upon that organ and interfere with urination. They may so involve the walls of the bladder as to cause a rupture of that organ, either into the vagina or the peritoneal cavity. The abscesses may rupture into the vagina, rectum, or peritoneal cavity.

The symptoms of peri-vaginal abscesses consist at first chiefly of a stiffness in the posterior portions of the body, with a disinclination to move, accompanied by general febrile disturbances, including elevation of temperature, loss of appetite and general dullness. The vulva is usually swollen, and upon separating the lips, the mucous membrane is usually found to be swollen and dark colored. Defecation is painful, if not difficult, because of the extreme sensitiveness of the parts, accompanied by more or less extensive swelling. If the abscesses are forming between the pubis and the vaginal floor, the act of urination is almost inevitably accompanied by pain and difficulty.

Upon manual exploration of the vagina, the parts are found to be very hot and sensitive, while at some point, most probably along the vaginal floor, extensive, hard swellings may be felt,

which, later in the progress of the disease, fluctuate. In a mare we observed almost the entire floor of the vagina involved in a series of large abscesses, which extended forward as far as the pubic brim. The fluctuation could be readily felt. The parts were exceedingly tender, and the animal moved with very great difficulty.

The prognosis of peri-vaginal abscesses must be based largely upon their location and the possibility or probability of their rupturing or being opened into the vagina or rectum.

The handling of peri-vaginal abscesses should be in accordance with general surgical principles, and should consist fundamentally of opening the abscesses into the vagina or rectum at the earliest possible moment. In the instance which we have already cited, we hesitated too long to open the abscess, lest we might thereby open the peritoneal cavity, and hoped for a spontaneous rupture into the vagina, but our delay permitted the abscess to rupture into the peritoneal cavity instead. It is hazardous to delay opening the abscesses. If they cannot be safely opened into the vagina or rectum, then fatal rupture into the peritoneal cavity is practically certain. Thorough irrigation of the vagina and abscess cavity should be applied daily or more frequently, according to circumstances. Internal antiseptics, such as quinine and potassium iodide, in full doses, are indicated.

7. Pyæmic Infection.

Aside from the strictly local infections of the genital tract, lesions of these organs afford a portal for the entrance of infections of various kinds into the system. The infecting organisms may gain the lymph or blood circulation, and be carried to distant parts of the body, where they may become lodged to multiply and produce localized inflammation, with the formation of abscesses or other changes, to constitute pyæmia. Pyæmic inflammations may involve any tissue or organ in the body, and consequently may produce a great variety of symptoms. In obstetric practice we observe chiefly, as pyæmic diseases belonging to the puerperal state, poly-arthritis or pyæmic arthritis, and metastatic inflammation of tendon sheaths.

a. **Poly-arthritis** may be defined as an arthritis following parturition, and generally involving several joints, especially the tarsal, carpal, and femoro-tibial articulations. No articulation is

immune. According to de Bruin the disease may have its origin in the articular serous membrane or in the bone marrow, and may be either serous or purulent in character. It is observed chiefly in the cow.

It is believed that the infection reaches the articulations primarily by being taken up by the veins from the uterus, probably in the form of small thrombi, which, passing to the heart and thence to the lungs, succeed in passing through the latter organs and gaining the systemic circulation, through which they eventually reach the synovial membranes or marrow of the bone, where the micro-organisms lodge and multiply to induce arthritis.

As a rule poly-arthritis follows some recognizable puerperal infection of the uterus, such as retained placenta, or other disease, followed by more or less evident metritis or vaginitis. In some instances the disease follows an apparently normal puerperal period, presumably because some very small wound of the mucosa of the genital tract, or other injury, has led to an infection which has escaped notice until the arthritis appears.

The symptoms of poly-arthritis usually appear at about 6 to 8 days after parturition, though they may be delayed for some weeks. They consist chiefly of stiffness in the gait, accompanied by more or less distinct lameness and difficulty in getting up. Pain is very evident, and the animal assumes the recumbent position for a large part of the time. There is well marked fever, with the accompanying symptoms of loss of appetite, cessation of rumination and a decreased secretion of milk. An examination of the uterus may reveal the presence of retained placenta, or of a dark-colored fluid, which may or may not be fetid.

The pain in the affected limb is so great that the animal declines to bear weight upon it so far as avoidable. The capsule of the joint is distended and tender. The epiphyses of the bones are sometimes swollen and painful. If more than one joint is simultaneously involved, the movements of the animal become exceedingly difficult and painful. The symptoms may be complicated by metastatic inflammation, or abscesses of some of the internal organs, which may cause edema of some of the dependent parts of the body.

The prognosis is variable. If the arthritis is serous in character, perhaps we might say if it is due to the irritation of the bacterial products in the part rather than to the presence of

the bacteria themselves, the disease may run a favorable course, with complete recovery in a comparatively short time. When the bone marrow is involved, the disease becomes more serious, and a fatal termination is probable, as is also the case when the disease assumes a purulent character and abscesses form in or about the articular capsule.

Upon post-mortem examination the synovial membranes of the joints are found reddened and thickened, and the superficial epithelium destroyed. The synovia is of a dark yellow color, or purulent in character, while the tissues outside the capsule are infiltrated. Scattered here and there are small purulent centers. The articular cartilage may be eroded and destroyed, and the epiphyses of the bones may have undergone purulent destruction.

Handling. Our first care in the handling of the disease should be the thorough and repeated disinfection of the genital tract, in order to prevent further absorption of septic material from the original source. If the fetal membranes, or fragments of them, still remain in the uterus, they should be removed. If some of the cotyledons are necrotic, and destined to slough away, the process should be hastened by their removal, and the organ thoroughly irrigated with antiseptic solutions.

Reliable antiseptics should be applied to the affected articulations by means of a large pack of cotton, jute or oakum, kept constantly saturated with the disinfectant. In some instances where the bone is extensively involved, it has been recommended to apply the thermo-cautery in small punctures. When abscesses form about the joint, they should be treated according to surgical principles, though as a general rule they cannot be successfully handled.

Internally the animal may receive antiseptics, among which de Bruin especially recommends camphor and turpentine.

b. **Metastatic Tendovaginitis.** Under this title de Bruin describes an inflammation of the tendon sheaths of cows during the puerperal state, occurring chiefly in the great flexor tendons.

The symptoms consist of a stiffness in the gait, with evidences of pain, accompanied by loss of appetite and of milk secretion, and a tendency for the animal to remain in the recumbent position. Examining the animal locally, the veterinarian finds the tendon sheaths hot, swollen and tender. The disease may co-exist

with poly-arthritis. The prognosis is fairly good if only one of the limbs is diseased ; but if all are involved, extreme emaciation is probable, along with extensive decubitis gangrene. These tend to greatly complicate the disease, and render the prognosis very grave. Even here, however, prompt and vigorous measures may save the life of the animal.

Handling. The general line of treatment is identical with that of poly-arthritis. The uterus should be cleansed and disinfected. The affected tendon sheaths should be enclosed in antiseptic packs, which are to be kept constantly moistened. If the tendon sheaths undergo suppuration, they should be freely opened from end to end upon the median line, and the cavity packed with gauze saturated with tincture of iodine, in order to bring about at once a thorough disinfection of the parts. Over this there should be placed an ample pack of surgeon's cotton or oakum, saturated with a reliable antiseptic.

8. Puerperal Septicæmia.

Puerperal septicæmia signifies the entrance into the general system of septic products, accompanied or not by the bacteria by which these products have been formed. Technically a distinction is made between septicæmia—by which pathologists understand the entrance of micro-organisms along with their products into the blood, and the continued multiplication of the bacteria in the body fluids—and sapræmia or toxæmia—by which is understood the entrance into the blood of the bacterial poisons only.

Clinically the differentiation between septicæmia, bacteriæmia and sapræmia is not easily defined. Yet they present an essential difference in prognosis. The condition accompanies to a greater or less extent most forms of septic infection of the genital tract during the puerperal state, but the intensity of the septicæmia is not necessarily parallel to that of the local disease. We meet clinically with very extensive septic inflammation of the uterus, resulting from a retained fetus undergoing putrid decomposition over a period of days, weeks or months, or from retained placenta undergoing rapid decomposition, during which the cotyledons may become necrotic and slough off, while the degree of septicæmia or sapræmia may be very insignificant. On the other hand, there may occur virulent septicæmia in the

presence of comparatively slight discoverable disease of the genital tract.

The disease may follow dystokia or normal birth, and the port of entry for the bacteria may consist of wounds or abrasions or of the denuded mucosa, resulting from the separation of the placenta. The organisms may be introduced by the obstetrist or other persons upon the hands or arms ; by means of instruments or apparatus, or in various other ways.

Symptoms. The symptoms of septicæmia are acute. The disease is usually ushered in suddenly in from one to four or five days after parturition or after the death of the fetus, with open os uteri and decomposition of the uterine contents. The symptoms consist chiefly of the general signs of fever, including elevation of temperature, cessation of feeding and of rumination, decrease in milk secretion, quickened pulse and respiration, with injection of the visible mucous membranes.

Locally there is swelling of the vulva, and when the disease is very intense the vulvar lips may become greatly tumefied, cold to the touch and blue-black in color. The vulvar mucosa is swollen and dark colored, and may show wounds or ulcers. The contents of the uterus may consist of shreds of placenta, with accumulations of pus of variable color, which is usually very fetid.

The patient generally shows extreme weakness and listlessness.. Most animals tend to lie down much of the time. The eyes soon become lustreless ; in the cow they may appear swollen. Ruminants may grit the teeth, and moan.

The bowels are irregular, at one time showing constipation, at another a fetid diarrhea. If purgatives are given, especially saline, oleaginous or aloetic, superpurgation is highly probable.

Acute puerperal septicæmia is usually fatal, generally ending in death within a few days. It sometimes runs a very stormy course. We have observed cases in the cow which have ended fatally in less than 24 hours after the advent of signs of disease.

Pathology. The changes in the genital tract are not always in harmony with the profound effect upon the general system. A diligent search may fail to reveal very pronounced changes in the uterus or vagina. The blood is thin and does not coagulate, and the muscles are pale and have the appearance of having been cooked. There may be more or less evident metritis, with all the changes belonging to that affection.

The peritoneum shows here and there ecchymoses. Enteritis may be present. The liver, spleen and kidneys show well-marked degeneration, and are somewhat enlarged and friable.

Handling. All attempts at therapeutics usually fail. De Bruin recommends camphor, turpentine and alcohol, but without having any faith in their bringing about a cure. He very properly places the chief emphasis upon the question of prophylaxis. Especially is it important that the veterinary obstetrist should take due precautions against acting as a bearer of the infection through his person, instruments or apparatus.

Any animal suffering from septic infection of the genital tract, or, for that matter, of any other organs or tissues, should be carefully excluded from the stable and vicinity of parturient animals, and there should be no intermediary communication between them by which the transportation of infecting material from one to the other is rendered possible.

Whenever a veterinarian is called to attend a parturient animal suffering from fever or other systemic disturbance, the genital tract, and especially the uterus, should first of all be thoroughly examined in order to determine whether it be the avenue of a serious infection.

Should the examination reveal septic utero-vaginal disease, no time should be lost in thoroughly cleansing and disinfecting the genital tract.

Time and again the careless veterinarian treats an animal, especially a cow, for indigestion, constipation, diarrhea or some other symptom of disease, without taking the trouble to examine the uterus and learn therefrom that the constipation, diarrhea or or other symptom which he is handling is dependent upon a serious puerperal infection, which demands prompt and vigorous treatment. The handling of these conditions falls essentially under "Retained Placenta," page 791, and "Acute Metritis," page 872.

9. Puerperal Laminitis. Paturient Laminitis.

While describing endometritis in the mare we had occasion to refer to parturient, or puerperal laminitis. So far as we have been able to determine, parturient laminitis occurs in the mare only, though there is no reason why it may not occur in ruminants, where laminitis from other causes is not unknown. Flem-

ing cites Roloff as having observed a peculiar inflammation of the feet of cows just after parturition, though the description which he gives does not fully identify it with laminitis.

Parturient laminitis in the mare is a well-nigh constant accompaniment of endometritis. It is so common that it may be regarded as an essential part of that malady. It is probably overlooked sometimes because there are present, in endometritis of the mare, two painful areas—the abdominal pain due to metritis, and the pain in the feet from the laminitis, each of which induces a stiffness in the gait which is very much like the other.

The nature of parturient laminitis, so far as we have been able to observe clinically, does not differ in any essential respect from the laminitis due to irritation of the intestinal tract from indigestion. It appears to be a purely metastatic inflammation, dependent directly upon the irritation in the uterus as a result of endometritis, and the absorption from the uterine mucosa of the products of bacterial decomposition.

The symptoms of puerperal laminitis are identical with the symptoms of the laminitis following indigestion. It usually occurs in those cases of endometritis in the mare which have their origin in a retention of the placenta in the non-gravid horn of the uterus. As a rule it follows an apparently normal birth, in which the placenta has been expelled promptly, and so far as the owner observes, completely, but that portion of it which has occupied the non-gravid cornu has been broken off and retained. In the course of 48 to 72 hours after parturition, there appear the general symptoms of endometritis, as already described on page 874. Upon examination, the fragment of placenta may still be found in the non-gravid cornu.

At the same time that the symptoms of endometritis are first observed, well-marked laminitis also usually appears. The disease may involve the two anterior feet, or all four feet. As in ordinary cases of laminitis, the animal moves with great difficulty, and places its weight upon its heels so as to relieve the sensitive laminæ upon the anterior walls of the feet from pressure as far as possible. If the disease is very severe, the animal tends to persistent recumbency, or stands riveted to the spot and can hardly be induced to move.

Examination of the hoofs reveals a distinct elevation in their temperature, varying of course according to the intensity of the attack. Throbbing of the arteries of the feet is very evident.

The prognosis of the disease is generally highly favorable, and is parallel to the prognosis of the endometritis. In fact the two diseases are inseparably bound up together, so that their prognosis and handling are essentially identical. Like laminitis from other causes, so puerperal laminitis is largely a disease of the draft animal. The prognosis will depend to a degree upon the size of the patient. The gravity of the disease increases with the weight of the animal.

The handling of the endometritis we have already discussed on page 874, and it is only essential at this time to consider the local treatment of the laminitis. There are two plans for handling the inflammation of the feet, each of which has its devotees —hot and cold applications.

We distinctly prefer the application of cold, either in the form of water or of ice, and that the application be continuous and ample. If the animal is recumbent or can be induced to remain recumbent, so much the better, because it relieves the feet from the weight of the patient. In the recumbent animal, cold water is not readily applied, and consequently one may most conveniently apply ice poultices, renewing them frequently in order to maintain constant refrigeration. If the animal can readily stand, and will do so, it should be placed in a bath of cold water, the temperature of which may be reduced to a low point by the frequent addition of ice. The cold water bath should extend up to or above the fetlocks, and the floor of the bath should be of some yielding substance, so that the entire plantar surfaces of the feet may contribute to the support of the weight. The shoes should be removed in order to prevent the sinking of the os pedis, or the dropping of the sole may be still better prevented by the application of special padded shoes, and the weight distributed equally over the entire plantar surface of the hoof.

The internal treatment and the handling of the uterus, which have already been discussed on page 875, are quite as important as the local applications to the feet.

10. Puerperal Tetanus.

In discussing the question of retained placenta in the sheep on page 811, and of prolapse of the uterus on page 827, we have alluded to the rare occurrence of tetanus as a complication. We observed one case of tetanus following retained placenta in a cow.

Tetanus infection may find entrance into the genital tract under still other conditions during the puerperal state, and induce typical tetanus. The obstetrist or others may readily introduce the bacilli into the genital tract, during a case of dystokia or the removal of placenta. Having gained the susceptible genital tract, the organisms may there multiply and induce the disease.

The period of incubation, symptoms, pathology and treatment are identical with those of cases of tetanus in which the micro-organisms have entered by other avenues. The number of cases of puerperal tetanus is small, so that the comparative prognosis is uncertain. In the case of prolapse of the uterus mentioned on page 827, the mare recovered successively from uterine prolapse and from tetanus.

PUERPERAL ECLAMPTIC DISEASES.

In domestic animals there occurs with considerable frequency a group of diseases characterized chiefly by a profound disturbance of the central nervous system, which express themselves either in tonic and clonic spasms or in coma. These diseases appear usually soon after parturition, but may occur during the act or shortly prior to that event. They all run a very rapid and stormy course, with a high mortality, except their course is interrupted by prompt and judicious treatment.

The pathology of this group of diseases is unknown. Various theories have been propounded to account for the occurrence of these affections, but none of them have met with general acceptance, and the correctness of none of them has been shown. Post-mortem examinations have revealed various lesions or alleged lesions, which may be regarded as results of, rather than the cause of, the malady. They fail to reveal the true character of the disease. For example, there is frequently found in parturient paresis of the cow a well-marked pneumonia, which we know is not a part of the disease, but an inter-current complication due to the inhalation of food particles or medicines. Hemorrhages upon the brain have been found; but this is not strange if an animal has thrown itself about violently for a number of hours, striking its horns with great force against the wall, floor or ground, and thus causing more or less injury by concussion of the brain. In a similar way we might account for other lesions which have been discovered upon post-mortem examination. In many instances the post-mortem revelations are *nil*, and it would appear from such knowledge as has been gained up to the present time that in reality no lesion has been discovered which constitutes an essential part of the malady, and consequently that its true pathology is unknown.

The causes of this group of maladies in domestic animals are unknown. It is difficult to arrive at a general conclusion, because various reasons are assigned, and there is no general agreement as to what maladies should be included in the group.

In woman there occurs a somewhat common and highly fatal disease known as parturient eclampsia, which some authors consider identical with the parturient paresis of the cow, while others strongly dispute the identity or analogy of the two.

The eclampsia of woman occurs most frequently, or in approximately 50% of the cases, during birth. About 25% occur before parturition, and the other 25% after childbirth. The history of the date of attack of eclampsia in woman and of parturient paresis in the cow are somewhat alike in so far as the occurrence of cases before, during and after birth are concerned, but the percentages of cases during these various epochs are not at all alike. Very few attacks of parturient paresis occur in the cow during pregnancy or labor, and almost all of them during the puerperal state.

Eclampsia in woman is characterized by sudden and severe spasms, which endure for a few minutes, to be followed by a pause and later a recurrence of the spasms. The pause is sometimes characterized by deep coma. The disease usually appears very suddenly, without warning, though in some cases there may be premonitory symptoms of unrest, headache and nervous twitchings. Then follows dilation of the pupil, with loss of consciousness accompanied by clonic and tonic spasms. The jaws are tightly closed, sometimes severely wounding the tongue. The temperature is usually high, and tends to become more elevated as the spasms are more severe.

Upon post-mortem examination, the changes which are observed can scarcely be considered as characteristic of the disease, or as indicating the essential pathology of it.

The symptoms of parturient paresis in the cow admittedly differ widely in a general way from those seen in the eclampsia of woman. This leads Harms to remark that a comparison of the symptoms of eclampsia in woman with this malady would cause anyone who had ever seen a case of milk fever in the cow to at once conclude that they were two wholly distinct maladies. Other veterinary obstetrists believe that the two maladies are essentially identical, in which opinion we concur. The two maladies appear at a similar date as related to parturition, the true pathology of neither has been satisfactorily determined, and post-mortem changes which can properly be considered as the basic lesions of the disease are wanting.

In some domestic animals, especially in the mare, bitch and sow, it is not rare to observe a parturient eclampsia which, in history, symptoms, course and termination, is quite parallel to that observed in woman. There are present similar tonic and clonic

spasms, the well-marked trismus, the *pirouetting* of the eyes, the elevation of temperature, the stormy course and the high mortality.

Though we usually observe profound coma instead of spasms in the parturient paresis of the cow, this does not prove the non-identity of it with the eclampsia of woman. Tonic and clonic spasms are common in woman, and in some of the domestic animals, from a variety of causes. Coma in some animals, like the horse, is exceedingly rare. In the cow coma is a common symptom of disease, and occurs in many maladies. We see it in indigestion, especially from over-feeding, in which, in the horse, in man or in carnivora, we might see spasms. We observe coma in the cow as a result of infections from the uterus or udder, and along with these we may meet with a sub-normal temperature, just as we do in parturient parasis. Coma also appears at intervals in the eclampsia of woman, and tonic and clonic spasms appear in the parturient paresis of the cow. The difference in symptoms is not basic, but rather a question of preponderance of spasms as related to coma, or vice versa, in the different patients.

In one instance we observed a cow in which the general symptoms of eclampsia were present a few hours after easy parturition. The pupils were dilated, the eyes were rolled, there was grinding of the teeth with frothing at the mouth, there were clonic spasms, especially of the head and neck, and a general disturbance of consciousness, so that the animal looked and acted as if temporarily insane. The condition lasted for about two hours, when the symptoms passed into those of ordinary parturient paresis, with the profound coma and sub-normal temperature.

In other instances of parturient paresis we have observed somewhat similar, though less marked eclamptic symptoms in the earlier stages, but these have quickly passed into the characteristic symptoms of paresis.

While our knowledge of eclampsia in woman and in the domestic animals remains so imperfect as at present, with our equal want of knowledge as to the nature of the parturient paresis in the cow, it is impossible to determine precisely what relation they bear to each other. It would appear from the foregoing that, until some positive knowledge as to the actual causes of these diseases is obtained, they should be considered as constituting one great group dependent upon the same general

causes. The disease is expressed somewhat differently by the various species of animals. Here and there a case occupies a middle ground between the symptoms recognized as characteristic of two different members of the group, constituting connecting links which serve to bind them more or less closely together into a highly interesting class of diseases.

a. Parturient Eclampsia in the Mare.

Parturient eclampsia in the mare is a disease which is closely related to the parturient state, and is expressed chiefly by violent tonic and clonic spasms, which run a very rapid course, and quickly terminate in recovery or death, without producing any lesions yet discovered which may be properly considered as fundamental.

So far as we know, the first definite description of this disease was a paper presented by the author before the Illinois Veterinary Medical Association, which later appeared in the American Veterinary Review, Vol. 14, page 559. Since that time a few cases have been described which seem to be identical, and in various personal communications, practicing veterinarians have assured us of the occasional occurrence of this malady in their practice. Under the designation of trismus, Plaskett describes cases which appear identical with ours. (American Veterinary Review, Vol. 23, page 254.)

There is a bare hint of eclampsia in the mare by Fleming (Veterinary Obstetrics, p. 660), who, in speaking of parturient apoplexy of the cow, says, "It is worthy of notice that the first stage of parturient fever, viz., the stage marked by congestion of the brain, is observed in the mare. It soon terminates in death, as is also sometimes the case with the cow, as a result of apoplexy. Such cases, though not sufficiently substantiated by the result of autopsies, have been described by Gerard (Veterinarian, 1874). The mares in question died during parturition, or soon after." Gerard's cases were evidently essentially different from those here described as eclampsia.

My first case occurred in an adult grade draft mare, which had at her side a healthy, vigorous foal, some ten days old. The mare had foaled naturally and easily at the ordinary time, and the very apparent vigor of the foal showed clearly that she had been furnishing an abundant supply of milk. The owner re-

ported that a few hours prior to my arrival the mare suddenly became strangely nervous, assuming a wild look, with staring eyes, restlessness, stiffness of gait, twitching of the muscles, occasionally lying down and getting up. The symptoms all very rapidly increased, until she lay prostrate on her side, unable to rise. In this position I found her, with the whole muscular system exceedingly rigid, breathing labored, convulsions constant, pupils greatly dilated, mucous membrane livid, firm trismus, and the muscles of her limbs so rigid that they could not be flexed sufficiently to raise her upon her chest.

The second case was a high grade draft mare, used exclusively for breeding purposes, and aged six years. The mare was quite large, very robust and had foaled ten days previously without difficulty. The foal at her side was very vigorous and well nourished.

I found the mare lying apparently quiet on her sternum, showing no evidence of suffering and looking quite bright and healthy. Upon approaching her, however, she showed marked nervousness, and at once tried to get up, but appeared to have lost the power of co-ordination. Her efforts brought on clonic spasms of a severe character. Her hind legs knuckled at the pasterns, much as in azoturia.

During my stay she became more nervous and uneasy, making repeated unsuccessful attempts to rise. Respiration was rapid and laborious, and there were constant and severe cramps of the entire body, tremblings and profuse perspiration, all of which appeared to decrease in intensity when we would withdraw and permit her to become more tranquil. The passage of the catheter increased the convulsions quite markedly. There was apparently hyperaesthesia of the vulva, and of the body generally.

I diagnosed azoturia, and prognosticated a favorable termination. Later observations have shown me that mares with young foals do not contract azoturia; moreover, the fact that the mare had been running at grass constantly, precluded the possibility of that disease. She died a few hours later.

During the summer of 1889 an unusual number of cases occurred in rapid succession, showing every degree of intensity. At this date our rapidly developing horse-breeding interests had about reached their maximum in my locality, so that large numbers of mares were kept solely for breeding purposes. Favor-

able weather during the season furnished exceedingly luxuriant pasturage. During that year I observed seven well marked cases, several of which offered favorable opportunities for observation throughout a greater part of the course of the disease.

A well-bred road mare, in high condition, with a vigorous, well-nourished foal, eight to ten days old, at her side, was brought from the pasture preparatory to being bred. Soon after her arrival at the owner's stable, it was noticed that the mare was restless and nervous, her eyes somewhat staring, and occasional muscular twitchings were present. Most noticeable of all was a peculiar, very well-marked throbbing of the chest, which shook the entire body. It seemed like an exaggerated heart-beat, and was quite regular in rhythm and force, but was not rhythmical with the heart-beat. The disturbance seemed greatest along the line of attachment of the diaphragm to the ribs, and the phenomena could be attributed to no other cause than clonic spasm of the diaphragm. There was some trismus present, but not sufficient to prevent the patient from eating with relish and comparative ease.

With quietude and moderate doses of belladonna and cannabis Indica, she made a good recovery in a few hours.

In another case I was called to attend a half-blood draft mare, aged seven years, in prime condition and perfect health prior to the date of my visit. She had foaled ten days before without trouble, and the foal was vigorous and well nourished. She was then brought from the pasture for the first time, and placed in the stable. Within a few hours, symptoms of disease were manifested.

I found the animal in great pain, very nervous, and easily disturbed by any movements or noise. She lay down quite frequently. While lying, she became more tranquil, and all the symptoms abated. While down, the animal lay on her sternum, and did not attempt to roll; in rising she did so with apparent ease. While standing there were constant clonic twitchings of the muscles of the entire body, spasmodic movements of the limbs, frequent changes in posture, trembling, profuse sweating, with the nostrils widely distended, and the movements stiff as in tetanus. There was no protrusion of the membrana nictatans over the eyeballs, but the eyes were staring, the pupils dilated, and the conjunctivæ dark livid in color. There was severe tris-

mus, and the jaws were wholly immovable. As in the preceding case, there was violent spasm of the diaphragm. She was bled freely from the jugular, and given large and repeated doses of belladonna and cannabis Indica. For nearly thirty-six hours the symptoms remained about the same, when they began to abate rapidly, and in 48 hours after the beginning of the attack the mare was in her usual health.

On the same day, on a neighboring farm, I attended another grade draft mare with a similar history of recent easy parturition, healthy foal at her side, etc. Prior to my arrival, she had shown a similar train of symptoms to those noted above; but the owner delayed calling me, so that upon my arrival I found the animal prostrate on her side, the whole muscular system thoroughly tetanized, the eyes set and insensible to light, firm trismus, well-marked opisthotomos, repeated severe convulsions of the entire body, readily increased by any sudden noise.

Barring the want of protrusion of the membrana nictatans and the greater nervousness, the case closely simulated recumbent tetanus. The animal succumbed after about twenty-four hours.

In another case I was called to attend a full-blood draft foal, five or six days old, which was suffering from lameness. In order that the foal might be well attended, the mare was brought from the pasture and placed in the stable. The next morning I was hurriedly called to attend the mare, which I had seen the previous day in apparently perfect health and unusually robust and vigorous. Upon my arrival at the farm I found her greatly agitated, the whole body tetanized, with constant clonic twitchings, spasmodic movements of the limbs, hurried, labored respirations, nostrils widely dilated, visible mucous membranes of a dark livid hue, firm trismus and profuse sweating. When on her feet she could not stand still, but continually moved about involuntarily, and so very uncertainly that she could scarcely be approached with safety. The perspiration was so profuse that it streamed from the dependent parts of her body, the nose was poked out, the head elevated, the back arched, the tail erected, giving the entire body the posture assumed in severe tetanus; but the well-marked protrusion of the membrana nictatans seen in the latter disease was wanting. The animal would lie down frequently, usually on the sternum, in which position she became more tranquil and apparently obtained some relief.

At other times she lay prostrate on her side, in severe convulsions, the legs all rigid, so that the upper feet did not touch the ground, but projected in a straight line from the body. The spasm of the diaphragm was so violent that even when the mare was lying on her sternum her whole body shook violently at each diaphragmatic contraction. When the patient was standing fifteen or twenty feet distant, a loud thumping noise could be heard, emanating from the chest, like violent palpitation of the heart; but upon close examination it was found that the disturbance was not synchronous with the heart-beat.

With great difficulty, owing to the uncertain convulsive movements of the animal, I drew about three gallons of blood from the jugular. This was followed by heavy and repeated doses of fluid extract of belladonna and cannabis Indica every hour.

My prognosis was very unfavorable, as death seemed imminent. After twelve to fifteen hours the symptoms rapidly abated, and within twenty-four hours after my visit she was apparently in her usual health.

In another case, a high-grade draft mare of vigorous constitution, with a well-nourished healthy foal about fifteen days old at her side, was taken from the pasture for the first time since foaling and put to light farm work. In a few hours she had developed all the symptoms enumerated in the preceding cases, and when I arrived she was unable to regain her feet. She rapidly grew worse, and died the same day, within twelve hours from the time she was brought from the pasture in prime condition, and only five to eight hours after the beginning of the attack.

Another case was that of a little imported pony mare in high condition, with a well nourished foal at her side, six or eight weeks old. The pony was brought from the pasture for the first time since foaling, saddled, and placed in the hands of children, who used her for a few hours in the morning. At noon the stableman found some difficulty in removing the bit from her mouth.

This attracted no particular attention, but when the owner attempted to bridle her again after dinner, and failed on account of firm trismus, it was evident that something serious was wrong. A veterinarian was at hand in a few hours, but the pony rapidly developed all the symptoms enumerated in the preceding cases. She was bled from one jugular on the first, and the other on the

second day. In about forty hours after the beginning of the attack, the symptoms suddenly abated, and within forty-eight hours the pony was apparently as well as ever.

We have here a series of cases presenting symptoms no more varied than we would expect to find in different individuals in different stages of the development of the disease, yet passing from one into the other by imperceptible gradations, all apparently due to the same cause.

In the earlier stages, and in the very mild cases throughout, all showed the restlessness, the staring, pirouetting eyes, the clonic spasms, especially marked in the diaphragm. In proportion to the nervousness, the pulse and temperature are little altered. If unchecked, the clonic spasms are largely succeeded by those of a more tonic nature, trismus becomes a marked symptom early in the malady, the restlessness and convulsions increase in intensity, the respiration becomes more labored, the mucous membranes livid from partial asphyxia, the whole muscular system extremely tetanized. The animal finally becomes unable to stand, or to find relief in lying on the sternum, but lies prostrate on the side in constant convulsions until it succumbs from asphyxia.

The history is quite uniform. The disease occurs wholly in vigorous mares, in high condition, of mature age, but not old. They have recently foaled naturally and easily, and have healthy, well nourished foals at their sides. The mammary glands are well developed and active in all cases. In nearly, if not all the cases I have related, the mares had been enjoying unrestricted freedom at pasture constantly since foaling, until taken up a few hours prior to the attack, which was suddenly ushered in without warning.

It seems that a sudden change of surroundings, a change from freedom to the stable or harness, probably by causing maternal anxiety for the foal, has an essential influence in the immediate causation of the disease. The symptoms indicate a grave disturbance of the central nervous system, expressed for the most part in convulsions and spasms of the striated muscles. The symptoms we have enumerated as occurring in the mare bear a close resemblance to those of eclampsia of other lower animals and of woman, as well as to the early stages of parturient apoplexy of the cow.

The disease in the mare is ushered in suddenly, runs a rapid course of twenty-four to forty-eight hours, and terminates as abruptly as it began, in complete recovery, or in death.

The diagnosis should apparently be quite easy in all cases. The history of the case, so far as observed, seems of special value. The clonic and tonic spasms, the extreme trismus, and the peculiar spasms of the diaphragm, are quite characteristic. It may be confounded with :

(a) Tetanus, from which it is distinguished by the sudden onset, the earlier and more complete trismus, the peculiar spasm of the diaphragm, the greater nervous irritability and greater tendency to clonic spasms, the greater tendency to lie down, the dilation of the pupil and pirouetting of the eyes, the absence of the protrusion of the membrana nictatans, the absence of any antecedent wound, the far more rapid course and the usually more favorable termination.

(b) Cerebro-spinal meningitis, from which it is to be separated by its history, its more sudden onset, its cramp unaccompanied by paralysis, its well marked trismus, rapid course and more favorable termination.

(c) Azoturia, from which it differs essentially in attacking animals not subject to that affection—that is, mares enjoying unrestrained liberty and having young foals. Aside from the fact that azoturia cannot be induced in such animals, the spasms are more general over the entire body, the trismus is characteristic, and the urine neither abundant nor highly colored.

The treatment should evidently consist first of quietude and comfort. The foal should be allowed with the mare. In my cases, free blood-letting apparently alleviated the symptoms, if resorted to early.

Fluid extracts of belladonna and cannabis Indica, in large and repeated doses, apparently allayed the excitability, and exerted a favorable influence upon the course of the disease.

b. Parturient Paresis in the Cow. Milk Fever. Parturient Apoplexy.

Parturient Paresis has long been known as an exceedingly common, and until recently highly fatal malady of dairy cows. It has apparently been known as long as dairying has been followed as a scientific pursuit, and cows have been bred especially for dairying purposes.

Somewhat rarely it may attack cows belonging to the distinctively beef breeds, but even then it is usually in those which are heavy milkers.

The disease occurs usually in adult cows, rarely in the young or aged. Harms, citing Bavarian statistics, gives the following table of the ages at which 127 cows were attacked by milk fever.

At the age of	3	years		1
" "	4	"		4
" "	5	"		20
" "	6	"		14
" "	7	"		22
" "	8	"		18
" "	9	"		22
" "	10	"		12
" "	11	"		3
" "	12	"		6
" "	13	"		2
" "	14	"		1
" "	15	"		2

Harms, quoting Haycock, gives the following duration of time after parturition, at which parturient paresis made its appearance.

5	times	immediately	after	calving.	
8	"	20	hours	"	"
5	"	23	"	"	"
5	"	24	"	"	"
3	"	30	"	"	"
2	"	36	"	"	"
1	"	42	"	"	"

We have diagnosed parturient paresis, both before and during parturition. In these cases all the cardinal symptoms of the malady presented themselves, and the course and termination were identical with those usually observed.

Harms, early in his career, diagnosed cases of milk fever before birth, during the act, and as long after parturition as 30 days; but later he concluded that he had been in error and had been dealing with spinal meningitis or hydrocephalus, two diseases which he regarded as very difficult to differentiate from milk fever. According to his view, parturient paresis in the cow does not occur at all before the fetal membranes have been expelled. He cites other practitioners, however, among whom is Thomsen of Flemsbury, who had a cow fall with paresis while he was remov-

ing the afterbirth manually, and Kohler, who found the detached membranes in the uterus in cases of paresis.

Other observers have seen cases in which the malady has occurred under other conditions. We were called to attend a cow because of presumed dystokia, and found her standing with portions of the membranes hanging from the vulva. Upon examination it was found that the fetus was in its normal position and alive, and that the cervix was fully dilated. All that appeared to be wanting was a moderate expulsive effort on the part of the cow, but this did not occur. She seemed well in a general way, except that she was unsteady upon her feet. The fetus was extracted under very moderate traction, without any aid from the mother. Some two hours later she fell, exhibiting all the symptoms of parturient paresis, and perished therefrom a few hours later.

In another instance in our practice, a typical case of paresis occurred, where the animal was down and comatose, and the placenta was still feebly retained in the uterus.

The disease is one of well-nourished animals. It does not occur in those cows which have been starved or have been kept upon food of very bad quality, and consequently are in poor condition. On the other hand, the excessively fat cow does not show so great a tendency to the disease as the one which is in good flesh. It is a disease belonging to the highly-nourished animal, and not to the obese or the emaciated.

In all those cases of parturient paresis occurring subsequent to parturition, and virtually all of them occur during this period, the disease follows an easy birth. Along with this, in almost every case, there is prompt expulsion of the fetal membranes.

Symptoms. When the animal is under close observation, preceding the full development of the symptoms of parturient paresis there is usually first noted a staring expression of the eye, with dilation of the pupil and a wild look. The eyes may be pirouetted or rolled in their orbits. There may be occasional muscular twitchings or contractions, and a condition of unrest. In rare cases there are very distinct clonic spasms, especially of the neck, with grinding of the teeth and slobbering. The animal acts as if affected with mania, and executes various movements with the head. In one case we observed that the cow would bite at her shoulder. If the cow is caused to move she

does so with a more or less unsteady gait. She seems especially weak and uncertain in her hind limbs, and sways somewhat from side to side or knuckles over. She may show considerable uneasiness and nervousness, and lie down, only to get up again in a few minutes, and perhaps with some difficulty.

As the disease progresses the animal goes down and is unable to rise. At first she lies upon her sternum, usually upon the left side, in a somewhat natural attitude, with the head up. Later she shows a tendency to rest the muzzle on the ground or the head in the right flank with the nose lying upon the ground. Still later she tends to lie prone upon the side.

Early in the disease coma sets in, and the animal becomes more or less insensible. Convulsive struggles occur for a time, in which the patient throws herself about violently; she may make unsuccessful and unconscious efforts to arise, and may succeed in getting upon her knees and floundering about violently. She may throw the head from side to side with great violence, and in doing so may shift from sternal to lateral recumbency, and from time to time may resume sternal decubitis. As the disease advances, there is a constantly increasing tendency to lie flat upon the side.

At first the pupils are dilated and the eyes have a wild and glaring look, but later they become dry and glassy-looking, probably because the eyelids are not closed frequently in order to distribute the tears over the cornea, and thus fail to keep it moist. An abundance of tears may flow down over the cheeks and keep them wet.

From the mouth there is an involuntary flow of saliva, due rather to failure of the animal to swallow it than to any increase in the amount secreted.

The temperature is sub-normal. Rarely in the earlier stages of the disease, accompanied by more or less violent muscular twitchings, there may be elevation of temperature. Later, when the disease has existed for some hours and there has been partial improvement, and a relapse occurs, not of paresis, but of inhalation pneumonia or other inflammatory complication, the temperature may become elevated. The respiration is deep and slow as a general rule, though in some cases it may be rapid and shallow. There is sometimes a moan during expiration.

The disturbances in the alimentary tract consist essentially of

a profound paralysis. There is difficulty in deglutition, so that in former times many cows were killed in attempting to drench them with fluids, which, instead of being swallowed, passed into the lungs, causing fatal strangling or bringing about an equally fatal foreign-body pneumonia. The rumen is paralyzed, and as a consequence tends to become filled with gas owing to decomposition of its contents. This is especially marked if the animal lies upon her side. This symptom is one of great danger for the animal, because the tympany tends to press the food up through the œsophagus into the pharynx, whence it drops into the larynx and is inhaled, to either cause fatal strangling or later a fatal foreign-body pneumonia. The intestines are likewise paralyzed, and little or no defecation occurs. If the hand is introduced into the rectum, a small amount of dry feces is found.

The kidneys cease to function, and little or no urine is poured into the bladder. Some veterinarians have urged that it is essential in the treatment of the disease for the catheter to be frequently passed in order to prevent rupture of the bladder. As a matter of fact, unless the bladder is distended when the disease comes on it does not become so until after the malady has ceased.

The secretion of milk is wholly in abeyance. There may be a small amount of milk in the udder at the time that the cow goes down, and this may remain for a time, but there appears to be some tendency for it to become resorbed and the udder very flaccid.

The pulse at first may be slow and weak, becoming later more frequent and irregular.

The general sensation is much depressed. Early in the disease the eye seems somewhat sensitive to light or touch, but later the cornea may be touched without causing any reaction, and the skin may be pricked at any point with a pin or other sharp object, without producing any evidence of feeling.

As the disease progresses, the coma and paralysis become more and more profound, and death may occur at any time without warning, or the coma may gradually deepen and the animal appear almost lifeless for hours before death occurs. As the fatal termination approaches, the coma and paralysis become more and more profound, the breathing more shallow, and the pulse weaker and more irregular, while the temperature continues to sink.

The course of the disease is rapid. Generally, the earlier the advent of the malady after parturition, the more rapid its course. The animal may die within 6 or 8 hours from the beginning of the attack, or the disease may be prolonged to two or three days.

Complications of great variety may occur. In some especially stormy cases there is complete prolapse of the uterus as one of the earliest symptoms, and in these death usually ensues very quickly. In two cases in our experience, the animals perished within two or three hours after the advent of the first symptoms of the disease.

One of the most common and serious complications observed in the course of the disease is that of foreign-body pneumonia, or of strangling owing to the inhalation of solids or liquids. A few years ago it was common to drench a cow with large volumes of oil or of solutions of saline cathartics or other medicines, which in many cases flowed directly into the lungs because of the unconsciousness of the animal and the paralysis of the pharynx. In other instances in the comatose animal, there is an involuntary passage of food from the rumen through the œsophagus into the pharynx, from which it is inhaled into the the lungs. In either case the animal may be quickly strangled by the blocking of the bronchial tubes from the food or medicines. It was formerly a common experience for the veterinarian to give a large dose of medicine and have the animal perish before he could get off the premises.

When immediate death from the inhalation of food or drugs does not ensue, the paralysis and coma may continue, and the symptoms of parturient paresis pass imperceptibly into those of pneumonia. In other cases the animal partially recovers, and seems brighter, and may even recover so far as to regain her feet and possibly take some food. After some hours, or even a day or more, she may show signs of pneumonia with elevation of temperature, and go down again to finally perish from the complication.

Diagnosis. The diagnosis is usually rendered clear by the period of the occurrence of the disease, the condition and character of the animal, and the symptoms. In some cases, however, the differential diagnosis may be exceedingly difficult, and afford abundant room for a conflict of opinion between practitioners.

Harms very properly points out that the peculiar attitude of the cow does not always indicate parturient paresis, but that other diseases, like acute hydrocephalus, spinal myelitis and meningitis, may cause the animal to assume the same position. Harms considers these the only diseases which may be mistaken for parturient paresis, and suggests that puerperal mania, puerperal fever, simple lumbar paralysis and fracture of the pelvis cannot deceive the scientific veterinarian. Harms points out that in his experience the diagnosis of milk fever may be excluded in those cows which have not calved recently, which show loss of sensation in the hind parts of the body only, or have a normal or elevated rectal temperature. Cows which retain an appetite until they fall, or even after they are down and unable to rise, he does not regard as being affected with parturient paresis. On the other hand, he claims that hydrocephalus may be excluded and milk fever diagnosed if the cow has calved within a few days, if the loss of sensation involves the entire body, if the rectal temperature is sub-normal, and the paralysis is so profound that the animal cannot rise upon its feet even with assistance.

The relation of calving to the diagnosis of parturient paresis, in our judgment, cannot be relied upon, although it constitutes important evidence. While Harms believes that the disease occurs only after parturition, and we agree with him in the main, we are nevertheless forced to hold, from our personal observation, that the malady is not confined to the post-parturient period, but may rarely occur before or during the act of parturition. The fact that a cow has recently calved does not prevent the occurrence, during this period, of other diseases which may closely simulate parturient paresis.

Schmidt (American Vet. Review, Vol. 22, 1898) draws attention to the fact that indigestion in the cow may very closely simulate parturient paresis.

In one case which we observed, a cow went down in the pasture with what strongly resembled parturient paresis in almost all essential respects, including paralysis, coma, and subnormal temperature, but she had calved six weeks previously. The disease was apparently due to a slight purulent mammitis. It is interesting to note, in connection with this case, that the injection of oxygen into the udder apparently led to a complete

recovery. This would lead many to believe that the malady was really parturient paresis.

Causes. While we do not comprehend the fundamental nature of milk fever in the cow, we nevertheless know fairly well the conditions which predispose or lead up to the disease.

1. Chief among the causes, stands the quality of the cow as a deep or profuse milker. Milk fever is pre-eminently a disease of the high-class dairy cow, and has herertofore stood as a perpetual menace against the improving of dairy breeds, because the more excellent the individual as a dairy animal the more vulnerable to the disease. On the other hand, cows belonging to the beef breeds, or poor milkers among dairy cows, are virtually immune.

2. The state of nutrition of the animal has a very marked and well known influence upon the occurrence of parturient paresis. This is a disease of the plethoric cow, and not of those which are emaciated or excessively fat. It occurs, we may say, in those animals which are in the highest possible condition, and apparently in perfect health up to the hour of attack.

3. Food and housing have been claimed to influence the tendency of the cow to parturient paresis, and this is in many respects very true. The malady is seen much more frequently in some seasons and in some communities than in others, which is variously attributed to the food or weather. These questions are inseparable from that of nutrition. If the weather is bad, the food may be bad. Undue exposure may lower the condition of the animal, and thus prevent the high condition which predisposes to milk fever.

We observe the disease in the stable and in the pasture, and the relative frequency will vary according to conditions. Parturient paresis may occur chiefly during the spring or early summer, in cows which are upon very rich pastures; or in other cases the disease may be seen most frequently in those animals which are kept in the stable. This will vary according to the comparative excellency of the pastures or of the food and feeding in the stable.

4. Abrupt changes in food, housing or other conditions may apparently influence the tendency to the disease. In the other members of this group of diseases we recognize very clearly the effect of psychic influences, such as removing the young from the mother or bringing the mother and her young into the pres-

ence of strange animals or surroundings, thereby causing maternal anxiety. This apparently has an effect in some cases in the cause of parturient paresis of the cow.

5. It is quite universally recognized that, when parturient paresis occurs soon after calving, at which epoch virtually all cases occur, the malady uniformly follows a very prompt and easy birth. No case has been recorded, so far as we can find, where parturient paresis in the cow has followed dystokia.

Pathology. As already stated, the pathology of the disease is unknown. Post-mortem examination reveals changes of an interesting character, which tend to throw some light upon the symptoms and course of the disease, without, however, making clear its exact character.

Because of the well-marked coma and the general disturbance of the nervous system, the condition of the brain and the spinal cord become of great interest. The dura mater is apparently sound, though in some cases a serous exudate exists beneath it. The pia mater is said to be somewhat congested; the veins, especially, are distended with blood. The interpretation of the conditions in the brain varies with different observers. Some have found the brain substance anaemic, while others have considered it congested. Hemorrhages are sometimes found upon the surface of the brain. Harms found emphysema beneath the pia mater and in the veins of the canal of the spinal cord.

The heart is usually pale and distended with blood, and occasionally shows ecchymoses of varying size.

The condition of the lungs is exceedingly variable. Harms found them edematous or emphysematous, but observed no foreign bodies in them. We have repeatedly discovered particles of food far down in the bronchial tubes, and in some cases of sudden death have found the larger bronchi completely occluded by food masses. In other instances we have been able to recognize the presence of drugs in the bronchial tubes, which had been forced upon the cow in the form of a drench some hours previously.

The alimentary tract, liver, spleen and urinary organs are usually comparatively normal. In the uterus there are no very remarkable changes. In harmony with the history of the disease, the uterus is not normally contracted. Like other organs of the body, the uterus is anaemic.

The theories regarding the nature of parturient paresis are innumerable, and difficult of classification. These may be divided into four great classes, according to the belief veterinarians hold as to the organ or system from which the disease takes its origin.

1. Many hold that the disease has its origin in some essential change in the brain or spinal cord. They believe the disease to consist of a congestion of the entire central nervous system, with overfilling of the veins of the brain and spinal cord. Other veterinarians hold that the disease consists of anaemia and paralysis of the central nervous system.

2. Another group of veterinarians believes that the disease has its essential origin in the uterus. In this group each individual has an opinion of his own, which differs somewhat from that of each of his colleagues. Some of them believe that, from the uterine mucosa, there is absorbed into the system an amount of infectious material or the products of bacterial activity within the uterine cavity, which, acting upon the central nervous system, produce the disease. The character of this toxic substance has not been revealed, nor has any clear evidence been adduced to show that such exists. It has not been shown why, if the disease consists of the absorption of toxic substances from the uterus, cows which are very thin in flesh, are poor milkers or have suffered from dystokia should not just as readily suffer from milk fever as deep milkers which are in high condition and have calved easily. Others, like Stockfleth, hold that milk fever is the result of embolism of the veins of the uterus, the emboli escaping to other portions of the body.

3. A third group of veterinarians, including Schmidt of Kolding, holds that the disease arises from the mammary gland, and consists of a toxaemia due to the absorption of colostrum, perhaps incompletely formed, or other secretions which possess a highly deleterious character.

4. Harms holds that the disease is a form of aeraemia, or air in the blood. In his post-mortem examinations he found air in the veins of the brain, spinal cord, lungs and other organs. This view has not been generally accepted.

As already stated, post-mortem examination has virtually failed to reveal anything definite regarding the actual cause or character of the malady. This and that lesion has been re-

corded, only to have its existence or importance disputed by others of equal authority. One finds hyperaemia of the brain, and another anaemia of the brain, with the possibility that either or both may be correct.*

Handling. 1. **The essential therapeutics of parturient paresis consists of the inflation of the udder with atmospheric air or oxygen.** So far as clinical experience reveals, it is not material which of these is used. As soon as the patient can be reached, and a definite diagnosis of parturient paresis made, a sufficient volume of oxygen or atmospheric air should be introduced into each quarter of the udder to quite thoroughly distend all parts of the gland. In order to avoid the escape of the air through the teat canal, it may sometimes be desirable to apply temporarily a soft ligature near the end of the teat, which is to be removed after the expiration of three or four hours.

The ligature should preferably consist of a soft piece of tape, which should be tied around the teat sufficiently tight to barely prevent the injected air from escaping through the teat orifice. If tied too tight, and allowed to remain for several hours, necrosis of the teat follows. The ligature is to be closely watched, and promptly removed whenever serious injury to the teat is threatened. The danger might be very largely avoided if a long piece of tape were used, and wound several times about the teat, from the apex upwards. Strips of adhesive plaster, applied directly over the teat orifices and extended upward along the teat, would probably fill all requirements and obviate pressure gangrene.

The necessity for ligating the teat is very questionable. The amount of gas injected is subject to no fixed rule. The udder should be firmly distended. Usually the sphincters of the teats will retain sufficient gas and permit any excess to escape. Some believe that the greater the distension of the udder with air, the more prompt and effective the treatment. Occasionally this is overdone, and we have observed extensive emphysema of the udder, thighs and croup from rupture of the mammary epithelium as a result of over-distension. No harm ensued. If the

*For a full resumé and discussion of the various theories of the nature of parturient paresis, the reader is referred to the contribution of J. Schmidt, Kolding, Monatshefte für Praktische Thierheilkunde. Bd. IX., S. 241, a translation of which appears in the Am. Vet. Review, Vol. 22, p. 392, Sept., 1898.

volume seems insufficient, if the response is tardy or feeble, more air or oxygen may be introduced at any time.

Should the first inflation fail to produce the desired results after an interval of 3 to 6 hours, a second inflation of the gland should be made. We have no evidence that any harm may occur from repeated inflations of the udder with air or oxygen, so long as no infection is carried into the gland.

Since the mammæ are at this stage in a very highly vunerable state, it is essential to safety that due precautions be taken against introducing infection into the gland upon the portion of the apparatus inserted into the teat, or forcing it into the gland with the oxygen or air which is being introduced.

The precautions to be taken are analogous to those for any surgical operation. They include the disinfection of the operator's hands; of the cow's udder, especially the teats; and of the injection apparatus, especially the tube which is to be introduced into the teats; and the protection of each of these parts from infection during the operation.

The udder should be carefully placed upon a clean cloth saturated with a reliable disinfectant, or upon a clean tray, after which the entire gland, and especially the teats, is to be thoroughly washed and disinfected. The apparatus to be used for injecting the air or oxygen, especially the tube to be inserted into the teat, should be sterilized by boiling.

Before inserting the tube into the teat, all antiseptics should be carefully washed away from the tube and the end of the teat with sterile water. **The introduction of antiseptics into the milk gland upon a tube or other instrument is as dangerous as the introduction of most forms of bacteria.** The operation is to be **aseptic**, not **antiseptic**.

The mechanism by which the inflation is brought about is not essential, so long as the general rules of asepsis are maintained. Various forms of apparatus have been introduced for the purpose of avoiding infection, but few, if any of them are free from objection. No difference what the particular type of apparatus, the general rules of aseptic surgery must be carefully applied by the veterinarian; the apparatus is not sufficient in itself. Many of these devices consist of a rubber bulb, attached to an elongated tube, into which is inserted a filter of asbestos, cotton or other substance. Beyond this, the rubber tubing ends with an ordinary

milk or teat tube, which is inserted into the milk canal. This form of apparatus is probably the most objectionable of any that has been devised, because the filter is difficult of sterilization and, becoming befouled, acts as a constant menace to the udder of the patient.

The simplest apparatus, the one which can be most readily sterilized by boiling, is the best. There is no great danger of the introduction of infection with the air which is introduced, if moderate care is taken not to stir up dust in the stall while the operation is in progress, and this danger may be eliminated in a variety of ways which are very simple. If a wash-bottle is constructed, and the air be forced through the water, and thence into the udder, any floating particles of dirt will be retained in the water, leaving the air free from infection.

Laymen have used the ordinary bicycle pump for injecting air into the udder, and the process has been bitterly criticised by some veterinarians. Such a pump, or one on a similar plan, with very ordinary precautions, is safer than the apparatus usually sold for the purpose. A pump of this type, with sterilizable piston, can be made a very convenient and safe appliance. It may be enclosed in a sterilizable metal case, and kept sterilized ready for use. At time of use, a few layers of sterile gauze over the intake effectively filter the air.

A very convenient and safe apparatus for the work is the oxygen, or compressed air tank. Under proper precautions, the tank may be charged by the practitioner with either air or oxygen, and is ready for safe use at any moment. The tube for insertion into the teat may be carried in alcohol, so that it, too, is ready in a moment.

A yet more convenient and safer apparatus for the inflation of the udder may be readily arranged by having a very small and strong compressed air tank, fitted with an opening armed with a stop cock. It could be made of the size of a pint bottle, and strong enough to contain sufficient air for the inflation of an udder. Two or more such tanks could be kept on hand so that one may always be charged and ready for use. The detached tube may be enclosed in a sterilizable metal container and quickly prepared for use.

The tank may be charged by the veterinarian, the air being filtered through sterile gauze as it enters the pump. Thus

charged, under suitable precautions, the apparatus is always ready, compact, light, easily applied, and free from danger of causing infection.

The milk tube or other tube inserted into the teat should be very short, barely long enough to freely enter the milk cistern. A longer tube may wound the parts during unexpected struggles.

It is apparently immaterial whether any milk which may be in the udder is withdrawn before the injection or not.

Some practitioners advise treatment supplementary to the inflation of the udder, but they have not yet clearly shown by clinical data that any good has come from such additions. Generally those who desire to add something to the udder inflation prescribe powerful heart stimulants, like strychnine or caffein.

As a remnant of by-gone days, some veterinarians still advise and practice catheterization. The secretion of urine ceases with the advent of the disease. Over-distension could not have existed in the healthy cow, and cannot occur in the paresis patient. A pint or a gallon of urine in the bladder can do no harm; catheterization may do much.

The attitude of the patient is of very great importance. From the first she should be carefully and zealously guarded against assuming lateral recumbency, or this position promptly corrected if already attained. The cow, like other ruminants, promptly suffers from tympany of the rumen whenever lateral recumbency is maintained for a prolonged period. The distension of the rumen, by its pressure upon the diaphragm, interferes seriously with respiration and with the action of the heart and other organs. The most serious danger from this position is that, in the paretic state of the animal, there is imminent risk of the involuntary passage of food from the rumen into the pharynx, and its inhalation into the lungs, to cause fatal strangling, or foreign-body pneumonia. It is consequently essential to keep the animal in sternal recumbency. This may be facilitated by packing bundles of straw about the animal. In cases of violence it may be desirable to secure the two anterior feet in such a way that the limbs cannot be extended. This is best accomplished by attaching a short strap or cord to each anterior foot, carrying these upward over the withers, and tying them together in such a manner as to keep the anterior feet completely flexed upon the carpus.

It is quite unnecessary to suggest that the animal be well bedded and otherwise made comfortable.

The practitioner should be on his guard against the dangers of moving the recumbent animal from place to place. If the patient has fallen in a bad situation, out of doors or elsewhere, it may appear desirable that she should be conveyed to a stable or other suitable place for handling. In bringing about this transfer it is well-nigh unavoidable that she be placed in lateral recumbency, and that she must undergo a form of handling which will strongly tend to cause the regurgitation and inhalation of some of the contents of the rumen.

It is therefore best, in all cases, to make the patient comfortable, if possible, where she falls. Abundant bedding, blankets if the weather is cold, or an improvised tent or shed if the weather is hot or rainy, usually suffices as well as a stable and avoids the danger of transfer. When moving the recumbent animal is imperative, she should be kept on her chest until all is in readiness, the transfer then made promptly, and the patient quickly replaced upon her sternum.

When the practitioner is called to attend a case of parturient paresis, he should rigidly abstain from drenching the patient, and carefully enquire, before he takes charge, if any drugs or medicines have been given by the mouth. If cows suffering from parturient paresis have been drenched, the mortality is exceedingly high, because portions of the drench usually pass down the trachea into the lungs. It does not matter at what stage of the disease the attempt to drench the animal occurs. While she is still upon her feet, and merely beginning to stagger, she is nevertheless very liable to become strangled. There appears to be from the first an anaesthesia or paresis of the larynx and other parts, which prevents coughing or any other signs of strangling. If the animal has received a drench, especially one which would be highly irritant to the lungs or could not be absorbed from the respiratory mucous membrane, an unfavorable prognosis should at once be given, and the handling begun with a definite understanding that the animal will probably die from inhalation pneumonia as a result of the drench.

* * * * *

The history of the origin of the present plan for handling parturient paresis dates back to the investigations of Schmidt of

Denmark, in 1897, when he introduced his plan of handling the disease by the introduction into the udder of a solution of iodide of potassium, commingled with atmospheric air. Later, various practitioners found that, failing to have the potassium iodide at hand, the distension of the udder by other liquids, such as very weak disinfecting solutions or normal salt solution, possessed a similar efficiency. Then oxygen was substituted for the potassium iodide solution, and its efficiency was found to be even greater. From this experience it was readily surmised that, in default of pure oxygen, the mixture of oxygen and nitrogen of atmospheric air might answer the purpose, and clinical experience early demonstrated this to be a fact. Today oxygen and atmospheric air are used indifferently, and with very great success.

The discovery of Schmidt, with its gradual development, leading to the now universally accepted mode of handling parturient paresis, constitutes one of the most remarkable and beneficent advances in therapeutics in the history of veterinary medicine. It has transformed one of the most fatal of diseases into one which, when promptly handled, is almost robbed of its mortality.

Prior to the investigations of Schmidt, parturient paresis was a great obstacle to the advancement of efficiency in dairy cows. As soon as a cow showed high efficiency, imminent danger to her life from parturient paresis at once arose, and the ranks of the best dairy cows annually suffered appalling losses.

Under the treatment with air or oxygen, the mortality in parturient paresis in the cow has dropped from 60–75% to less than 5%, in those cases which are promptly attended and in which there has been no meddling by the administration of medicines by the mouth.

From the standpoint of prophylaxis, the attitude of the profession has been quite generally modified by the advent of the present method of handling. Formerly it was advised in many cases to withdraw a portion of the milk from the udder before the cow calved, and to keep her well milked immediately after calving, but this rule has been reversed, and it is now advised to leave the udder fully distended with colostrum or milk.

It was formerly advised, also, that a purgative be given either just before or immediately succeeding parturition, in order to

prevent parturient paresis ; but this has been generally discarded since the advent of the inflation treatment.

It is now uniformly advised, in case there appears to be any danger of an attack of parturient paresis, that the udder be inflated at once with oxygen or air as a prophylactic measure.

The history of the therapeutics of parturient paresis is extensive and interesting. Almost every form and character of treatment possible has been advised, and favorable reports of the use of each have been made. Purgatives long held a very high place, in spite of the fact that they were generally poured into the lungs instead of the rumen, and quite generally hastened the fatal termination. Stimulants, narcotics, sedatives, in endless profusion, were recommended by one, only to be condemned by others and finally to be discarded.

Blood-letting was advised and abandoned. Hypodermic injections of strychnine, eserine, pilocarpine and many drugs were advised, with the great advantage that they did not get into the lungs and strangle the animal, but the results from their use were not satisfactory. External applications were used, such as stimulating liniments to the spine, and ice to the head. Intrauterine injections of solutions of alum or other substances were advised. In spite of all these innumerable methods which were recommended by this or that practitioner, the high mortality of the disease still held its sway.

Puerperal Eclampsia in the Sow.

Hegel (Repertorium, Vol. 46,) de Bruin (Geburtshilfe bei den Kleineren Haustieren) and others, describe puerperal eclampsia in the sow. The malady is characterized, according to Hegel, by spasmodic movements of the neck, grinding of the teeth, convulsive movements of the facial muscles, inability to stand and elevation of temperature.

De Bruin has usually observed the disease two to five days after farrowing and expulsion of the fetal membranes. Usually the birth has been easy. The symptoms are chiefly a more or less complete suspension of lactation, with paresis, coma, and intestinal torpidity.

The prognosis is good, and most cases tend to spontaneous recovery after a few days.

Hegel advises bleeding from the tail, cold poultices to head and back, purgatives, tobacco clysters, etc., and, if trismus persists, the application of chloroform and oil to the masseter region.

De Bruin warns the practitioner against drenches, always dangerous for swine because of strangling. He advises the use of electuaries composed of 10 grammes sulphate of magnesia, 50 grammes powd. anise seed, and common syrup sufficient to make a paste. This is placed upon the tongue with a wooden spatula, and the entire quantity used during one day. He further advises applying tincture of camphor over the body to arouse the skin secretions.

The Milk Disease of Sheep. Parturient Paresis in Sheep and Goats.

De Bruin describes a malady of ewes, closely resembling the parturient paresis of the cow, under the designation of milk disease. It occurs chiefly in ewes from which the sucking lambs have been removed after having lambed normally some six weeks previously. The disease appears usually 2–24 hours after the removal of the lambs from the ewes.

The symptoms consist of absence of appetite, rumination or other digestive functions. The ewe ceases to bleat or hunt for her lamb, becomes paretic, with glassy eyes, loss of corneal reflex, coma, and the general symptoms of parturient paresis of cows.

The prognosis is good, and the method of handling it is the same as for parturient paresis in the cow.

De Bruin describes, under a separate heading, a parturient eclampsia of sheep, goats and swine, regarding this malady as essentially different in etiology or pathology from the milk disease described above.

The real ground for differentiation is not clear. In these cases the animals show definite tonic and clonic spasms. The disease is usually acute and stormy. It appears ordinarily soon after birth, though it may occur ante-partum. There is present trismus, opisthotonos, and general convulsions, with pirouetting of the eyes, followed by coma.

Chloral hydrate in enemas, and hypodermic injections of morphine, are recommended for handling, and good results are reported. De Bruin does not mention inflation of the mammæ with air or oxygen ; nor does he intimate why this should not be quite

as successful in the eclampsia of the sheep and goat as in the paresis of the cow.

Puerperal Eclampsia of the Bitch.

Next to the cow, probably the bitch suffers most frequently from puerperal eclampsia or paresis. The malady has rarely been observed prior to, or immediately following parturition. Usually it occurs from 2 to 8 days after giving birth to young. Occasionally it occurs 10 to 14 days after parturition, and rarely as late as 30 days. Ordinarily it follows easy parturition. It is most frequently observed in highly bred nervous animals, and occasionally follows the psychic disturbance incident to removal of the puppies from the patient.

The symptoms are analogous to the eclampsia already described in the mare, ewe, goat and sow. The first symptoms are those of anxiety, restlessness and uncertain gait. The patient falls in convulsions, the voluntary muscles being affected with severe tonic and clonic spasms. As in other eclamptic diseases, the body excretions are largely in abeyance, the bowels are torpid, the urinary secretions are suspended, and the mammæ are flaccid and devoid of milk.

During the convulsions, the patient remains conscious. Later the convulsions may be followed by coma and unconsciousness. During the convulsions, the visible mucosa are cyanotic. The affection greatly resembles strychnine poisoning, but De Bruin points out the important difference that in strychnine poisoning the patient is easily excited, while in eclampsia no hypersensitiveness is apparent.

The course of the Disease, like in other members of the eclamptic group, is usually stormy, and, unless energetically handled, ends fatally in 24 to 48 hours. **The prognosis** is good when the disease is promptly handled.

De Bruin strongly recommends 20–40 mg. (0.3–0.6 grains) of morphia hydrochlor, hypodermically, repeated in a few hours if necessary. Others advise chloroform inhalations or chloral hydrate enemas. Some have recommended the administration of ether or chloroform syrup by the mouth; but, as in all diseases of this group, the powers of deglutition are uncertain, and there is constant danger from the introduction of medicines into the lungs.

DISEASES OF THE MAMMARY GLANDS.

In mammalia, the mammary glands constitute an essential part of the reproductive system, because it is through these that the new-born is enabled to live for a time after its birth, before it acquires the experience and power necessary to provide its own food. The mammæ ordinarily come into function at the time when young are born. As soon as the young animals have acquired sufficient age and strength to lead an independent existence, the glands cease to secrete milk, until their function is aroused anew at the next period of birth.

Following the general rule of vulnerability of organs, the mammæ are most subject to disease and accident during their period of activity, and rarely suffer during their interval of rest. The diseases of the milk glands may, accordingly, very properly be dealt with as a part of obstetrics, because they not only jeopardize the life and well-being of the mother chiefly during the puerperal state, but also have great importance for the life of the young at the beginning of its extra-uterine existence.

Anatomically the milk glands of animals belong to the acinous type. The glands consist of numerous acini or glandular vesicles, lined with cuboidal epithelium. From each of these cells there emanate small milk canals, which finally unite with each other into common canals of larger size. These may empty into a large cistern and thence through a common opening at the end of the teat, Fig. 5A, p. 37, or two or more cisterns form, each of which opens through a separate milk duct, or the milk canals may remain separate, without milk cisterns and open directly at the end of the nipple. There are consequently two great types of milk glands—the one with a cistern, in which a considerable volume of milk accumulates; and the other without a cistern, in which the milk canals lead from the glandular substance directly to the end of the teat.

Solipeds, ruminants and swine have capacious milk cisterns; in carnivora milk cisterns are absent. The general anatomy of the milk glands has been briefly outlined on page 35.

The variations in the structure of the milk glands in different animals are very interesting in relation to their tendency to disease. The highly-developed glands of ruminants, with a single large cistern and a very large excretory canal through the end of the

teat, are subjected to very great danger from acute infection. In animals where extensive milk cisterns do not exist, like the mare, and in carnivora, which have no cisterns at all, the tendency to acute mammary infection is very much less.

On the other hand, we find that in the carnivora, especially in the bitch, without any milk cistern, there is a pre-eminent tendency for the glands to become the seat of malignant new-growths. When infection occurs in the capacious single milk cistern of a ruminant, the entire quarter is almost inevitably involved. In those animals with two or more cisterns, or with numerous milk canals without cisterns, a single lobule of the gland may become infected and the others remain sound.

For convenience of description we may divide the diseases of the udder into: (1) Acute Infections, (2) Chronic Infections, (3) Wounds and Injuries, (4) Neoplasms.

Acute Infections of the Mammæ. Mammitis. Mastitis.

Mammitis consists essentially of an infection of the mammary gland, and, like the infections of other organs or tissues, may be extremely variable in character. The different species of domestic animals show great variations in their susceptibility to mammitis, and in the type or types which the disease may assume. By some authors, the inflammations of the gland have been divided into catarrhal, phlegmonous and interstitial mammitis. Others add to these, purulent and gangrenous mammitis.

Until we understand better the exact nature of the various forms of mammitis, especially in relation to the bacteriologic cause of each, any classification which may be made is merely a matter of convenience for purposes of description, which may facilitate our understanding of certain more or less distinct types of disease observed.

The various species of domestic animals show such marked differences in the prevailing type or types of diseases of the milk glands that it is advantageous to consider those of each species separately, although in many respects they may be identical.

a. Mammitis or Mastitis in the Cow.

The cow constitutes the chief dairy animal, for which purpose she has been specially bred for centuries, and has been brought

to a high state of perfection as a milk-producing animal. With this specialization of function, there has arisen a vulnerability of the milk glands to injuries and diseases, which surpasses that seen in any other domestic animal. We consequently meet with a great variety of inflammatory diseases of the milk glands in cows. These variations are due in part to the intensity of the infection and the comparative power of resistance of the gland, and are in large part due to the specific differences in the infections themselves.

Mammitis in dairy cows has a wide economic and sanitary interest. The pathologic milk of mammitis is usually rejected as human food by the repulsive taste, smell or visible appearances. Pathologic milk, unrecognizable by the special senses, like that from a tubercular udder, may possess far greater danger for man.

According to the avenue of infection, the inflammations of the mammary glands may be divided into two groups, very unequal in size and importance :

1. The infections which gain entrance into the cavity of the milk gland from the exterior, through the milk orifice or orifices in the teat, or through some wound involving the tissues which constitute the walls of these cavities.

2. A lesser group of infections, which reach the tissues of the gland from some other portion of the body, through the medium of the lymph or blood channels, *e. g.*, tubercular mammitis.

1. Acute Mammitis. Acute Mastitis.

Acute mastitis may be defined as an infection of the milk gland, due to the entrance into its substance of the micro-organisms ordinarily inducing wound infection. We might liken acute mammitis to wound infection itself, and regard the epithelial lining of the milk cisterns, ducts or acini, or all these areas combined, as representing the wound area which has become infected.

As in wound infection, so in acute mammitis, the infecting agent may be of very diverse character. Investigators, in dealing with acute mammitis, have found virtually all the types of organisms which are recognizable in wound infection, such as diplococci, streptococci, staphylococci and bacilli.

In accordance with the clinical history of wound infection,

some have believed, with apparently good reason, that there are variations in the virulence of mammitis, somewhat in harmony with the species of the infecting agent. As in ordinary wound infection, so in mammitis, streptococci apparently lead in virulence, while the staphylococci are believed to induce a milder form of inflammation.

The avenue of entrance of the infecting organisms is regularly through the orifice of the teat. Their source of origin may offer great variety, but ordinarily the infecting organisms are abundant, and only require some favorable opportunity for passing through the teat orifice and gaining the interior of the gland. The more abundant and virulent the micro-organisms in the immediate environment of the cow, the more probable the infection. The bedding, floor and stall constantly afford more or less infective material, the virulence of which may be partly dependent upon the cleanliness of the stall, but in the main is not understood. The dairyman may reduce the degree of filth, and hence of infection, to the minimum. Accidental conditions which we do not understand sometimes seem to cause a sudden increase of virulence or volume of infection in the stable, which may express itself for a time in the form of enzoötic mammitis.

In a large proportion of cases, there are good clinical evidences of the source of origin of the infecting material. Whenever a suppurating wound exists upon a teat, or some adjacent part of the udder, and the pus has an opportunity to flow down the teat to come in contact with the teat orifice, mammitis almost invariably follows, unless some adequate precautions are promptly taken by the veterinarian to bar the entrance of the infection through the milk canal. Retained and decomposing afterbirth, or any putrid discharge from the uterus or vagina, always tends very strongly to induce mammitis. The pus flows down over the thighs and udder, and thence along the teat, naturally the posterior teat, and, gaining the apex of this, the infection finds its way upward through the orifice in the teat, and mammitis at once results. Possibly more direct and effective is the infection through the teat orifice, when a retained afterbirth hangs down so low that it comes in direct contact with the teat and is actually pressed against the teat orifice. Or the tail, saturated with the discharges from the vulva, may be lashed against the ends of the teats and force the infection into the teat orifice. Not only may

such a cow bring about an infection of her own udder, but with her soiled tail she may convey the infection to another cow in an adjacent stanchion, or the neighboring cow may strike her tail against the soiled parts of the diseased animal, and thence carry the infection to her own udder.

There is frequently convincing clinical evidence that a milker carries the infection to a healthy teat. He may get the infection upon his hands from an animal which is suffering from mammitis, and may readily convey it to another teat of the same udder, or, without washing his hands, may carry it farther and deposit the infection upon the teats of a healthy cow, and induce the disease. It is not essential that the milker should get the infection from a diseased milk gland. He can as readily and as seriously infect his hands by handling a putrid afterbirth, or an aborted fetus, or an infected wound upon any animal, and, by negligence or oversight, carry the infection to the udder of a healthy cow.

It has been suggested that, when cows lie down, straws from their bedding may be pushed through the orifice into the milk cistern and carry with them virulent and infectious material, and there have probably been sufficient observations upon this point to establish the fact that such infections really occur. Every veterinarian in dairy practice has probably observed numerous cases of infection by means of the milk tube. Laymen very generally believe that they can meddle with the inside of a cow's teat with the same degree of abandon with which they may handle the outside, and many of them do not hesitate, upon the least excuse, to insert a milk tube, a sound, a wire, a knitting needle, or almost any implement, into the teat, and do not anticipate therefrom any serious consequences.

Thus, in many ways infection of a virulent character may be forced through, or find its entrance into, the milk cistern. Once it has reached the milk cistern and milk canals, it is in a favorable environment for growth. The infection may then extend according to virulence and the resistance of the tissues, along the larger, and thence along the smaller milk ducts, and may finally reach the milk acini and attack the secretory epithelium of those structures, and produce any symptoms or pathologic conditions which the various forms of organisms are capable of inducing in such tissues.

The handling of parturient paresis by intra-mammary injection is a fruitful source of mammitis, as already related while discussing that affection.

Most infections of the body have been attributed to "taking cold," and it is assumed that mammitis may be caused or its establishment favored by exposure to cold, dampness or drafts. Perhaps these factors do depress the system and favor the advent of mammitis.

Contusions exert an important influence by devitalizing the tissues and rendering them more vulnerable to infection. Thus a very pendent udder, buffetted back and forth between the legs of a rapidly moving cow, may seriously contuse the gland and destroy its normal power of resistance. A rough milker may readily induce contusions of the udder which may do much to cause mammitis.

It is unnecessary for the infection to be introduced immediately from the outside. The teat orifice and lower part of the cistern already contain, in the milk, some bacteria, usually of a kind not pathogenic for the parts so long as the gland is not disturbed. Whenever the gland is contused, or other accident occurs to depress the vitality of the tissues, the hitherto harmless (saprophytic) bacteria, may become pathogenic.

When the udder is overdistended, the tissues become weakened and infection is favored. The whole udder projects very prominently in the cow, and is accordingly exposed to injury. The posterior teats are shorter than the anterior, are more rigid, and are directed more or less backward in a direction which renders them more susceptible to injury from pressure and from dirty bedding-straws being pushed through the orifice into the milk cistern.

Symptoms. Mastitis occurs almost wholly in cows in full milk, and chiefly very soon after calving. It is at this time that the udder is most active, and consequently offers the greatest vulnerability to infection, and it is at this period that the udder is most exposed to virulent infections of various kinds. The maximum distension of the udder subjects the secretory tissues to a compression, which, if not promptly relieved by milking, lowers the powers of resistance in the parenchyma of the gland. At the same time, the engorgement causes the udder to project farther, more directly and rigidly from the body walls,

exposing the udder and teats to increased danger from contusions and abrasions; intensifies the danger of forcible contact of the teat orifice with infected objects; and favors the entrance into the teat of straws or other rigid infection-bearing bodies. The disease may occur, however, at any date during the period of milking, or in the dry cow. We have observed the disease in heifers.

Usually only one quarter of the udder, most commonly a posterior one, is involved. The disease may simultaneously or consecutively affect two, three or all of the quarters.

The period of incubation in acute mammitis is brief. Experimental infection has induced the symptoms of mammitis in 12–24 hours. We also observe a similar period of incubation clinically following operative interference of the mammæ. The forcible insertion of a milk tube; the inflation of the udder in milk fever; or the overcoming of atresia of the teat by incision or puncture is frequently followed by mammitis in 12–24 hours.

Lameness is a common and early symptom of the disease. It is frequently the first symptom observed by the owner, though it may occur at any time during the disease. The lameness may be referable to three different causes.

1. In the first stages of the disease, the owner may observe lameness as the first symptom of mammitis. In such cases the lameness is apparently an expression of pain in the affected quarter or quarters. The lameness may be more severe when a hind quarter is involved than when an anterior one is affected, because, in progression, the posterior quarter is more severely compressed or contused by the hind leg as the limb is carried forward and weight placed upon it. Doubtless not all the pain and consequent lameness is due to the sensitiveness of the affected quarter, but must be largely referred to lymphangitis or phlebitis of the chief mammary veins and lymphatics in their course through the inguinal canal, where any tenderness causes intense pain during any movements of the limbs or body which may bring into play the surrounding muscles. When both sides of the udder are simultaneously inflamed, the disinclination to move becomes very strong, with evidences of very great pain.

2. **Pyæmic arthritis** may arise at any time during the affection, as a complication of mammitis, and induce symptoms parallel in all respects with the pyæmic arthritis already described

on page 902 as a sequel to puerperal infection. Such arthritis cannot be differentiated from that arising from septic inflammation of the uterus, except it occurs at a time when the uterine avenue of infection may be excluded.

3. **Paretic lameness or paralysis** occasionally accompanies mammitis, and appears in two somewhat distinct forms.

a. **Acute mammary gangrene** with acute septicæmia frequently causes rapid and complete paralysis of the posterior portions of the body.

In particularly stormy mammitis with gangrene, complete paralysis has sometimes been the first symptom observed by the owner. During the night, or other interval without observation, other preliminary symptoms may have come and gone, and when first observed the cow is prostrate and unable to rise.

b. **Mammary toxæmia or pseudo-parturient paresis** may occur in very mild, insidious cases of mammitis. Ere the owner or veterinarian realizes or suspects serious consequences, the cow goes down, is more or less completely paralyzed, her temperature may be sub-normal, and more or less marked coma may appear. Two facts serve to differentiate this from parturient paresis. It occurs, or may occur, four to six weeks after parturition, perhaps in an animal not a good subject for parturient paresis, and a history of the case will reveal the existence of a more or less evident mammitis. According to our observation the mammitis in such cases has been of a very mild type, slight swelling, the disease apparently confined chiefly to the milk cistern and ducts and accompanied by well marked, though not extreme, changes in the secretions of the affected quarter. The milk had for a few hours been thin, wheyey and flocculent, but not fetid.

Apparently such paralysis is due to toxæmia from the absorption of bacterial products from the diseased udder. In one case observed by us, inflation of the udder with oxygen promptly overcame the paralysis and coma, and apparently also disinfected the diseased quarter.

The local symptoms of mammitis consist essentially of the cardinal symptoms of inflammation, with the various consequences of inflammation in these tissues.

Heat is usually a prominent symptom in the affected quarter, and is very readily recognized by the sense of touch, especially

when compared with an adjacent healthy quarter. The intensity of heat is not indicative of the seriousness of the inflammation within the gland. The inflammatory processes may be chiefly taking place in the central portion of the gland,and the skin may be but slightly involved. While the presence of heat may aid in the diagnosis, it is of comparatively little value as an aid to prognosis.

The pain in the inflamed gland shows every possible variation in intensity. As in the case of heat, so the degree of pain does not reveal the seriousness or extent of the malady. As a general rule, the pain is most marked upon pressure when the disease is largely concentrated in or about the teat, that is, when the disease most seriously involves the more superficial, sensitive portions of the gland. There may be a deep-seated inflammation of the gland, which may be freely palpated without causing evidence of great pain. When necrosis occurs in any part of the gland, sensation in that portion necessarily ceases.

The redness of the tissues is usually in harmony with the degree of heat and pain. When the inflammation is at all superficially located, the redness is usually very intense, and in marked contrast to the color of the adjacent healthy quarters. When gangrene occurs, and involves the skin, that portion which is gangrenous assumes a necrotic-black or necrotic-green hue, and the epidermis may slip off upon touch, exposing the naked skin.

Swelling constitutes one of the most prominent and important local symptoms. At the very beginning of the disease, the swelling is usually quite evident to both sight and touch. It becomes especially marked when the healthy quarters of the gland have been milked out. Upon manipulation, the diseased quarter is found to be more or less extensively enlarged, sometimes to double the size of the corresponding normal quarter when filled with milk. There is, however, a somewhat definite limit to the rapid swelling of the gland, owing to the very inextensible gland capsule. As the inflammation continues, the capsule may become slowly increased to an enormous size.

There are variations in the character of the swelling, dependent somewhat upon the chief center of the disease and the virulence of the infecting agent. When the inflammation is deep-seated, the external appearances of swelling may consist very largely of edema, which appears subcutaneously about the upper

part of the udder, and may extend forward along the floor of the abdomen toward the anterior limbs, and upward and backward between the thighs to the vulva and perineum. Sometimes the volume of the edema is very great, while at other times edema may be virtually absent.

In other instances, the swelling assumes, instead, the character of induration, or we might say it is chiefly within the capsule of the gland, involving the glandular and interlobular connective tissues and, by causing parenchymatous engorgement, stretches the gland capsule tight and causes a firm compression of the contents within. Manipulation of the diseased quarter reveals great tenseness and hardness in the deeper parts of the organ.

When suppuration appears, and pus is formed, there soon occur the cardinal symptoms of abscessation, with the prominent firm swelling, redness and pain, to be followed by fluctuation. Usually there is a single abscess involving much or all of a quarter. Rarely one, two or all the quarters become the seat of multiple recurrent abscesses, the udder enormously enlarged, with abscesses scattered here and there, discharging copiously a thick, fetid pus.

When gangrene supervenes, the redness, pain and heat may disappear, the swelling may become softer, and, if the skin is involved, the surface becomes cold and the epithelium is readily displaced.

When the disease continues for a long period of time, and enters upon a chronic state, sclerosis, with absence of pain and heat, may follow, and the gland assume an enormous size.

The disturbance of function in the gland is one of the most marked and important symptoms of mammitis. From the very first, there is a more or less marked decrease, or a total suspension of the secretion of milk in the affected quarter. At the same time, there usually occurs a more or less marked diminution in the amount of milk secreted by the apparently healthy quarters.

The changes in the character of the milk are highly important, and reveal to a certain extent the virulence of the malady. The milk loses its neutral or faintly alkaline character, and becomes somewhat acid. The casein becomes precipitated and flocculent. The clumps of casein may be so tough and of such large size as to render it difficult or impossible for them to be forced out through the teat orifice. In many cases they probably remain incarcerated

in the larger milk ducts, to add to the engorgement of the gland. The liquid portions of the milk are watery, and vary in color according to circumstances. Usually in the earlier stages the liquid portion of the milk is white, faintly bluish-white, or yellow. Sometimes it is streaked with blood, or merely somewhat tinged with blood, to give it a faint reddish color. When gangrene appears, the liquid which may drip or be expressed from the teat has a tell-tale necrotic-red color, which at once reveals the condition of the deep-seated tissues.

The albumen in the milk may be increased ten-fold ; the salts may be largely increased ; while the fat and casein almost disappear. Sometimes the contents of the milk cistern are principally or wholly of pus.

The milk may be either odorless or more or less fetid. In many cases, when the diseased liquid is pressed out from the teat and caught, it is found to be extremely fetid, giving off the odor of fetid pus from wounds. In gangrene, the typical gangrenous odor may be present in the fluid. The taste of the diseased milk shows every possible variation, usually is somewhat salty or may be bitter.

Bacteriologically, the discharge from the gland may be highly variable, and include, as already suggested, various forms of diplococci, streptococci or bacilli, and other organisms characteristic of wound infection. The infection may be pure or mixed.

The systemic disturbances of mammitis are not always in harmony with the extent and intensity of the local lesions. Usually, in severe, acute mammitis, there are well-marked systemic disturbances, consisting essentially of fever or septicæmia. In very acute cases of mastitis, we have observed the temperature rise suddenly, reaching 106° F. within twenty-four hours from the time of infection. Generally, when there is an extensive inflammation of the udder, a more or less marked fever is present, with all the symptoms which that term usually includes, such as loss of appetite, torpidity of the bowels, dry muzzle, suspension of rumination and decrease of thirst. The urinary and other functions are decreased, and there is more or less profound depression. In the early stages of the disease, there may be chills, with staring coat. When the disease becomes very severe, there ensues a loss of sensibility, and the

patient ceases to care for her calf and becomes more or less unconscious of her surroundings. When gangrene is threatened or present, there may be more or less complete paralysis, as already stated ; or a somewhat similar paralysis may occur sometimes as a result of intoxication owing to absorption from the udder of bacterial products, in comparatively mild attacks.

Course and Termination. In a large proportion of cases the course and termination of the disease is unfavorable. Even in those cases counted as recoveries, the glands are almost inevitably more or less damaged, and their function interrupted either temporarily or permanently.

The complete loss of one or more quarters by atrophy, induration, abscessation or gangrene is common, resulting in a three-or two-teated cow of greatly diminished value. A three-teated cow may yield a high percentage of the normal amount of milk, but the diseased and functionless gland may constitute a menace to the adjacent quarters, and is unsightly and undesirable. When two quarters are lost, the decrease in the milk yield is so great that the value of the cow as a dairy animal is ordinarily at an end.

The mortality from the disease is by no means insignificant. The disease may terminate in resolution ; abscessation ; chronic mastitis, with atrophy of the glandular substance, which may be accompanied by hyperplasia of the connective tissue with induration and enlargement ; gangrene ; pyaemia ; or septicæmia.

a **Resolution** may occur early in the attack, at any period from the third or fourth to the eighth or tenth day, or even later. In very acute cases, resolution may follow in the course of a very few hours ; in fact, in some very virulent cases resolution must occur very quickly or the animal necessarily perishes. When resolution occurs, the swelling and pain in the udder abate, the appetite returns and the milk secretion becomes re-established, while the general appearance of the animal improves in harmony with the local conditions. The milk may remain somewhat abnormal for a time. The milk flow very rarely recovers its normal amount, but remains somewhat lessened throughout the involved milking period. The volume may or may not become fully restored at the next calving.

Vennerholm agrees with Franck that resolution seldom follows, while Stockfleth estimates that resolution occurs in at least 50%

of the cases. In our experience resolution has been very rare indeed.

Too frequently the acute disease passes into the chronic form. If the changes brought about by the disease are not too serious, the period of rest, while the cow is dry, may afford an opportunity for the complete resolution of the gland, so that when she again calves she may yield almost or wholly her normal amount and quality of milk. If the gland has been once seriously affected, it is rendered so vulnerable to any subsequent infection that the disease may at any time recur.

b. **Suppuration** and the formation of abscesses may originate in any of the tissues of the gland—in the subcutaneous connective tissue, the inter-lobular connective tissues, or the parenchyma of the gland.

In many cases we observe that the suppuration affects chiefly the epithelium of the milk canals and acini, to constitute catarrhal mastitis, in which case there may not be very extensive swelling, and the area of the disease may be more or less confined to the milk cistern and the larger milk canals, without involving seriously the acini themselves. Rarely an abscess forms in the milk cistern, without involving the parenchyma of the gland at all. Abscesses in the milk cistern are very liable to cause the destruction of the milk canals, by causing their complete atresia, so that they can never re-open. The formation of abscesses in the udder leads almost uniformly to the permanent destruction of the involved quarter, though in rare instances there may be a partial restoration of milk production after the next calving.

Purulent mastitis may lead, in somewhat rare instances, to pyæmia or to metastatic complications of the joints or tendon sheaths. Abscesses may become encapsulated, with indurated abscess walls which surround the pus, and continue as hard swellings in the affected part.

c. **Atrophy** of the gland substance occurs frequently, with or without induration.

Following many cases of acute mastitis, a chronic inflammation remains, which causes, in addition to the atrophy of the substance of the gland itself, an extensive hyperplasia of the inter-lobular substance. The gland becomes indurated, hard, and incapable of secreting milk. The indurated gland may as-

sume enormous proportions, and finally take the character of a connective tissue tumor, and, by its weight, drag the capsule of the quarter downward until it nearly reaches the ground. In some cows the indurated udder is so enormous in size, and hangs so low, that it interferes greatly with locomotion. It is constantly subject to injuries during the animal's movements, by coming in contact with obstacles of various kinds, which cause wounds and contusions and bring about infections of the enlarged functionless gland which may give more or less annoyance.

At each birth period, also, indurated glands are liable to become congested and inflamed, and give rise to more or less serious complications. Such a gland is always beyond restoration.

d. **Gangrene.** Gangrene constitutes the most serious termination of mastitis, because it destroys absolutely the function of all that portion of the gland which is involved, and seriously imperils the life of the animal. It occurs usually as a direct result of the intense infection of the part, which leads to the destruction of the circulation in the affected gland. It may appear very quickly, or may be somewhat delayed in its advent. Gangrene may involve the parenchymal and inter-lobular tissues alone, or may include the skin. It may be confined to one of the quarters or a portion of it, or may involve the half or all of the gland. The gangrenous portion may partially undergo purulent destruction. The surrounding parts may suppurate in such a manner that a sequestration of the necrotic tissue occurs, and the gangrenous portion is later thrown off.

In the more acute forms of gangrenous mammitis, the course of the disease is entirely too rapid and virulent for a sequestrum to form or suppuration to take place, and the animal dies very quickly from acute septicæmia or pyæmia. Few diseases run a more stormy course than the more acute types of gangrene of the mammæ. In one instance, which we observed, a cow was left apparently well at milking time in the evening ; when found the next morning she was down and unable to rise because of acute mammitis, which quickly advanced to gangrene of the organ ; she died during the day. Other instances have been observed where the disease has pursued a similarly rapid course.

Pathology. The pathology of mammitis includes every possible morbid change in an acinous gland, important changes in the milk secretions, and such systemic disorders as pyæmia and

septicæmia, which may emanate from the disease processes in the glands.

An incision through a milk gland recently attacked by mammitis, reveals engorgement, injection and hemorrhages in the parenchyma. The milk canals contain abnormal secretions, usually flocculent in character, due to clots of casein. The groups of acini upon the cut surface appear as small yellow clumps. Serous or sero-sanguineous fluid may be pressed from the cut surface.

If the disease assumes the catarrhal type, and limits its ravages chiefly to the epithelium of the gland, the milk cistern and milk ducts usually contain muco-purulent or purulent secretions. The accumulated secretions may be thin and watery with caseous clots floating in them, stringy and tenacious, or purulent and fetid.

Sometimes the disease may be limited to the milk cistern, and a catarrhal inflammation ensue with discharge of the pus through the teat orifice ; or the teat orifice may become blocked, converting the cistern temporarily into an abscess cavity, which eventually ruptures by re-opening of the milk orifice, and the discharge of the accumulated pus follows. Such an abscess tends to cause permanent atresia of the larger milk ducts and, preventing the escape of milk into the cistern, produces engorgement of that portion of the gland from which the affected duct normally serves as an outlet. Later the engorgement destroys the secretory power of the part, and there may remain for a time an imprisoned volume of milk—a "milk cyst." Catarrhal inflammation of the milk cistern may lead to atresia or adhesions in any part of the cavity. Sometimes the entire milk cistern becomes occluded, the cistern walls adhere from the base to the apex of the teat, and even though the gland itself may escape destructive inflammation, it is later doomed to pressure atrophy from the compression of the imprisoned milk. Such adhesions occur most readily in the dry cow or heifer, when the changes named are not interrupted by a constant flow of milk into the cistern.

When the catarrhal inflammation extends to the smaller milk ducts and acini, the secretory epithelium is more or less injured or wholly destroyed, while the cavities of the acini become occluded with exudate. Later the glandular tissue may undergo

atrophy. The atrophy may be intensified and increased by hyperplasia of the inter-lobular connective tissue septa.

Treatment. The treatment of mammitis is necessarily unsatisfactory.

The anatomy of the gland is such that when the tissues become infected there is no known method of reliable disinfection. Acute inflammation of the parenchyma at once causes the milk ducts and acini to become filled with exudate. Into these blocked passages we are powerless to introduce remedies, and from them we are alike powerless to extract the exudate. The gland is firmly bound down by its very tense fibro-elastic capsule, derived from the abdominal tunic. When the imprisoned gland becomes inflamed and swollen, great pressure is at once exerted upon its substance by the unyielding capsule, its circulation is impeded or suspended, and the infecting agent is afforded an excellent opportunity for rapid multiplication and destructive activity in the weakened tissues. Further complications arise from the dependent position of the gland, which interferes seriously with the return of the venous blood.

As in all diseases where no specific method of handling has been devised, so in mammitis, an almost endless variety of means have been suggested, tried, approved or condemned. It is impracticable to relate each method of handling, nor would it be profitable.

The various forms of handling may be more or less definitely classified.

1. **Disinfection.** Since acute mammitis is referable to infection, the most rational course for treatment, the one which technically appeals most directly to reason, is disinfection. Unfortunately, as already stated, we have no efficient plan for bringing this about. Three plans for disinfection have been tried, and each has had its champions, possibly because each possesses some degree of efficiency.

a. **Intra-mammary injections of disinfectants** have long been practiced and advised by some veterinarians, but the plan has never acquired general adoption. Nocard, Franck and other authorities have reported favorably. Vennerholm, Zschokke and other equal authorities have failed to secure benefit from this method of handling. In our hands, a 2 @ 5% boric acid solution, injected into the udder by gravity, has not only

failed to reduce the infection and inflammation but has apparently intensified the disease.

In the healthy udder, only a small amount of fluid can be introduced under a gravity pressure of three or four feet. We have succeeded in this manner in injecting little more than a pint into a quarter from which five to eight times that volume of milk had been withdrawn. This signifies that, in the healthy udder, fluids injected through the teat pass into the cistern and larger milk canals, but not into the smaller milk ducts and the acini.

In the vast majority of cases of mammitis, the small ducts and acini, not the milk cisterns and larger canals, constitute the chief center of disease. Fluids injected into the udder usually reach the least important part of the gland only—the cistern and large canals. As a consequence, not much can be expected from this plan of handling. If the disease is largely centered in the cistern and large sinuses, disinfection by intramammary injections may prove highly efficient, but such cases are in the minority.

The selection of a disinfectant for such purpose is not highly important, though certain principles may have clinical importance. Boric and other acids tend to coagulate any casein or albumen present. The same holds true of mercuric chloride, and the salts of the heavy metals generally. Carbolic acid, creolin and allied drugs are highly irritant. Probably lysol, bacillol and other drugs of this group are most useful for injection.

Whatever disinfectant is employed, it must be in very weak solution. Of lysol or bacillol, not to exceed 0.5% should be used. The chief reliance should be placed upon the irrigation of the cistern and sinuses with the warm water, rather than upon the efficiency of the antiseptic contained. The various soluble silver salts have been proposed for this purpose, but have failed to secure a prominent place.

b. **Disinfection by external applications** is an old plan of handling. Probably in many cases, the practitioner has not had disinfection in mind when applying it. Camphor, iodine and mercury, in combination with various substances, have long been used in the form of ointments thoroughly anointed over the affected area. Their value has been stoutly asserted by practi-

tioners like Johne, Bang and Franck. They probably exert some favorable influence as disinfectants. It is possible, however, that the massage used in applying the ointment constitutes as great, or even a greater, factor than the absorbed portion of the ointment. The drugs named are also rubefacients, and may favorably affect the diseased gland by exciting increased vascularity with exalted leucocytosis.

c. **Systemic disinfection** in mammitis has not yet received much attention. How effectively it may be employed remains to be determined. We know that potassium iodide exerts a somewhat specific effect, when given internally, upon lesions of actinomycosis and botryomycosis—chronic infections which are not wholly unlike the acute infections of ordinary mammitis.

Aromatics and gum resins, when given to healthy, lactating animals, are recognizable in the milk by the sense of odor and taste. Most of these drugs, like camphor, turpentine and the aromatic oils, are efficient disinfectants, and given in full doses tend somewhat to lessen infection in the mammary gland.

2. Modifications in the blood-flow to the udder have been claimed to affect the course of mammitis. In former times practitioners aimed to reduce the intra-mammary blood pressure by means of venesection. Local applications of camphor, belladonna and other drugs have been made, in the belief that they decreased the amount of blood sent to the udder, though the truth of this has not been clearly shown. On the other hand it is not impossible that they increase the blood supply and also the leucocytosis, through which the treatment may act favorably upon the diseased organ.

Just as in the application of antiseptics, so here the massage incident to application may exert the chief favorable influence.

Cold has been used and advocated by some, either cold water or ice being applied to the inflamed gland. It has not proven of any marked value. Its tendency is to cause decreased vascularity during the continuance, to be followed by increased blood flow and vascular engorgement as soon as the cold is withdrawn.

Fomentations with hot water, to which vinegar and various other drugs are added, have long been recommended, and with the accompanying massage, appear to exert a favorable influence. For this purpose, a sufficiently capacious vessel should be filled with as hot water as the patient can bear, and the vessel placed

directly beneath the udder. The fomentation and massage are then applied, the bath being kept hot by repeated additions of hot water.

It has been recommended also to modify the blood flow in the mammæ by suspension or compression of the glands. Some recommend that a three-cornered piece of cloth, of sufficient size to encompass the udder, be fitted with long straps, those from one corner passing up behind on either side of the tail, those from the other corners upwards along the flanks, and all tied securely over the loins. This may support the weight of the pendulous udder, exert some pressure upon it, and decrease the engorgement of the gland. Some would cut holes in the suspensorium, through which the teats may project, so that the cow may be milked; others advise that the teats be included in the bandage, and one corner detached while the cow is being milked.

It has also been proposed to strap the udder tightly with strips of adhesive plaster, and to thereby exert compression upon the gland, but the plan has not come into general use, presumably because it has failed to produce the expected results.

The form, direction and location of the udder of the cow render suspension and adhesive strapping exceedingly difficult, and the efficiency of neither has been demonstrated. It may well be questioned whether the inevitable partial displacement of such appliances, when the animal lies down, does not induce injuries which more than counterbalance any possible good it is hoped to derive from the strapping or suspension.

With the aid of the suspensory bandage, poultices were formerly applied to the inflamed udder. They were highly commended by many, but their use has been largely discontinued. They are difficult of application and retention, and their value is very problematic.

Instead of attempting to decrease the blood flow to the inflamed gland, some would increase it. This is probably in a measure brought about by massage and by the application of stimulating liniments. Cupping has also been tried. A cupping glass of sufficient size is fitted over the teat of the affected quarter, and the air exhausted. This may cause the discharge of quantities of secretions which could not be withdrawn by milking, and stimulates increased nutrition in the diseased tissues.

Modern therapeutics recognizes the value of increased numbers and activity of leucocytes in a diseased area. Cupping, massage, repeated milking, fomentations, and the application of stimulating liniments or ointments, all probably favor leucocytosis. It may be that the chief value of each of these applications lies in this influence upon the abundance of leucocytes in the part.

3. It has been proposed to exert a favorable influence upon the course of mammitis by decreasing the flow of milk. In a way, this plan is closely allied to the decreasing of the blood supply to the gland. In considering the symptoms of the malady, we had occasion to note the inevitable decrease of milk secretion, or even its total suspension, as soon as mammitis becomes established. The artificial checking of the secretion of milk is usually quite unnecessary; it becomes checked or suspended as an inevitable consequence of the disease. Not only is the secretion of milk decreased or suspended in the affected quarter, but also in the sound areas of the gland.

Nevertheless many practitioners would have us decrease the milk secretion by the application of belladona or camphor to the exterior of the affected gland. Others recommend reduction of lactation by a reduced diet or by laxatives or purgatives. Whether or not these be of direct value in precisely the way intended, is possibly of no great consequence. Two essential therapeutic principles are involved: 1. The maintainance of the vigor of the animal system—as a whole; and, 2. The placing of the diseased organ at rest. We cannot maintain the highest systemic vigor upon a too restricted diet, and it is equally injurious to overfeed. The forced feeding of dairy cows is highly inimical to the progress of mammitis, just as it is of any other serious organic malady. It is consequently important that, in mammitis, the food rations be adjusted to the needs of a sick animal, and this in itself will reduce the tendency to active lactation. For this purpose it is well to allow a restricted ration of bran, roots or grass, freely salted, to emphasize the laxative tendency.

4. **Elimination of disease products from the system.** Acute mammitis is inevitably accompanied by the entrance into the system of important disease products which more or less seriously affect the general health of the patient. These disturbances are reflected back to the affected organ, there to intensify the local disease. Not only is it important, for the progress of

mammitis, that the animal system be kept in the most vigorous condition possible, but it is equally important that the disease products shall be promptly eliminated.

Whenever these fail to be promptly eliminated, they at once act unfavorably upon the system, inducing fever, with its important train of symptoms. With the advent of fever, the kidneys, bowels and other eliminating organs fail to perform their normal functions.

Mastitis in ruminants is especially marked by great torpidity of the digestive system: rumination ceases, the bowels are torpid, digestion is at a standstill, the aliment within the canal tends to undergo decomposition, and waste products which are normally eliminated through this channel are retained within the system.

It has accordingly long been the custom of veterinary practitioners to favor elimination by stimulating the alimentary tract to increased activity. This is partly accomplished by a laxative diet, which in mild cases frequently suffices. In the more serious cases, the patient does not eat, or for other reasons a laxative diet fails to produce the desired results and the practitioner needs appeal to more radical measures.

The administration of purgatives in acute mammitis has accordingly become recognized by many practitioners as highly valuable. Most practitioners rely upon the administration of magnesium, or sodium sulphate with various adjuncts. They have the common defect of inducing a degree of nausea, decreased thirst and inappetence, which combine to retard or prevent catharsis. At best they are slow of action. Oils are little, if any, more effective.

In our experience, the hypodermic cathartics—eserine, arecoline and pilocarpine, combined where advisable with strychnine—constitute the most reliable, prompt and efficient means for unloading the alimentary tract. They save 12 to 20 hours in time, hours which may be of critical importance in the control of the malady; they are safe and bear quick repetition when the dose proves too small; and they possess very high efficiency.

In one case occurring in our clinic, acute mammitis of a very virulent type, in all four quarters, followed the iodide of potassium infusion in handling parturient paresis. The temperature was 106° F., the pulse very rapid, the muzzle dry, the animal

extremely dull and weak and paying no attention whatever to her calf. The udder was immensely enlarged, hard and unyielding, and but a few drops of a thin, serous fluid could be pressed out of the teats. The general appearance of the animal indicated that the disease was progressing rapidly to a fatal termination, and in our judgment the patient would not have survived many hours under the usual methods of treatment.

We ignored the local handling of the organ, and instead injected a full dose of eserine sulphate and pilocarpine hydrochlorate hypodermically. The purgation and salivation were very prompt and decided. The improvement in the condition of the animal was also prompt and remarkable. The temperature fell at once, and continued to drop at the rate of more than 1°F. per hour, until it reached normal. The muzzle soon became moist, and the cow renewed her attentions to her calf.

The engorgement of the udder diminished rapidly ; the gland quickly became less tense and hard, and milk soon reappeared in the gland. The recovery was as prompt as had been the onset of the disease, which had shown unusual virulence from the beginning.

Vennerholm regards the repeated withdrawal of the milk or excretions representing it, and thereby the removal of so much infectious material, as one of the most important elements in the handling of acute mammitis in the earlier stages. He recommends that the milk which accumulates in the cisterns should be withdrawn at least hourly so long as there is a hope of bringing about the resolution of the gland. He very properly remarks that the infectious fluid should on no account be deposited upon the stable floor, but should be milked directly into a container partly filled with a reliable disinfectant. Too much reliance should not be placed upon the withdrawal of the small amount of fluid which has accumulated in the milk cistern. In most cases of acute mammitis, the amount of this is not large, although we know full well that it is highly infected, and may consequently look upon its retention in the cistern and sinuses as very undesirable. The important pathologic changes are taking place chiefly in the acini, and not in the milk canals or cistern, and such influence as we may be able to exert upon the large milk canals and their reservoirs is not of fundamental importance. Our anxiety is centered upon the acini themselves.

While the infection has admittedly entered through the milk cistern and the milk canals, nevertheless after the infection has traversed these parts and reached the parenchyma, the importance of these canals in the course of the disease has been largely eliminated.

When considering the symptoms of acute mammitis we have referred to the advent of coma in rare cases, and have stated that in at least one instance the inflation of the udder with oxygen overcame the coma, and apparently at the same time eliminated the infection. In ordinary mammitis it would appear that inflation with air or oxygen would prove valueless.

As in other infections, so in mammitis, it has been hoped that curative sera may be devised which may be turned to practical account. The uncertain and usually mixed character of the infection constitutes a serious obstacle to serum therapeutics.

Cows which are suffering from mammitis should be milked by a person who does not come in contact with the other cows, or should be milked last, so that the milker may not pass from the diseased cow immediately to a healthy one, with the possible danger of transmitting the disease. The same rule should be applied to the healthy portions of the gland of an animal suffering from the disease ; the healthy quarters should be milked first, followed by the milking of the diseased ones.

Disinfection of the udder externally is of very great importance in the control of the disease. Before beginning to milk an affected gland, the entire udder should be thoroughly disinfected, and after the milking of the diseased gland has been completed it should again receive thorough disinfection. The milker should also very thoroughly disinfect his hands before and after the milking, and especially should always most thoroughly disinfect his hands after having milked a diseased gland before he milks or otherwise handles the udder of a healthy cow. The best disinfectant for this purpose is 1-1000 corrosive sublimate solution, because of its high efficiency and freedom from odor, so that if used in a stable where milking is going on, there is no danger of causing the milk to become tainted.

In stalls where mammitis exists, great care should be taken to thoroughly cleanse and disinfect the floors and gutters, in order to prevent the spread of the infection from animal to animal. It

is important also, as has been suggested in dealing with the causes of the disease, that the tails of neighboring cows should be kept disinfected, or, preferably, that a cow suffering from mammitis should not be kept so near to a healthy cow that a transfer of the infection from one to another, through the medium of the tail or otherwise, is probable.

In wounds of the teats or udder, it is highly important that the disinfection of these should be as complete as it is in the power of the practitioner to command, in order to avoid the entrance of infection through the teat orifice into the gland. In dealing with metritis, or other disease accompanied by infective discharges from the vulva, which may flow down over and soil the udder and teats, the practitioner should exercise care in order to prevent the infection from gaining entrance into the teats.

The surgical handling of mammitis consists in the opening of abscesses, the detachment of necrotic areas, or the amputation of the gland.

The handling of abscesses of the mammae offers few special problems as compared with the handling of abscesses of other portions of the body. Following the general rule of procedure, they should be opened as early as fluctuation is clearly present ; the opening should be free and dependent as in other abscesses ; the abscess cavity should be thoroughly disinfected and any necrotic tissue lying within the cavity should be removed.

In some instances of suppuration, the pus collects very largely in the milk cistern and is discharged through the orifice of the teat. In some cases this discharge of pus is not as free as should be, and it is occasionally advisable to amputate the end of the teat in order to secure a perfectly free opening. The question of the preservation of the teat is usually of no significance, because the quarter has lost its power of again secreting milk and is consequently useless.

In some instances of severe mammitis, with great enlargement of the udder and extreme tension of the capsule of the gland, the virulence of the disease may be largely overcome by long and deep scarifications, by which the capsule is incised at a number of places in such a manner as to relieve the compression of the gland. This may be followed by liberal bathing with warm antiseptic solutions. In this way gangrene of the gland may be avoided, and the inflammation largely overcome; but after

all no very useful purpose has been served, except possibly that the danger to the life of the animal has been lessened. The affected gland is destroyed, and consequently useless. Amputation would generally be preferable.

Whenever gangrene threatens the life of the animal; when the udder is the seat of enormous abscesses which must eventually destroy the integrity of the gland and cause prolonged disease and loss of condition; when tumors of large size or chronic inflammatory processes with great enlargement and pendulousness of the udder exist; or when the gland is the seat of actinomycosis or botryomycosis, the udder should be amputated. It is impractible to amputate one of the quarters of the cow, since the two quarters of one half are too intimately blended for separation.

The cow is to be cast, and preferably secured in lateral recumbency. Vennerholm recommends dorsal recumbency, but this is constantly objectionable in ruminants because such position tends to induce tympany, and consequently should be avoided as far as practicable. The patient should be secured by means of two stout ropes, one of which is to be attached to the anterior, and the other to the posterior feet. The patient is then to be extended by attaching each rope to a post or other secure fastening, sufficiently far apart to allow the animal to be fully stretched between the two points.

The question of anaesthesia is one upon which practitioners are not agreed. Vennerholm recommends complete general anaesthesia. In our experience general anaesthesia in the ruminant is dangerous, because of the probability of food being regurgitated from the rumen and inhaled, to cause foreign body pneumonia.

In one case of amputation of the udder in the cow, where the entire gland was removed, as it was completely gangrenous, the cow was in a comatose condition and required no anaesthetic, because, so far as could be seen, no sense of pain was induced in the animal during the entire operation. Neither is the operation a very painful one in most cases, so far as can be judged by the character of the tissues involved. The principal pain is induced by the cutaneous incisions, and the ligation of the chief mass of inguinal vessels. The operator may consequently choose between general anaesthesia and local anaesthesia to the skin, followed by local anaesthesia to the vessels passing through the inguinal canal.

With proper care in application, the local anaesthesia is efficient and ample from both humane and surgical standpoints, and is far safer than general anaesthesia in ruminants.

If the entire udder is to be removed, it is most easily accomplished by amputating the two halves separately. If the skin is healthy, enough of it should be retained to readily cover over the denuded tissues, though most of it would best be removed with the gland. A curved incision is made around the half of the udder to be removed, at such a point that sufficient skin will remain to properly close the wound. The incision should extend only through the skin into the subcutaneous connective tissue. The skin is separated, by means of the fingers or the scalpel handle,

FIG. 142. UDDER OF COW, SHOWING PRINCIPAL BLOODVESSELS. (FÜRSTENBERG).

a Ext. pudic art.; *b* Ext. pudic vein; *c* Arterial twig to the lymph gland; *d* Posterior mammary gland; *e* Anastomotic twig of external pudic artery; *g* Larger venous trunk; *h* Posterior mammary vein; *l* Lymph gland; *m* Milk vein; *o* Ant. mammary vein; *r* Lymphatic vessel; *t* Nerve trunk (ilio-hypogastric and ext. spermatic).

from the fibro-elastic capsule of the gland. As this division approaches the base of the gland, the operator encounters the subcutaneous abdominal vein and a branch of the external pudic artery, which should be ligated, preferably with a double ligature, in order to prevent anastomatic hemorrhage.

Posteriorly the operator encounters branches of the external pudic vein and artery, which require ligation. As the operation extends upward, the capsule of the gland needs be detached from the abdominal tunic, of which it constitutes a part, and when the region of the external inguinal ring is reached the operator encounters the chief vascular supply of the gland, as the vessels emerge from the inguinal canal. These should be carefully and securely ligated *en masse*. Any failure to properly secure these vessels may lead to serious or fatal hemorrhage, as has been repeatedly observed.

By properly dividing the connective tissue from these vessels, they may be readily bared for some distance, and a ligature passed around the group of vessels, which may then be divided with scalpel or scissors some distance beyond, leaving a sufficient stump to insure against displacement of the ligature. If these vessels are properly ligated, there can scarcely occur a serious hemorrhage from any of the others.

If the other half of the gland is to be removed, the animal, if secured in lateral recumbancy, should now be turned to the opposite side, and the operation repeated.

The wound should then be thoroughly cleansed and disinfected, all blood clots washed carefully away, and all vessels which can be discovered properly secured, after which the margins of the wound should be trimmed in such a manner that they can be brought together in proper apposition, without being either stretched or flaccid. In the wound should be laid some antiseptic tampons, such as strips of iodoform gauze, in order to provide drainage and secure antisepsis.

2. Infectious Mammitis of Cows. Infectious Agalactia. "Gelber Galt."

Messrs. Borgeaud, Nocard and Mollereau, Zschokke, Bang, Kitt and others, describe an epizoötic form of mastitis in cows which sometimes occasions very serious losses. Zschokke asserts

that some dairymen dread the malady more than foot and mouth disease, so extensive are the losses sometimes occasioned in affected dairies.

The malady has been observed chiefly in Switzerland, where it has been extensively studied. We have seen no definite account of the existence of the malady in America, but its chronic, insidious character renders its importation easy. It probably already exists in this country, and merely awaits recognition and report of its presence.

The disease consists of a catarrhal mastitis accompanied by slight or inconspicuous tumefaction of the affected quarter or quarters. The onset is somewhat insidious. The gland does not swell greatly, if noticeably. There is little or no tendency to abscessation or gangrene, and no marked systemic disturbances.

The milk from the affected gland diminishes in quantity and undergoes gradual changes in quality. It becomes serous, bluish, and more or less viscid or flocculent. Later the color of the milk may be reddish or brownish. It acquires a slight acid reaction, is odorless and has a salty taste.

The affected gland, which at first was but little altered in size, consistency or temperature, begins after 2 or 3 weeks to atrophy, and the milk secretion largely or completely ceases. After 2 or 3 months the gland becomes extremely atrophied and shriveled, and the gland tissue so far disappears as to be almost unrecognizable by palpation. After the disease has run its course, the gland remains functionless at least until the cow calves again, possibly permanently.

Ibel (Archiv. Tierheilk, vol. 30) found that the lacteal vesicles largely disappear, so that instead of 200–300 in a lobule, but 15–60 could be found. The diameters of the lacteal vesicles were also greatly reduced. The acini were sometimes empty, sometimes contained granular leucocytes or albumen coagula.

The interlobular connective tissue was found somewhat thickened and sclerotic. Ibel concludes that "gelber galt" at first consists of a comparatively mild parenchymatous mastitis, with the escape of leucocytes and albumen into the alveoli.

The disease is highly contagious, and is readily transmitted from the diseased to the healthy glands of the same udder or from cow to cow, through the agency of the milker's hands.

The cause is a form of streptococcus, which can readily be ob-

tained in pure cultures, and by which the typical affection can be experimentally induced.

Zschokke recognizes two types of the disease—the curable and the incurable. The first is caused by a short streptococcus ; the latter by a long streptococcus. Apparently this is a variation in the virulence of the same organism ; if very virulent it forms in long chains if milder in short chains.

Zschokke insists that the microscopical diagnosis is practical, and fundamentally important. Not only would he differentiate microscopically between acute mammitis and infectious mammitis, but he would recognize, by the length of the cocci chains, the grade of virulence in individual cases of infectious mammitis. He considers the early bacterial diagnosis of the greatest importance in order that control measures may be properly instituted early in an outbreak.

The handling of infectious mammitis or agalactia has proven unsuccessful. No method of treatment has been found which exerts any recognizable influence from an economic standpoint. Zschokke tried intra-mammary injections of potassium iodide, 1–1000, and itrol (silver citrate), 1–4000, but without result. He also tried, in vain, subcutaneous and intra-mammary injections of anti-streptococcus serum.

Cantharides and other stimulating applications to the udder reduced the infection ; but the milk flow was suppressed, the gland continued functionless, and the betterment was without economic value.

The experiments of Zschokke convinced him that it is best to leave a milk gland, affected with infectious mammitis, wholly alone. If the milk is drawn from the gland, the free leucocytes are also extracted. If left alone, the leucocytes destroy the streptococci, especially those in short chains. If the milk, or mammary excretion representing it, is left in the gland, not only do the leucocytes tend to destroy the cocci, but the spread of the infection to other quarters of the udder or to other cows is obviated. So long as the infected excretions remain in the udder, they do no harm to the gland, but the affected gland tends more to recovery than if the excretions were removed.

The most important feature of handling the malady is the prevention of its spread from diseased to healthy glands. Diseased cows should be as well isolated as practicable, and should be

milked by separate milkers, or, if by the same milker, they should be milked last. When the disease exists in a dairy, disinfectants should be freely used on the milker's hands and the cow's udders, both before and after the milking of each cow.

3. Exanthema of the Udder. The Mammitis of Cow-pox and Pock-like Diseases.

Pox of the udder is quite common in milk cows in some regions. Some hold that there is a true and a false pox, while others claim that the two alleged diseases are really identical and consist of the genuine cow-pox.

Cow-pox is usually of a benign character, though at times it is severe and tends to produce mammitis. At the beginning of the disease there may be present the general symptoms of fever, including chills with constipation and a decreased flow of milk. This is followed in the course of a few hours by characteristic lesions of the teats and the parts immediately surrounding these, consisting at first of hyperæmic areas, with swelling of the surrounding skin. The skin is tender upon handling, and the cow resists being milked. In the course of two or three days there appear distinct papules in the inflamed areas, which vary somewhat in their appearance according to the color of the skin. If the integument is not too highly pigmented, the papules are surrounded by a red zone, and become pitted or pocked in their center. The contents of the papules are at first clear and lymphoid in character, but later become cloudy and more or less purulent, and finally dry, to constitute a scab, which drops away in two or three weeks, leaving a reddish, depressed scar.

Should the pustules be injured by careless milking or otherwise, and the crusts torn away, the disease processes become intensified, the ulcers extend, and perhaps those which are near together become confluent. The crusts forming over the surface are very extensive, and under repeated irritation the lesions tend constantly to grow worse. The eruptions do not all appear simultaneously, but new crops arise from time to time, so that there may be fresh papules alongside the old crusts or ulcers.

While the course of cow-pox is usually benign, in severe cases there is a tendency to the occurence of mastitis of a severe type. It is not known that the mastitis is due to the entrance of the cow-pox organism into the udder. It is probable that the pox

lesions upon the teat and udder cause a purulent infection, which furnishes a supply of highly virulent pus, ready to induce infection at any time that it may chance to find entrance through the teat canal into the milk cistern and thence into the milk canals.

The source and character of the infection of the cow pox is unknown. In some cases, however, it is traceable to vaccination in man. The milker may have been vaccinated, or may have handled the vaccination wounds in children or others who have been vaccinated, and thus may bear the disease, upon his hands, to the teats of the cows while milking. Once the affection has gained entrance into a dairy stable, it is readily transmitted by the hands of the milkers from one cow to another.

The handling of cow pox in dairy cows is chiefly prophylactic, and consists of the application of the fundamental rules of disinfection. So far as is practicable, the affected cows should be isolated from the sound ones, and should be milked last. If the disease exists in a dairy stable, the hands of the milkers should be thoroughly disinfected before and after the milking of each cow. In our judgment the best disinfectant for this purpose is corrosive sublimate, because of its efficiency and absence of odor.

* * * * * *

We meet from time to time, in various localities, with other forms of exanthema of the teats and udder.

In the vicinity of Ithaca, N. Y., there has prevailed from time to time a disease having the general clinical characters of an infection. So far as we have been able to observe, the disease is unaccompanied by the formation of vesicles, pustules or other lesions to definitely identify it with cow-pox. At first there appear small inflamed areas in the skin of the teat or contiguous parts of the udder. Later the areas become hemorrhagic, and finally necrotic, when they dessicate, turn black and constitute a large scab, which is exceedingly hard, tough and adherent. The number of these necrotic areas is usually limited to from two to five or six upon the entire udder and teats. They vary in size from one-quarter to one-half inch, or even more, in diameter. Ordinarily the disease pursues a comparatively benign course; but the diseased areas are sensitive and painful, so that the cow resists being milked. In some cases the disease is followed by a very destructive streptococcic mammitis, which usually leads to the permanent destruction of the affected quarter

or quarters. The danger of mammitis increases as the proximity of the lesion to the teat orifice increases. Sometimes the lesion occurs in the teat orifice itself, interfering promptly with the passage of milk and leading quickly, in many cases, to infection of the gland.

Apparently the mammitis is not the direct, but rather an indirect result of the presence of the eruptions. The infection of the gland takes place after the scabs have attained large size and more or less abundant suppuration has occurred around their borders. It seems that the infection is attributable to the pus which thus forms, and later gains access to the milk cistern through the teat orifice. Our chief interest in the disease is the prevention of the mammitis by thorough disinfection. Whether this be genuine cow-pox or not, the disinfection should be careful and ample. The diseased parts should be thoroughly disinfected before and after milking, and the hands of the milkers should be well disinfected before and after the milking of each cow, whether diseased or sound. We recommend in this disease the washing of the udder of the cow and the hands of the milkers with a 1-1000 corrosive sublimate solution, to be followed by the application of a disinfectant to the teats and adjacent parts of the udder, consisting of equal parts of tincture of iodine, tincture of arnica and glycerine. If the crusts become detached, leaving a raw sore, this may be carefully touched with stick silver nitrate, or with tincture of iodine.

When the lesion is located directly in the milk orifice, vigorous disinfection should be instituted. The part should be pencilled with a fine cone of silver nitrate, or a drop of tincture of iodine inserted by means of a medicine dropper.

4. Tuberculosis of the Udder. Tubercular Mammitis.

Tuberculosis of the udder is virtually confined to the cow. Although tuberculosis is very common among dairy cows, recognizable tubercular disease of the udder is comparatively rare. When it does occur it is regarded as especially important because of the highly infectious character of the milk.

Symptoms. The symptoms of tuberculosis of the mammary gland consist usually of a tense swelling of the mammæ, generally of one quarter only, and most frequently one of the hind quarters. The general condition of the animal is not affected by

the tuberculosis of the udder, and whatever constitutional symptoms may appear are referable to the ravages of the disease in other parts of the body. The mammitis is chronic in character, and increases very gradually in volume and hardness. After a time the affected quarter becomes very hard and extremely large. Franck records cases in which the udder has attained a weight of 30 to 40 pounds.

The secretions of the gland depart from the normal very gradually, and may retain the general appearance of milk for weeks or months, and then slowly become watery, filled with clots and perhaps becomes yellowish in color. The lymph glands on the proximal side of the mammæ, the supra-mammary lymph glands, become swollen to such a degree that they may be felt or seen.

The diagnosis of tubercular mammitis is to be made in conjunction with the general symptoms. The definite diagnosis must depend largely upon the tuberculin test. According to Bang the disease is characterized by the fact that, for some time after the advent of the malady, the secretions of the gland remain apparently normal in appearance and quantity, although in some cases the disease may be acute from the beginning, and consequently the amount of milk very much decreased. In comparison with other forms of mammitis, it is important to note that as a rule there is little or no pain in the tubercular portion of the udder.

Tuberculosis of the udder occurs chiefly in very severe cases of tuberculosis. The course is comparatively rapid, and the animal may succumb to general tuberculosis in a few months.

Upon post-mortem examination the swelling of the affected glands is usually diffuse, though in some cases it is nodular. Upon section, the swollen parts of the udder are found very firm, and the cut surface is even, while the affected portions are prominently separated from the sound parts by a clear line of demarcation. There occur, throughout the diseased portion of the gland, more or less numerous yellow spots or tubercules, while the larger milk canals may contain yellowish caseous masses and the walls of the milk cisterns may show small tubercular elevations.

In cases of long standing, the tubercular degeneration of the gland becomes more evident, and the tubercles may become

widely disseminated through the glandular tissue without causing a very dense swelling.

Microscopic examination of the caseous masses, the miliary tubercles, and the milk from the tuberculous udder, reveals an abundance of tubercle bacili.

The feeding of such milk has produced tuberculosis in swine, rabbits, cows, cats, goats and other animals, and numerous instances are cited where fatal tuberculosis of man has apparently resulted from the ingestion of such milk, especially by children. Tuberculosis of the udder is incurable.

5. Actinomycosis of the Udder.

Actinomycosis of the udder may occur in any animal which is subject to actinomycotic infection, but has been observed chiefly or wholly in the cow and sow. It closely resembles in many respects tuberculosis of the udder. Prior to the identification of actinomycosis, the disease was usually mistaken for tuberculosis. It may affect one or all quarters, but has a great tendency to remain confined to one quarter, because as a general rule, the source of the infection is local and not systemic; whereas the opposite usually holds true in cases of tuberculosis.

The malady usually reveals itself in the form of a chronic, slow-forming nodular disease of the gland, the nodules varying from ¼ to 4 inches or more in size, and consisting of small abscesses surrounded by thick and dense connective tissue. These small foci behave like actinomycotic abscesses occurring in other tissues of the body; they tend to rupture one after another, and leave small fistulous openings, which are somewhat retracted, and heal tardily.

Upon section, the actinomycotic lesions have the superficial appearance of tuberculosis, and may at first be mistaken for that disease. The section reveals abscesses of various sizes, surrounded by more or less dense connective tissue walls. If the abscess is large, and contains much pus, the wall is usually very thick and dense. If the abscesses are very small, or consist of very small suppurating areas, the walls are not so conspicuous, and the tissues invaded by the disease present a yellowish, granular appearance, quite characteristic of the malady, and different from that of tuberculosis. In actinomycosis, caseation and calcification do not occur. The diagnosis may be definitely made by

the microscopical examination and the identification of the actinomyces.

The handling of the disease does not differ from the treatment of actinomycosis in other parts of the body. It depends essentially upon the internal administration of iodine, or the direct surgical removal or destruction of the diseased parts. Internally potassium iodide may be administered to the cow, in doses of 1 to 3 drams per day, while tincture of iodine or iodine ointment may be locally applied to the udder. In other cases it is best to extirpate the affected part completely with the scalpel. When large abscesses appear, they may be sloughed out by opening them and then filling the cavity with sulphate of copper crystals, and leaving them in position until they come away spontaneously.

6. Mastitis in the Mare.

Acute mastitis due to ordinary infection of the udder is rare in the mare. It is occasionally observed at about the time of foaling, or within a few days thereafter, and may run a similar course to the disease in the cow, though not usually so violent.

Abscesses occur somewhat rarely, but are largely referable to other causes than ordinary wound infection, chiefly to strangles and botryomycosis. As in the cow, it is possible for the inflammation to pursue a chronic course. The prognosis in mammitis of the mare is more favorable than in the cow. The handling of the disease in the mare calls for nothing different from that in the cow.

7. Mammary Strangles in the Mare.

When strangles attacks a mare which is nursing a young foal, the infection is very liable to involve the milk glands and cause abscesses of these or of the neighboring lymph glands. The abscesses are frequently very large, and are accompanied by extensive and virulent inflammation of the gland. The abscess may rupture externally, and escape over the side of the udder, or it may rupture within and escape through the teat with the milk.

An abscess of the mammary gland, due to strangles, does not vary in any essential particular from a strangles abscess in any other portion of the body, but may at first be mistaken by the practitioner for an ordinary case of mammitis. Generally, however, the abscess of the udder follows the formation of abscesses

in the sub-maxillary glands or elsewhere, so that the practitioner is forewarned as to the character of the disease.

The chief significance of strangles abscess in the mammary gland of the mare is in relation to the health of the foal. In our experience, when a young foal takes milk from a mare which is suffering from strangles, and especially when the strangles affects the udder itself in the form of abscesses, the malady has an unusual virulence for the foal, and it is very liable to perish.

The handling of strangles of the mammary gland demands the same general measures as in other cases of strangles, in so far as the mare is concerned. The abscesses should be opened early, and the animal should receive internally reliable antiseptics, especially large doses of potassium iodide, in order to overcome the infection as early as possible.

The foal should be removed from the mare, and fed upon milk from a healthy mare or from a cow, and should receive some preventive treatment, such as the administration of potassium iodide in its milk, in order if possible to decrease the severity of the attack, which must almost inevitably occur.

8. Botryomycosis of the Udder.

There occurs occasionally in the mare a chronic, indurative inflammation of the milk gland, which is characterized by a very tense and hard enlargement of the udder, with chronic fistulæ and small recurrent abscesses. It is claimed to be due to a special form of micro-organism, known as the botryomyces equi or micrococcus ascoformans. Some pathologists claim that this micro-organism is simply one of the pus-forming organisms, and that the peculiar characters of disease resulting from it, the new formation of sclerotic connective tissue, the formation of abscess and fistula are due, not to the special form of the agent causing it, but to the peculiarities of the tissues of the animal itself. The general character of botryomycosis of the udder of the mare is analogous in all respects to that of botryomycosis of other tissues and organs of the horse.

Symptoms. The symptoms of botryomycosis of the udder in the mare are generally well developed before they attract any attention. The disease may occur in an animal which is nursing a foal, or in one which has been dry for months or years, or possibly has never bred. It is usually first observed by the owner when the

gland becomes much swollen because of the maturing of an abscess preparatory to its rupture. The gland may become so swollen, tense, and sensitive that the animal shows pain, expressed by lameness in the hind limb of the corresponding side.

There is usually some edema in the subcutaneous tissues of the udder and neighboring parts. As a rule, but one-half of the gland is involved. After a few days the matured abscess ruptures and discharges a small quantity of pus, and there remains for a period of time an inconspicuous fistulous opening, from which a very small quantity of pus exudes. The mouth of the fistula sinks deeply into the skin by retraction of its scar tissue. If a probe be inserted into the fistula, the canal is found tortuous, but one may be able to follow it for a distance of two to six or more inches. After a time the fistula heals, and later another small abscess forms in some other portion of the gland, and ruptures, to be followed by another fistulous opening. In some cases there may exist, at one time, two, three or more fistulous openings, from each of which a very small quantity of thick pus is discharged.

The general health of the patient is not apparently affected. The diseased gland continues to grow, and may attain a very large size.

The disease is chronic, and shows no tendency toward spontaneous recovery, but rather continues from year to year. There is little tendency for the disease to pass beyond the capsule of the gland and involve neighboring tissues. Vennerholm states that it may extend to the thigh or perineum, and may thus cause marasmus and the death of the animal.

The differential diagnosis sometimes offers difficulties. A gray mare, entered in our clinic, presented symptoms which made it difficult to determine whether she was suffering from botryomycosis, melanosis or a malignant new-growth. The affected half of the gland was enormously enlarged, and the animal showed a distinct cachexia and was very stiff in her movements. Exploring the pelvic cavity and posterior portion of the abdomen per rectum, we found that the growth extended up through the inguinal ring into the peritoneal cavity. An unfavorable prognosis was given, and the animal was destroyed, whereupon it was found that the gland was invaded by a malignant melanom, and

the liver weighed 72 pounds, it being likewise the seat of malignant melanosis.

Generally the disease is easily diagnosed by the chronic course, the enlarged sclerotic gland, and the small abscesses and fistulæ.

The handling of the disease consists essentially of the early amputation of the gland, by the method which we have already described for amputating the udder of the cow. As in botryomycosis of other parts of the body, so here we may cause improvement of the disease by the internal administration of iodide of potash. In our experience, however, we have never succeeded in bringing about the cure of botryomycosis, in any organ, by means of this drug.

9. Infectious Gangrenous Mammitis of Ewes.

Pustular Eruptions of the Lips of Nursing Lambs.

We observed in our clinic an important outbreak of gangrenous mammitis in ewes, which proved uniformly fatal. The mammary affection began very suddenly, with intense inflammation, engorgement and redness of one-half of the udder. The patient at once became very lame, much depressed, with loss of appetite and cessation of rumination. Within 24 to 48 hours after the advent of the attack, the apex of the nipple of the affected gland assumed a dark necrotic-black color, the teat was cold and its epithelium was easily detached and rubbed off. Paralysis and death rapidly followed.

Searching for the source of the infection, we discovered that most of the lambs in the flock were affected with pustular eruptions of the lips. The pustules were located chiefly upon the labial margins, were about ⅜ in. high, sharply conical and filled with yellow pus. Breaking, they left behind slow-healing ulcers.

Apparently the disease of the lips of the lambs, and the gangrene of the mammæ of the ewes, were identical, and the nursing served to transmit the infection to the udders of the ewes and vice versa. Thorough disinfection of the lips of the lambs, with penciling of the labial ulcers with silver nitrate, was followed by a cessation of the mammitis in the ewes.

10. Infectious Agalactia in Goats and Sheep.

There has been observed from time to time, in Italy, Switzerland and France, an infectious disease of the mammary glands of sheep and goats, characterized chiefly by a gradual decrease in the volume of milk and an extreme atrophy of the glands.

Clinically the disease presents all the characteristics of an infection which is readily transmitted from animal to animal, and involves not only the infection of the mammary glands, but also the articulations, the tendon sheaths and the eyes. Vennerholm mentions one herd of 28 animals, in which, during the course of six weeks, 24, including one buck and one kid, showed symptoms of the disease. The male animals suffered from the disease of the eyes and articulations.

The malady does not seriously affect the general well-being of the animal. The milk becomes greatly changed, is grayish-white and flocculent, and after standing there appears a precipitate of pus, which is separated from the normal milk by a sharp line of red, due to the presence of red blood cells, The milk acquires a bitter, saline taste; while the reaction is variable, sometimes feebly acid and sometimes alkaline. In very severe cases the milk may be firmly coagulated and opaque. The quantity of milk may be decreased rapidly, to the extent of 90 to 95%.

As in the agalactia of the cow, so in the disease of the sheep and goat, there are no marked evidences of acute inflammatory changes, as exhibited by swellings or tenderness in the gland. The gland tends rather to become atrophied, and finally retracts to one-tenth of its original volume and becomes very inconspicuous. Later in the course of the disease, without any evidence of pain, there may appear abscesses of a chronic or "cold" character in the udder, as well as in the parotid salivary glands and in the region of the stifle. These abscesses contain a thick yellow pus. In a manner somewhat similar to the formation of metastatic abscesses, there also appear inflammations of the fetlock, stifle, hip, carpus and elbow, which in some instances constitute the only evidence of the disease, especially in males or in females which are not in milk. Tendo-vaginitis may also appear.

In a large proportion of cases there appears a well-marked

keratitis, in which there is either a local or a diffuse cloudiness and ulceration of the cornea, with increased vascularity and hemorrhages. In some cases staphyloma, followed by rupture of the cornea and hernia of the iris, has occurred. The disease of the eyes continues for a prolonged period, and generally ends in recovery in from six to eight weeks, though white or pigmented spots sometimes remain upon the cornea. These changes in the cornea are accompanied by conjunctivitis.

As a general rule the animals recover, and finally their power of milk production becomes restored. The cause of the disease has not been determined, and attempts to transmit it from one animal to another have failed. Isolation and disinfection are apparently indicated.

11. Mammitis in Swine.

Inflammation of the mammæ in swine is an exceedingly rare disease. It may involve one or several of the glands, and present the ordinary symptoms of mastitis, with swelling, pain and a general depression of the system. The inflammation may end in resolution, induration or gangrene, and in the latter case may result in the death of the animal. The sow is so immune to ordinary wound infection that it is only under very great provocation that the glands become inflamed. The handling is according to the general rules already related for mastitis in the cow.

12. Mammitis in the Bitch.

According to Vennerholm, mammitis is very common in the bitch, when her puppies have been prematurely taken away. As in the sow, so in the bitch, there is a high degree of immunity against invasion by the ordinary organisms of wound infection, except under peculiarly favorable conditions. In the bitch, as in other multiparous animals, inflammation of those glands which are not used is not usually observed. Ordinarily the number of glands exceeds that of the young, each of which has its own teat, from which it obtains its milk supply. Any extra glands which the mother may have are allowed to atrophy, and cease to function from the first, without apparently causing any marked degree of discomfort or danger; but, after a gland has been fully aroused to its function because of its use by the new-born animal, if the young is removed before the normal decline in lactation, mastitis is probable.

The symptoms of mastitis in the bitch are peculiar chiefly in the fact that the milk canals are swollen and distended, so that they feel like stretched cords. As no milk cistern is present, the mammitis tends to become lobular, being confined to the lobule of the milk canal into which the infection has penetrated. Otherwise the swelling does not differ materially from mastitis observed in other animals. The character of the milk is changed, becoming serous or purulent, and mixed with blood. The inflamed gland is not especially painful. More or less edema may be present, in the early stages. The course of the disease is not so acute as that observed in ruminants, but tends rather to become chronic and to result in induration and atresia of the milk canals. These changes in general take the character of adenofibroma.

In some rare instances the glands become rapidly gangrenous, but as a general rule this does not cause the death of the animal.

The handling of the disease is essentially the same as in other animals, and consists of repeated massage and milking out, with the application of an antiseptic poultice. Later, if the disease becomes chronic, or should gangrene occur, the affected gland or glands may be amputated.

13. Edema of the Udder. Mammary Engorgement.

Clinically there not infrequently occurs edema of the udder, which may be of a more or less physiologic character and may consist largely of engorgement of the gland without the advent of inflammation.

It may appear either during pregnancy or early after parturition. In some instances, during pregnancy, the occurrence of engorgement and edema of the mammary glands may suggest the death, or some disease or disturbance of the fetus. Very frequently the symptoms are followed by abortion. Toward the culmination of pregnancy, the mammary glands become more or less congested, depending somewhat upon the species and individual. As a general rule, the congestion and edema are most marked in animals which have not previously given birth to young.

The symptoms in such cases apparently rest upon a physiologic basis, depending upon the harmonious functioning of the uterus and the mammary glands. In some animals, especially in

the bitch, edema of the mammæ may occur at about the normal time for parturition, after the disappearance of estrum without impregnation. In these instances it seems that the functional activity of the glands becomes aroused without pregnancy having taken place at all, as the result of some organic sympathy between the two parts of the generative system.

We have also observed such edema of the udder, in the non-pregnant mare mule, accompanied later by the active secretion of milk. In these cases the edema was related to the functional activity of the uterus and ovaries, and occurred during the breeding season only.

In the cow, when for any reason the milk canals or the teats become blocked so that the milk cannot escape, there occurs a great distension of the gland, by the accumulation of milk within its canals, until the pressure within its cavity attains such a degree that the further secretion of milk is stopped. This condition of over-distension brings about an edema of the gland, accompanied by retrograde changes in the milk and its final resorption, followed by atrophy of the gland.

When the young is removed from the mother while lactation is still active, a similar edema results because of the over-distension of the gland. This very frequently leads to infection, because the orifice to the teat is open, which permits the invasion of micro-organisms. Should the gland escape infection, the changes taking place pursue the same course as in those instances where the teat orifice is blocked and infection prevented.

The symptoms consist essentially of a gradually increasing tension of the gland, which may be more or less painful and may involve a quarter or half or the entire gland, while the edema may extend forward anterior to the mammæ, or upward and backward to the region of the perineum.

The temperature is little or not at all elevated, and the secretions from the gland are not materially altered from the normal.

The anatomical conditions, in cases of edema or congestion of the udder, consist essentially of vascular engorgement and congestion of the inter-glandular connective tissue. Unless the edema leads to infection, the disease pursues a favorable course and ends in spontaneous recovery after a few days. Especially is this true of the engorgement of the gland just prior to parturition.

It is not essential, usually, that any active handling occur. As soon as lactation has become well established and the young sucks regularly, or the gland is well milked out, the edema spontaneously disappears. If, however, the young dies or has been removed, and it is not desired to keep up the lactation for the production of milk, it is advisable and frequently essential that a portion of the milk should be withdrawn two or three times a day, until the activity of the gland becomes diminished. If less and less of the milk is withdrawn each day, the lactation gradually ceases, and the milking may be discontinued generally within five or six days. Most domestic animals are thus easily dried up, though in some instances there is considerable difficulty, especially in the milk cow. In some of the best dairy animals it is almost impossible to stop the secretion of milk without endangering the integrity of the gland. This difficulty is also observed at times in ewes, when weaning lambs, especially if they are weaned somewhat early, before the milk glands have largely ceased their functions. In some of the larger breeds of sheep, which are very heavy milkers, it is well to carefully watch the ewes while the lambs are being weaned, and withdraw part of the milk from those which show very great distension of the gland with the consequent edema.

14. Tumors of the Mammæ.

Tumors of the mammary glands are very rare in domestic animals, with the exception of the bitch, in which they are common. Ruminants are almost wholly free from any form of mammary tumor. In the mare we observe chiefly the botryomycotic udder, which has already been described upon page 974, and belongs distinctly to infections, not to tumors proper. The bitch suffers occasionally from a form of granulation tumor or adeno-fibrom, in which the general characters of adenoma and fibroma are combined. Such adeno-fibroma are usually the sequel of infection.

The adeno-fibrom consists chiefly of an increase of the connective tissue between the lobules of the gland, which new-formed tissues press upon the acini and gradually bring about their destruction, until there remains simply the epithelial debris surrounded by firm connective tissue.

Malignant neoplasms of the mammæ are very common in the bitch, and exceedingly rare in other domestic animals. In aged bitches mammary carcinoma are very common. They assume various types, most frequently scirrhous, more rarely myxomatous, and in some rare cases are accompanied by calcification or ossification. The cancer may break down and result in ulceration, or the blood vessels may become eroded and cause a hematom. The carcinoma usually originate in the substance of the gland, although more rarely they may have their beginning in the skin covering it. As a general rule the development of the tumor is slow, although it may at times be rapid. In some instances the tumors remain quiescent for a long period of time, especially if not interfered with ; while in other cases, especially if the glands have been removed, metastatic tumors occur in the surrounding tissues, which pursue a very rapid and virulent course.

In carcinoma of the mammæ of the bitch, the affected gland or glands are enlarged and hardened. The swelling is distinctly lobular, and usually commences near the base of the teat, extending thence upward to involve the entire gland. Sometimes the disease is confined to a single gland, but frequently it involves several, and in some cases virtually all of the glands, one after another. The extension from one gland to another may be very rapid.

Sarcoma of the milk glands occur chiefly in the bitch and mare, as nodular and more or less soft swellings, which may reach very large proportions. In the mare the tumor may extend upward from the gland through the inguinal canal into the peritoneal cavity.

As in the adeno-fibrom and the carcinom, so in sarcoma, there may be a tendency to ossification, or cysts may form containing a variable quantity of fluid, which may resemble mucus, and contain detritis of cells, along with fat and crystals of cholesterine.

Other tumors of the mammary glands, such as chondroma, lipoma and osteoma, occur in domestic animals, especially in the bitch. Very rarely large cystic tumors form in the mammæ, filled with a mucoid substance, while their boundaries may be calcified and sharply limited so that they can be easily enucleated.

Rehmet relates the occurrence of echinococcus polymorphus in the udder of a cow. Numerous large firm nodules were observed, which were suspected of being tubercular in character ; but,

when examined after slaughter, were found to consist of very tense cysts, varying in size from a hazelnut to a hen's egg, and containing a clear fluid and echinococci.

There are also observed, in the udder, retention cysts. A milk canal leading from a portion of the gland becomes occluded, and consequently a quantity of milk is imprisoned until it causes a sufficient distension that it is readily seen and felt. It presents the characters of a fluctuating tumor, and, when opened, discharges ordinary milk.

The handling of tumors of the udder consists essentially of their early enucleation, or the amputation of the entire gland. It is especially important, when malignancy is suspected, that the entire gland should be removed early, and along with it should be included any neighboring lymph glands which are probably or possibly involved. If the malignant tumor has existed for a long period of time, the probabilities are that its removal will but excite other disease foci in neighboring glands to increased activity, and that the disease will run a more virulent course than if left untouched.

15. Hemorrhages in the Udder.

Hemorrhages may occur in any part of the udder, either because of trauma or exalted blood pressure, and may result in the formation of hematoma; or the blood may flow into the larger milk canals or milk cistern and be milked out.

The symptoms necessarily vary greatly according to the location of the injury and volume of blood escaping from the vessels. A large volume of blood causes a distinct swelling of the udder. This is especially notable if a hematom occurs in the subcutaneous connective tissue. In pendulous udders the gland is constantly turned to and fro upon its long axis, during the progression of the animal, because at each step it strikes against the advancing hind limb, or it comes in violent contact with obstacles in the path of the animal, from either of which causes the udder may receive more or less serious injuries. In the normal gland, injury may result from rough milking, from treads or otherwise.

The milk from an animal suffering from mammary hemorrhage may be mixed with blood, or pure blood may be drawn from the teat. If the hemorrhage is very extensive, the udder

may hang very low because of the great weight of the large hematom which it contains. If an injury has caused hemorrhage into the udder, and the blood becomes mixed with the milk, the mixture is usually somewhat clotted. When mammary hemorrhage is due to the passage of red corpuscles through the walls of the capillaries into the milk vessels, the blood is uniformly mixed with the milk, and may give it a reddish tinge, or may pass unobserved until the milk has stood for a time, when the blood, on account of its weight, sinks to the bottom and is very readily seen.

The advent of blood in milk not infrequently indicates the commencement of a chronic catarrhal mammitis, affecting chiefly the milk cistern and large canals. The bloody character of the milk may presently abate, but the catarrh persists, leading gradually to atresia of the teat. The atresia may mature during the milking period, or its completion be delayed until the dry period, and when the cow again comes into milk the atresia may be found complete.

Special forms of infection sometimes cause a reddish tint of the milk, in the absence of blood or blood-coloring matter.

Termination. In those cases of bloody milk due to exalted blood pressure in the gland, the duration of the condition is usually prolonged, so that it is a long time before the milk again becomes normal. As a general rule the result is very unfavorable, because the same condition tends to recur at each calving. If hematoma form, they are slowly resorbed, to leave cysts behind, or induration of the gland occurs, or the wall of the hematom gives way and its contents escape externally. Should the hematom become infected, mastitis results, usually followed by abscess.

When a limited amount of hemorrhage occurs in the milk, the most that can be done is the careful milking out. This does not prove very satisfactory, as the milk is unfit for use, and the animal tends to give bloody milk again and again at the beginning of each milking. When hematoma form, an attempt may be made to check the hemorrhage, if still existing, by the application of cold, especially of ice by means of a suspensory bandage, or by hemostatics given internally. Generally this is not necessary. The hematom should be left alone for two or three days, until assured that the hemorrhage will not be renewed and that

a somewhat resistant wall is formed around the escaped blood. The hematom may then be opened and the blood removed, after which the lesion is to be handled as an ordinary wound.

16. Milk Fistulæ.

A milk fistula consists of a communication of the milk cistern or one of the large milk canals with the exterior, through a canal other than the normal one. While such fistulæ are possible in any animal, they occur, or are observed, practically in the cow alone. Their very rare occurrence in other animals is of little or no significance. The fistulæ may be congenital, but generally they are caused by penetrating wounds of the milk cistern during the period of lactation. They arise from trauma of various kinds, and in some instances result from operative wounds, or from abscesses forming in the milk cistern or large milk sinuses and rupturing outward through the wall of the teat or udder.

Symptoms. Milk fistulæ may open at any part of the teat, or of the udder near the teat base. They are most common in the teat near its base, though sometimes observed at the apex of the teat, within a very short distance of the normal opening. If the fistulous opening is very small, the milk may not flow from it except when the teat is being milked and greater pressure is consequently placed upon the fluid within the cistern. If the fistulous opening is large, the milk drops away continually whenever the pressure of the milk in the cistern is sufficiently high.

Fistulæ of the milk canals tend to heal spontaneously in a comparatively short time, while those of the milk cistern, and especially those of large size, do not readily heal of themselves, and are liable to become permanent unless active intervention occurs. If the fistula forms somewhat early, during active lactation, its walls tend to become healed and covered over by a protective epithelium, so that they will not readily adhere. If the perforating wound occurs while the cow is dry, or if she ceases to milk before the walls of the fistula become covered over with epithelium, adhesion of the wound margins, with spontaneous obliteration of the fistula, is probable.

Treatment. Perforating wounds of the milk cistern or canal should be handled as soon as possible after their occurrence. The handling should consist essentially of the thorough and careful disinfection of the wound, after which it may be neatly sutured

and measures taken to protect the sutures during milking. It is highly important that strict antiseptic rules should be followed in order to prevent infection of the gland. It has been suggested that the danger of disturbing the sutures should be overcome by the use of the milk tube, under very strict antiseptic precautions. Vennerholm advises that a rubber band may be placed over the suture to afford pressure, being careful not to apply it so tightly as to cause a disturbance of the circulation. One may do much also to prevent the tearing out of sutures, or even to overcome the necessity for their insertion, by applying a strip of adhesive plaster carefully to the part. The strip should be long and narrow, and applied by encircling the teat several times, each course overlapping the preceding one, the whole forming a solid encasement, insuring the accurate and secure closure of the wound.

In chronic fistula, in which the walls are covered over with epithelium, it is essential that the protective epithelial layer be destroyed before adhesion can take place. The epithelium of the fistula may be most readily destroyed with a fine thermocautery point, by inserting it well into the fistulous tract and continuing the cautery until the epithelium has been completely destroyed. In place of the thermocautery one may use a caustic, especially the nitrate of silver. If the fistula is at the apex of the teat and near by the normal opening, it may sometimes be best handled by the amputation of the teat just above the fistula.

It is usually desirable that any interference with chronic milk fistula should be deferred until the cow is dry, in order to avoid as far as possible the danger of infection of the gland as a result of the injuries to the tissues during the operation.

Supernumerary teats sometimes exist in a manner to constitute an annoyance in milking, because they are constantly in the way of the milker. Sometimes they act as fistulæ, through which milk escapes while the milking process is going on with the normal teats. Should they prove annoying, it is best to amputate them during the dry period, when the healing of the wound will usually cause an obliteration of the duct or cistern of the supernumerary nipple.

When heifer calves are born with supernumerary teats, which may later prove annoying or unsightly, they may readily be removed by clipping them off with scissors. The teat should be well drawn out, and excised close against the gland. In healing,

any milk orifice traversing it will be closed and, if clipped closely, will not show when the animal is grown. When the heifer calves, the rudimentary gland may function temporarily, but soon ceases to secrete because of the pressure of the confined milk. Later the gland atrophies.

There is a want of power in the teats of some cows to retain the milk within the udder, so that as soon as the gland becomes distended, the milk begins to escape involuntarily through the teat canal. This causes great waste by allowing a large proportion of the milk secreted to escape from the teats during the interval between milkings. Various plans for overcoming the difficulty have been suggested and tried, but none of them are very satisfactory. The cow may be milked very frequently, so as to prevent any great pressure of the fluid within the gland; or the lumen of the teat canal may be closed by the application of a rubber band or a metal ring.

Vennerholm suggests the possibility of bringing about a narrowing of the teat canal by the excision of a wedge-shaped piece of the teat wall, in the hope that, in healing, the teat orifice may contract sufficiently to hold the milk. He admits, however, that it is exceedingly difficult to determine the proper amount of tissue to remove. If too much is included, the teat canal may become obliterated or excessively narrowed; if too little is taken, the object is unaccomplished. Amputation of the apex of the teat may also cause narrowing, but the degree can not be foretold.

17, Milk Stones or Milk Calculi.

There are occasionally found, in the udder of the cow, concretions of the carbonate of lime, mixed with small proportions of fat or casein, and varying in size from that of a mustard seed to a large bean. They may occur singly or in large numbers.

When very large they may readily be felt through the walls of the large milk canals or of the cistern, and may become lodged in the teat canal in such a manner as to interfere with the flow of milk, and cause pain to the animal during milking. When occurring in large numbers, they may cause a general sensitiveness of the gland, accompanied by some stiffness and a straddling gait.

They are to be differentiated from nodular enlargements in the teats. The latter are immoveable and grow slowly, while the

calculi are generally movable, at least during their early stages or until they accidently become incarcerated in the teat canal.

Sometimes milk stones may be forced out through the teat canal without injury, but if too large for this to be accomplished, it is advisable to remove them by means of an incision through the walls of the gland, after which the wound should be carefully closed immediately.

18. Pendulous Udder.

The mammæ of the cow, ewe and goat frequently become very pendulous, and hang down almost or quite to the ground. Such an udder is in constant danger of injury from being struck by the hind legs during locomotion, especially when the animal is forced to run. It may also come in violent contact with obstacles of various kinds in a manner to cause wounds, to be followed by infection.

Sometimes a pendulous udder apparently results from a gradual yielding of the suspensory apparatus of a comparatively normal gland. Once the gland drops away from the abdomen for a short distance, its weight tends to cause it to drop lower until the pendulousness becomes extreme. In other cases the pendulousness is attributable to mammitis, followed by induration and enlargement, the increased weight overcoming the power of the suspensory apparatus and causing the gland to drop down away from the abdomen.

We have no successful method for overcoming the pendulous udder. An ordinary animal so affected should be fitted for the butcher. In a pedigreed cow having a very high value as a breeder, if the udder is much enlarged and indurated, is so pendulous as to constitute a constant and serious impediment to locomotion, or menace the health or life of the animal on account of repeated infections from injuries, the pendulous organ should be amputated according to the technic already suggested on page 963.

19. Dermatitis of the Udder.

Inflammation of the skin of the udder is said to be caused at times from exposure to the rays of the sun in hot weather. The effect is referable, according to Vidmark, to the action of the ultra-violet rays upon the non-pigmented skin, which leads to dermatitis and mummification.

When cows are exposed to cold and damp winds, the skin of the teats and udder is liable to become inflamed and cracked. If the teats of the cow are bathed or moistened, preparatory to milking, and then left to dry in a cold draft, the skin is liable to crack and become very sore, so that in milking it bleeds and causes quite severe pain to the animal, which not infrequently leads to uneasiness and kicking.

Dry gangrene of the skin of the teats is said to result in some cases from the feeding of cows upon potato refuse or ergotized fodder. Wounds or other injuries to the teat or glands may likewise cause dry gangrene.

The symptoms of dermatitis of the udder are as variable as the causes which may induce it. There may be redness accompanied by sensitiveness in the part, or there may be small fissures or excoriations from which blood exudes. When gangrene occurs there is swelling of the parts, a black or blue-black color, with usually a well defined line of demarcation. The sequestration of the mummified portion is usually very slow.

In the Mississippi Valley and some other portions of the United States, there appears from time to time, usually in the late summer or autumn, a disease affecting the feet, mouths and udders of cattle, which was at first mistaken by some for the contagious foot and mouth disease. It occurs almost, if not entirely, among animals which are upon the pasture. The disease first expresses itself by a stiffness in the gait, as a result of the sore feet; and a dribbling of saliva from the mouth, as a consequence of the necrosis of the buccal mucous membrane. Hemorrhagic areas occur in the skin of the feet, especially between the claws; upon the teats and udder of milk cows; and in the mucous membrane of the mouth, especially upon the bars and pad of the upper jaw. Later the areas become necrotic and slough away, leaving painful ulcers, which heal in the course of a few days. Upon post-mortem examination, in fatal cases, hemorrhagic areas are found throughout the length of the alimentary canal.

The character of the disease is not well known, though it has been described by Mohler as mycotic stomatitis. So far as we know, the disease of the udder has not proven annoying in any case, and simply constitutes an interesting symptom in the course of the more widely diffused disease. It calls for no special treatment, so far as observed.

The prognosis is favorable, except for the danger of infection of the glandular tissue itself, leading to mastitis and a disturbance of the milk-secreting functions.

The handling of dermatitis of the udder should be specially determined for each case, according to the cause. Generally the treatment should consist of the application of antiseptics and protectives to the injured skin. When the teats are fissured and excoriated as a result of exposure to damp winds, or of wetting the teats during milking and not properly drying them, great care should be taken to thoroughly cleanse them with a warm antiseptic solution. Immediately afterward a protective antiseptic dressing should be applied. One will usually obtain excellent results by first cleansing the parts with warm antiseptic solution and then applying, after the completion of the milking, a mixture of one part each of tincture of iodine, glycerine, and tincture of arnica. Such a mixture should be sparingly applied, so as to constitute a thin coating over the part. Care should be taken to not apply so much as to make the parts sticky, and thereby cause dirt to adhere. Vennerholm suggests the application of a salve, consisting of tannic acid and oxide of lead, or other similar substances, but such applications cause dirt to adhere and keep the teat soiled, unless applied very sparingly.

If gangrene of the skin is threatened, antiseptics should be applied more liberally, and it is suggested by some writers that the skin should be scarified, antiseptic poultices applied, and the udder supported by a bandage.

If the gangrene extends into the deeper parts of the teat, it may be advisable to amputate it in order to hasten recovery. If the gangrene extends into the cistern, the glandular tissue is almost inevitably involved in mammitis, and the amputation of the teat affords excellent drainage for the gland and permits all excretions to drop away almost immediately.

20. Furunculosis of the Udder.

Johne has recorded a special form of disease of the udder of the cow, under the name of furunculosis. In the cases thus recorded, there occurred swellings, which were one-quarter to two inches in diameter, chiefly above the base of the teat. The swellings were quite hard and painful for a time, but after some weeks fluctuated and finally ruptured, discharging pus, mixed

with fragments of necrotic tissue. Later the abscesses healed, without serious interference with the secretion of milk.

Johne did not determine the cause of the disease. Clinically it assumed an enzoötic character, and appeared chiefly in stables where potato tops and mouldy straw were used for bedding. In the handling of the disease, the abscesses were opened and disinfected according to general surgical principles.

21. Wounds of the Udder and Teats.

Wounds of the udder and teats present every possible variety in cause and degree. Cows which are kept in crowded stanchions frequently suffer from wounds to the teats caused by neighboring animals treading upon them. In many parts of the United States a very common cause of wounds to the teats of cows is barbed wire, especially where a fence has been badly built and cows have crowded through it or attempted to jump over it. If the cow is in full milk, so that the udder is tense and distended, the wounds from the barbs of the wire may be very severe and extensive.

Wounds or contusions may also occur from rough milking. If a milker is careless in regard to his finger nails, the teats may be badly abraded by these. We have observed wounds, of a more or less serious character, inflicted by pigs or other animals in sucking. When pigs are allowed in the same enclosure with milk cows, and there chances to be a cow from which the milk flows involuntarily when she is lying down with the udder well filled, pigs, coming about, detect the milk and eat it. Following up the stream to its source, the pig finally acquires the habit of sucking the cow, incidentally wounding the teats with the teeth. In one case we observed a heifer, pregnant for the first time, acquire maternal attachment for a half-grown pig, which she persistently suckled. The sucking by the pig caused unimportant teat wounds.

From wounds of such diverse characters, equally variable lesions follow, such as milk fistula, suppuration, ulceration and mammitis. Wounds of a quiescent udder usually heal well, but if the cow is in milk and the lesions involve the teats it may be exceedingly difficult to milk the cow without irritating the wound and delaying the healing process.

As we have already stated in discussing the subject of mammitis, suppurating wounds of the active udder or teats possess great danger for the integrity of the gland because of their tendency to produce mammitis. Penetrant wounds of the milk cistern or deep wounds near the apex of the teat in milk cows are especially dangerous.

In the absence of a penetrant wound, the pus flows down over the teat to the teat orifice, and thence the infection passes up into the cistern ; or the careless dairyman, finding the cow nervous or unruly because of the sensitive and painful teat, resorts to the milk tube for withdrawing the milk. The milk tube, probably already filthy from prior use, becomes contaminated further as it is being inserted, and carries infection up into the cistern.

Such contamination is preventable only by the strictest possible precautions, consisting of the thorough disinfection of the teat-wound, the entire teat, and the hands of the operator ; and the sterilization of the milk tube. Even then the teat orifice may contain virulent organisms to be pushed up into the cistern on the end of the milk tube.

It would be far better to aspirate the milk from the wounded teat by means of a cupping glass. It would cause much less pain to the cow, and would permit far better asepsis.

Vennerholm suggests that, when wounds of the teats are very sensitive, there should be applied to them a 5% solution of cocaine at milking time, in order that the process may be carried out without causing pain. The pain of milking can always be reduced greatly by first bathing the part with warm water, to which has been added a small amount of carbolic acid. After milking, the wound should always be carefully dressed with the most reliable antiseptics, for which purpose we recommend equal parts of tincture of iodide, tincture of arnica and glycerine.

22. Warts on the Teats.

Warts on the teats are very common in milk cows, and differ greatly in form and size. As a general rule they are more or less polypoid or pedunculate in character, and have a very small neck, though they are sometimes conical or sessile. They are especially common on the teats of young cows. There may be 15 or 20 or even more on one teat, scattered over the organ from

the apex to the base, and spreading somewhat over the contiguous udder. Generally they are not particularly sensitive, but some of them are markedly so, and under certain conditions and situations, because of being pinched in the process of milking, they may be quite painful, and cause the animal to become uneasy, and resist milking by stamping or kicking.

If the warts are causing no annoyance to the cow and are not in the way in milking, they should be left alone. If they are causing annoyance they may be very safely clipped off with shears, under local anaesthesia, or cauterized with silver nitrate or with the thermocautery, during the dry period. One of the most efficient and convenient remedies for warts is the application of strong nitric acid. The end of a small glass rod is dipped in the acid, and with this the surface of the wart is cautiously moistened. This may be repeated every two or three days, until the wart contracts and the small, hard eschar drops away. If carefully done, not too much of the acid applied, and none allowed to touch the normal skin, no pain will be caused whatever. This is of importance as affecting the temper of the cow. In young animals they tend after a time to disappear spontaneously. They may also be caused to disappear in some cases by the internal administration of arsenic.

23. Stricture or Atresia of the Teats.

In cows there not infrequently occurs stricture or atresia of the milk orifice, the cistern, or the milk canals, which may either render milking very tedious and difficult or completely prevent the withdrawal of the milk from the gland. While it is possible for similar lesions to occur in other animals, such as the ewe and goat, from an economic standpoint the condition is confined to the cow, where it exerts a very great influence upon the production of milk and offers an exceedingly complicated and difficult problem to the veterinarian, because in the present state of our knowledge the handling of this group of affections is exceedingly unsatisfactory.

The teats of cows show as great variety in their internal structure and arrangement as they do in their external form and size. They may show upon the internal wall of the cistern small gland-like prominences of a spherical form, but having no special

influence upon the process of milking. The teat walls may be very thick, leading to a small lumen of the teat canal, accompanied by difficult milking, but this condition cannot be regarded as pathologic. In addition to these there may be transverse folds of the mucous membrane projecting out into the milk cistern, which may possibly be normal, and yet may offer some obstruction to the passage of the milk.

Jensen records the occasional occurrence of perpendicular partitions in the cistern of the teat, constituting essentially double teats. There may be supernumerary cisterns, with small teat canals opening near the base of the teat, so that they behave as milk fistulæ. Vennerholm states that there frequently occur, in the cistern, small papilloma, which interfere with the passage of the milk by partially filling the cistern. Such papilloma may also become displaced and, dropping into the teat canal, partially block it. The cause of these papilloma is presumably the previous occurrence of trauma.

The stricture or atresia may occur at any point in the teat, from its apex to its base. Most of the lesions are found at the base of the teat or in the teat canal at its apex, while the capacious cistern remains comparatively free.

The symptoms of stricture or atresia will depend primarily upon the location of the lesion and its extent. If the stricture or atresia occurs in the teat canal, the teat promptly and readily becomes distended with milk, but it is exceedingly difficult or impossible to press it out through the teat orifice. When the milk is forced out, it comes away in a fine stream.

This condition should not be confounded with those instances in the cow where the teat canal is normally very narrow and the sphincter muscle surrounding it is very powerful, rendering milking exceedingly difficult. In such cases, ordinarily, all four teats of the cow are alike, and merely require extra pressure in order to force the milk through the narrow canal. Such teats are normal upon digital palpation, and in other respects.

By palpation of teats affected with stricture or atresia, one can usually recognize a hard, dense, cord-like thickening along the position of the teat canal, which indicates that the mucous membrane and sub-mucous connective tissue are thickened and indurated.

In most cases in which the obstruction exists at the base of the

teat, it is found that the milk descends slowly or not at all into the teat, but, if it once descends into the milk cistern, is easily pressed out. When the cistern is emptied, however, it is slow in refilling, and consequently the milking process is exceedingly tedious. In those cases of stricture where the upper part of the cistern is completely closed, the milk may readily be felt in the milk canals above, pressing down upon the obstruction, while the teat remains empty. Examining closely the base of the teat, one usually finds in the central portion of the teat base a hard, firm nodule, irregularly spherical in form and varying in size from ⅛ to ¼ inch in diameter

The pathologic processes which lead to a narrowing of the teat canal are usually referred to some traumatism, involving the epithelium, the mucous membrane, or the sub-mucosa of the teat canal. Lesions of this character are assumed to follow such injuries as treads, blows or rough milking. Following these injuries, hemorrhages may occur into the sub-mucosa, accompanied by exudation into the surrounding tissues. After the wounded parts have become infected and inflamed, and have later healed, there remains a cicatricial thickening and induration of the epithelium and sub-mucous tissue. In some cases the thickening involves almost the entire length of the teat canal, and extends completely around it.

In our observation, most of the cases of stricture and atresia of the teat occur at the base, without any history whatever of traumatism or preceding mammitis. We frequently observe the slow formation of a nodular enlargement of a very firm character at the base of the teat, usually almost directly in its center, at the point of entrance of the milk canals into the cistern.

As the nodule begins to form, the milker first observes that the milking process is retarded. The milk is readily pressed out from the well-filled cistern through the teat orifice, but the cistern does not promptly refill. After waiting for a time, the cistern again fills and the teat becomes distended.

Slowly and insidiously the difficulty in milking increases, and careful palpation reveals a firm hard nodule centrally located in the base of the teat. At first it appears about ⅛ inch or less in diameter, very firm, painless. It grows some, but does not attain a large size, usually not more than ¼ inch.

The teat remains empty, the nodule in the teat is very evident, and above it are the milk canals, widely distended by the imprisoned milk. A chronic catarrh of the epithelium apparently exists with the new formation of dense sclerotic connective tissue in the form of a nodule. If left alone it has little tendency to cause marked mastitis. In a large proportion of cases, however, the use of the milk tube, sound, or other implement, creates a wound and deposits virulent infection in it, resulting finally in mammitis. If left alone the nodule finally causes complete atresia, and the milk is imprisoned until the intramammary pressure reaches the point at which milk secretion cannot be continued, after which the quarter commences to atrophy.

The process is a chronic one, may continue to develop and increase week by week, but usually does not advance far enough to bring about complete atresia during the milking period when its appearance is first observed. After the cow is turned dry, however, the process continues, and leads usually to complete atresia, so that at the next calving, it is found that the affected teat is completely closed at its base, making it impossible for the milk to enter the cistern from the larger canals.

The disease may affect but one teat, or may involve two, three, or all of them. It behaves clinically as a chronic infection, and appears to spread from one quarter of the cow to another, until each is involved and ruined. We have observed each of the four quarters of the udder ruined consecutively because of such nodular growth at the base of the teat. After the cistern has been completely closed at the base, the disease extends down, and in many cases brings about a complete obliteration of the cistern and the teat canal.

In many other instances the atresia has its beginning in an ulcer involving the milk orifice. First there arises difficulty in withdrawing the milk from the cistern. If the nipple is carefully examined, it will be found to have a small, hard, sclerotic mass at the teat orifice, usually not painful. If the milk orifice is carefully inspected, there is frequently observed a red, angry ulcer, involving the milk meatus at the apex of the teat. Like the preceding disease, the course is chronic and insidious.

There is, however, no limitation of the area in which the sclerotic enlargement may occur. While most of these changes are ob-

served either at the apex or the base of the teat, the intervening portion of the teat is nowhere exempt.

The prognosis of atresia or stricture of the teat depends largely upon the position of the lesion. The outlook is the more favorable as the lesion is situated nearer to the end of the teat, and becomes more serious as it is nearer the base, or when it involves an extensive area in the cistern or teat canal.

There is little danger to the life of the animal if the disease is left to itself, especially if the atresia is complete. If surgical interference is undertaken, except under the most rigid precautions, there is great danger of mastitis, because the veterinarian cannot certainly prevent the invasion of bacteria.

Handling. In many cases it is advisable, especially when there is complete atresia at the base of the teat, to allow the gland to atrophy rather than assume the risk of causing infection by an operation, thereby completely destroying the affected quarter, greatly diminishing the milk secretion from all the other

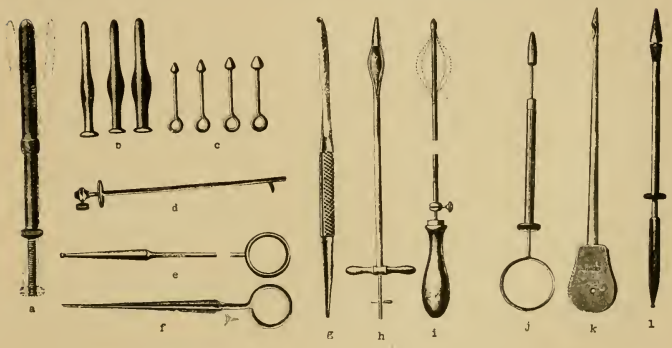


FIG. 143.

a, Pomayer's teat dilator.
b, Aluminum dilating sounds, 5, 6 and 7 mm.
c, Teat sounds of Giovanoli.
d, Concealed teat knife.
e, Lance-shaped teat knife, with probe point. American.
f, French teat dilator.
g, Holland teat knife and dilator combined.
h, Wessel's concealed knife for dilating teat canal.
i, Fraun's perforator.
j, Teat reamer of Hug.
k, Teat lancet of Hug.
l, Teat dilator of Parmans. (Hauptner.)

quarters, and bringing into jeopardy the life of the animal. This is especially true of such operations, when 2, 3 or all the teats are affected and the number of operations required renders serious mammitis well nigh inevitable. After all the danger to the animal, the outlook for any definite improvement is virtually hopeless.

Should the veterinarian decide to operate, the essential object to be attained consists of a dilation of the teat canal, or of the communication between the teat cistern below and the milk canals above. Any and all operations having such an end in view require the strictest possible asepsis. The hands of the operator, the teat and the instruments must be scrupulously clean, and the operations must be carried out without introducing into the teat any form of infection or irritant. Even after an operation has been successfully performed, from the standpoint of asepsis, it is still a difficult problem to so instruct a caretaker that he will use the necessary precautions to maintain an aseptic condition in the part during the process of healing. Various methods for overcoming the stricture or atresia have been suggested, differing in detail, and belonging essentially to two classes —the bloodless and the bloody dilations.

The dilation of the narrowed canal, without the division of the tissues, is attempted by means of bougies or sounds. This method can only be applied in those cases where the lumen of the canal is narrowed, but not completely closed. Some advise the introduction of a piece of catgut about two to three cm. in length, bearing a head at the distal end, which will prevent it from slipping entirely into the teat. When this is introduced through the constricted portion, it swells by absorbing surrounding moisture, and gradually dilates the constricted part. It may be inserted just after one milking, and remain in position until the next. Others advise the repeated insertion or prolonged retention of metallic teat sounds or bougies like *b. c.* Fig. 143.

Other forms of bougies have been suggested, such as one consisting of pure gum, which exerts gradual pressure upon the part and brings about dilation.

These palliative measures have generally proven unsatisfactory, being accompanied by very decided danger, without any corresponding probability of permanent benefit.

The dilation of the canal or cistern by incision has been quite largely practiced for many years, and numerous instruments have been devised and recommended for carrying out the operation. The stilette of an ordinary trocar serves the purposes of dilating the teat canal quite effectively, in so far as the immediate results are concerned. Various instruments, known as milk needles, and having a small caliber and the stilette of a trocar, have been devised for this purpose. Some operators have used a small lancet, a probe-pointed bistoury, or a bistoury cache. Various forms of the latter have been recommended, such as *a* and *d*, Fig. 143, and many other forms involving similar principles.

The perforator of Fraun, Fig. 143 i, has been highly recommended by some, because with it transverse membranes may be perforated, and the perforation enlarged by means of the four blades, which can be pressed out laterally after the introduction of the instrument into the constricted portion.

In addition to these cutting instruments, one requires, for handling the teat after the operation, one of the ordinary forms of milk tubes, by which the edges of the wound may be kept apart, and their adhesion prevented during the process of healing, and with which the milk may be drawn with the least possible injury. It is highly important that milk tubes, or other instruments designed to remain in the teat, should be of pure silver, because the silver is antiseptic.

The operative dilation of the teat may be undertaken upon the standing animal. The foot upon the affected side may be secured by passing a side line around it, and thence around the limb opposite, the end of the line being held by an assistant ; or the operator may place himself upon the opposite side to the affected teat, under the assumption that the cow will kick with the foot upon the affected side. It is better, however, that the animal should be cast, or still better, confined upon an operating table, where the antiseptic precautions can be more effectively applied. The instruments, hands and teat should be thoroughly disinfected, and the cistern should be carefully washed out with sterile water. Some even recommend that the cistern be washed out with a 1–1000 corrosive sublimate solution, by means of a hypodermic syringe.

The operator grasps the teat with one hand, above the point of obstruction if possible, presses the milk down against the obstruc-

tion, and then introduces the instrument through the teat canal until it reaches the point of disease. Bang directs that, in case a knife is used, the incision through the constricted portion should be backward in an anterior teat and forward in a posterior teat, in order that the resulting stream of milk may be favorably directed. This applies only to those cases in which the obstruction is in the teat canal and not in the base of the teat. When the teat canal is sufficiently dilated, the cow loses her power to hold the milk, and it flows away involuntarily ; but during the process of healing she regains the power of retaining it.

The after-handling consists in frequent milking and in very careful disinfection and cleanliness of the parts. While healing is going on, it is desirable to insert a milk tube daily, and retain it in position for several hours in order to prevent adhesion during the process of repair. Even with this precaution, it is exceedingly difficult to prevent a recurrence of the stricture ; and finally, during the dry period, complete atresia is liable to occur.

Strebel and others recommend that the thickened tissues which cause the stricture should be removed by curetting. They advise, as an instrument, a stilette with a sharp shield at the distal end, which may be pushed through the thickened part, and then forcibly drawn out, cutting away a portion of the diseased tissues. By repeated use, this instrument finally enlarges the canal to a sufficient size, after which the treatment is of the same general character as that already described after dilating by cutting. Others use a small curette in the same way, or even a very narrow-bladed knife or scalpel.

Others have suggested incising the teat from the side, cutting down upon the obstacle and removing it completely with the scalpel, and, under strict aseptic precautions, carefully suturing the wound. Later great care should be used in milking, so as to avoid the tearing out of the sutures and the consequent establishment of a milk fistula. The operation has not come into general use, because it is almost impossible to carry out the operation and the after-treatment with sufficient care to avoid mammitis.

If the obstruction is near the end of the teat, the amputation of the obstructed portion immediately above the seat of the disease may afford satisfactory results. The operation is espec-

ially favorable in those cases where the obstruction is quite near to the end of the teat, and the teat is so long that it will have ample length after amputation. The teat is grasped with the fingers, and is amputated immediately above the point of obstruction, either with a pair of scissors or with a scalpel. As the teat is at the moment somewhat stretched, the stump assumes the form of a crater, which favors healing. Kühn has constructed special forceps, Fig. 144, for holding the teat in such a manner that the excision is readily performed with the scalpel.

Fig. 144. Teat-Amputating Forceps of Kühn.
(Bayer and Fröhner.)

After the teat is amputated, the milk flows away involuntarily, but later, as the healing process goes on, the opening narrows, and finally the milk is retained as before. Following the amputation, there is little difficulty from hemorrhage, and if any occur it may be checked by a bandage or by a rubber band, placed around the teat, but not too tightly, lest it interfere with the life of the tissues. It may be well, for a time, to protect the wound against infection by means of antiseptics applied upon a cotton pack, which covers the wound and the teat generally and maintains antisepsis for a few hours. This dressing may be retained in position by a ligature about the teat, or with strips of adhesive plaster.

If it is desired to prevent the milk from escaping, it may be retained by the application of an elastic, or other ligature, near the end of the teat, sufficiently tight to close the milk canal, but not tight enough to interfere seriously with the nutrition of the part.

Amputation of the teat is impracticable when the obstruction is located near its base.

Vennerholm recommends that, when there are transverse membranous folds across the cistern, the teat should be as firmly grasped as possible above the obstruction, and then so vigorously pressed that the milk contained brings about a rupture of the

band, after which the affected teat is to be very frequently emptied for a few days. Others attempt to rupture these transverse bands by still greater pressure than can be applied by means of the hands, but the recorded results from the operation do not seem to strongly commend it. Wherever these operations are undertaken, mastitis very frequently follows, and the cow eventually becomes three-teated.

In a somewhat extensive experience in the operative handling of the nodular obstruction at the base of the teat, we have had success in a small minority of cases; whereas, in the larger number, mastitis of a more or less serious form has been induced, which has usually ended in the loss of the affected quarter or quarters. Under these conditions it seems more judicious in many cases to allow the gland to atrophy and the cow to become three-teated rather than to involve the risk of a dangerous infection to be followed later by the destruction of the gland.

DISEASES OF THE NEW-BORN ANIMAL.

1. Infections of the New-Born.

At the time of birth there necessarily occurs a wound of the new-born consisting of a division of the umbilic cord. The division of the cord may occur just prior to the completion of the expulsion of the fetus, after a portion of the fetal body has passed beyond the vulva, as is usually the case in those animals having a very short umbilic cord, like the cow and other ruminants. In other animals, where the umbilic cord is long, as in the mare, the fetus is usually wholly expelled before rupture of the cord takes place. In any animal, though extremely improbable in ruminants, the entire fetal placenta may follow the expulsion of the fetus immediately, and the cord remain intact. As a general rule this presages the death of the fetus in the larger animals, because the separation of the fetal from the maternal placenta has advanced to such a degree before the expulsion of the young that it disturbs the aeration of its blood and leads to its death by strangling. In multiparous animals, where the fetal placenta must necessarily follow each fetus before a succeeding one can be expelled, the fetal membranes very frequently remain attached to the fetus by the umbilic cord, which is divided by the mother with the teeth. In other young which may be born with the navel cord unbroken, its rupture very frequently results from the struggles of the young animal, or may be brought about by the mother.

The point at which the navel cord divides is usually very close to the umbilicus—in the foal and calf from one to three inches—in which region the cord is normally smaller and weaker than at other parts. After the rupture, the normal course of events consists of the retraction of the two umbilic arteries and of the urachus, upward and backward into the peritoneal cavity, drawing with them, in their retreat, portions of the loose connective tissue which immediately surround them. In this retraction the walls of the vessels become thickened, while their lumen becomes correspondingly decreased, thus preventing the escape of blood from the arteries or of urine from the urachus. The escape of urine or of blood is further safeguarded by the connective tissue,

which is continuous with the external layer of the vessel walls, adheres to the divided ends of the vessels, and becomes retracted along with them, serving to close over the broken ends and form a fibrous network which offers an impassible barrier for the blood or urine.

The umbilic vein, having very thin walls, collapses at once after rupture, so that its lumen is closed and what blood remains within, being free from any cardiac or capillary pressure, soon coagulates and blocks the remaining cavity. The Whartonian gelatine included within the cord rapidly loses its fluid portion, which oozes away from the broken end; within a few hours the navel becomes dessicated to a hard, dry crust, which hermetically seals the surface of the wound, and aseptic healing occurs beneath the scab.

Prior to the hermetic sealing of the wound by dessication, it is open to infections of an extended variety, which acquire special significance because of the vulnerability of the tissues involved.

The tissues of the umbilic cord, including the urachus, veins and arteries, invested with connective tissue and Whartonian gelatine, become dormant when the cord ruptures, and possess little or no power of resistance against bacterial invasion. The conditions prevailing at this epoch rather invite infection, as the tissues provide abundant moisture, nutrient material and warmth for bacterial growth.

Opportunities for infection are not wanting. Even before the fetus has escaped from the vulva or the cord has ruptured, any infection existing in the vulvo-vaginal canal of the mother may have acquired a habitat on or in the cord. Nocard and others hold that the appallingly fatal infectious diarrhea of calves is due chiefly to navel infection, and that the infection is already lying in wait in the vulvo-vaginal canal of the cow when the calf is being born. Later, when the cord ruptures, the umbilic stump is readily brought in contact with the earth, bedding, dung, urine, etc., whence it may acquire virulent infections.

The anatomy of the part permits the infection to reach the circulatory system by a short route through the inert, open umbilic vein, and to be carried thence to remote parts.

1. Purulent Infection of the Navel. Omphalitis. Omphalo-phlebitis. Pyo-septhæmia.

Purulent infection of the navel is greatly favored by many of the circumstances attending the birth of the young animal. When it is born in a stable or barnyard, or in surroundings where filth and dirt are abundant and omnipresent, there is constant exposure to infection of the new-made wound. Whenever the animal lies down, especially in sternal recumbency, the new-made wound comes in direct contact with infected bedding, decomposing feces or urine, or with other filth which may chance to exist at such a point.

The carnivorous, and to a lesser degree the herbivorous mother habitually cleanses the broken cord by licking, and thereby withdraws from it a large part of the Whartonian gelatine, thus favoring the early dessication of the stump. It appears that, in spite of the fact that the mouth usually abounds in pathogenic bacteria, the process of licking the navel is, according to clinical observations, comparatively safe and tends to protect the navel against infection. We observe infection of the navel most frequently in the foal, whose mother pays less attention to the navel than do other domestic animals.

Purulent infection of the navel very frequently arises, also, as an indirect result of ligating the umbilic cord. The danger from ligating the cord consists usually of two principal elements—the infection of the wound by careless ligation, and the providing of a breeding ground for bacteria by the inclusion of the Whartonian gelatine.

From a surgical standpoint, nothing can well be more dangerous to the new-born animal than the careless or filthy ligation of the umbilic cord by a layman or a veterinarian with dirty, infected hands and an unclean ligature. Most ligatures applied to the navel are placed there by laymen, who are ignorant of the fundamental rules and practices of surgery, and consequently pick up almost any kind of ligature, which they apply without disinfection or sterilization, and usually without disinfecting or even washing their hands. They thus bear directly to the cord abundant infection of a dangerous character.

Even when a ligature is applied to the navel under some of the rules of modern surgery, other important ones are habitually

neglected, and the ligature is nevertheless wrongly and dangerously placed. The exterior of the cord consists of the impermeable amniotic sheath, which encloses within it the vessels surrounded by the Whartonian gelatine. If the cord is tightly ligated; the gelatine is firmly enclosed, and its fluid portions cannot escape readily and permit proper dessication of the stump. Even if the ligature has been applied under other antiseptic precautions, but retains the Whartonian gelatine, the procedure is at once in conflict with surgical practice, because this substance constitutes an excellent medium for the growth of pathogenic bacteria and assumes the same surgical significance as extensive blood clots when retained in a wound. The danger from infection is further emphasized if the ligature is placed at a point too distant from the umbilicus, thus increasing the amount of tissue in the cord which must undergo dessication or putrefaction. The greater the amount of moist tissue, the more probable is putrefaction, and the less likely is dessication to occur.

Ligation possesses yet another danger, in the possible incarceration of the two umbilic arteries and the urachus. If the ligature is applied very tightly before the cord is severed, the retraction of the arteries and urachus into the abdominal cavity may be prevented. Being retained in the navel, the open ends of the arteries and urachus are freely exposed, and rendered more subject to infection during putrefaction of the tissues.

The possibility of either preventing or decreasing navel infection by ligating the stump is by no means clear upon surgical grounds. When a living tissue is ligated, and the ligature so tightly applied as to cause necrosis on the distal side, it appears clinically to cause a prompt protective reaction (leucocytosis) on the proximal side of the ligature, which largely serves to prevent important infection. But when a ligature is applied to a dormant or dead tissue like the umbilic stump, no such reaction is caused, and the stump goes on to putrefaction or dessication, as circumstances may favor. The application of a ligature about a mass of dead tissue cannot prevent infection of the necrotic mass on either side of the ligature, but may greatly favor putrefaction by confining fluids within the parts. When such bacterial infection and decomposition occur in the necrotic tissues of the cord, the more or less dormant vessels incarcerated in the decomposing tissues are seriously exposed to bacterial invasion.

It is thus a common clinical observation that purulent infection of the navel is greatly favored by the process of ligation, and the more improperly ligated the greater the danger. Admittedly a navel cord may be safely ligated. If the cord is divided at the proper point, the Whartonian gelatine thoroughly pressed out and the stump ligated under perfect aseptic precautions, followed by the application of an aseptic covering, and its retention in position and in an aseptic state (a very difficult task with domestic animals), the operation is safe.

Another method by which infection apparently takes place is through the medium of flies, which are attracted to the cord while it is yet moist after birth. These filth carriers, having previously been in contact with infected wounds or putrid organic matter, carry the infection to the navel. Foals born during fly time very frequently suffer from navel infection.

Symptoms. Navel infection occurs within a few hours after birth, and the danger is eliminated as soon as the cord is thoroughly dessicated. Consequently, the danger period is during the first 12 to 24 hours after birth. The symptoms usually follow very promptly after this period, although in the initial stages of the disease, the malady may be overlooked or unrecognized by the owner or attendant. First there usually occur the general symptoms of local infection, modified by the peculiar structure of the navel. In the foal, Fig. 90 B, page 559, there is an extension of a hairless skin from the umbilicus, to constitute the cutaneous portion of the cord, beyond which the cord is somewhat smaller, softer, more fragile, and covered with the amnion. It is just beyond this cutaneous area of the cord that it normally ruptures.

When the umbilicus becomes inflamed, this projection of hairless skin becomes intensely reddened, tense and glistening. Further examination will reveal the fact that, instead of the part having dessicated normally, there exudes from near the center of the cord a dirty, thin, watery, flocculent serosity, which may be grayish-white or tinged with blood. If the part is carefully examined with a fine probe, it will usually be found possible to pass the instrument upward and forward for a variable distance toward the liver along the course of the umbilic vein. If the infection has extended along the vein in its course through the peritoneal cavity, the probe can probably be passed for a distance

of two, three or four inches, or even more. If the infection has been arrested in the umbilic ring, the probe cannot pass beyond it.

The behavior of the case will depend primarily upon the degree of extension of the infection. It may be confined chiefly or wholly to the umbilicus itself, to constitute simple *omphalitis;* or it may pass beyond the umbilicus, in the lumen of the umbilic vessels, and the infecting agent and its products gain entrance into the blood stream, by which they may be carried to distant parts, to produce septic or pyæmic disturbances of a grave character, which we recognize as *omphalo-phlebitis or pyosepthaemia of the new-born*.

It is an important clinical fact that the gravity of navel infection is usually in inverse proportion to the local disturbances. If the local changes are great, inducing severe local omphalitis, the systemic disturbances are usually unimportant; if the infection gains admission to the umbilic veins, and thence enters the general circulation, the local disturbances may be comparatively insignificant, while the sepsis or pyæmia is exceedingly grave.

When the infection remains localized in the umbilicus itself, the part becomes swollen, somewhat tender to the touch, and soon suppurates. Small abscesses form in and about the umbilicus, which open and discharge pus. The abscesses may be followed by fistulæ of varying lengths, into which a probe may be passed for a distance of one, two or more inches. Sometimes the fistula may consist of the suppurating walls of the umbilic vein or artery. The swelling from local umbilic infection may be very great, sometimes offering a sharp, hemispherical swelling, 4–6 inches in diameter.

The course of such local infection is usually chronic, continuing for week after week. A somewhat limited amount of pus is discharged, which is generally of an ordinary consistency, without odor. Such an inflammation does not involve the general well-being of the young animal; it takes its food in the normal manner and amount, its digestion is undisturbed, it is playful, and its growth is usually unaffected.

When the infection, instead of expending its virulence upon the tissues of the umbilicus, gains admission to the open umbilic vein and extends along its course toward the heart, and the

bacteria and their products enter the blood stream, the symptoms are wholly different from those of the local disease. The coagulated blood within the umbilic vein breaks up under bacterial invasion, liquifies, and may be partly discharged into the hepatic vein from the central end of the umbilic vein, and externally from the stump of the cord as a dirty, flocculent, reddish-gray liquid, consisting of the disintegrated blood clot mingled partly with pus. The entire lumen of the umbilic vein has become a suppurating cavity. The tissues about the umbilicus are slightly, if at all swollen, but the umbilic stump is swollen, tense, glistening, and projects out from the umbilic ring as an elongated cone, having in its center a very small opening, from which the discharge appears. This discharge may occur as early as the 3rd or 4th day after birth, and may continue for a period of one, two, or even more weeks, should the animal survive. During the continuation of the discharge from the umbilic vein through the stump, the hairs about the navel are kept befouled and moist. Usually the adjacent hairs become matted together, and may more or less hide the broken end of the stump. Later the befouled, matted hairs drop away, leaving a depilated, naked surface.

Soon after the commencement of suppuration in the umbilic vein, there frequently occurs also a corresponding infection in the broken end of the urachus, which results in the duct becoming reopened, with a consequent dribbling of urine from the navel, which adds to the moist condition of the diseased part and gives to it the odor of decomposed urine. Usually this condition is attributed to "persistent" urachus, but according to our observations, this designation is ordinarily erroneous, since the open condition of the urachus with dribbling of the urine is generally secondary.

In the more serious cases of navel infection, the local symptoms are so insignificant in a general way that they may wholly escape the observation of the owner or caretaker. The first signs of disease which he notes are the more serious systemic disturbances, because of the entrance of the infection into the general circulation. When the young animal has reached the age of two to four days or somewhat more, there suddenly appears in many cases a high fever, with loss of appetite and extreme dullness. The udder of the mother becomes over-distended with

milk as a consequence of the loss of appetite of the young. The coat of the young animal is staring and dull. There may exist either constipation or diarrhea. In many cases distinct chills are noticed as a symptom of the fever which is present. The young animal in many cases shows very great weakness, and may perish from the infection in the course of 24 to 48 hours after the first symptoms of disease are observed.

The symptoms of general infection vary widely in intensity. Between the rapidly fatal septicæmia which we have outlined and those cases which for a time do not attract any notice, there is every gradation. In many cases the symptoms of fever continue for a day or two, with a decreased appetite and other general febrile symptoms, disappear, and the young animal apparently regains its usual health, although it may not seem quite as vigorous as should be expected.

In some of the very mild cases, no febrile symptoms appear of such a character as to attract the attention of the owner, and the early stages of the general infection pass unnoticed. This very frequently occurs, and it is only when the secondary symptoms of the infection arise that the attention of the owner is attracted to the diseased condition of the patient.

When the young animal has reached an age of from three to five or even ten days, and sometimes more, there suddenly appear, without warning, acute septic or pyæmic inflammations of various parts or organs of the body. Pre-eminently there occur septic or pyæmic inflammations of the articulations. The young animal is left apparently well in the evening, and is found the following morning severely lame in one of its limbs—usually so lame that it will not bear weight upon the affected member. Upon examination of the limb, one of the prominent articulations is found swollen, hot, tense, and painful upon manipulation. The inflammation usually affects the more important articulations, especially the hock and stifle, and less frequently the elbow and carpus or other joints. The suddenness and intensity of the arthritis usually leads the owner to believe that the dam has injured the joint of the young by treading upon it.

The course of the inflammation of the articulation varies according to circumstances. In many cases it increases in intensity for a few hours in the articulation first involved, and then very suddenly abates, while another articulation becomes violently

inflamed. The inflammation may thus involve one after another of the articulations, disappearing from one to reappear in another. This has caused the disease to be designated by some as rheumatoid arthritis, and by others as foal lameness, calf lameness, etc. As the disease continues, there is a well-marked tendency for the arthritis to become fixed and permanent in a given articulation, and at the same time additional articulations become involved, so that in many instances two, three, or four joints are simultaneously diseased.

We recognize two somewhat distinct forms of arthritis; the one a serous inflammation without the formation of abscesses, the other characterized by the presence of abscesses, the contents of which are usually mixed with synovia. The apparently serous arthritis, in which abscesses do not form, constitutes the most common type of articular disease.

The inflamed articulation is greatly enlarged, tense, hot and painful. The distended synovial sac may offer some symptoms of fluctuation, but does not "point." Later the articular tissues hypertrophy, the subcutem, synovial membranes and other parts thicken and become more or less sclerotic. At the same time the contents of the synovial sac may become increased, causing severe distension, which may remain permanent. When involving the femoro-patellar articulation, the synovial distension floats the patella upwards until it reaches the level of the top of the external femoral condyle, when the patella slips out laterally to constitute "floating luxation of the patella" which may prove temporary or permanent.

Less frequently the arthritis is of a purulent character, and the joint soon becomes the seat of an extensive suppuration, the pain is very severe, and the accompanying constitutional symptoms are exceedingly grave. After the lapse of a few days, the pus in the synovial sac becomes so abundant that distinct fluctuation is present. Unless opened surgically, the abscess ruptures and discharges a flocculent pus mixed with abundant synovia. In most cases, however, the sepsis is so acute and severe that the young animal perishes before the abscess ruptures spontaneously; or, if the abscess is opened, the animal soon succumbs from septicæmia.

The abscesses are not confined to any particular articulations of the body. They are observed chiefly about the principal

articulations of the limbs, such as the tarsus, carpus, fetlock and stifle, but usually do not include the coxo-femoral or scapulo-humeral joints, though somewhat rarely these are involved. When the hip joint becomes affected, the symptoms are not so well defined, because of the depth of the abscess. The animal is excessively lame in the affected hip, and there is a general swelling of the gluteal region. The imprisoned pus finally approaches the exterior at some point, causes fluctuation if the young animal lives for a sufficient time, and may then rupture or be opened, and the true character of the disease becomes revealed.

The severe lameness caused by the arthritis exerts an important influence upon the course of the disease, aside from the septicæmia with which it is so closely associated. The lameness interferes with the young animal securing proper nourishment, because in many instances it is unable to rise or even to stand while it sucks, and thus it suffers from starvation. In chronic cases, also, the young animal suffers greatly from decubitis gangrene upon various portions of the surface of the body, so that from these sores alone it may soon become a very repulsive and pitiable object.

The formation of pyæmic abscesses does not confine itself to any organs or tissues, but may occur at almost any point within the entire body. Abscesses may form within the lungs and, rupturing into the bronchial tubes, cause death from an acute septic pneumonia. In other instances the abscess forms in the articulations of the vertebral column, and may extend inward to press upon the spinal cord, thereby inducing a more or less sudden and complete paralysis; or the abscess may form in the spinal canal and bring about similar symptoms.

Spinal paralysis, due to pyæmic abscess as a result of navel infection, may cause either sudden or gradual paralysis. If the abscess forms in the inter-vertebral space, and suddenly forces its way into the spinal canal to cause pressure upon the cord, the paralysis may be very sudden and unexpected, as we noted in one instance where a foal had been apparently well and very thrifty and vigorous until some 8 or 10 weeks old, when it was found one morning unable to rise. It could not stand when helped to its feet, and presented all the appearances of a broken back. Upon post-mortem examination, there was discovered a

small abscess at the dorso-lumbar articulation, which, rupturing into the spinal canal, had caused pressure upon the spinal cord.

In another instance, in a calf, there appeared at the age of 6 or 8 weeks a gradually increasing paraplegia. The caretaker had not observed any disease or infection of the navel, but a careful inspection of the part revealed the presence of an old suppuration, the evidence consisting chiefly of dried pus upon the surrounding hairs, and a naked point at the navel, indicating that a limited infection of the part had existed. Being unable to account otherwise for the paralysis, we diagnosed spinal abscess as a result of navel infection, and finally, destroying the animal, we discovered upon post-mortem examination a large abscess in the spinal canal, pressing upon the cord, as shown in Fig. 145.

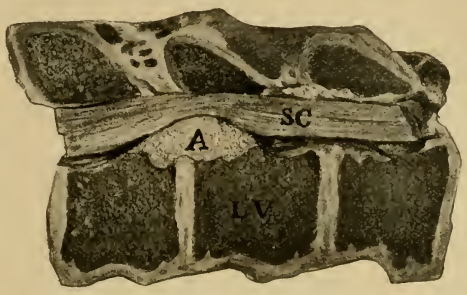


FIG. 145. OMPHALO-PHLEBITIS.

Spinal abscess, in a four-weeks-old calf.

A, Inspissated pus in spinal canal, pressing upon the spinal cord, SC, causing paralysis of posterior parts.

Pathology. The disease is the result of the entrance, into the freshly broken navel, of pus-forming micro-organisms. So far as we are aware, the disease is not limited to any one form of infection. In one instance, where a foal had succumbed to the disease, bacteriologic examination of deep-seated pyaemic abscesses revealed the presence of a pure streptococcic infection. The local infection of the navel is a mixed one, as has been shown by Bollinger and others. Clinically we observe that,

along with the general purulent infection, there may also occur a tetanus infection, inducing a virulent form of that malady. Nocard and others have shown that, in calves, along with other infections, or without them, there may enter through the broken navel cord the germs of infectious diarrhea. One organism or another may acquire precedence, and consequently modify the symptoms of the infection.

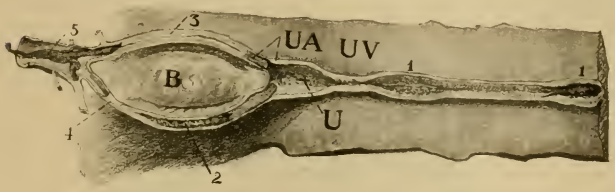
The force of the infection is sometimes expended upon the navel and its immediate neighborhood, producing a type of disease depending somewhat upon its virulence. In such cases it appears that a sufficiently resistant embolus forms in the umbilic vein to constitute an efficient barrier against the centripetal progress of the infection and limit its ravages to the umbilic region. The infection induces a more or less severe inflammation, with swelling, suppuration, and the formation of abscesses and fistulæ. If the infection possesses a still higher virulence, gangrene or necrosis of the tissues may occur.

If the infection extends beyond the immediate area of the navel through the lumen of the umbilic vein or other umbilic vessels, it quickly gains entrance to the general system, and induces septicæmia or pyæmia. Upon post-mortem examination in such cases, the navel vein is usually found filled with decomposed blood, mixed with a dirty-gray, flocculent pus.

The umbilic vein is converted into a vast suppurating tube, opening at one end into the hepatic vein, at the other externally at the umbilicus. The purulent contents may escape outwards through the navel or inwards into the hepatic circulation. Once the infection reaches the hepatic circulation, it flows freely to the heart, passes through the pulmonary system and gains the systemic circulation. The gravity of the attack is dependent upon the amount and virulence of the infection entering the hepatic circulation, and the power of resistance (age and vigor) of the patient. In many cases the septicæmia is so acute and intense that the patient succumbs in a few hours, presenting essentially only the symptoms of high fever with very slight navel disease.

In other instances the disease assumes the character of pyæmia, and the clumps of bacteria, passing into the general circulation, are forced through the pulmonary vessels, into the lungs, where they may lodge to bring about pulmonary abscesses.

Passing through the pulmonary capillaries, and reaching the systemic circulation, the infection may become arrested at any point, and induce an acute septic or pyæmic inflammation. The infection is especially liable to become lodged in the capillaries in or about the synovial membranes of the articulations or of the sheaths of tendons, and to induce therein either an acute serous or purulent inflammation.



FIG, 146. ABSCESSES OF UMBILIC VEIN AND ARTERIES IN OMPHALO-PHLEBITIS OF FOAL.

A section of the abdominal floor, including the umbilicus, seen from above.

B, Bladder.

U, Emergence of umbilic vein from naval cord into intra-peritoneal portion of that vessel.

UA, Umbilic arteries retracted to the fundus of the urinary bladder, B,

1, 1, Pus cavities in umbilic vein.

2, Abscess in right umbilic artery.

3, Greatly thickened walls of left umbilic artery.

4, A brief segment of apparently normal artery.

5, Thrombus in posterior aorta and iliac arteries.

No tissue or organ of the body is immune against the ravages of the disease. The internal organs are by no means free from the dangers of pyæmic infection. Abscesses of the liver, kidneys and spleen are frequently found.

We have frequently observed abscesses within the umbilic veins and arteries, as shown in Fig. 146, especially when these vessels have been caught and held as a consequence of the ligation of the umbilic cord. If the cord has not been ligated, and the arteries thus held, they quickly retract into the abdomen and are comparatively free from danger.

Pyæmic arthritis is usually highly destructive to the affected articulation. When the focus of infection is within the articulation, the synovial membranes are found greatly thickened, intensely injected, and frequently necrotic. The articular cavity is usually distended with purulent synovia, as indicated at A A Fig. 147. The infection spreads rapidly to the surrounding tissues, causing extensive suppuration in the neighboring tendon sheaths, like at C, and in the subcutaneous tissues at B.

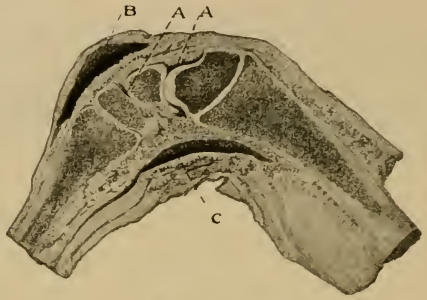


FIG. 147. OMPHALO-PHLEBITIS. FOAL.

Sagittal section from carpus. Same case as Fig 146.

A, A, Intra-articular abscess of carpal joint, communicating with an extensive subcutaneous abscess, B, and posteriorly with an empyæmic cavity, C, in the vaginal sheath of the flexor tendons.

The articular cartilage undergoes rapid destruction, as shown at A and B, Fig. 148. In addition to the lesions already mentioned, there may occur septic inflammation of the pleura, intermuscular abscesses, opthalmia, leptomeningitis, catarrhal enteritis, pneumonia, myocarditis, bronchitis, etc.

FIG. 148. OMPHALO-PHLEBITIS.

Cross section of Fig. 147, showing lower row of carpal bones, seen from above.

A, B, Purulent destruction of articular cartilage. At the upper part of the illustration is seen the pus cavity, B, of Fig. 147, in cross section.

Prognosis. The prognosis is very grave in all cases of omphalo-phlebitis, that is, in all patients suffering from umbilic infection in which the infection gains the hepatic and general circulation. It is most hopeless in the foal, in which animal the mortality exceeds 95%. Of the few which ultimately survive, the vast majority are comparatively valueless because of permanent changes in the articulations or in other parts of the body. In the calf the prognosis is somewhat more favorable, but is still exceedingly grave. The greater the age of the young animal when the symptoms of the disease appear, the more vigor and strength it has acquired; the better the prognosis. If the infection is so mild that the first evidences appear only after the young patient is 2 or 3 weeks old, the prognosis is fair.

When simple omphalitis is present and severe, and the local swelling and inflammation indicate that the entrance of the infection into the general system is barred by a resistant embolus in the umbilic vein, the prognosis is good.

Handling. The handling of the localized infection of the navel consists essentially of local disinfection. The navel should be thoroughly cleansed ,and if a portion of the cord is still present and undergoing decomposition it should be cautiously removed, and any necrotic tissues should be excised or curetted away as far as is practicable. Abscesses in the navel should be opened promptly, under strict antiseptic precautions. It is highly essential, also, that, before attempting to operate, one should carefully differentiate between inflammation of the navel and umbilic hernia. In some cases the two conditions coëxist, and become highly confusing, so that the hernia may be mistaken for an abscess, or vice versa; or a fistula may exist along with hernia. When attempting to lay open a fistula, the surgeon may open the peritoneal cavity and invite intra-peritoneal infection, or a protrusion of the omentum or the intestine. Suppurating fistulæ about the navel should usually be treated by the injection of antiseptics, such as tincture of iodine, rather than by opening, unless the more conservative method fails to produce the desired results.

The selection of a disinfectant is not so important as the thoroughness of its application, except that it should be one which will penetrate the tissues freely, We prefer the application of

the tincture of iodine or of other antiseptics in alcoholic solution. They have the advantage that the alcohol quickly evaporates and leaves the antiseptic behind in a dry state. It may be equally effective to apply a wet dressing to the part, in the form of an antiseptic pack, to be retained in position by means of a bandage. If this is attempted, the pack needs be kept constantly saturated with the antiseptic and frequently renewed.

When the infection has become general, and septicæmia or pyæmia has developed, all forms of handling become almost hopeless. In accordance with general surgical principles, we would promptly open abscesses, and disinfect their cavities whether they involve the muscles or the articulations. Internally there may be given various antiseptics, and we especially recommend large and repeated doses of quinine, or in the foal we may add to the quinine large doses of potassium iodide, or supplant the quinine by the iodide.

Recent developments in opsonic and serum therapy have aroused interest, and in the minds of some, hope has been established that pyo-septicæmia of the new-born may be brought under control. As yet, the problem is undecided. Spencer (Proc. Am. Vet. Med. Ass'cn., 1908, p. 393) claims definite results in severe cases, but the data submitted are not convincing. Most of his cases were comparatively old foals, in a fair proportion of which spontaneous recovery might have been anticipated. He gave 10 cc. of anti-streptococcic serum subcutaneously, daily. No evidence is submitted that the foals had streptococcic infection. If the infection was streptococcic, we have no evidence that the serum was from the same organism. In about half his cases, S. used influenza serum instead of the antistreptococcic preparation. In one case he combined them. Were we to accept the conclusion that the sera acted specifically in these cases, we would be forced into the position that the character of the infection is unimportant, and all that is necessary is to buy some kind of serum from a manufacturer, administer it in any kind of infection, and get a speedy cure.

It is to be sincerely hoped that investigations along these lines may develop a safe and reliable remedy for umbilic infection of the new-born, but until we are supplied with more definite data regarding this or other remedies, the practitioner needs rely upon prophylaxis, not upon therapeutics.

While the handling of pyo-septhæmia of the new-born is exceedingly unfavorable and well-nigh hopeless, prophylaxis of navel infection is highly successful, and should be regularly applied in stock-breeding, especially in horse-breeding. Franck recommends that, after the navel cord has been ligated, it should be penciled over with concentrated carbolic acid, but Vennerholm contends that this converts the covering of the cord into a parch-

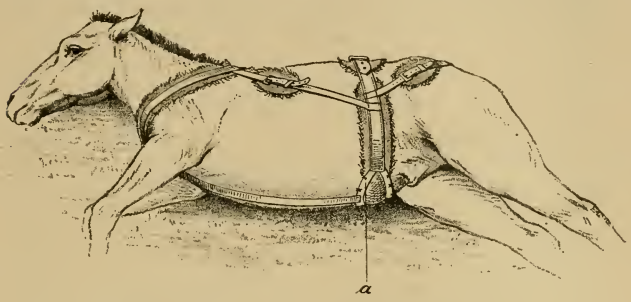


FIG. 149. SOHNLE'S NAVEL BANDAGE FOR FOALS.
a, Elastic girth inserted in the suspensorium. (Bayer & Fröhner).

ment-like membrane, which interferes with the escape of the tissue-fluids, and consequently with the mummification of the cord. He recommends instead the plan of Sohnle of Wurtemberg, who uses a special navel bandage, as shown in Fig. 149. Vennerholm recommends that the surrounding parts be carefully shaved, in order to prevent the adhesion of dirt. The navel is then disinfected, and further protected by the application of the Sohnle apparatus. The leather surcingle, and other parts of this apparatus, are well padded, to prevent galling of the young animal, and applied as shown in the figure. The navel rests in a depression in the surcingle, in which there is placed sterilized cotton, upon which the disinfected navel rests. The parts are disinfected and redressed daily, until the navel stump sloughs away and granulation is fully established.

The plan of Vennerholm and Sohnle is admittedly good if thoroughly applied, but it requires a very long and tedious course of procedure, with a somewhat expensive apparatus and no little annoyance to the foal. It is dangerous to entrust such a

method of handling to laymen, but the remedy demands application by the veterinarian himself. Unless properly applied, closely watched and carefully reapplied, the pad quickly becomes befouled and at once acts as a retainer and promoter of infection. In our judgment, so complicated a method of handling is alike needless and dangerous.

In our experience we have had most excellent results by a far simpler method, which we believe safer and more efficient. We provide the breeder with a dessicating antiseptic powder for application to the navel cord as soon as the foal or other young animal is born. This powder may be variously compounded, according to the taste of the veterinarian, but should consist of reliable antiseptics having a distinct dessicating power. We would suggest, for such a powder, equal parts of iodoform, tannin, oxide of zinc and starch, all finely powdered and mixed. The oxide of zinc might be displaced by calomel, or the latter might be added to the compound suggested. Quite as good, or perhaps even superior, is a powder consisting of equal parts of dessicated alum, gum-camphor and starch, finely powdered and thoroughly mixed. The latter mixture is especially efficient in keeping flies away from the moist cord.

For the application of such a powder, the owner or veterinarian should first thoroughly cleanse and disinfect his hands. If the navel has become soiled, it also should be cleansed and disinfected. **The navel cord should not be tied.** We have already stated our objections to ligating the cord, on page 1005. If it is unruptured, the caretaker, after disinfecting his hands, should pull, tear or scrape the cord in two, under antiseptic precautions, at a distance of about two or three inches from the navel, after which, with his thumb and finger, he should press out from the stump the Whartonian gelatine and fluids. After this has been well done, the powder should be dusted over the stump of the navel very freely and repeatedly, until the remnant of the cord has become completely dessicated and the navel hermetically sealed.

If the application is repeated three or four times at intervals of one-half hour, the stump of the cord is well mummified within two to four hours and the danger from infection is eliminated. The horse-breeder should be impressed with the fact that the efficacy of the remedy depends wholly upon the early and

thorough application, and that any delay or carelessness is liable to vitiate the result.

Antistreptococcic serum has been heralded as a valuable prophylactic against this infection, but is wholly needless. Local cleanliness is ample, and other means superfluous or worse. Few diseases of animals are more subject to safe, convenient and economic prevention than navel infection of the new-born. Its success calls for fidelity to cleanliness on the part of the owner, preceded by timely and intelligent advice by the veterinarian.

2. Tetanus Neonatorum.

Tetanus of the New-born.

Tetanus of the new-born acquires special significance because of the avenue of entrance of the tetanus bacilli. While tetanus may appear in any new-born animal from the same causes which induce it in the adult, it is of especial interest to us when occurring as a result of navel infection. Owing to the method of infection, the malady acquires a distinctive name, though differing in no essential respect from the ordinary disease, except perhaps that it is more virulent because the toxic substances enter more freely and directly from the umbilic vein into the general circulation. In domestic animals, tetanus of the new-born is chiefly confined to the foal.

The symptoms of tetanus of the new-born are identical with those observed in the adult animal, except that in our observation the onset is more sudden, the course more violent, and death more certain. We have not observed a recovery, but in the few instances which we have seen the course of the disease has been especially brief and stormy. As a general rule the foal goes down and is unable to stand within 24 hours after the first symptoms are noted.

If the navel is examined in these cases, so far as we have observed, there is found in each instance a well-marked purulent discharge emanating from the navel vein.

The disease is handled the same as other cases of tetanus, but, so far as we have observed, is hopeless from the outset.

Tetanus of the new-born may be safely and readily prevented by the same precautions which we have suggested in the foregoing article, for ordinary purulent infection of the navel.

3. DYSENTERIA NEONATORUM. DYSENTERY OF THE NEW-BORN. WHITE SCOURS.

In all new-born animals there may occur disorders of the digestive tract, which are expressed chiefly in the form of dysentery, due as a rule to the entrance into the alimentary canal, and multiplication therein, of various forms of bacteria which induce a catarrhal inflammation of the alimentary mucous membrane, accompanied by an acute diarrhea. While the disease may affect the new-born of any species of animal, it is most common and fatal among calves. In this animal there is a distinctively infectious form, in which the disease becomes enzoötic, and assumes the proportion of a very destructive plague in dairy herds. The calf is no more subject to digestive disturbances, aside from the infectious diarrhea, than are other new-born animals. In fact it may well be questioned if dysentery of the new-born animal is not more common in the foal, when we leave out of consideration the specific dysentery of the calf.

a. Sporadic Dysentery of the New-Born. White Scours.

Dysentery of the new-born consists of a diarrhea which attacks the young animal, usually during the first few days of extra-uterine life. The disease appears occasionally among all species, especially among foals and calves.

Symptoms. When the young animal has reached the age of two to ten days, symptoms of general illness of a more or less severe type appear.

The feces are very fluid, and usually somewhat mixed with mucus. They are generally fetid, and vary in color, frequently being of a dirty yellowish or whitish tinge. They may partake of the peculiar coloring of the foods consumed, so that, in case the young animal partakes of green grass, the feces assume a tinge of green. The feces are usually mixed to some extent with gas bubbles, because of gaseous decomposition taking place within the alimentary canal, and the presence of these bubbles imparts to the feces a frothy character. The liquid feces are sticky, and the tail and buttocks soon become soiled by the adherent discharges. This constitutes one of the first noticeable symptoms of the disease.

The evacuations from the bowels are frequent, and the feces are usually expelled with force. When the disease is well advanced the feces are highly irritant, the amount of feces expelled at a given time is usually very small, and the expulsion is accompanied by straining and other symptoms of pain. The disease may cause symptoms of colic, as indicated by the whisking of the tail, kicking at the abdomen and looking at the flank. The patient becomes weak ; if the disease is very severe, it lies most of the time, and when it gets up, it staggers about in a very weak manner. The eyes become sunken, the animal very listless, and saliva may flow from the mouth. Emaciation is very rapid in the severe cases, and the coat is dry and rough. The measurement of the temperature is not very reliable, because in the weakened state of the animal the anus remains somewhat open. Moreover, the frequent passage of liquid feces tends to keep the rectal temperature somewhat depressed.

As usually observed, the principal postmortem change is an irritated condition of the gastro-intestinal canal, which is largely concentrated in the colon and rectum. In these parts there is present a well-marked catarrhal inflammation of the mucous membrane, with a greatly increased secretion of fluids and mucus. There is usually very marked anæmia and paleness of the tissues.

The bacteriology of the disease has not been well determined. Usually there is a mixed infection. Various forms of microorganisms have been described by different writers, but it has not been definitely shown that the disease is due to any one alone.

Causes. Sporadic diarrhea of the new-born depends largely upon the abrupt introduction of pathogenic organisms into the alimentary canal of an animal which is not inured to their presence. The young animal has undergone a sudden transition from the uterus of the mother (which, with the placenta, has served as a barrier against most infections) to extra-uterine life, where it is subjected to the dangers incident to taking into the alimentary tract, food which is almost inevitably contaminated with microörganisms capable of inducing disease.

Anything which may depress the general strength of the young animal, and which may supply a favorable breeding ground for the bacteria introduced into the digestive tract, serves indirectly to favor the multiplication of the disease organisms. If too much food is taken, it over-taxes the digestive powers,

and thus invites the occurrence of disease. It is frequently observed that, when young animals are over-fed, and especially when they receive their food in too large amounts at a given period, they are liable to suffer from dysentery. Under natural conditions, where the young animal is constantly with the mother and has opportunity to suck as often as it may like, the danger from over-feeding is not very marked. However, if the young animal is separated from its mother during long intervals, and thus becomes very hungry, it will eat voraciously when opportunity is afforded, and will partake of more milk than the state of its digestive organs warrants, thus tending to induce digestive disturbances. In mares it is frequently observed that the udder is greatly distended with milk at the time that the foal is born, and that the young animal shows a voracious appetite, attempting to take all the milk present, with disastrous results.

An improper quality of milk is also dangerous for the digestive functions of the new-born. When mares or other mothers are hard-worked, and especially in warm weather, their milk is very liable to produce digestive disturbances in the young animal, and all the more so because the foal is usually denied the opportunity to suck at frequent intervals, and becomes very hungry. Added to this condition, the foal of a work mare is occasionally compelled to follow her upon a long journey, the fatigue of which favors the occurrence of dysentery, and greatly aggravates the disease when it already exists.

The adaptability of the food to the new-born is highly important. New-born animals sometimes show a depraved appetite, and soon after birth partake of food which they are not competent to digest. In one instance we found upon post mortem examination, in a case of fatal diarrhea in a foal three or four days old, a tangled mass of straw in the stomach, weighing perhaps half a pound, incapable of digestion or of escaping from the organ through the pylorus, and acting as an irremovable irritant. It is very common to observe foals habitually swallowing bedding and other forms of rubbish or indigestible substances. It is a very common experience, when examining the feces in a case of scours, to find mixed with the intestinal discharges, undigested particles of straw or other similar substances. The eating of hay by very young animals frequently acts as a cause of persistent dysentery.

Decomposing foods constitute a fertile source of diarrhea, and the disease is consequently very largely seen among young animals which are artificially reared. Milk which has been allowed to partially decompose, which has begun to ferment or sour, is always dangerous as a food for the new-born ; but even more dangerous is food which is contaminated with filth. In many instances the vessels, from which artificially-reared animals are fed, are exceedingly filthy and dirty, and contain particles of milk which have been allowed to remain and decompose day after day.

Prognosis. The prognosis of sporadic dysentery in new-born animals is usually favorable. In those animals in which the disease appears very early, within two or three days after birth, the prognosis is less favorable than in those in which the attack is delayed until the animal has acquired some age and strength. The prognosis necessarily depends somewhat upon the cause of the disease, and the power of the veterinarian to overcome it. In such a case as that to which we have above referred, in which the animal had swallowed a large amount of straw which had become molded into a tangled mass in the stomach and was neither removable nor digestible, the termination could not be other than fatal.

Handling. The prevention of sporadic dysentery in young animals is highly important. The food of the new-born animal should be as free as possible from pathogenic organisms, should be allowed in proper amounts and at sufficiently frequent intervals, and should be as readily digestible as circumstances will permit. If the young animal is allowed to suck the mother, it should be given such opportunity quite frequently ; at first the young animal should be allowed to be with its mother constantly. If the amount of milk in the udder is excessive, a portion of it should be withdrawn, so that the young animal will not be tempted to over-feed. This is especially true of the foal, since the mare sometimes has an enormous quantity of milk when the foal is born, and the latter is so voracious that it may greatly overfeed, if not prevented by the timely withdrawal of a portion of the milk. The objection has been interposed that the withdrawal of the milk removes the colostrum, which some have alleged is essential to the well-being of the young animal.

How true this may be, has not been definitely shown, but it is certainly true that many animals are well raised without having access to the colostrum. In many mares the milk has been flowing freely from the udder for days or weeks before the foal is born, and the colostrum has already escaped. Yet, so far as we have clinically observed, the foal does not suffer from this cause.

When young animals are to be artificially reared, the task should be undertaken with a practical understanding and application of the rules of aseptic feeding. The food should be given frequently, and in small amounts, in harmony with the undeveloped state of the alimentary tract, and it should be as free as practicable from decomposition and from filth bacteria. The vessels from which the milk is fed to the young animal should be regularly cleansed and sterilized by boiling before each feeding. In some instances it may be desirable to Pasteurize the milk before it is fed to the young animal, but this process reduces the digestibility of the milk to a degree, and is undesirable except in those cases where dangerous pollution cannot otherwise be avoided.

The composition of the food should resemble as closely as possible the normal milk of the species of animal to which it is being fed. When a young animal is being reared artificially, the milk should preferably be derived from an animal of its own species.

The surroundings of the new-born should be scrupuously clean, and there should be a careful avoidance of any dangerous substances which are likely to be swallowed. If the young animal exhibits a morbid appetite, such as a tendency to eat bedding, it is highly important to apply effective preventive measures. In some instances the young animal shows a marked tendency to eat fecal matter which has been voided by itself or other animals. The eating of bedding may be largely overcome by removing it and keeping the animal upon a bare floor, or still better, when the season and surroundings will permit, by placing the animal upon clean grass. In other cases, where the morbid appetite is marked and serious, we have found it necessary to apply a muzzle to the young animal so that it could not swallow rubbish.

When the disease has become established, the precautions above suggested should be rigidly enforced, and in addition, measures should be taken to remove, from the alimentary

canal, indigestible and irritant substances, allay the irritation in the parts, and disinfect such contents as may remain in the canal. First of all we strongly recommend the administration of an oleaginous cathartic, such as castor, linseed, or cotton seed oil. To the foal may be given one tablespoonful of castor oil, or two to three ounces of linseed or cotton seed oil. The oil is administered to gently evacuate the intestinal canal of its irritating contents, and at the same time to bring about a soothing of the irritated mucous membrane.

Many practitioners have proceeded in an opposite direction, and have administered opium, tannin, catechu, alum and other astringent substances, which tend to retain within the canal the irritant substances which contain or bear the infecting agents. We have not been able to observe the benefits from this class of drugs, which have been claimed for them by many writers.

The disinfection of the alimentary canal, after the removal of the infecting discharges so far as practicable, should receive close attention upon the part of the practitioner. Many drugs exert either a direct or an indirect influence upon micro-organisms in the digestive canal. Since the discharges are usually acid in reaction, many practitioners have strongly advised the use of alkaline carbonates, such as chalk or sodium bicarbonate. Others have had excellent results by the administration of powerful antiseptics, like corrosive sublimate or carbolic acid in appropriate doses. Indirectly, excellent results have been obtained by the administration of small doses of calomel, which, by exciting the functions of the liver, cause an increased amount of bile to be poured into the intestines, which acts as an antiseptic, increases the peristalsis of the bowels, and causes the expulsion as well as the destruction of the micro-organisms. Salol and other similar drugs have been used and recommended by some.

Stimulants and carminates have also been used and highly commended by many practitioners. We have largely used the tincture of ginger, with apparently good results. Any of the carminates or aromatics may perhaps be used with benefit. Some of them have a direct antiseptic influence, while indirectly they all tend to disinfect the alimentary canal by arousing the normal peristalsis and secretions of the intestines, which in themselves control to a great extent the question of infection. There are probably few disinfectants which are superior in effi-

ciency to the normal peristalsis of the intestines and the correlated normal secretions of the alimentary glands. Stimulants strengthen the animal and help tide it over a crisis in the course of the disease. Alcoholic stimulants act also as antiseptics.

Much good may sometimes be had from the administration of gruels or other substances which are at once nutritive and soothing to the irritated mucosa. For this purpose one may use a thin gruel of elm bark or of starch, or may administer the whites of eggs, but care should be taken not to force too large an amount of these substances upon the young animal unless the conditions warrant us to believe that they will be digested, and not decompose to further complicate the disease.

It is desirable to overcome as far as practicable the tenesmus due to the irritation by the intestinal discharges in the rectum, for which purpose one may advantageously administer enemas of a soothing and aseptic character, such as a 0.5% solution of carbolic acid in starch or milk. Enemas of elm bark gruel, to which has been added salicylate of soda, may be used advantageously.

The surroundings of the young animal should be clean and comfortable, and any exertion upon its part should be carefully avoided, since this tends to greatly aggravate the disease.

b Infectious Diarrhea of Calves.

There occurs frequently in calves a serious dysentery or scours, which is regarded as a specific infectious disease, differing materially from the sporadic dysentery of the young animal. It appears usually during the first few days after birth, but may appear almost immediately after birth, and, in fact, seemingly exists in some instances at the time that the young animal is born, so that it quickly perishes from the disease without having sucked the mother. The disease is highly fatal, and runs a very acute course.

Causes. Franck was one of the first to describe diarrhea as an infectious disease, since which time many writers have verified his conclusions, that it is a highly contagious malady due to a specific cause.

Nocard asserted the identity or close relationship between infectious abortion and dysentery of the new-born, but there seems to be no very good clinical grounds for such an assumption,

though the possibility of the co-existence of the two maladies in one herd cannot be denied. Nocard believed that the infection usually enters the body of the calf through the umbilic cord, and consequently may occur during the passage of the fetus through the birth canal. It has been shown by Walther Schild that newborn animals have bacteria in the alimentary tract prior to the ingestion of food.

Jensen does not accept the views of Nocard, but inclines to the belief that the infection is usually transmitted directly to the alimentary canal through the mouth, or at least that it may be so transmitted. Jensen found oval bacteria in pairs or short chains, in the mesenteric glands, spleen, liver, kidneys, heart, lungs and elsewhere. The organism is apparently closely allied to the *bacterium coli communis* and *bacillus fetidi lactis*. The findings of Jensen have in the main been verified by other investigators. He induced the disease experimentally, by administering a culture of these organisms, with milk, to calves of susceptible age.

Symptoms. The symptoms of the disease appear usually in from one to two days after birth, but in some instances within a very few hours. The first symptom observed by the owner is usually tenesmus, accompanied by fluid evacuations which are at first of a yellowish color and stinking. At first the liquid feces are expelled with considerable force, but later the intestines largely lose their power and the evacuations take place involuntarily, while the color changes from the normal yellow to a gray or whitish-gray, and becomes very thin. The young animal ceases to take food, and rapidly becomes weak and dull, with cold extremities. The course of the disease is usually very rapid, and death follows in from 12 to 48 hours. According to Friedberger and Fröhner, the mortality ranges from 80 to 100%.

Sometimes the disease is accompanied by stretching, and at other times convulsions are present. In those cases where the calf sickens within a very few hours after birth, before it has sucked, the course is very rapid and fatal. This fact has supported the opinion of Franck and Nocard, that the infection occurs during the intra-uterine life of the calf or at the time of birth while the fetus is passing through the vagina. Upon similar grounds Friedberger and Fröhner are of the opinion that infectious uterine catarrh (granular venereal disease?) of the mother may

become transferred to the alimentary tract of the fetus and induce the diarrhea.

Thus, according to one and another investigator, a relationship is suggested between several more or less serious maladies—abortion, diarrhea, uterine catarrh. At the present time the writer is handling a herd for severe granular venereal disease, in which abortion and diarrhea co-exist, but the relationship of the diarrhea to the granular vaginitis is not clear.

Upon post-mortem examination the chief changes are found in the alimentary canal and in the heart. The digestive mucous membrane is injected and hemorrhagic, and in some places shows a denudation of epithelium. The irritation is largely concentrated in the rectum, where the mucous folds are excessively hyperaemic. The mesenteric glands are enlarged and infiltrated, as are also the liver and kidneys. The spleen is apparently normal; the heart at times shows ecchymoses. In addition to these changes, there are present at times small areas of pneumonia.

Handling. The therapeutics of this disease has constantly proven unsuccessful, and the chief attention is necessarily turned to preventive measures. More than a quarter of a century ago, Franck advised that pregnant cows be removed from infected stables four to six weeks prior to parturition, and that they be placed in clean and disinfected stalls. Others have advised that the posterior portions of the pregnant animal, the vulva, perineum, tail and buttocks, be carefully disinfected, that the vagina be irrigated with warm antiseptics shortly prior to parturition, and that the udder be washed with a 2% carbolic acid solution before permitting the calf to suck or before drawing milk from the udder to feed the calf. Morkeberg succeeded in reducing the mortality from 77 to 33%, by applying careful disinfection, followed by the immediate removal of the calf and feeding it upon clean milk. The udder was carefully washed with corrosive sublimate solution before the milk was drawn for feeding the calf.

Nocard advises that the navel cord should be ligated and excised, and the stump carefully disinfected, because he believes that the disease is largely transmitted through the wound of the ruptured cord while the calf is passing through the vagina or while the freshly ruptured cord is yet in contact with, or moistened by, the vulvo-vaginal fluids. While we admit the probability of the transmission of the disease through the navel wound,

it would certainly be unfortunate to ignore other even more probable avenues of infection.

If the infection exists in the genital passages of the mother, it may as readily gain the lungs and alimentary tract by entering the nostrils and mouth as it may enter the system through the umbliic wound. It is therefore quite as important to guard these portals of entry, as it is the umbilic stump. Assuming the correctness of the view that the infection is already lying in wait in the genital canal when birth begins, antiseptic irrigations of the vaginal canal of the cow just prior to labor, and the immediate disinfection of the nostrils and mouth of the new-born are indicated. As we have already indicated on page 561, we very greatly prefer, and strongly recommend, the application of dessicant antiseptic powders to the freshly ruptured navel, and would omit the ligature. We regard the dessication of the navel stump as more efficient, convenient and economic. Apparently those who advise ligation of the cord desire that it shall be done prior to rupture, but the cord of the calf is so short that it usually ruptures at the moment of expulsion, and immediately encounters the most critical exposure in its history, if we accept the theory of intravaginal infection. A ligature, encircling the now dormant cord and presumably infected stump, cannot act as a barrier to the spread of the infection, but it may readily favor the extension of the infection in the necrotic stump by retaining the included Whartonian gelatin.

The calf should at once be removed from the cow and from the infected stable. The removal is to be followed by the rigid application of the general rules of asepsis and antisepsis. These must include clean and comfortable quarters for the new-born, and strictly clean milk in proper quantity and at proper intervals. In applying these rules, the milk must be withdrawn from the cow under the strictest possible precautions to avoid its contamination. Before the milk is drawn, the milker should carefully disinfect his hands and the udder of the cow. The milk should be drawn in a sterile vessel. Ample precautions are to be taken against contamination of the milk between its withdrawal and feeding to the calf. The feeding vessels must be handled under strict aseptic precautions, being sterilized before each feeding. Care must be taken also that the infection shall not be borne to the susceptible young by intermediary bearers, such as caretakers,

animals, bedding or food. When the disease exists in a stable, it is of great importance that all fecal and other excreta from the diseased calves shall be promptly disinfected. The buttocks and other soiled parts should be cleansed with a reliable disinfectant, and the soiled bedding and floor should be given close attention.

When the young animal has once become infected, the case is almost hopeless. Various antiseptics have been used and recommended, such as the tri-chloride of iodine, creolin, carbolic acid, salicylate of soda and others. Opium has also been used and recommended, in conjunction with powdered rhei radix. Opsonic and serum prevention and cure have been proposed, but at present do not warrant any relaxation in disinfection.

c. Septic Pleuro-pneumonia of Calves.

Under the name of septic pleuro-pneumonia, Poels has described a fatal disease of calves, complicated by inflammation of the pleura and lungs, and caused by specific bacteria which belong to the colon group. Poels secured pure cultures of the bacteria, which caused a disease in experiment calves that could not be clinically distinguished from that in calves which had acquired the infection in the natural way. The artificially-grown bacteria also killed mice, rabbits and guinea pigs, and induced in swine a disease which appeared very much like swine plague. The bacteria were found, upon post-mortem examination, in the blood and internal organs, and in the pleura and pulmonary exudates. It is believed that the infection may enter through the alimentary tract, the navel, the respiratory organs, or wounds upon the body surface.

The clinical and bacterial differentiation between calf dysentery and pleuro-pneumonia in calves is not yet clear. Some hold the two for identical; others consider them as distinct diseases, due to wholly distinct micro-organisms.

It is common in outbreaks of calf pleuro-pneumonia, to observe diarrhea. In some outbreaks of pleuro-pneumonia, diarrhea is the rule rather than the exception.

The reverse is equally true. Pleuro-pneumonia is by no means rare in outbreaks of infectious dysentery. Certainly the two may coëxist. While the evidence for and against the idenity of

diarrhea and pleuro-pneumonia is very confusing, their mode of origin, avenue of infection, prognosis and handling are essentially the same.

Poels recommends that calves suffering from pleuro-pneumonia or diarrhea should be fed upon sterilized milk, from vessels which have been sterilized by boiling, and that great care should be taken to avoid infection passing to the young animal through the medium of dirty milk. Especially he recommends that great care should be taken in those cows in which there is a septic discharge from the vulva, which may thence be transferred to the udder and gain entrance into the milk, and suggests that in all such cases, the parts which are liable to be soiled, including the tail and udder, should be thoroughly disinfected. He further suggests that the navel should have antiseptic handling at the time of the birth of the young animal.

d. Calf Septicæmia.

Jensen has described a fatal disease of calves occurring in Denmark, which is caused by ovoid bacteria, closely resembling those of swine plague, but in their pathogenic properties exhibiting some characteristic differences. Jensen considers this disease closely allied to the pleuro-pneumonia described by Poels, but it runs a more rapid course, without producing inflammation of the lungs. In Jensen's observations the calves died in from 12 to 24 hours after the first appearance of the disease. The calves were attacked very suddenly, and became at once so weak that they could not stand, the temperature became elevated to about 41 C., and the patients quickly perished, with symptoms of diarrhea and dyspnoea.

Upon post-mortem examination, Jensen found acute fibrinous inflammation of the pleura and pericardium, with ecchymoses in these two membranes, gastro-enteritis, enlargement of the spleen, and infiltrations about the larynx and pharynx.

e. Bacteriæmia of Thomassen.

Thomassen has described a fatal infection of calves due to a bacillus of the colon group, which he could distinguish from the *bacterium coli communis* only by its greater virulence. He considered the infection even more virulent than that of diarrhea. According to Thomassen the calves are born sound, and show

the first symptoms of the disease within from 5 to 8 days, or even more, when they suddenly become weak and listless, remain recumbent, and, when they are compelled to get up, habitually stretch themselves.

Along with the dry muzzle, the respirations are increased to 50 or 120 per minute, the pulse is small, 100 to 150 per minute, and the temperature is elevated as high as 42° C. Some of the patients cough. The appetite is greatly diminished, though the calf may continue to drink some milk. In these outbreaks diarrhea is rare, and usually the feces are normal, while the urine is frequently voided in small amounts and contains epithelium from the bladder and tubular casts from the kidneys. In some cases cerebral symptoms are present, in the form of tonic and clonic spasms, to be later followed by paralysis.

The disease has a duration of 5 or 6 days, and in the experience of Thomassen is uniformly fatal.

The pathologic anatomy consists chiefly of great enlargement of the spleen, which is 5 to 6 times its normal size and has a weight of about 500 grams. The pulp of the spleen is congested and chocolate color or black, and it sometimes shows an irregular form, being more swollen at one point than another. In smear preparations of the spleen, there are found many bacilli. The kidneys are affected with a parenchymatous inflammation, and the mucous membrane of the bladder shows streaks or spots of a brown-red color. The mesenteric lymph glands are enlarged and show hemorrhagic spots. The mucous membrane of the fourth stomach, and to a lesser degree that of the small intestine, show numerous dark red petechia. The liver has undergone parenchymatous degeneration. The endocardium is covered with red petechiæ.

Thomassen administered various antiseptics to the diseased animals, such as carbolic acid, eucalyptol, trichloride of iodine, Lugol's solution and others, but without any success.

NON-INFECTIOUS DISEASES AND DEFECTS OF THE NEW-BORN ANIMAL.

1. Asphyxia of the New-Born.

Asphyxia is not rare in the new-born, and may proceed from a variety of causes. If the mother has suffered from some malady which interferes with aeration of her own blood, just prior to parturition, the fetus must necessarily suffer in a somewhat similar manner. For example, if a mare in advanced pregnancy is suffering from pneumonia, hydrothorax, or other disease which interferes with her respiration, the foal, during this diseased condition of the mother, necessarily suffers more or less for want of oxygen.

If for any reason the fetal placenta becomes detached from the maternal placenta before the fetus has sufficiently emerged from the genital tract to breathe, and parturition is in any way delayed, asphyxia must necessarily result very quickly. Especially in the mare, where the adhesion between the fetal placenta and the uterus is very slight, the placenta may become partially or wholly detached before the fetus is expelled, and may even be expelled ahead of the fetus, causing in either case, a fatal asphyxiation.

During parturition, if the fetus moves slowly through the birth canal, especially when in the posterior presentation, and the navel cord becomes tightly compressed between the wall of the fetal chest and the pelvis of the mother in a manner to interrupt the circulation, the delivery must be very quickly concluded or fatal asphyxia results. The navel cord may become entangled about one of the limbs or the head of the fetus, and the circulation thus be interrupted.

In one instance of asphyxiation in pigs, we observed upon post-mortem examination a firm clot of mucus occluding the glottis and causing, immediately after birth, difficult respiration accompanied by dyspnœic sounds.

It is only rarely that any efforts which the attending veterinarian may be able to exert will successfully overcome suspended animation due to asphyxia of the new-born. Usually the asphyxia has proceeded too far before the extraction of the fetus, and any

attempts at resuscitation will prove of no avail. If the heart still beats, there may be hope that the asphyxia can be overcome. The attendant should attempt to induce artificial respiration by such means as are at hand. In some cases, like those related above in the pig, there may be present in the larynx a clot of mucus, which should be removed. This mucus might be dislodged by drawing forcibly upon the tongue and then suddenly releasing it, and continuing this operation as long as may seem prudent. In the usual case of asphyxia, respiration may be favored by alternately compressing and relaxing the chest with the hands, or by extending the anterior limbs alternately forward and backward.

It has been suggested that a tube might be passed through the nostril and larynx into the trachea, and amniotic or allantoic fluids drawn off which have been inhaled prior to the expulsion of the fetus. Such suggestion is based upon an error. If the fetus has inhaled amniotic fluid before its expulsion, it will be very quickly absorbed from the lungs and will cease to act as an impediment to respiration almost immediately, and consequently need not be taken into account in any measures for inducing artificial respiration. Suspending the asphyxiated young by the hind legs tends to stimulate respiration by inducing cerebral engorgement with venous blood, and incidentally any fluids in the lungs may freely escape.

One of the most efficient means for inducing respiration is the alternating electric current, but unfortunately as a rule such apparatus is not at hand at the critical moment. In many instances a sharp blow upon the nose or other sensitive part tends to induce respiratory effort. It has also been suggested that dilation and irritation of the anus will tend to produce inspiratory effort. In a similar manner one may stimulate efforts at breathing by dashing cold water upon the skin of the animal. It has also been suggested that respiration be stimulated by the inhalation of ammonia fumes ; but the efficiency of this plan may well be doubted so long as no respiration is taking place, because the fumes cannot well be introduced into the nostril except with the aid of inspiration.

It has also been advised that the lungs be inflated by means of bellows, applied to one nostril while the other is closed ; but this is not necessarily effective, because the larynx may be closed

and the lungs fail to become inflated. If one would be sure of the introduction of the air into the lungs, it would be best to introduce it into the trachea, and close the nostrils and mouth so that it could not escape in that way. In some cases, where the larynx seems to be occluded and it is impossible to induce free breathing through that organ, it might be well to perform tracheotomy, until whatever obstruction existing in the larynx may be removed. Ordinarily tracheotomy of the newborn involves great danger of tracheal collapse later, and is accordingly to be avoided as far as possible, and, instead, an incision made through the crico-thyroidean liagament large enough to admit the operator's finger

2. Umbilic Hemorrhage.

Umbilic hemorrhage in the new-born animal is very rare. We have not had occasion to observe this accident in any case. Under normal conditions, when the umbilic arteries rupture they retract within the abdominal cavity, as shown in Fig. 56, and in so doing withdraw with them, in an inverted manner, the connective tissue surrounding them, and thus form a net-work of fibers, which serves to cause the blood to coagulate and make hemorrhage extremely improbable. The retraction of the arteries also causes a thickening of their walls, and a distinct decrease in their caliber, thereby so narrowing the lumen that it is exceedingly difficult for blood to escape from their divided ends. In addition to this, there is a general physiologic law that the blood pressure is decreased whenever the blood is no longer required by the tissues. Since the function of the umbilic arteries has ceased, the blood pressure within them becomes suddenly decreased.

Fleming states that hemorrhage may take place from these arteries in the foal, because they are firmly attached to the umbilic ring. After repeated autopsies, we have failed to find an instance where such was the case, except the umbilic cord had been ligated, and the arteries thereby held so firmly that they could not retract. In addition to this, when the cord is ligated it is usually divided at an abnormal distance from the umbilic ring, so that its retraction is difficult. In all foals which we have examined, where the navel cord had been allowed to rupture normally, the arteries had promptly retracted to the

position shown in Fig. 56, on page 337. Fleming admits that this retraction of the artery takes place in the ruminant. The only difference, so far as we are able to observe, is that the cord of the ruminant is so short that it ruptures during birth, and ligation is consequently excluded. In the foal, the cord is very long and does not spontaneously rupture so promptly. It consequently affords an opportunity for mischief-making by attendants, who may so fix the arteries with a ligature that they cannot retract.

Fleming claims that hemorrhage may occur from the umbilic vein in ruminants, because of the presence of the ductus venosus, although why this should predispose the animal to the accident is not made clear. Zundel claims that in some individuals a predisposition to umbilic hemorrhage exists. Fleming alludes to the possibility of hemorrhage occurring from the umbilic cord when the animal is several days old. Perhaps in this case he is dealing with secondary hemorrhage due to an infection of the artery, probably as a result of ligation of the cord without proper antiseptic precautions. It is claimed also that hemorrhage may be caused by the umbilic cord rupturing too close to the umbilic ring, though why this should be so does not appear.

A neighboring veterinary practitioner related a case to us of fatal umbilic hemorrhage in a foal, in which case the cord had been ligated and later excised. So far as could be determined, it seemed that the hemorrhage was the indirect result of the ligation. The artery had been caught and held by the ligature, but, since it was not bound sufficiently tight to prevent hemorrhage, remained stretched. The blood pressure was probably increased because of the ligation.

Whatever the cause of umbilic hemorrhage, such cause needs be removed if possible, in order to control the escape of blood. If the cord is too long, and perchance has been ligated, it should be divided at the proper point by scraping or tearing. In the foal, the point for division is about two to three inches from the umbilic ring. After the division of the cord, the Whartonian gelatine is to be pressed out and the arteries permitted to retract into the abdominal cavity, when hemorrhage must necessarily cease. If for any reason the artery does not retract, it should be separated from the surrounding tissues and carefully ligated under antiseptic precautions. Should hemorrhage from the

umbilic vein occur, it is advisable to search for the vessel and place a ligature about it. The ligation of the cord itself, as advised by some, is not sufficient, because the arteries or vein may not be included, as they may have broken at a point higher than that at which the ligature is applied. In such cases ligation would tend to favor, rather than prevent the hemorrhage, because it would simply prevent the blood from escaping from the amniotic covering of the cord, which has been converted into a sac by the ligature, and must eventually become filled with blood, causing the ligature to be pushed off.

In a general way we may best avoid umbilic hemorrhage by permitting the cord to rupture spontaneously, or by rupturing it at the proper point by linear tension, laceration or ecrasement. We should avoid dividing the cord by cutting.

3. Persistent Urachus.

Prior to the birth of the young animal, in all those which have an allantoic sac, the urinary bladder has two openings, one posteriorly through the urethra into the amniotic cavity, and the other anteriorly through the umbilic ring and urachus into the cavity of the allantois.

At the time of birth the narrow anterior canal, constituting a part of the umbilic cord, becomes ruptured, and under normal conditions behaves similarly to the umbilic arteries, and retracts with, or is retracted by the arteries, into the abdominal cavity. Thereafter the urine can escape only through the urethra. Somewhat rarely the urachus remains open after birth; how rarely is not clear. We have not personally observed this condition. It is probably very rare.

A more common condition is the re-opening of the urachus in cases of umbilic infection, owing to a destruction of the tissue which has occluded the ruptured end of the canal at the time of birth. This condition we have observed only in the foal. Fleming asserts that persistent urachus is most frequently observed in the foal, because the vessel is closely attached to the umbilic ring and does not become retracted. However, so far as we have observed, the urachus retracts promptly when the cord is ruptured, and does not protrude beyond the umbilicus except in those cases where the cord has been ligated and then excised.

Symptoms. The symptoms of perforate urachus may be divided into two groups, according to causes.

1. In cases where the urachus is for some reason abnormally open, or has become in some way abnormally divided, or if the meatus urinarius is constricted or absent, the young animal, in urinating, discharges a large part or all of the urine through the navel. If the urethra is closed, the entire amount must flow through the navel; while, if the normal passage is open, a part of the urine may flow from each opening.

2. When the urachus becomes secondarily re-opened, as a consequence of umbilic infection, the discharge of urine through the navel is not very great in amount, but dribbles away or flows in a very small stream during urination, and perhaps oozes somewhat continuously from the navel, keeping the region soiled, moist and fetid. In such cases the navel is inflamed, and may be swollen, or the patient may show well-defined symptoms of pyo-septhæmia or inflammation of the umbilic vessels. In these cases the foal or other young animal has remained apparently well for some days after birth, and no discharge of urine from the navel has been noted during this period. After infection of the umbilicus takes place, perhaps three to five days after birth, the dribbling of urine from the navel appears. This condition is by no means a rare one in foals, and in our observation has been most frequently seen when the cord has been ligated and cut long, causing the stump to undergo putrid decomposition and the urachus to re-open.

Handling. The method of handling pervious urachus must be based primarily upon its cause. If the opening is present at the time of birth, it must be regarded as a menace to the health of the patient, because it invites infection of the umbilicus by keeping the stump of the cord constantly moist and preventing its dessication. If it is due simply to an abnormally large or inefficient urachus, it may be closed by applying to the part dessicating and astringent antiseptics, which, at the same time, guard the umbilicus against infection.

If the pervious urachus is dependent upon an imperforate urethra, the urachus must on no account be closed until the urethra has been satisfactorily opened, since otherwise a rupture of the bladder or other serious result must necessarily ensue.

When the urachus becomes re-opened as a consequence of

umbilic infection, its handling must necessarily be based upon disinfection of the part. If we can accomplish the disinfection by means of astringent remedies, we may aid materially in overcoming the difficulty. The prognosis in these cases must be based upon the severity of the umbilic infection, and follow the general prognosis of that malady.

The prognosis of persistent urachus, in general, must be based upon its cause. If due to an imperforate urethra, the prognosis will be dependent upon the possibility of overcoming the urethral atresia. In one case, recently brought to our notice by a neighboring practitioner, the urachus was still open in a colt aged one year, and efforts to close it surgically, failed.

Retention of the Meconium.

During fetal life there accumulates, in the intestinal tube, a mixture of epithelial debris and secretions from the glands connected with the alimentary tract, especially from the liver, which excrement is largely retained within the alimentary canal until birth, though some of it is frequently found floating in the amniotic fluid. The appearance of meconium, in color and consistency, varies somewhat according to species and individual. It usually varies in color between yellow and a dark green or greenish-black. In most new-born young, the meconium occurs as a pasty mass, but in the foal it is frequently hard and dry, and moulded into pellets by the floating colon and rectum. The mass is found chiefly in the rectum and floating colon, but may occupy the entire large colon and the cæcum.

Since the meconium in most animals occurs in the form of a pasty mass, it is usually promptly expelled by the new-born without difficulty, and leads to no complications. In the foal, where it is hard and dry, it is not infrequently retained, and may induce more or less serious disease, which, if not promptly and efficiently handled, may lead to the death of the animal.

Causes. Some claim that retention of the meconium usually occurs in foals which are weak or poorly developed, but this we have been unable to wholly corroborate, and have found it in foals which to all appearances were strong and vigorous at the time of birth, and would presumably have continued so had proper oversight been given them at the time. In our expe-

rience it has appeared that retention of the meconium is most common in foals whose mothers have been kept continuously stabled and upon dry food prior to parturition. Mares which are regularly exercised, enjoy the freedom of the pasture, or are judiciously worked, as a general rule give birth to foals which do not have difficulty from retained meconium. It has been asserted that retention of the meconium is usually caused by the failure of the young animal to secure the colostrum or first milk, but this cannot properly be held, since the condition exists at the time the fetus is born, so that the colostrum could only act as a curative agent and not as a preventive.

Symptoms. The symptoms of retention of the meconium appear very soon after birth, within 10 to 20 hours, but may be so slight as to escape observation by the owner until some time later. Usually within 24 hours after birth, very evident symptoms of illness appear, consisting fundamentally of intermittent colic, with the general symptoms of impaction of the large colon. These consist chiefly of stretching, or standing in a position of extension, with the hind limbs extended far backward, the anterior limbs forward, and the back depressed much as if the animal were attempting to urinate ; but the position differs from that attitude in that the hocks are not flexed and that there is no real effort being made to urinate. A close watch will develop the fact that there is straining, as if to expel something from the abdominal cavity, but the impaction of the hard, dry meconium in the rectum prevents its walls from contracting, and hence the actions of the foal are wanting in the definite symptoms of an attempt at defecation.

The colic present may be of any degree of severity. Usually it is quite mild at the beginning. The young animal will look at its flank and kick at the abdomen with its hind feet, will lie down and roll, and show a strong tendency to attempt to balance itself upon its back. After lying for some time it will get up, looking bright, and perhaps go to the teat and feed with an apparently normal appetite for a little time. It will then let go the teat and resume its stretched condition, perhaps standing in this attitude for 10 to 20 minutes at a time, occasionally looking somewhat anxiously at its flank ; it may then lie down and roll again. Thus the symptoms may change more or less rapidly

between the stretching, or rolling as in colic, and the bright intervals when the foal again sucks.

In one instance observed by us, in addition to these general symptoms there was a morbid appetite, which led the young foal to devour quantities of hay and straw, which added very much to the intestinal obstruction.

The symptoms above related are characteristic, and in themselves are well-nigh diagnostic, especially the peculiar stretching with the dropping of the back when the animal is standing. In almost all cases the diagnosis can be readily and completely verified by inserting the index finger into the anus, where the hard pellets of meconium are readily felt and recognized.

In foals, especially those of value, the caretaker should observe the new-born animal closely, and see that the meconium is expelled within an hour. Should such expulsion not occur, the caretaker should at once take measures to bring it about. The best means for this is enemas of warm water, to which some soda bicarbonate or 1% of common salt has been added. Solutions of soap or other irritants should be carefully avoided, as they cause straining by the pain which they induce. It is not straining that we wish to accomplish by the enema. Instead, it is desired to soften and macerate the dry pellets so that they will be easily expelled, and to this end it is important that only a small amount of a bland liquid shall be gently introduced into the rectum at a given time. We have usually found that one pint of the liquid at a time is ample, and sometimes even less should be used. The amount should be so gauged that the little patient will not throw it out immediately, but that it will remain in the rectum for some time in order to accomplish the maceration desired.

Care should be taken, in administering enemas, to avoid injuring the anus or rectum. It is especially desirable to avoid using a large metallic or wooden nozzle upon a syringe, because when the intestine is so firmly impacted with dry pellets of meconium there is constant and serious danger of the rigid nozzle gliding to one side and rupturing the intestinal wall, inducing a fatal lesion. It is preferable to use some other apparatus than the ordinary enema syringe. A very convenient implement is the ordinary bulb syringe, or the fountain syringe used in households. Sometimes it is desirable to introduce the enema deeply

into the intestine. For this purpose an ordinary soft rubber horse catheter may be passed into the intestine as far as possible, and the end fitted upon a syringe, or a small funnel may be inserted into the catheter and elevated sufficiently that fluid poured into the funnel will gravitate into the intestine. If the catheter is used, it may be possible to pass it gently along the wall of the intestine, and, by keeping the fluid flowing through it, to push it beyond the pellets of meconium, so that the fluid is deposited behind them, insuring their being forced out at the first expulsive effort. In some cases we have supplanted the normal salt solution or soda bicarbonate solution with warm cotton seed, olive, or raw linseed, oil.

Complementary to the enema it may be advisable to administer cathartics. The choice of cathartics may vary with circumstances. If the case does not seem at all urgent, a bland oil is the best. An ordinary foal may be given 2 ounces of castor oil, or 4-ounce doses of raw linseed, cotton seed, or olive, oil. In other instances the practitioner may not feel disposed to await the slow action of oil, and may resort instead to the hypodermic cathartics in small doses, such as eserine sulphate or arecoline in doses of 1-20 to 1-12 grain, which may be repeated in 30 to 45 minutes.

But with all this treatment, if the case has been neglected, it may be impossible to dislodge the pellets. They may be tightly impacted for a considerable distance along the rectum and floating colon. In one neglected case in our clinic, we could recognize the pellets of meconium, which completely blocked the rectum, at a distance of 12 inches from the anus. The hard pellets could be clearly felt with an ordinary gum horse catheter. The liquids injected directly against the obstruction were all to no purpose. Eserine failed to cause the expulsion of the meconium. The foal eventually perished, apparently from toxæmia, since there was no enteritis present upon post-mortem examination. The conditions presenting themselves upon post-mortem examination, in this one case, suggested that, had we performed laparotomy and grasped the intestine, the pellets of meconium could have been pushed backward and finally forced out, or the intestine might have been opened and the pellets thus removed. But, in our experience, if the case has prompt attention no such operation is demanded, and ordinarily the case is easily handled.

Some practitioners have devised and recommended meconium extractors, such as shown in Fig. 150, with which they have claimed good results. In default of these, a wire loop could be tried. We have observed but the one case which could not be relieved by enemas and oil.

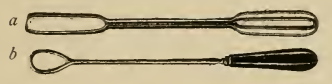


FIG. 150.
MECONIUM EXTRACTORS.
a, Meconium extractor of Masch.
b, Meconium extractor of Mensik-Babolna.

In the handling of retention of the meconium, it is important always to determine when the difficulty has been fully and completely surmounted. The expulsion of more or less meconium does not indicate that the difficulty has been completely overcome. The full accomplishment of the object has been only certainly attained when all the pellets have come away and there has been expelled some soft, pasty meconium. Whether looking at the affection from a preventive or a curative standpoint, our efforts should not be relaxed until we are fully assured that all pellets of meconium have been expelled.

ANATOMICAL DEFECTS OF THE NEW-BORN.

In tracing the history of the development of the embryo and fetus, we have had occasion to remark the occurrence of deviations from the normal course of development, which serve to render the animal abnormal at the time of birth. In many of these cases the aberration from the normal is so great as to cause what are known as monstrosities, in which case the young animals are born so faultily developed that they usually perish immediately, or if they live, the deformity renders them useless, and they are consequently destroyed. The consideration of these belongs to the domain of teratology, and, as such, are of very great scientific interest.

Quite frequently there exist, in new-born animals, various deviations from the normal, insufficient to immediately compromise life, which may be spontaneously overcome, may be curable by surgical procedure, or may persist, and the animal yet be able to perform its functions without very great inconvenience.

This group of minor deviations should be duly considered at the time of the birth, and handled according to the outlook for the ultimate value of the defective animal. It should be determined whether, by any means, the defect can be overcome, and to what extent its persistence will destroy the usefulness of the animal. If it is irremediable, and its persistence destroys the value of the animal, it is highly important, in the interests of economy, that the patient should be at once destroyed. Still more important is the relation of these defects to the question of hereditary transmission. The majority of them tend strongly to become fixed as hereditary defects. Such animals show a constant tendency to reproduce their own defects in their progeny, even though artificially or spontaneously cured. Such animals are consequently unsuitable for breeding purposes.

These defects accordingly assume a highly important place in the breeding of animals, whether viewed from the standpoint of surgery or of zoötechnics.

1. Umbilic Hernia.

Exomphalus. Omphalocele. Navel Hernia.

Umbilic Hernia consists of the non-closure of the umbilic ring in the abdominal floor, while the skin closes over the region in

the normal manner. In tracing the development of the embryo on page 558, we noted that the somatopleur folds ventralwards and finally unites upon the median line, to constitute the umbilicus, through which normally pass the allantoic stalk, including the allantoic or umbilic arteries and veins, the urachus, and the yolk stalk, surrounded by the amnion.

During the earlier periods of fetal life, the abdominal cavity is comparatively small, while the abdominal viscera are so voluminous that there is not sufficient room within the cavity to accommodate them. They consequently press, or grow outward through the wide umbilic ring into the navel cord, so that, in fetuses of an early age, a large part of the intestinal mass, omentum, and liver, may lie outside the abdominal cavity, lodged in the umbilic cord. As the fetus develops and approaches maturity, the abdominal cavity increases in size, while the umbilic ring gradually contracts, until finally the opening becomes virtually occluded and the margins of the ring adhere closely to the umbilic vessels. For reasons unknown to us, the normal closure of the umbilic ring may not occur, and when the young animal is born there persists a variable-sized opening through the abdominal floor, usually elongated from before to behind as an oval slit, wider at the anterior end. In some cases the opening is almost circular in form. The diameter of the opening may vary from so small a size as to be barely distinguishable, up to six or eight inches. The resulting hernial sac corresponds in size.

The defect may be present in any species of domestic animals, though it attracts the most attention, and perhaps is most frequent, in foals, pigs and puppies.

Some writers recognize a congenital and acquired umbilic hernia. Only the congenital defect is of interest to us. Some writers have claimed that an acquired or accidental umbilic hernia may be caused by severe muscular exertion of the newborn animal, in running or playing, but we find no records of cases in our literature to substantiate the correctness of such a view, and have not observed such an occurrence in actual practice. We have observed from time to time that umbilic herniæ, which were comparatively inconspicuous at the time of the birth of the young animal, later became more conspicuous, and were increased in size to such a degree as to attract attention. When umbilic hernia exists at the time of the birth, anything which

may increase the intra-abdominal pressure, such as severe expulsive efforts due to the retention of the meconium, or to constipation of the bowels, may cause a marked increase in the size of the hernial sac. The same increase in size may be caused by the allowance of large quantities of bulky food.

Fleming cites Zundel and others in support of his belief that environment, and especially the character of food, tends to induce the disease. He believes that the young of animals kept upon low and marshy pastures, or subsisting upon soft, luxuriant herbage during a rainy season, are especially subject to herniæ.

The majority of writers, with whom we are in full accord, consider the defect to be chiefly hereditary. We have repeatedly observed the strong hereditary tendency of this defect. In one instance a client purchased an imported French draft stallion for service in a valuable stud of pedigreed draft mares, in the progeny of which, umbilic hernia had previously been unknown. The first crop of foals showed about 50% of umbilic herniæ. The stallion was promptly sold, and umbilic hernia did not recur the following season or thereafter. We have noted the same hereditary tendency among swine, where a farmer has been careless in the selection of his breeding animals. In some cases we have observed an entire litter of pigs affected with herniæ. It is interesting to note that, in the pig at least, umbilic and scrotal hernia seem to be interchangeable, so that, in a given litter of pigs, males may suffer from scrotal or umbilic hernia indifferently, or even from both, while the females show only the umbilic defect.

Symptoms. There is present, at the umbilicus, a tumor, which may be either spherical or pyriform or may be more or less elongated from before to behind. The size of the hernial ring varies greatly according to species and individual. In the puppy it may be ½ to 1 inch in diameter; in the foal 1 to 6 inches in diameter.

The character of the tumor, as revealed by palpation, necessarily depends upon the contents of the hernial sac, and the question of their incarceration or freedom to return into the abdominal cavity. The contents of the hernial sac usually consist of portions of intestine containing liquid feces, or of portions of the omentum. Except these become incarcerated, a soft, fluctuating tumor results, which is usually readily pushed upward into

the abdominal cavity, rendering the hernial ring easily recognizable by palpation. Usually there is no pain upon pressure or manipulation. If the young animal is turned upon its back, the tumor usually disappears spontaneously. If the animal is caused to struggle, or its nostrils be closed for a time so as to cause severe respiratory effort, or it is made to cough, the hernia temporarily increases in size.

In some cases the intestine occupying the hernial sac may contain hard, firm masses of feces, which render the hernia hard and firm. Such fecal matter is not readily pushed through the ring into the abdominal cavity.

The contents of the hernia may become incarcerated or strangulated, and induce thereby symptoms differing very materially from those which have already been described. If the hernial contents consist of intestines, and strangulation occurs, the tumor at once becomes very tense and hard, and is more or less enlarged as compared with its previous condition, and the animal shows severe pain, expressed by violent colic. The hernia may also be sensitive to the touch.

When the hernial contents consist of omentum, and it becomes incarcerated, the tumor becomes tense and indolent, cannot be reduced, and induces no pain upon palpation.

Diagnosis. Though umbilic hernia is not liable to become mistaken for other diseases, it should be borne in mind that there are possibilities of error in diagnosis. In one instance we attended an umbilic hernia complicated by the presence of umbilic fistula from infection at the time of birth. The enlargement present was attributed to the chronic infection alone. In opening the fistula we punctured the peritoneal wall of a small hernial sac, and caused a prolapse of the omentum. Abscesses may occur at the navel as a result of infection, and may lead to diagnosis of hernia, but the abscess is irreducible, and may readily be tested, in cases of doubt, by aspirating with a hypodermic syringe. It is virtually impossible to differentiate between an uncomplicated hernia of the intestines and hernia of the omentum ; nor is the differentiation of any great practical value. Strangulated umbilic hernia of the intestines is recognized by the hernial colic, the irreducibility of the hernia, and the firm, hard character of the tumor. Incarcerated umbilic hernia of the omentum, occur-

ring chiefly in pigs, is recognized by the firm, irreducible tumor, unaccompanied by inflammation or pain.

Prognosis. The prognosis of umbilic hernia is favorable. Many cases, especially small herniæ in foals, recover spontaneously, and the others may be surgically overcome with comparative certainty and safety. If left undisturbed, umbilic herniæ rarely become incarcerated or otherwise interfere with the well-being of the animal. If the hernial ring is small, when the animal develops and the intestines increase in size, they can not pass through the opening. If the hernial contents consist of omentum, when the animal grows older, the omental expanse becomes comparatively retracted and no longer reaches the open umbilic ring. Although the ring may persist throughout the life of the animal, the hernial sac no longer becomes filled and is not noticeable. The greatest loss attributable to the defect, is the decreased value of pedigreed animals for breeding purposes, because of the well-marked tendency to transmission.

Treatment. Umbilic herniæ in young animals disappear spontaneously so often that, in all cases where the hernial ring is very small, an opportunity should be given for a spontaneous recovery. However, when the hernial ring is large, such a result cannot be reasonably anticipated, and it becomes desirable to use some means for overcoming the defect, except in those cases where the animals are intended for early slaughter, where handling may well be ignored in most instances. Before undertaking any operative treatment, it is desirable that the young animal shall have acquired some age and considerable vigor. It is generally preferable to postpone a radical operation until the animal is two to four months of age. However, it should not be too long delayed, because as the animal grows larger it is somewhat more difficult to handle. When fatalities from an operation occur, the loss becomes greater to the owner in proportion to the age of the animal. The chief plans of handling include :

a. **Bandages.** Many writers have advised the application of a bandage or truss for the cure of umbilic hernia, apparently somewhat in imitation of the human surgeon. For this purpose a wide girth or surcingle is applied about the body, over the umbilic ring, and maintained in position by straps or bands. In a general way these bandages are similar to the Sohnle apparatus, Fig. 149, page 1019. One or more straps pass forward

between the fore legs, and are attached to a band about the neck. Along the back, the position of the bandage is maintained by a back-strap, which extends forward to the neck-band, and backward to terminate in a crupper. Bandages or trusses are constructed in great variety, but they all depend upon the common principle of compression of the umbilicus in such a manner as to push the intestines upward, toward or into the abdominal cavity, assuming that, in the meantime, the hernial ring will close and retain them there.

Those who recommend a truss claim that it requires from two to three months to effect a cure. Even then it is not perfectly clear that a large proportion of the alleged cures may not have taken place spontaneously. It is to be constantly remembered that the truss or bandage cannot keep the intestine or other hernial contents within the abdominal cavity, but can only press them upward as far as the bandage pushes the walls of the hernial sac, leaving the hernial contents lying in the hernial ring. This tends to keep the ring open. If there is a projection upon the bandage, by which means the contents are pushed up into the abdominal cavity completely, the projecting portion of the apparatus is pushed into the hernial ring, and, in its turn, keeps it open and prevents healing.

Serious objections to the truss are its expense, when well constructed, and the long period of time during which it must be kept applied in order that it may induce a cure. The apparatus requires much careful watching and oversight on the part of the owner of the animal, since it needs be readjusted frequently, because the abdomen is constantly changing in size according to the amount of food taken. A very formidable objection, also, is the question of injury and annoyance to the young animal. Its skin is tender, and great care is necessary to avoid galling and other injuries from pressure or friction.

It must be constantly borne in mind that the veterinarian has no such opportunity for the efficient application of the truss as has the human obstetrist. The patient of the veterinarian either stands with the body horizontal, with the entire intestinal mass resting directly upon the hernial ring; or, when lying down, it usually remains in the sternal position with the weight of the intestines still upon the defective part. The human practitioner may keep his patient constantly upon the back, so that the ab-

dominal viscera do not bear upon the part. When the hernial ring is very large, hope of a cure, through the agency of a bandage, is virtually excluded from the first.

b. **Topical applications** have been used for decades, for the cure of umbilic hernia. Various substances have been used for this purpose, among which may be prominently mentioned the application of the mineral acids, either sulphuric or nitric. The intent is to cause dry gangrene of the skin and hernial sac by the application of the acid thereto ; and, by causing an intense local inflammation with much swelling, to induce closure of the hernial ring. For this purpose, sulphuric or nitric acid is applied over the hernial sac, by means of a glass rod, until the skin has been well saturated and an extensive necrosis of the tissues is assured. Prior to the application of the acid to the skin, the hernial sac may be shaved or clipped. The acid needs be applied quite liberally, in order that the death of the skin shall be complete and the resulting swelling extensive ; otherwise a cure is not certain, or even probable. Lafosse recommends the use of 24 to 32 grammes of nitric acid, applied over the whole surface of the hernial sac, followed by friction, to be continued for three to five minutes. The nitric acid usually needs be applied but once in order to produce the desired result, but, if the first application fails, it may be reapplied in about 15 days.

Zundel highly recommends this plan, although he admits that it is sometimes followed by accidents, the most serious of which is an extensive sloughing of the hernial walls, which finally involves the peritoneum and permits the intestines to become prolapsed through the opening. Reynal has seen peritonitis following nitric acid cauterization, and Lafosse has observed tetanus as a result. Hertwig prefers sulphuric to nitric acid, and applies it in lines with a glass rod, twice daily until four applications are made. He sometimes added an application of turpentine and oil to the part, in order to increase the amount of swelling and edema.

Other irritants have been used and recommended in the treatment of this defect. Like the mineral acids, they are intended to induce an intense local inflammation and swelling, by which means it is hoped to block up the open umbilic ring. Blisters of various kinds act in this way. Some veterinarians have practiced hypodermic injections into the walls of the hernial sac, near to the hernial ring, of irritants of various kinds, such as

oil of mustard, concentrated solutions of salt, and spirits of turpentine. Great care should be taken not to inject the irritants into the peritoneal cavity, as such an error would be exceedingly dangerous.

c. **Ligation.** In umbilic hernia, where the ring is very large, there is little if any hope of succeeding by either of the previous methods. Consequently some method must be applied for bringing the margins of the hernial ring into close apposition, and retaining them in contact until they become adherent. This usually involves the destruction of the hernial sac. Numerous methods have been introduced for bringing this about, one of the oldest and crudest of which is the ligation of the entire hernial sac at its base, so tightly as to cause its death and sloughing away. Such a ligature, if well applied, decreases greatly or closes the hernial ring, by the tension exerted upon the walls of the hernial sac and the surrounding tissues. For the application of such a ligature, the patient is secured upon its back, and the hernial sac is firmly grasped. After the contents have been safely returned into the abdominal cavity, the sac is drawn up tightly, and the neighboring skin and skin muscle are brought together in such a manner as to tend to draw the margins of the umbilic ring nearer to each other. Then, around the base of the hernial sac, a stout ligature is tighty applied. The ligature may consist of a strong silk or linen cord, in harmony with the size of the hernia, or of an elastic ligature which may act more promptly than the others. The latter does not need tightening, because its elasticity causes a continuous compression until the tissues become destroyed and the sac sloughs away. If there should appear to be any doubt about the security of the ligature, a suture or a skewer may be passed through the hernial sac below it, and any danger from its slipping thus obviated.

The results from ligatures have not generally been satisfactory, and the method has largely fallen into disuse. They are uncertain in their action; they may cause a very tardy slough; the hernia may reform before the sac is completely destroyed; or a very rapid necrosis may occur, resulting in prolapse.

d. **Clamps** have been recommended very highly, by some practitioners, in the treatment of umbilic hernia. They do not differ materially, in their general character, from the clamps used in castration, and their application is upon a similar princi-

ple. Various types of clamps are listed by veterinary instrument makers, based upon the recommendation of practitioners who have used them and found them satisfactory; but no one possesses any special advantage, and the practitioner may readily make clamps from a stick of wood which will answer all essential purposes. The clamps are applied essentially the same as the ligature. The animal is secured upon its back; the contents of the hernial sac returned into the abdomen; the sac firmly grasped; and the clamps applied antero-posteriorly, as close to the abdomen as possible, and fixed very tightly so as to cut off the circulation from the sac and cause its death.

Two dangers confront the practitioner in the use of clamps. Some have found that, as with the ligature, the clamps may cause a very rapid gangrene, with consequent early sloughing and protrusion of the intestines. In our own experience we have found the clamps inefficient. After having applied them as close to the abdominal floor as possible, and secured them very tightly, we succeeded in producing necrosis and the destruction of the entire hernial sac. However, while this was going on the intestines were constantly pressing through the hernial ring, so that, when the sac, which had been included between the clamps, had completely sloughed off, it was found, to our disappointment, that the weight of the intestines from above had pushed the skin downward and a new hernial sac had formed, which, though somewhat less in size, was just as objectionable as the original defect and required further surgical attention.

If clamps are to be applied, the operation should be carried out under antiseptic precautions, the area shaved and disinfected, and either general or local anæsthesia induced. The hernial sac is to be grasped, drawn out as far as possible, and the clamps applied close to the ring, including all the tissues which can be drawn into them. The clamps are then to be closed by means of forceps, and secured with a cord. An abundance of antiseptic cotton or gauze is then to be packed about the clamps and over the incarcerated sac, and over this a strong bandage is to be placed, and well secured in position in such a manner that it will hold the clamps tightly against the umbilic ring. By so doing, the hernial sac is held against the ring, and the inflammation caused by the necrosis of the sac induces inflammatory adhesion and closure of the hernial ring.

Strict antisepsis should be maintained, and the necrotic hernial sac prevented from decomposing or becoming harmfully infected. Usually the necrotic sac drops away within seven to ten days. The atresia of the hernial ring may be furthered and rendered more secure by the continuance of the supporting antiseptic bandage for a few days after the necrotic sac has dropped away.

e. **Sutures** constitute the most radical, and, in our hands, the most satisfactory method for handling umbilic hernia. The sutures may be applied by a great variety of methods.

In very large herniæ it is best to open the hernial sac freely, under general anaesthesia and strict asepsis, and, after denuding the margins of the hernial ring, to pass strong sutures through the margins of the ring and forcibly draw them together. In one instance in our clinic, a yearling filly had an umbilic hernia, the oblong ring of which measured approximately 4 by 8 inches. The animal was secured in the dorsal position upon the table, and anesthetized. With the aid of two assistants, the hernial sac was opened from end to end under strict aseptic precautions. By means of a strong needle, sutures were passed through the skin and other tissues into the muscular walls of the abdomen, and then carried across from one margin of the ring to the point opposite, where they were finally brought out through the skin on the opposite side, some distance from the margin of the hernial ring. The suture was then returned in the opposite direction, at a distance of about ½ inch, a piece of rubber tubing passed between the closed end and the skin, and a second piece of tubing laid between the two free ends, which were now tied and drawn sufficiently tight to bring the two margins of the ring into immediate contact.

A series of these sutures was applied, sufficient in number to thoroughly close the entire hernial ring from end to end, thus constituting essentially a quilled suture. The hernial sac was excised, and the margins of the skin brought together by ordinary interrupted sutures. A broad bandage was then passed around the body of the filly, and a large antiseptic pad securely attached to it, pressing upon the operative area. The pad of absorbent cotton was saturated several times daily with 1-1000 corrosive sublimate solution. There was little reaction from the operation, and the suppuration in the wound was trivial in

amount. After about two weeks the sutures were removed, and the animal was discharged, completely cured.

In other cases, where the hernia was not so large, we have operated by cutting a hole into the hernial sac, through which an index finger is passed in order to constitute a guide and insurance against the wounding of the viscera. A heavy needle, armed with a strong suture, is then inserted into the skin at a distance of two or more inches to the right or left of the margin of the hernial ring, and carefully guided through the abdominal muscles of the one side, and across the hernial ring, to penetrate the abdominal muscles on the other side of the ring, and through the skin, to emerge some distance from the hernial ring. The needle is then reversed, and thence returned at a distance of about ½ inch from the point of beginning, where the two ends are tied as in the preceding case. Other sutures are added until the ring is completely closed, as determined by digital examination.

In small umbilic herniæ a modification of this suture has been used by us, with very satisfactory results. The animal is secured upon its back, and the area is shaved and disinfected. The hernial contents are returned into the abdomen, and the hernial sac grasped with one hand and drawn out as far as possible. The hernial sac is then firmly grasped from side to side, between the thumb on one side and the fingers on the other, and the walls brought tightly together. In small herniæ, if as much as possible of the skin on either side is grasped in this manner, and the two sides brought together, the operation also draws the margins of the hernial ring together. A needle armed with a heavy silk suture is inserted immediately against the thumb and finger, between them and the abdominal floor, so as to avoid any danger of wounding the intestine, and is forced through to the opposite side as shown in Fig. 151 A. Grasping the hernial sac anew, and reversing the needle and inserting it about ½ inch from its point of emergence, the operator carries it back to the opposite side parallel to the first suture, and ties the two ends together, as indicated in Fig. 151 B, so tightly as to close the hernial ring.

A second suture is now inserted in the same way, at a point about ½ inch distant from the first, and the series of sutures is continued until a sufficient number have been inserted to prevent the escape of the hernial contents between or beyond the sutures. Care is to be taken that at either end the sutures extend beyond

the hernial ring, including all of the hernial sac, thus excluding the possibility of the intestine slipping out from behind or in front of the sutures. By this method the hernial sac does not become necrotic, and is not destroyed if the operation has been carried out under strict antiseptic precautions. Under this plan,

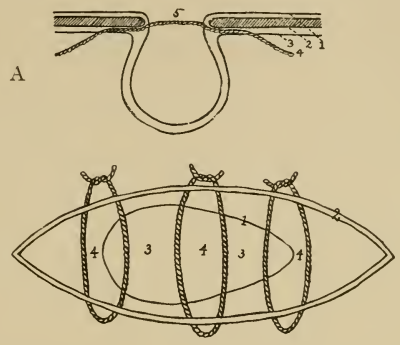


FIG. 151. DIAGRAMMATIC ILLUSTRATION OF SUTURES FOR UMBILIC HERNIA.

A, Cross section through the hernial ring and sac, showing relations of suture to hernial parts. 1, Peritoneum ; 2, Muscles of abdominal floor ; 3, Skin and subcutaneous tissues ; 4, Suture ; 5, Hernial opening.

B, Diagram of hernial ring viewed from below, with hernial sac cut away to show plan of sutures. 1, Hernial ring ; 2, Margin of the skin where hernial sac has been cut away ; 3, 3, Areas between the sutures in which the hernial sac is not strangulated ; 4, 4, 4, Areas in hernial sac which are included in the sutures but which still receive a vascular supply from areas 3, 3.

according to our experience, the hernial ring closes more surely than with strangulation and necrosis of the hernial sac, and any risk from rapid or extensive sloughing is excluded. A broad, many-tailed bandage is applied around the body, and an antiseptic pack is applied over the operative area and repeatedly saturated with antiseptics until danger from infection has passed. The bandage is kept in place for five or six days, and the sutures are left in position for three weeks or longer, when they are to be

removed. The hernial sac remains as an empty pouch, but after a time this tends to disappear spontaneously, or may be clipped off.

Others apply sutures in such a way as to constitute essentially a multiple incarcerating ligature, causing the entire hernial sac to become necrotic and slough away. This plan has little if any advantage over the simple ligature.

Ligatures, clamps and sutures have the common danger of infection, which should be avoided by the application of strict antisepsis. While it is essential that strict precautions be taken preliminary to and during the operation, it is just as important that the resulting wound be handled according to antiseptic methods. Thus, whether we use the ligature, clamps or sutures, an antiseptic dressing should be applied to the area of operation, and the part should be maintained in an antiseptic state from the completion of the operation until danger from infection has been safely passed, which is usually after about one week.

When an intestinal umbilic hernia becomes strangulated, radical measures should at once be taken to bring about a cure. It is first essential to relieve the strangulation, which may be done in some cases by securing the animal upon its back and carefully manipulating the hernial contents, so that they may be pressed back into the abdominal cavity. This process may be greatly favored by general anaesthesia. If the contents of the intestines are liquid, the incarceration may be overcome by aspirating portions of the fluid contents by means of a hypodermic syringe or a small trocar, after which the prolapsed intestines may usually be readily returned. If these measures fail, the hernia should be cut down upon, the ring dilated by cutting, the strangulated viscera returned, and the margins of the hernial ring brought together by sutures, such as we have described above.

When there exists a hernia consisting of omentum, and it becomes incarcerated, the death of the strangulated portion produces no general symptoms, but the hernial tumor becomes rather hard and unyielding. By such means, the hernia becomes spontaneously obliterated, but the tumor remains. This condition we have observed in several instances in the pig. The condition is not a serious one, and its only significance is the blemish, which can readily be removed by opening the hernial sac and excising the necrotic omentum, after which the ring and sac are to be closed under antiseptic precautions.

2. Scrotal Hernia. Inguinal Hernia.

Scrotal or inguinal hernia may exist in any new-born domestic animal, perhaps most frequently in the foal and pig, rarely in ruminants and carnivora. Inguinal hernia is virtually a defect of the male, though very rarely it exists in the female. As shown in Fig. 57, page 338, there exists, early in fetal life, the internal inguinal or abdominal ring, through which passes the gubernaculum testis from the scrotum to the testicle. Later, as the male animal develops, there occurs an evagination of the peritoneum, the processus vaginalis, through the inguinal ring into the scrotal pouch, and the testicle ultimately descends, until finally the evaginated portion of the peritoneum forms the external or parietal layer of the scrotal peritoneum.

As already related on page 336, the descent of the testicle occurs at a variable period of time, controlled largely by species. In solipeds and ruminants, as well as in swine, the glands are usually in the scrotum at the time of the birth of the young animal. In some cases the inguinal ring in the fetus is abnormally large, and the intra-abominal pressure during early fetal life may cause portions of the viscera to be forced out through the ring, and, remaining there, prevent the latter from normally closing, or narrowing to such a degree as to prevent the escape of viscera from the abdominal cavity. In all domestic animals, the inguinal ring normally remains pervious throughout life, and consequently inguinal hernia does not depend upon the abnormal existence of an opening, but merely upon its abnormal size.

In new-born foals, especially among the draft breeds, scrotal hernia is very common at birth, but is usually of a temporary character, and spontaneously disappears. However, this does not always occur, and in some instances the internal inguinal ring is excessively large, so that portions of viscera protrude through it, which, by their weight, tend to render the abnormal dilation of the ring permanent and to cause the hernia to persist throughout the life of the animal unless surgically handled. In the pig, scrotal hernia is quite common, and usually tends to remain permanent unless surgical interference takes place.

The size of the hernial ring shows every possible variation. We have observed, in the foal, an internal ring four or five inches in diameter, through which virtually all the abdominal viscera,

which were not too closely retained by mesentery, dropped out into the hernial sac, descending to the level of the hocks. Such conditions inevitably persist unless surgical relief is applied, and the size of the hernia tends to grow, rather than decrease. It is not rare to see a stallion with a scrotal hernia extending down to the hocks, and with the internal ring so large that the veterinarian may pass his hand through the rectum, into and through the hernial ring, covered by the intestine, and down into the scrotal sac. The contents of the hernial sac may consist of either intestine or omentum.

The symptoms of scrotal hernia in the new-born are usually very apparent, and consist essentially of an increased size of one or both halves of the scrotum. Upon manipulation, it is usually found that the herniated intestine or omentum can be readily returned into the abdominal cavity, especially if the patient is placed upon its back. After the contents have been returned, the enlarged ring can be discovered by digital exploration.

Strangulation, or incarceration, of scrotal hernia is very rare in new-born animals. We have noted but one instance in a young animal, which occurred in a foal, some weeks of age. When strangulation occurs, the ordinary symptoms of strangulated hernia appear, consisting of severe and constant colic, with sweating and trembling. The volume of the hernial contents is increased ; the sac is tense, firm and painful.

The course and termination of scrotal hernia vary, according to species and the size of the hernial ring. In most animals scrotal hernia tends to persist, and to increase rather than decrease in size, as the patient grows older. In the foal, when the scrotal hernia is small, it tends to disappear spontaneously with age. In probably 90%, or even more, of foals born with scrotal hernia, the defect becomes spontaneously remedied, so far that they may be safely castrated by the open operation when one year old. The contents of scrotal hernia very rarely, if ever, become adherent, except because of some ineffectual surgical handling.

The defect is markedly hereditary, and its existence in the young animal serves to render it of diminished value for breeding purposes. In the foal, it has yet another significance, from a clinical standpoint, in that, even though the defect may be apparently overcome in a spontaneous manner, it may yet

lead to serious or fatal accident in later life. If such an animal is castrated after apparent recovery, without unusual precautions having been taken, protrusion of the omentum, or still worse, of the intestine, is liable to occur, and lead to serious or fatal results. If the animal is retained for breeding purposes, it may, at any time after reaching adult life, suddenly develop strangulated hernia, owing to some accident or exertion which may cause a sudden increase of the intra-abdominal pressure, such as jumping, rearing, or copulating with a mare.

Handling. Since scrotal hernia in the foal usually recovers spontaneously during the first year, a reasonable opportunity for such recovery should be advised. If, however, the hernia is very large or tends constantly to increase in size, or if it threatens to become strangulated, a radical operation for its cure should not be long delayed. The new-born foal is usually wanting in the desired vigor to withstand such an operation, and whenever practicable the veterinarian should postpone surgical interference until the foal has acquired strength and the tissues have developed increased powers of resistance.

The surgical handling of scrotal hernia consists essentially of the removal of the testicle, and the closure of the ring or of the inguinal canal. The most common and preferable operation is that of "covered" castration. The animal is cast and turned upon its back. In case of the foal, general anaesthesia should be induced.

Under thorough antiseptic precautions, the skin and dartos are incised down to the cremasteric fascia. The testicle is grasped, inclosed within the cremasteric fascia and peritoneum, and traction exerted upon it, while the dartos is separated from the cremasteric fascia and muscle by means of the fingers or scalpel handle. The separation is carried upwards to and beyond the external abdominal ring. In this manner the two groups of tissues of the scrotum are separated from each other. The skin and dartos derived from the external body wall, are separated from the cremaster and peritoneum, which have been carried down from the abdominal cavity with the testicle in its descent.

A curved needle, armed with sterilized silk, is passed through the cremaster and spermatic cord, as high up against the internal ring as is practicable. After the needle has been removed, the

ligature is tied tightly around the entire cord. Having been passed through the cord, the ligature is insured against slipping.

While catgut presents the advantage of being absorbed by the tissues, its use is excluded in this operation because it quickly softens and relaxes to such a degree as to permit hemorrhage from the spermatic arteries, or the ligature slips and prolapse of the intestine or mesentery occurs. In one case, where we ligated carefully with catgut, severe and dangerous hemorrhage occurred, although the ligature remained in position. The cord had to be later ligated with strong silk in order to save the patient's life.

After the ligature has been securely placed about the parts, the ligated tissues may be severed with a scalpel, or preferably with scissors, at a distance of not less than 1 inch beyond the point of ligation. Great care should always be taken to leave a sufficiently long stump. The pressure of intestines or omentum above tends to pull a portion of the ligated inguinal wall out of the ligature, even though it has been passed through the cord and investing tissues.

If the hernial ring is comparatively small, the wound through the skin and dartos may be allowed to remain open, but we believe such a course inadvisable, and would recommend the closing of the scrotal wound by means of sutures. If the ring is very capacious, and the hernia very large, the cremaster muscle may be so much attenuated that it does not offer sufficient strength to render the maintenance of the weight of the viscera secure against prolapse of the intestine. In order to guard against this, it is essential that the scrotal wound be closed. If the sac is very large, the ligation of the cremaster and peritoneum, and the suturing of the wound of the skin and dartos, may not prevent the intestinal mass from breaking through to constitute prolapse.

As a further guard against the descent of the viscera, a portion of the scrotal sac may be removed, after which the suturing of the margins of the wound stretches the skin across the external abdominal ring and exerts some pressure upon the parts. This pressure may be accentuated, and rendered far more efficient, by inserting into the external abdominal ring, against the ligated stump of the cord and excised cremaster, a large mass of antiseptic gauze, so that, when the skin and dartos are brought together and sutured over it, a distinct pressure and support is obtained. Other means for insuring ample pressure upon the

part may be used. The skin from the inguinal region may be drawn down tightly over the external ring, and sutures passed through it and the internal and anterior margins of the ring, so that the skin and dartos are thus firmly fixed to the deeper parts, and the external abdominal ring virtually closed. Or, with heavy silk, the margins of the external abdominal ring may be brought together.

The operation upon the pig is carried out in a similar manner. The position of the scrotum in the pig renders it less difficult to retain the intestines within the abdominal cavity.

After the performance of the operation, the patient should be allowed quiet and clean quarters. In the case of the foal, the parts should be disinfected several times daily, but otherwise should go undisturbed except in those cases where a pack of gauze or other material has been inserted, as above recommended, which should be removed in the course of 48 hours, when a sufficient swelling will have taken place in the part to prevent the prolapse of the intestine. For a time the animal should be fed very lightly, in order to avoid distension of the abdominal cavity and unnecessary pressure upon the parts. Should the ligature about the cord become infected, a fistulous opening may result, and necessitate cutting down upon the cord at a later date, and removal of the ligature. Sometimes the ligature infection takes the form of botryomycosis or schirrhous cord, and necessitates the removal of the diseased cord.

The age at which scrotal herniæ should be operated upon will vary according to circumstances. In the foal, unless there is some reason to the contrary, such as strangulation, or growth of the hernia, it should be postponed until the patient is eight to twelve weeks old, but it may be performed at any age when circumstances may demand it. In the pig there is little, if anything, to be gained by delay; and the animal may as well be operated upon at the usual age of castration.

3. Imperforate Anus.

In considering the development of the embryo, we have learned, on page 310, that at an early period in its history the posterior gut ends blindly, and, opposite to it upon the external surface, there appears a depression in the ectoderm known as the proctodeal pit, which gradually becomes deeper while the wall be-

tween it and the end of the gut becomes more and more attenuated, until finally it disappears and the gut opens posteriorly as the anus. In some cases the attenuation and disappearance of the walls of the proctodeal pit fail to occur, and as a result the young animal is born with an imperforate anus.

In other cases, not only is there an arrest of the development in this part, but the entire posterior gut, or any portion of it, may fail to form or may become obliterated early, so that there is an absence of both the anus and the rectum.

The diagnosis of imperforate anus is comparatively simple, since it depends upon the absence of that organ. Upon examination no posterior opening of the gut is discoverable. If only the anus fails, the meconium may be pushed back against the thin membrane, to form a tumor in the anal region ; while, if the rectum itself is absent, no such tumor occurs.

The handling of imperforate anus consists of making an incision through the skin of the part, down upon the accumulated meconium. If the rectum is absent, so that the accumulation of meconium in the anal region does not occur, the animal should be destroyed as valueless.

In some instances in new-born females, there occurs an imperforate anus, accompanied by an imperfect vulvo-anal partition, and the feces drop downward into the vulva through the defective partition, and escape therefrom involuntarily. Such a case is illustrated in Fig. 42 on page 310. It may possibly be overcome by inserting the finger or a curved sound through the vulva up into the anus, and, directing it backward, cutting down in the anal region until the wall is perforated. The communication between the anus and vulva may then be denuded of its mucous membrane, and closed by sutures. However, because of the difficulty of bringing about the closure of an opening in this place, it would be better as a rule to destroy the young animal, unless it is of unusual value for work purposes. An animal with such a defect should not be used for breeding.

4. Imperforate Vulva.

Imperforate vulva is fundamentally referable to the same cause as we have already described as operating in imperforate anus. The vulva is formed in the same manner as the anus, that is, it originates from the lower portion of the proctodeal pit. The

atresia or closure may not end with the vulva, but may include other parts of the urino-genital canal. If the vulva is completely closed, it prevents the discharge of urine through the normal channel, and forces it to continue to pass through the urachus.

The handling of imperforate vulva cannot as a rule be successful, because it is difficult or impossible to discover the urethra and open it in a manner which will prove effective. The animal may continue to live indefinitely with an open urachus, but is of no value. When the vulva is only partially closed, and there is room for urine to escape readily, there is no occasion for surgical interference. As a general rule, such partial atresia or absence of the vulva in reality depends upon an asexual state, as is observed in freemartins, so that the animal is incapable of breeding. Consequently, there is no object to be gained by any surgical attempt at dilating the vulva.

5. Atresia of the Posterior Nares.

In studying the development of the embryo on page 296, we noted that the nasal and oral cavities are at first one common chamber, which later becomes divided into two separate passages by the lateral ingrowth and fusion of the palatine plates, which eventually become ossified throughout most of their extent, to constitute the hard palate. In some cases it is found that this partition between the nasal and oral cavities continues backward to the base of the sphenoid bone, thus causing a more or less complete atresia of the posterior nares. The defect has been recorded in man and in the horse. When involving but one nostril, the defect may escape detection, because, unless the young animal is caused to undergo severe exertion, the one free nostril answers all demands for respiration and no inconvenience ensues. If both posterior nares should be occluded, severe dyspnœa results, and oral breathing becomes necessary.

When an animal, with atresia of one posterior naris, arrives at a working age, and is put to heavy draft or rapid travel, the defective respiratory passage becomes at once evident, and a distinct roaring noise is present. In one case existing in a three-year-old in our clinic, there were no external evidences of disease, such as bulging or inequality of the face, no nasal dis-

charge, no abnormal odor. One posterior naris was completely closed, and consequently there was unilateral breathing. A sound, passed along the floor of the affected nostril, when it reached the posterior naris, passed upward and backward until it lodged against the base of the sphenoid bone, instead of gliding downward and backward into the pharynx.

The handling of this defect should be undertaken early, or at least recognized early, in order to determine whether the difficulty can be successfully removed or not. If the case is properly diagnosed, the prognosis is good.

By means of a rigid curved sound, the membrane stretching across the posterior naris may usually be ruptured. In operating, the occluding partition should be carefully broken down until free respiration through the nostril is obtained. If necessary, the frontal bone may be trephined on a level with the posterior nares, and the partition ruptured with forceps, sound or other instrument, through the trephine opening.

6. Atresia of Other Body Openings.

An imperforate condition of any other body opening may exist, but aside from those already mentioned, which are not at all common, such conditions in our domestic animals are exceedingly rare, and are of scientific, rather than practical interest.

Imperforate prepuce has been described by Brugnone as occurring in foals. He recommends that the organ be divided, and the opening held apart by some suitable contrivance. If such an opening is not made, the urine must necessarily be voided through the urachus. The operation cannot usually succeed unless the atresia involves the prepuce only. If the urethra itself is closed, it is generally impossible to effectively open it.

Epispadias is a term used to designate a defect in the urethra by which it opens upon its superior surface at some point other than the extremity of the penis. In other instances the abnormal opening may occur upon the inferior surface of the tube, and is then known as hypospadias. In such instances there is an absence of the urethral canal beyond the point of opening.

In the majority of cases in veterinary practice, and described as epispadias or hypospadias, the condition is in reality an approach toward, if not actual hermaphroditism. There are present, in varying degrees of development, some parts of both the male and

female generative organs. This is especially true in the horse, where cryptorchid testicles frequently develop, along with a more or less imperfect vagina and vulva, and an erectile organ which may occupy an intermediary position between the normal clitoris of the mare and the penis of the stallion.

The handling of these abnormalities will vary according to circumstances. Unless by surgical interference the urine can be caused to be voided in an unobjectionable direction and manner, it is advisable to destroy the young animal at once as being worthless. If there is a well developed vulva, the abnormally long clitoris or short penis, as one may prefer to term it, may be amputated within the vulva, so that the animal will urinate as though a mare. In such cases of hermaphroditism the testicles may be removed, when the animal has reached the proper age, in the same manner as ordinary cryptorchids are castrated; or, as in one case upon which we operated, the glands may be removed through the vagina in the same manner as the ovaries in the mare.

Occlusion of the eyelids sometimes occurs in the new-born. In carnivora and rodents the eyelids are normally adherent at the time of birth, while in other animals they are open. If the eyelids are adherent merely by their margins, they may be separated by tension or by carefully dividing them with a scalpel. In some cases, however, the lachrymal cavity is wanting and the eyelids are adherent to the cornea. In such a case there is no help for the condition. In other instances we have observed the new-born animal without a cornea, and the sclerotic coat covering the entire eyeball. This is not subject to remedy.

Occlusion of the auditory canal occurs occasionally, especially in the dog. It is recorded that in some cases there is a soft tumor at the point where the opening of the canal should exist, which can be readily seized with forceps and excised with a scalpel, exposing an accumulation of cerumen or ear wax, which may be removed by syringing out with tepid water. Such animals are usually incurably deaf.

7. Fissure of the Palate.

Fissure of the palate is a comparatively rare congenital defect in the new-born. In our museum, there is one specimen of fis-

sure of the palate, in a colt which lived to about one year old, when it was destroyed as incurable.

The defect consists of an arrest in the development of the palatine laminæ or arches, which fail to come in contact and fuse upon the median line, thus forming a direct opening from the mouth into the nostrils, as indicated in Fig. 35 on page 298. The fissure permits the passage of food from the mouth into the nasal chambers, from whence it drops out through the nostrils. In this way the young animal is placed at a serious disadvantage by losing a large part of its food through the nostrils, and thus undergoes partial starvation. At the same time, the lodgement of food in the nostrils irritates the parts, and its discharge therefrom presents so repulsive an appearance that the animal is rendered valueless.

The handling of fissure of the palate, in domestic animals, is virtually barred by the great depth of the oral cavity, which prevents the surgeon from attempting to bring about an adhesion of the two sides by means of an operation, though in some cases it might be theoretically possible.

8. Persistent Foramen Ovale. Cyanosis.

In describing the fetal circulation on page 328, it was mentioned that, since the lungs are inactive up to the time of birth, their office must be performed by the placenta. In order that the blood leaving the right ventricle may readily pass to the placenta of the mother, there exists in the fetal heart a communication, the foramen ovale, between the two auricles. This should normally close at about the period of birth, but sometimes does not, and as a result the new-born animal suffers from cyanosis or a mixed circulation, in which the arterial blood assumes a venous character and gives to the visible parts a blue color. This defect is very rare in animals When present it is usually accompanied at the time of birth by extreme weakness, with rapid respiration and a deep blue color of the visible mucous membranes, the consequence of the partial asphyxia from which the animal is suffering.

The condition is beyond remedy. Spontaneous recovery may occur. If the defect persists the animal may survive for some time. Zundel records a case in a horse which reached the age

of 7 years. In man even a greater age is sometimes attained, though as a general rule the patient succumbs at a comparatively early date, except recovery ensues.

9. Tongue-Tie.

Veterinarians have recorded a few instances of tongue-tie, or decreased mobility of the tongue, due to a too restricted *frænum linguæ*. According to Tyvaert, who has observed a number of calves so affected, the defect prevents the prehension and swallowing of food. The animal cannot well drink milk from a pail, or readily grasp the teat to suck, and consequently tends to die of starvation.

Examination of the tongue reveals the nature of the anamoly. The handling of it is very simple, and consists merely in dividing the frænum linguæ to a sufficient degree to permit of free movements of the tongue.

10. Hernia Cerebri. Hernia of the Brain.

Serious defects in the development of the brain usually lead to the death of the fetus immediately upon birth. We have made some interesting observations, where hernia of the cerebrum became hereditary in a family of swine bred upon one farm. The female line had been maintained unbroken for generations, while the boar used for breeding purposes had been regularly changed, and new blood introduced. Year after year, however, there occurred, with ever increasing frequency, new-born pigs showing a tumor in the frontal region, which was sometimes covered over with skin, and at other times showed a naked epithelial covering. In some litters of pigs the defect was apparent in more than 50%. Some of the pigs died after a few days, under symptoms of epilepsy, while others slowly recovered and the tumor disappeared. The appearance of the hernia is shown in Fig. 32, on page 294. The defective family of swine was finally sold to the butcher, in order to avoid the recurring losses from the difficulty.

11. Odontomes.

In tracing the development of the teeth, on page 311, we suggested that during the embryonic period the dental follicles

sometimes undergo aberrations which lead to more or less serious consequences, not only for the integrity of the teeth, but also for the usefulness or the life of the animal. Some of these aberrations take place early in fetal life, and at the time of birth have acquired such proportions as to imperil the life of the animal. This is especially true of the follicular cysts, of the compound follicular odontomes, and of the composite odontomes of the superior grinders. In these forms of aberrations in the development of the teeth, large cysts filled with lymph press their way into the sinuses of the face or into the nostril, and, by their great size, cause much deformity of the face, and such pressure upon the nasal passages as to threaten the death of the young animal by asphyxiation.

When odontomes, especially large ones of the cystic variety, are present at the time of birth, the foal at once shows difficulty in respiration, because of the pressure upon the nasal chamber. There is bulging of the face over the area of the cyst, unilateral breathing, and a marked increase in resonance over the area of the cyst.

The prognosis of odontomes is usually highly favorable under proper surgical handling, and equally unfavorable if neglected.

The surgery of odontomes is usually demanded for the colt or for the adult, and only very rarely for the new-born foal. We have observed and recorded odontomes which have threatened the life of the foal before reaching the age of 90 days, and other writers have observed them at the time of birth. Since we usually do not obtain clinical evidence of their presence until after the colt has attained some age, it is not desirable to deal extensively here with their handling. Instead we merely draw attention to the occurrence of these in the new-born or very young foal, and refer the reader to the more extensive literature upon the subject in special surgery.

12. Rupture of the Extensor Pedis Tendons in the Anterior Limbs of the New-Born.

We have had occasion to observe, in the vicinity of Ithaca, N. Y., six cases of rupture of the extensor pedis tendons, of new-born foals, in the region of the carpus. How common the disease may be, we cannot say, since there are few records of its occur-

rence. Four of the cases observed by us occurred upon one farm, in two successive years, and comprised all the foals dropped upon the farm during that period. The foals were in some instances apparently well at the time of birth. Attempting to stand, they soon went over on their knees, and were quite unable to extend the metacarpus upon the radius. Others showed more vigor, and for a time were able to get up and stand without aid. However, there was a constant tendency for the carpus to suddenly flex forward and the animal to fall, though the more vigorous ones were able, with some difficulty, to stand, and to walk without falling.

In all instances which we have observed, the tendons have ruptured in both legs, and the point of rupture is usually at the upper part of the carpal sheath, where the tendon merges with the muscle, as shown in Fig. 152. After the rupture, the end of the tendon drops down in its carpal sheath, and reunion with its muscle, either spontaneously or by surgical interference, becomes impossible.

In one instance the rupture of the tendons was accompanied by extreme luxation of both patellæ, the two patellæ being completely dislocated laterally, disabling the foal behind as well as in front, so that, when it was raised upon its feet and the ante-

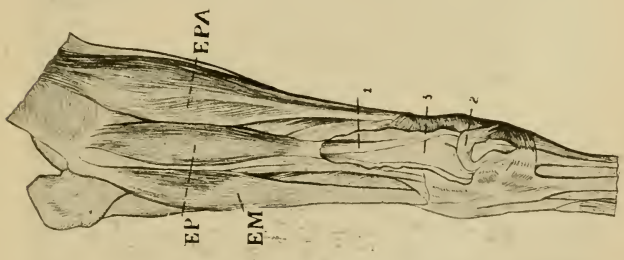


FIG. 152. RUPTURE OF THE EXTENSOR PEDIS LONGUS MUSCLE IN NEW-BORN FOAL.

Right anterior limb seen from in front.

EM, Extensor metacarpus.
EP, Extensor pedis longus
EPA, Extensor pedis longus accessorius.
1, Proximal ruptured end
2, Distal portion of tendon dropped down in the sheath, 3.

rior limbs extended, it assumed the position shown in Fig. 153. Of the six cases observed, four died in a few days after birth or were destroyed as hopeless. Two recovered, and are still living and performing satisfactory services, without extensor pedis muscles. The animals extend their fore feet by the extensor pedis accessorius and the extensors of the metacarpus, producing a peculiar gait.

The cause of rupture of the extensor pedis tendons in the new-born is unknown. In the region where we have observed these cases, that group of bone diseases of which spavin, ring bone and navicular disease are typical, is very common, and it is possible

FIG. 153. EXTREME LUXATION OF THE PATELLÆ IN A NEW-BORN FOAL. Accompanied by rupture of the two extensor pedis longus muscles of the anterior limbs. From a photograph. a, Patella ; b, Femoro-tibial articulation.

that a relationship exists between these and the rupture of the tendons.

The prognosis is exceedingly unfavorable, since, although some of the cases may live, their locomotion is interfered with by the absence of the extensor pedis longus muscles, and the value of the animals is consequently greatly lessened except for slow work, because for driving or riding they would inevitably prove insecure upon their feet. For any fashionable use, their peculiarity of action would render them unsuitable.

The handling of the malady is uncertain, and apparently there is little to do beyond taking good care of the animal and aiding it in getting upon its feet in order to suck. While the foal is sucking, an assistant should grasp it by the knees, and, pushing backward, prevent their flexion, thereby assisting the animal in standing. Unless the foal is of considerable value, it is advisable in most instances to destroy it at once.

APPENDIX. I.

THE GRANULAR VENEREAL DISEASE OF COWS.

INFECTIOUS GRANULAR VAGINITIS. VAGINITIS VERRUCOSA. INFECTIOUS VAGINAL CATARRH.

On page 97, we have given a brief account of the granular venereal disease of cattle, basing our description upon European veterinary literature. We were not aware, at that time, of the existence of the disease in America. We there suggested that the disease might well be imported at any time, and that it might even then exist in America without its presence having been recognized or announced.

A few weeks later a communication reached us which led us to suspect the existence of the disease in a dairy herd in northeastern New York.

A visit of inspection to the herd confirmed our suspicions. It was then attempted to procure data regarding the probable dissemination of the malady. The herd in which we recognized the malady was one in which no effort was made to raise dairy cows. Fresh cows were bought, milked and bred, their calves used for veal, and the cows butchered or sold whenever unprofitable for dairy purposes. As a consequence, new cows were frequently entering the herd. Some of the new cows, which had been in the stable but a few days, were badly affected, which indicated that they had been diseased when purchased, and consequently that neighboring herds were similarly diseased. Soon afterward several herds in the immediate vicinity were inspected by other veterinarians, and reported similiarly affected.

The results of these inspections led us to suspect that the malady had a somewhat extensive distribution. One large herd in southeastern New York had been reported to us as suffering persistently from abortion, and we were led to suspect that the granular venereal disease was present, and inspection confirmed our belief. We soon had opportunity to observe the affection in western New York, and especially in our immediate vicinity. In the region of Ithaca we have inspected a number of dairy herds, finding them uniformly infected. We do not know of a sound herd in our region.

Veterinarians in various portions of the state, having had their attention drawn to the existence of the malady, find, upon search, that the disease is common in many localities in New York.

We have observed the malady in pedigreed breeding herds of Holsteins, Jerseys and Guernseys. Breeding stock is constantly being sold from these herds to all portions of the state and country. We have satisfactorily determined that affected animals have gone from New York to several other states, and that diseased cattle have been brought into New York from other states.

How long the disease has existed in New York or in the United States, can not be determined. One veterinarian in Pennsylvania relates orally that he observed the lesions in aborting cows in his state some five or six years ago, but apparently made no public announcement of the fact. Breeders state also that they have observed the granular lesions in their herds for some time past.

If we are to estimate the duration of the disease in America by its probable relation to abortion, it has existed for a long time. A serious malady, known as contagious abortion, has been widespread and has caused appalling losses to dairymen in New York and other states for more than a quarter of a century. How much of the abortion has been due to this malady, we do not know, and there is now no method for determining. At present we have been unable to find a dairy in which abortion exists, or has recently existed, where the granular venereal disease is not present in a severe form.

Such observations as we have been able to make, in the few months elapsing since the recognition of the malady in this state, lead us to conclude that the disease has probably existed in the United States for a quarter of a century, that it is widely disseminated wherever dairying is largely conducted, and that it is responsible for a very large part of the immense losses from abortion and sterility in cows.

For these reasons, we consider it essential to add to the description already given of this disease, some interesting data acquired through our investigations. Admittedly our observations are incomplete, and any conclusions we may now draw are subject to revision. The investigations thus far made should suffice, however, to place veterinary practitioners on their guard,

lead them to make careful observations, and enable them to contribute important data to our knowledge of the malady.

Our suspicions of the existence of the disease in this country were first aroused by a communication from a veterinary practitioner, relating to abortion and sterility in a dairy herd of 40 cows, which we shall designate **Herd 1**. The letter stated in part, "They have had considerable abortion the past year, and now many of their cows are sterile. Some have been bred as many as nine times without becoming pregnant." The sterility was not confined to cows which had aborted, but included some which had recently given birth to apparently healthy calves. It was noted that the different bulls used in the herd seemed to suffer from enlargement of the penis, and became somewhat indifferent sexually. The practitioner also stated that, following an interval of 12–24 hours after breeding, the cows bled somewhat from the vulva. Apparently this latter phenomenon was misinterpreted, and really consisted of the regular menstrual flow following estrum without impregnation. In this disease, however, the menstruation seems exaggerated. The general phenomena related are typical of the history of the prevalence of this malady in a dairy.

Herd 1. An inspection of the suspected herd, Jan. 3, 1909, revealed the fact that, of the 40 cows, 25, or 62.5%, showed typical lesions of the disease; 4, or 10%, were regarded as questionable; and 11, or 27.5%, were apparently well.

The symptoms were thoroughly typical. The lesions corresponded to those recorded by European investigators. Many of the moderately affected cases were identical in appearance with Fig. 154. The mucous membrane of the vulva was thickly studded over with countless granular elevations about the size of hemp seed. The areas of mucosa in which the granules were located were generally injected, sometimes intensely inflamed and thickened. In such cases, the granules were very abundant, reddish in color, but not so intensely injected generally as the contiguous mucosa.

In many cases, where abundant granules of large size were present, the mucosa was not greatly injected. In these instances the granules were very prominent, not so numerous, but appeared larger. These were not usually injected, but were more

or less transparent, appearing like small, deep-seated vesicles, as if filled with a transparent, colorless lymph.

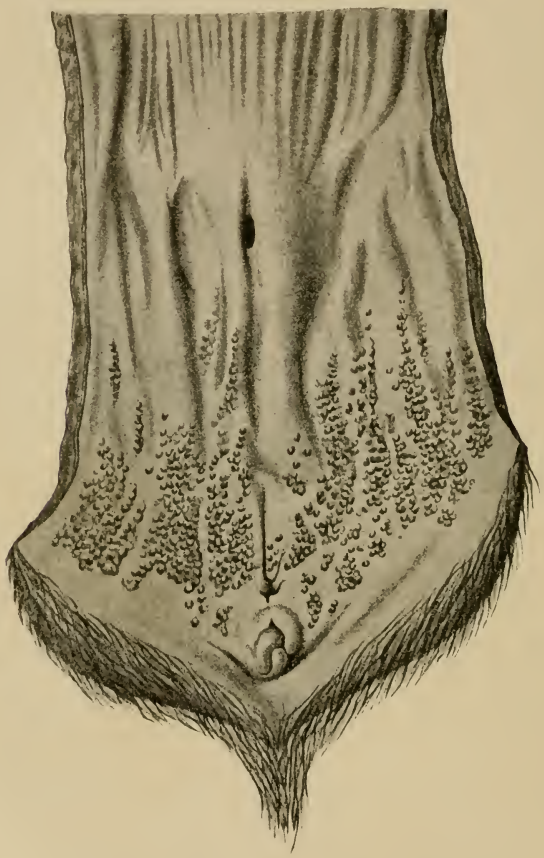


FIG. 154. INFECTIOUS GRANULAR VAGINITIS.

Mucosa of the vestibule after three months duration of the disease. (Hutyra and Marek, after Ostertag.)

Vulvar discharge was generally present, and the muco-purulent substance accumulated in dirty crusts about the vulva and tail. The herd of 40 cows was established in 1905, and during the three subsequent years 74 different cows entered the stable, 34, or 46%, of which have been sold or slaughtered. Though the records of the dairy are not explicit as to reasons for disposal, the prevailing reason for slaughter or sale, so far as can be determined, was abortion, followed by sterility and an unprofitable milk production.

At the date of inspection, 24 cows, or 60%, were pregnant, and 16, or 40%, were barren. Many of these had been repeatedly bred, without result, and several of them had proven so persistently sterile that it was intended to slaughter them for beef. The institution to which the dairy belongs requires a large amount of beef for its inmates, and consequently they have aimed to butcher each cow which proves unprofitable as a dairy animal, as soon as she can be put in fair beef condition. New cows in advanced pregnancy, or recently fresh, are bought to replace them, and thus the proportion of sterile animals is reduced to a minimum.

The data regarding abortion in the herd is also inaccurate. In general terms, the superintendent states that abortion has been frequent during the entire history of the dairy. Some have aborted two and three times in succession. Generally they are butchered before abortion occurs more frequently than twice.

While the losses in this herd have not been so great as those recorded by some European observers, they have nevertheless been serious, so much so that the governors of the institution to which the dairy belongs are very anxious to check the severe economic losses. Since they do not attempt to raise the calves, they do not feel severely the direct loss from abortion or sterility; and the fact that the institution can make good use of each fat cow for beef diminishes greatly the economic losses on the cows themselves. Even under these exceptional conditions, and with the disease in the herd of a mild character as compared with the malady in some other herds coming within our observation, the economic losses from impairment of milk production are proving a severe burden. It is difficult, under the conditions, to produce sufficient milk, or at a reasonable cost, for the use of the inmates of the institution.

Herd 2. The next herd investigated by us consisted exclusively of pedigreed Jerseys. There were on hand, at the date of our first inspection, 228 cows, heifers and heifer calves. In addition, there were 8 bulls of breeding age and 10 bull calves.

In three stables containing 96 females, among which were a few cows, but mostly heifers from 1½ to 3 years old, 89.6% were diseased and 10.4% apparently well.

In a fourth stable, containing 40 cows and heifers, all in milk, 98% were affected and 2% (1 cow) apparently well.

A fifth stable, designed for pregnant cows about to calve and for calves, contained 6 cows or heifers in advanced pregnancy or recently calved, 5 of which were evidently diseased and 1 apparently well. The remainder of the stock in this barn consisted of virgin heifers, and heifer and bull calves.

Of	8	heifers	about	9	mos.	old,	8	were	affected,	0	apparently well.
"	20	"	"	6	"	"	18	"	"	2	" "
"	6	"	"	3	"	"	1	"	"	5	" "
"	7	"	"	1	"	"	0	"	"	7	" "
"	3	"	"	1	week	"	0	"	"	3	" "

Of the total 44 virgin heifers and heifer calves in this stable, 61% were diseased and 39% were apparently well. Excluding the heifer calves under 6 months, 93% of the virgin heifers were affected.

In a sixth stable, containing 42 cows, chiefly adult or aged, 31, or 74%, were affected, and 11; or 26%, were apparently well.

In the entire herd of 22 8females, 198, or 82.5%, were affected; and 40, or 17.5%, were apparently well. If we deduct from the 228 females, the 17 apparently well heifers and heifer calves not over 6 months old, and which we may assume remain apparently well because not yet infected, there remain 211 females, of which 188, or 89.1%, are affected.

The foregoing statistics, it has since been determined, are defective, and show too large a percentage of well animals. Cows in advanced pregnancy, or about to abort, when the vulva becomes swollen and edematous, cease to show the granules in the vulvar mucosa, and consequently the number of apparently well is probably excessive to the extent of all of those cows which were very near to parturition or abortion, in which the lesions were hidden by the edema present.

The symptoms in this herd were far more intense than those observed in Herd 1. In the cows and heifers which had calved or aborted, and in some of the virgin heifers, there was present a very noticeable muco-purulent vulvar discharge, which soiled the external portions of the vulva and the contiguous portion of the tail. The discharge adhered especially to the tuft of hairs at the inferior commissure of the vulva. Sometimes the muco-purulent discharge dried upon the vulvar tuft as dirty brownish crusts; at other times the moist, sticky discharge hung down in ropy masses several inches long. Similar masses of discharge were observed upon the ventral and lateral surfaces of the tail.

Upon separating the vulvar lips, there was observed, in many cases, adherent masses of muco-purulent secretions. Frequently, when parting the vulvar lips, the muco-purulent masses stretched across from side to side as adherent, tenacious strings, not losing their continuity until the walls of the vulva had been parted for a distance of two, three, or more inches. The discharges were generally tenacious, stringy, white, or rarely faintly yellowish, and more or less opaque. In some instances, the discharge was flocculent, and, upon separating the vulvar lips, the mucosa was seen to be dotted over with pale yellow, repulsive-looking, flat masses, 0.1 to 1 cm. in diameter. In one diseased cow, whenever the vulvar lips were separated and the clitoris pressed from beneath, approximately one to two cc of a thick white pus were discharged from the prepuce of the clitoris. In addition to the vulvar discharges mentioned, muco-purulent discharges emanated from the vagina and the uterus. More than 2% of the affected cows had pyometra following parturition or abortion, and showed the same character of discharge as pyometra from other causes.

The granular lesions in the vulvar mucosa were very much more pronounced than in Herd 1. In the milder cases, the granules were few in number, and grouped largely about the clitoris. They were arranged in irregular, indistinct rows, corresponding to the ridges in the mucous membrane. According to the severity of the case, the granules spread forward toward the vagina and upward along the sides of the vulva, to finally converge and meet on the roof of the vulva. Fig. 154 represents a comparatively mild case as related to the area involved and the profusion of granules. As the superficial area of the

disease increases, the irritation of the mucosa and the abundance of granules tend to increase.

The granules are best observed by refracted light. The vulvar lips are readily parted with the fingers, when the granules are easily observed upon some portion of the mucosa, usually best on the side opposite to the observer. Changes in position and the obliquity of the illumination aid in bringing the granules into clear vision. In fair daylight, with the vulva of the animal directly or obliquely facing an open door or a window, ample illumination of the vulva is afforded, when the lips are parted. In dark stables, on a dark day, or at night, the vulva may be conveniently and amply illuminated with the aid of a good stable lantern. A good reflecting lamp or lantern is even better, and affords an illumination equal to sun-light. The ordinary small electric hand lamp with a dry battery gives an ideal light at night or in dark stables. When the granules extend over the entire circumference of the vagina, they may be best observed by holding the vulvar lips well apart and looking along the vaginal roof, when the granules will stand out very boldly.

The granules differ greatly in color. In the intensely inflamed cases, the granules usually partake of the deep injection of the surrounding mucosa, but are somewhat lighter in color and show a tendency towards transparency. In cases where no great irritation is present, the granules stand out prominently, as more or less translucent, hemispherical elevations. They are especially prominent in virgin heifers.

When parturition or abortion is near, and the vulva becomes edematous, the granules disappear from view. They apparently do not cease to exist, but the general edematous condition hides them and produces an even surface as seen in Plate II, Fig. 4. So far as we have investigated, we are unable to detect the disease clinically at this period. In two or three weeks after abortion or parturition, the granules again become visible.

The degree of irritation in the vulvar mucosa is not directly dependent upon the numbers of granules present, though in general the greater the number of granules, the more intense the inflammation of the mucosa. In some cases, especially after repeated irrigations with antiseptics, the vaginal mucosa is normal or even pale in color. In severe cases, the mucosa is intensely

red and angry-looking, and bleeds easily. It is sensitive to the touch, and the patient resists palpation. Urination causes some irritation of the parts, expressed by uneasy stepping and whisking of the tail. When the irritation is very intense, the vulva becomes visibly swollen, especially the upper portions of the labiæ, opposite the superior commissure. The vulvar lips at this region become distinctly enlarged, tense and sensitive.

It was observed, during our investigations in this herd, that copulation greatly increased the vulvar irritation. So marked was this coïtal irritation that we were enabled to largely anticipate the breeding history of a cow by inspecting the vulva. If bred within a week or two, the vulvar irritation was very greatly accentuated. This is in harmony with observations upon most coïtal infections, and has a distinct and important influence upon the question of therapeutics. No method of handling can well succeed under the irritation of copulation.

Estrum also caused a somewhat increased vulvar irritation, but not of the same grade as coition. It seemed, also, that in this herd menstruation following estrum was especially marked and abundant.

An interesting phase of the disease in this herd was the large percentage of heifer calves affected. European writers mention the occasional transmission of the disease to heifers and calves, but lead one to assume that such occurrences are rare. In this herd, 61% of all virgin heifers, or 93% of all virgin heifers over 6 months old, were affected. This fact is very important in relation to abortion, sterility and the transmission of the disease from herd to herd.

The method of infection in these cases is not wholly clear. Our investigations developed the fact that the same grooming implements, metal currycombs and stiff fiber brushes, were used alike on diseased cows in adjoining stalls, and on the heifer calves. In grooming, the vulvar region necessarily received extra attention in order to rid the region of dried fecal, and other accumulations. In doing this, the vulvar lips were parted and the infected currycomb and harsh brush were brought into contact with the vulvar mucosa.

Later observations, upon other herds, disclose the fact that such infection of virgin heifers is not common when they are

kept in stables with diseased cows, if the heifers are not groomed.

The relation of the disease to abortion in this herd was apparently very important. In Herd 1 abortion was persistent but scattering. While no large number of abortions occurred in any month or year during the existence of the herd, the total for the three years was of distinct economic importance.

In **Herd 2**, abortion was far more frequent and serious. It might be said that abortion was comparatively as much more frequent in this herd than in the first one, as the vulvar lesions were more abundant and intense. That is, the number of the abortions in the two herds was approximately parallel to the respective intensity of the lesions in the two herds.

In this herd, 156 cows were bred to calve during 1908, and kept on the farm until the result was known. Of these, 42, or 27%, aborted; and 14, or 9%, were slaughtered because of sterility. Four cows or heifers, which had been bred and conceived, were sent to the butcher as sterile, after having aborted. Exact statistics for prior years are not available, but abortion and sterility have been causing serious losses for a number of years. The ravages of abortion reached the climax in 1908. As accurately as statistics can be readily compiled, the losses in the herd, between January 1901 and May 1905, averaged 0.5 abortions per month; between May 1905 and March 1907, 0.86 abortions per month; and during 1908, 3.5 per month.

Most of the animals aborting in 1908, and indeed throughout the history of the herd, have been young cows and heifers. Very largely they have been heifers pregnant for the first time. This is in harmony with our observations in other affected herds. Abortions occur chiefly in heifers, or in cows newly introduced into the herd.

In this herd, one stable is made up almost wholly of adult cows, 42 animals in all. Of these, 31, or 74%, were affected, as against an average of 82.5% for the entire herd, though, in arriving at this percentage for the herd, new-born heifer calves were included. In this stable, where the largest percentage of apparently well cows was found, abortion was virtually absent, there being records of but two cases during a period of several years.

We have stated above that the comparative frequency of abortion in affected herds is in harmony with the percentage of animals affected and the average virulence as revealed by the vulvar lesions. This harmony is quite as well emphasized between the various stables in this herd. The abortions have occurred in those stables where the disease is most universal and the vulvar lesions most intense. In the stable of 40 cows, with 98% affected, the abortion was decidedly the most severe in the herd.

The observations relative to the variations in the prevalence of abortion, in the different stables on this farm, bring up other interesting questions. Of the 17.5% of apparently well females, 17 animals or 42.5% of those not showing vulvar lesions were virgin heifers, so young that it is a fair assumption that they were free essentially because they had thus far failed to become infected. Of the remaining 23 apparently well females, 11, or 27.5%, were adult cows in barn six; and 8 others, or 20%, mostly adult and aged cows, were in another barn. Thus, in a herd consisting for the most part of young cows and heifers, there were 40 apparently well females, 42.5% of which were virgin heifers or heifer calves, 47.5% adult or aged cows, and but 10% among the young cows and heifers, which constitute the majority of the herd.

Two assumptions seem to be warranted by the observations in this herd:

1. As the cows grow old, and have been infected for several years, they acquire an indefinite immunity from the effects of the malady. The lesions become less intense, and abortion occurs less frequently or is wholly absent.

2. The cow may eventually recover spontaneously, and the lesions disappear. This is in accord with the popular belief relative to "contagious abortion", whatever that term may mean. It is commonly said that a cow aborts twice, and becomes immune. While in this herd there are sufficient cases to disprove this as a universal fact, there is much to support the rule. Several important questions which repeatedly arise in reference to spontaneous recovery may be tentatively answered by the observations in this herd. It is one thing for a cow to recover from the disease and cease to be capable of transmitting it to other animals, and quite a different matter for her to cease to abort.

Many cows have the disease more or less intensely, yet breed regularly, and produce healthy, vigorous calves. *The cows included in the 40 apparently healthy animals, in this herd, breed regularly, and drop healthy calves.*

Based upon this feature of the malady, a thriving trade is carried on by fraudulent veterinarians with "abortion cures". When a dairyman has lost one or two crops of calves, and turns with a forlorn hope to the "abortion cure" fraud and applies the remedy, if the time is opportune, the abortion ceases and the dairyman writes a "testimonial", but the disease remains in the herd, and sooner or later will again bring disaster. Should the fraudulent remedies be applied at an inopportune epoch, the abortion goes on, and the remedy seems almost to cultivate it. Thus in this herd the writer was informed that one of the most highly lauded "abortion cures" in America was given a complete trial in one of the stables, with the result that a far higher percentage of the cows aborted in that than in either other stable on the farm. The remedy was just as effective as it ever is, but was used at the wrong time, when the abortion was not ready to cease.

Another important element in connection with the outbreak in this herd is the prevalence of sterility. In dealing with the problem of sterility, and quoting Professor Hess, on page 171, it is asserted that the granular venereal disease is one of the most common causes of sterility from cystic degeneration of the ovaries. That is, according to the observations of Hess, that malady causes the ovarian disease. Our studies upon the herd in question went far to substantiate the views of Professor Hess, differing from his observations in some important respects, though in no wise contradictory.

The herd records showed the most serious sterility, not in cows, but in heifers which had not bred at all, or, if they conceived, had suffered from invisible abortion, *i. e.*, had aborted ere the fetus had reached a size that its expulsion was detected by the keepers. Fourteen such heifers were sent to the butcher during 1908 because all efforts at breeding proved futile. Some were served five to ten times each, without avail, estrum recurring regularly every three weeks. Others would show estrum regularly two or three times, then miss one, two or more periods

(pregnant?) and unexpectedly again show estrum (invisible abortion?). Finally, in despair, they were sent to the butcher, and the highly pedigreed animals of otherwise great promise became a total loss.

The majority of the heifers became pregnant, and carried the fetus to the sixth, seventh, or eighth month, when they aborted, or gave birth to a premature calf, which with careful handling sometimes survived. After aborting, various troubles arose. Many suffered from retained placenta. A few died from septic metritis following the retained placenta. Some suffered severely from chronic metritis or pyometra. Many of the aborted heifers proved difficult or impossible of impregnation.

Cystic degeneration of the ovaries and persistent hypertrophied corporea lutea abound in the herd. In one stable of 38 females, manual examination of the internal genital organs was made, except in pregnant animals. Of those examined, five had cystic ovaries; four had persistent, hypertrophied yellow bodies; and two had pyometra. One of the cows affected with pyometra also had a cystic ovary, making five animals with cystic degeneration. Thus, amongst 38 animals, 11 or 29% had disease of the ovaries or uterus which would probably bar fecundation until properly handled.

In a second stable of 40 cows, preparatory to handling, manual exploration was made per rectum, revealing cystic ovaries in 11 cases and persistent yellow bodies in 9 animals, or abnormal ovaries in 50% of the cows. Some of these were not sufficiently affected to clearly interfere with breeding; others were badly degenerated, and sterility very probable. Numerous cows remained sterile after several breedings. One was nymphomaniac. One heifer had aborted some months ago, and has not been observed in estrum since. The right ovary contained a yellow body 1½ inches in diameter, which was pressed out. Three weeks later, a new yellow body of nearly the same size was again present, in the same location as before, and it too was pressed out.

The investigations in this herd thus indicate the correctness of the views of Professor Hess, that ovarian and uterine diseases very largely follow virulent attacks of the granular venereal disease.

Observations in this herd carry us even further in one important respect. The investigations indicate that in highly bred

and unusually highly kept cows and heifers, are exposed to special dangers from the malady. **Through grooming, without proper precautions being taken, the disease is transferred to heifers and heifer calves, and the infection is already in the genital tract before the animal is bred.** Consequently, when the heifer is bred, the disease already exists, rendering fecundation difficult or impossible. Should the heifer become impregnated, the chronic infection of the genital tract, already present for months, imperils the life of the fetus and may induce either abortion or premature birth, to be followed by various complications.

Another interesting question has been raised by the clinical history of this herd. Mammitis of a very peculiar type sometimes occurs in heifers which are threatening to abort. In such, a severe, purulent mammitis now and then arises, causing atresia of the milk cistern or larger milk canals, so that when the heifer finally calves or aborts, one, two or more of the quarters are blocked, and no milk can be withdrawn.

At the time named there is an excessive vulvar discharge which soils the perineum, tail, thighs and posterior portions of the udder. Thus it is suggested that the disease may indirectly cause some cases of mammitis.

Herd 3. A third dairy inspected consisted of 87 cows, heifers and heifer calves. In one stable containing 30 cows in milk, 27, or 90%, were affected. In the same stable, in stalls comparatively detached, were 24 heifers and heifer calves, of which 6 or 25% were diseased, and 18 or 75% apparently well. In two other barns were 33 females, mostly cows, with some heifers one year old or over, of which 31 or 94% were found affected. In the entire herd of 87 females, 64 animals, or 74%, were affected. There is at present no abortion in the herd. Four years since, approximately 50% of the pregnant cows aborted, and the following year 25% aborted, since which time the herd has been free from abortion. During this period of freedom, few if any new cows have been introduced. While abortion prevailed, the service bulls were subjected to disinfection of the penis and sheath before service. Granular venereal disease was not in mind, and not looked for by the veterinarian in charge.

Since the cessation of abortion, sterility has prevailed to a degree which has caused considerable economic loss. Three or

four cows have been sent to the butcher on this account. One was sent to the butcher because we had diagnosed ovarian abscesses. Our diagnosis was verified by post mortem examination. Aside from these, approximately 10% of the cows of breeding age have been handled annually by us for sterility due to ovarian disease.

The lesions of the disease in this herd are more intense and more universal, in the cows of breeding age, than found in Herd 1, and far less intense than in Herd 2. The prevalence of abortion and sterility in the herd is in harmony with the observations in the two prior herds. The lesions are not severe; no new cows have entered the herd; no abortions are occurring. The lesions are more intense than in Herd 1, and sterility is present in a marked degree, and assumes definite economic importance. The sterility is due almost wholly to cystic ovarial degeneration, some cases to persistent hypertrophied yellow bodies, and one case to ovarial abscesses.

The recorded observations by European investigators, coupled with the history of the abortion in this herd, followed by the large percentage of sterility and the high prevalence of the granular venereal disease in the herd at present, warrant the assumption that the malady was present when the abortion raged.

The small percentage of affected heifers and heifer calves in this herd is interesting, when compared with Herd 2. In Herd 2, the heifers and heifer calves are kept in the same barn, and in close contact with a few badly diseased cows. The calves in that herd are regularly groomed, and the same currycomb and harsh fiber brush are used for grooming both cows and calves. The cows usually kept in the stable with the heifers are those in advanced pregnancy, and those which have recently calved or aborted. Many of them have abundant vulvar discharges, which greatly befoul the grooming implements and afford ample opportunity for the carrying of the disease from cows to calves.

In Herd 3, the conditions are different. The calves are kept in a distant part of the stable, virtually equivalent to a separate building. They are abundantly bedded and scantily groomed. They are not kept on exhibition for prospective buyers, as are those in Herd 2.

Herd 4. This small herd consisted originally of grade cows, to which were added, by purchase, a few months prior to our observations, 3 pedigreed Guernsey heifers and 1 pedigreed Guernsey bull calf. We were asked to examine two of the three Guernsey heifers because of sterility. The three heifers and the bull, as well as the other cows and calves on the premises, were well kept, in good flesh and vigorous general health. In spite of repeated breeding, only one of the three heifers had become pregnant.

Inspection showed all three Guernsey heifers affected with granular venereal disease (100%), while of the 6 original grade cows, 3 or 50% were affected. 2 heifer calves kept in another stable were healthy. In the herd of 9 females of breeding age, 3 animals, or 33%, were sterile, one of the original stock having become sterile since the introduction of the Guernsey heifers. Abortion has not existed in the herd. Of the total of 11 females in this herd, 6 or 54% are affected. The history and conditions in this herd suggest that it was free from the malady until introduced by the purchase of the pedigreed heifers.

Herd 5. A herd of 10 females, attended by my colleague, Dr. J. N. Frost, Instructor in Surgery, because of sterility in 2 heifers. Of the 10 cows and heifers, 8, or 10%, were affected. The herd had suffered severely from abortion for several years. The two apparently well cows were adults. They have at no time suffered from abortion or sterility. The two sterile heifers, 20% of the herd, were badly affected; and each had cystic ovaries, which were crushed.

Herd 6. A milk dairy consisting of 40 cows and 6 heifers. No herd records are kept, so that losses from abortion or sterility can only be estimated. In 1906, about 20% aborted; in 1907 about 15%; and in 1908 about 10%. The degree of sterility could not be determined. The cows are mostly grades, and whenever sterility threatened, and the cow was at all fit for slaughter, she was sent to the butcher. Inspection showed 44, or 96%, affected; and 2, or 4%, apparently well. The cows and heifers of breeding age were all affected. The sound animals were yearling heifers which had not been bred. The lesions were very moderate in intensity. One heifer had aborted in the summer of 1908, was bred, and aborted in April, 1909. The abortion was followed by retained placenta.

Herd 7. A herd consisting of 12 cows and 1 yearling heifer. No definite record of abortions and failures to breed. Owner estimates loss by abortion in 1907 at 20%. In 1908, 10% of herd was sent to butcher because of sterility. The original herd, all common cows, have been sold recently, except 4 aged cows and the yearling heifer, and in their stead 8 pedigreed Holstein cows introduced. Of the four original cows, 2 are slightly affected, 2 apparently well. The yearling heifer is affected. The 8 new cows are affected mildly to moderately, the lesions in these animals being apparently old.

Examination of the genital organs of the 8 Holstein cows revealed 1 pregnant, 3 with enlarged persistent yellow bodies in ovaries, 2 with cystic degeneration of ovaries, 1 with enlarged uterus and cystic ovary, and 1 normal, non-pregnant.

Herd 8. A herd of high-grade Jerseys, consisting of 53 females. The herd has been kept unusually isolated. Few new cows have been added during the entire history of the herd; 52 of the 53 females were born on the farm; and the one remaining cow was introduced into the herd some years since. New bulls, or rather bull calves, have been added from time to time. Eight or ten years ago a breeding bull was hired temporarily from Herd 3. Owing to the continued comparative isolation of the herd and a history of virtual freedom from abortion for half a century, it was hoped to find a sound herd. An inspection revealed 3 animals so near parturition that the presence or absence of the granular lesions of the vulva could not be determined. Of the other 50 females, 33 or 66% were affected, and 17 or 34% were apparently well. Among these 50 females, 6 were heifers, 6 to 12 months old, which had not been bred. They were kept in the same stable, but fairly well isolated. They were carefully and plentifully bedded, but not groomed at all. Of these 6 heifers, 1 or 16⅔% was diseased, and 5 or 83⅓% sound. This is in marked contrast with Herd 2, where the heifers were regularly groomed with infected utensils.

The other 12 sound animals were mostly aged cows, which may have spontaneously recovered.

On the whole, the percentage of affected animals is the lowest we have yet observed in a large herd. The lesions in the vulva are also less severe, the granules less numerous and less promi-

nent, the irritation of the vulvar mucosa almost wanting, and vulvar discharge recognizable in but few animals.

In harmony with these clinical data, abortion is rare, never exceeding, according to the owner's estimate, 2 to 4% in any year, while sterility is low. Probably an average of 4 to 5% of the females are sent to the butcher annually for sterility, but dairymen in New York have come to regard this as possibly normal. Still, some abnormal losses from sterility are recognized by the owner of the herd. In 1908, 2 heifers were sent to the butcher because of sterility, a loss in these alone of 4% of the females of breeding age. These animals were of an age at which they should have bred promptly.

The owner of the herd complains chiefly of the excessive occurrence of retained placenta, estimating the retention at 20%, although the cows are *very* well kept, strong and vigorous. We have casually inspected numerous other herds in the vicinity of Ithaca and elsewhere, uniformly finding them infected. Where the disease is severe, abortion is common; where the malady is mild, the losses are correspondingly low. In no herd investigated do the results vary in any material way from those described in the 8 herds we have already reported in detail.

The symptoms of the disease have been largely related above. Within 2–5 days after infection, the vulvar mucosa becomes injected, dark-red and swollen. The longitudinal rugæ of the mucous membrane become more prominent, and within a few days small granular elevations about the size of mustard seed appear in the vulvar mucosa as hemispherical elevations above the surrounding epithelium. They appear mostly in somewhat indistinct longitudinal rows. Usually they are most prominent about, or just anterior to, the clitoris, and are seen chiefly along the summits of the longitudinal mucous ridges. In heifer calves, where the granules are usually few but very large and clear-cut, they sometimes tend to be confined to the immediate region of the clitoris.

In moderate and severe cases, the granules spread completely around the vulva, but do not extend to the cutaneous margin. We have not observed the enlarged follicles nearer to the margins of the labiæ than ½ inch. Forward, they extend as far as may be seen by parting the vulvar lips. The irritation of the mucosa increases anteriorly.

INFECTIOUS VAGINAL CATARRH OF COWS.

Photo-Micrographs after Thoms, from the Monatshefte für Praktische Tierheilkunde, Vol. 17. P 25.

PLATE I.

FIG. 1. Section from the left side of the vestibule of the vagina showing an elevation in the mucosa due to a single follicle.

FIG. 2. Section through 4 contiguous follicles which cause a single, rather flat elevation of the surface.

PLATE II.

FIG. 3. A Knob-like elevation of the mucosa due to several contiguous follicles.

FIG. 4. A section from roof of the vagina, showing marked follicle-formation without macroscopically visible elevation of the mucosa.

PLATE I.

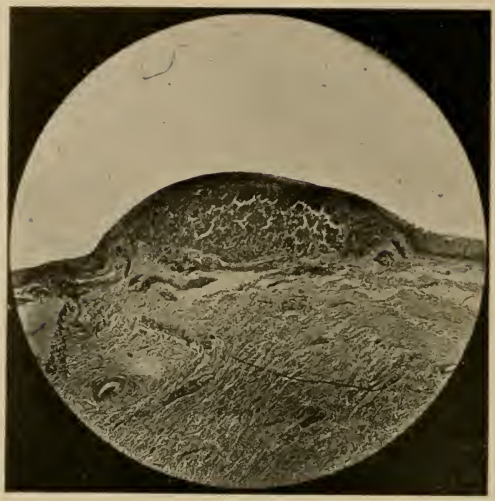


FIG. 1.

FIG. 2.

PLATE II.

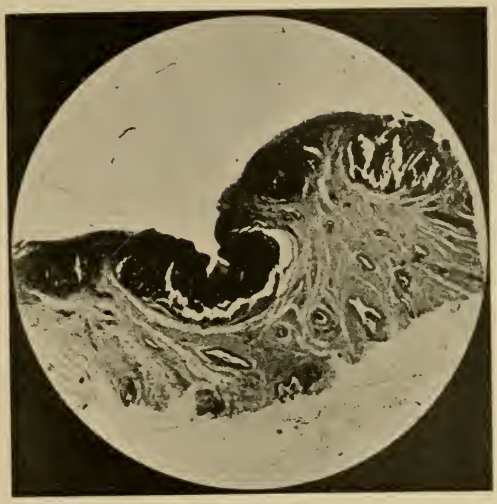


FIG. 3.

FIG. 4.

The injection of the mucosa varies in intensity in different herds, in different individuals of the same herd, and in the same individual at different periods. The variations in intensity are frequently very abrupt, and sometimes not readily explained. When a non-pregnant animal comes in estrum, the mucosa becomes increasingly irritated and reddened. If coïtion occurs, the irritation is very greatly increased. The entire visible portion of the mucosa is intensely inflamed, dark red, and swollen, and the epithelium is covered over with flocculent muco-purulent exudates. After estrum and service, the intensity slowly abates, and the mucosa may largely lose its irritated appearance in 10 to 15 days. If pregnancy occurs, the vulvo-vaginal irritation may remain static, increase, or decrease. In old cows which have been long diseased, the mucosa becomes more pale, yellowish and flaccid. Ecchymoses in the mucosa are frequently observed.

The vulvo-vaginal discharge is parallel to the degree of vaginitis. Whenever the disease is intense, there is more or less constant mucous, muco-purulent or purulent discharge, which soils the tail and vulva, and especially adheres to the vulvar tuft of hairs. When complicated with pyometra, there is usually a profuse purulent discharge, and one or two pints are frequently observed in the gutter behind the cow.

The prepuce of the clitoris is occasionally the seat of profuse suppuration. In such cases, pressure from outside and beneath the clitoris, while the labiæ are parted, causes 15 or 20 drops of thick white pus to be pressed out. The lips of the vulva are frequently swollen, tense and somewhat sensitive to the touch.

When parturition or abortion approaches, the enlarged follicles become less conspicuous, and finally disappear more or less completely from vision. As soon as the vulva and vulvar mucosa become markedly edematous, when the animal is "springing", the granules rapidly become less conspicuous, and sometimes 2, 3 or more weeks prior to parturition or abortion, the enlarged follicles are no longer visible. After the animal calves or aborts, the granules usually remain invisible for one or more weeks, until the edema of the external genitals subsides, when they reappear.

The nodules have not ceased to exist, so far as we can determine, but have merely become hidden in the edema of the mucosa. In some cases one may still recognize the hidden granules with

the finger tips. In some cases the granules may remain hidden for even a longer period of time. In pyometra, following abortion or retained placenta, the vulvar mucosa may remain edematous and swollen for a long period of time, and the granules scarcely, if at all visible. According to our observations, the injection of the genital mucosa, just prior and subsequent to parturition or abortion, is more intense, and the tissues are darker and are usually more swollen than at the same period in healthy cows.

The invisibility of the granules during the parturient state is significant and important. Failure to recognize the fact may lead to overlooking the disease, especially in cases of abortion and retained placenta, and cause the veterinarian to render a false diagnosis. The error in diagnosis tempts the veterinarian to conclude that the malady has no important relation to abortion, because the cows which show the granules in abundance do not abort, and those which do abort show no granules immediately before or after abortion. If the disease exists in the herd, and the veterinarian is called to attend an animal for abortion or retained placenta, he should tentatively regard the patient as infected with granular venereal disease, and handle the case accordingly. Later, when the puerperal edema vanishes, the granules will generally become evident and verify the diagnosis.

The symptoms in the bull are far less conspicuous than in the cow. This has led some veterinarians to conclude that the bull is immune to the disease and acts only as a passive bearer of the infection from cow to cow through coition. Others observe catarrhal inflammation of the genital mucosa, with muco-purulent dischage from the prepuce. The penis of the bull is not freely open to deliberate inspection. We have noted very marked muco-purulent discharges, which disappear under antiseptic irrigations. The penis seems enlarged, and the mucosa injected and roughened. In some cases, ecchymoses about the preputial ring are very evident. In one herd, the herdsman complained that the bulls became lethargic and were slow to copulate.

The diagnosis in the cow needs offer little or no difficulty. As in other diseases, so in this, an individual case may be questionable, but in a herd where it prevails, with the exception of pregnant animals near to parturition or abortion, or during the puer-

peral state, the affected animals show definite and easily recognizable lesions.

Pathology. The bacteriology has been extensively studied by Ostertag[1] and other European investigators. Ostertag found a diplococcus or short streptococcus, which he grew in pure cultures, and injected into the vaginæ of healthy heifers, inducing the symptoms of the disease. He recovered pure cultures of the organisms from the vulvar discharges of the diseased animals. The organism grows readily in glycerine agar, urine agar, and other neutral or alkaline media. It stains with most aniline bases, especially with methyline blue.

The organisms are found in the muco-purulent discharges, between the pus cells or within the protoplasm of these. They are able to penetrate the vaginal mucosa, and are found between the epithelial cells, as well as in the mucous pappillæ, a fact which explains the great tenacity of the infection and the difficulty of curing it.

While transmission experiments on healthy female cattle succeeded, attempts to transmit the malady to horses, sheep, swine, goats, rabbits and Guinea-pigs were negative. Ostertag also attempted to transmit the disease to a bull, but failed to induce visible symptoms, and concludes that the bull does not become affected with the malady. This is in conflict with our observations, since the breeding bulls in Herd 2 showed in some cases a distinct preputial catarrh. When the penis was exposed for copulation, it seemed swollen and deeply injected, and showed very marked ecchymotic areas at the preputial ring. We believed, also, that we saw granules similar to those in the vulvæ of the cows, but the opportunity for deliberate inspection was not present.

Ostertag found the organisms in the uterus of one cow, while in others he failed to find the cocci beyond the vagina, and concludes that it may persist in the vagina month after month, without invading the uterine cavity.

For three months Ostertag handled one artificially infected heifer with alum and tannin (1-5% solution) and Lysol and Creoline (½-1%) without results. Ostertag regards the disease, from his observation, as a very serious malady. Out of 250 ani-

[1] Monatshefte für Praktische Thierheilkunde, 1901, p. 536.

mals inspected by him, 120 had to be abandoned for breeding, because of vaginal discharge, sterility or repeated abortion.

Ostertag recommends that the disease be handled by the official veterinarians, and quarantine be maintained against the introduction of diseased animals into healthy herds. His cultures from the closed uterine cavity were pure. The extension of the infection into the uterine cavity is significant. The fact probably has a definite relation to the induction of abortion and sterility. Abortion, retained after birth and pyometra are perhaps referable directly or indirectly to the invasion of the uterine cavity by the organisms. Others have recognized the organisms in the degenerated ovaries. These facts or assumptions exert an influence upon the prognosis of the malady.

The experiments of Ostertag and others indicate that the period of incubation is very short, 2-5 days, and that sometimes irritation is evident within 24 hours.

The granular elevations in the mucosa are due to swelling of the lymph follicles in the vulvar mucosa. They are most prominent in heifers.

The complications and sequelae of granular venereal disease are diverse and important.

Abortion. European authors are practically unanimous in regarding it as the cause of much of the abortion in cows. Some regard the disease as identical with "contagious abortion", while most observers regard it as wholly distinct, nevertheless highly important as a cause of abortion. Many have observed 20, 50, 70, and 80% of abortions for one, two or more successive years. In other affected herds, the disease exists for several years without the occurrence of abortion. In America we have no data available upon the question, beyond the observations related above. In numerous herds, where the disease exists in a mild form, no history of prior abortions can be obtained. We have no positive data how long the disease has existed in any one herd, but its wide dissemination, its presence in well nigh every herd in the regions inspected, indicate that it is not new. In our observations, 50% of abortions appears to represent the maximum. It is not rare in the dairying districts of this state for 80% to 90% or more of the pregnant cows to abort, but we have not, in the brief time elapsing since the recognition of the malady, had opportunity to determine the presence or absence of the

malady in such herds. Whenever the vulvar lesions are generally intense in a herd, we have observed abortion in a serious degree, 10–50%. When the vulvar lesions in the herd are as a rule mild, abortion is rather unimportant or absent.

Premature births are also not rare. They occur in those herds where abortion is common. The calves are weak, though some of them survive. Prematurely born calves apparently suffer directly from the infection in many cases, and repeatedly emit a peculiar bleat which dairymen recognize as belonging to contagious abortion.

Retained placenta is common, following abortion, premature birth and calving at full term. The retention is comparatively severe and serious. It occurs in well kept, vigorous cows and heifers, as well as those which are emaciated or weak.

Septic metritis, septicæmia, pyæmia, and pyometra frequently follow abortion, premature birth and full term parturition. These complications are severe and malignant. They offer otherwise the usual symptoms, course and prognosis.

Death of the fetus, without expulsion, but undergoing emphysematous decomposition instead, occasionally occurs. The fetus perishes; the cervical canal dilates tardily and incompletely; emphysema occurs promptly; the uterus becomes paretic from distension or gangrene; no visible, or only feeble, labor pains occur; and the first symptom to attract the owner's attention is the protrusion from the vulva of decomposing afterbirth, or the appearance of a dirty reddish or brownish, thin, fetid discharge from the vulva.

Diseases of the ovaries are among the most common and serious complications and sequelæ. These have been alluded to in our account of the prevalence of the disease in various herds. When the disease is mild in a herd, ovarian diseases may be unimportant or absent, but when severe, 10–50% of the animals may suffer from ovarian diseases, and become thereby sterile.

Cystic degeneration of the ovaries is the most common form of resulting ovarian disease. We have already discussed this disease under "Sterility" on page 161.

Persistent, hypertrophied corpora lutea are also common following this disease. These too have been discussed while dealing with sterility.

Accompanying these ovarian diseases are frequently nymphomania or absence of estrum (stillochsigkeit). One large, vigorous heifer in Herd 2 aborted at 2 years, and after an interval of 6 months has not been in estrum so far as discovered. The left ovary contained a hypertrophied corpus luteum 1½ inches in diameter. It was crushed out. Three weeks later, another of similar size had formed in the same place. It too was pressed out. These diseases may possibly recover spontaneously. In mild cases of the disease, a large proportion of cows breed, if the cysts or yellow bodies are pressed out.

Abscess of the ovaries occasionally occurs. In one case, we diagnosed the condition by rectal palpation, supported our diagnosis by digital exploration through an incision in the vagina as for spaying, and verified the conclusion by post mortem examination.

Inflammation of the oviducts, pyosalpinx, is also observed. Presumably the diseases of the uterus, oviducts and ovaries are due to an extension of the infection along the genital tract, involving the oviducts, which may leave them permanently affected, containing pus (pyosalpinx) or causing atresia. When ovaritis or abscess of the ovaries occurs, the pavillion of the oviduct may become adherent to the gland.

The significance of the disease to the cattle breeder is highly important. European investigators, in Switzerland, Austria, Italy, Germany and Denmark, are practically unanimous in regarding the disease as one of the worst scourges known to dairymen. Hutyra and Marek (Special Pathology and Therapy of Domestic Animals), Friedberger and Fröhner (Special Pathology and Therapy), Ostertag, Hess, Zschokke, Nielsen, and other European investigators, teachers, and authors of the highest rank, unite in regarding the malady as exceedingly serious from the standpoint of economics. Some observers regard it as more to be dreaded, economically, than Foot-and-Mouth Disease.

The data submitted in regard to the various infected herds investigated by us indicate that it is no less serious in America. The fact that some affected herds apparently suffer no ill consequences from the malady neither removes nor ameliorates the losses incurred in others. In one herd, where tuberculosis has existed in a large measure and the Bang method is being applied, the

manager is very emphatic in the view that the granular venereal disease is much the more expensive and dreadful of the two maladies, coëxisting in the herd.

The frequently appalling losses from abortion, and the sterility accompanying the malady, make it highly important that the dairyman and cattle breeder recognize this as a serious affection, and enlist the best veterinary advice for the purpose of preventing and eradicating the disease.

To the veterinarian, the recognition of the malady, and its importance, is of even greater consequence. "Contagious Abortion" and "Sterility" have long been a nightmare to the American veterinarian. He has been helpless to extend any scientific aid or advice to the dairyman or breeder, and has opened the way and left the field unoccupied and undisputed for the charlatan, with his nostrums for abortion, and his panaceas, impregnators and sorcery for sterility.

If the veterinarians will but recognize and scientifically study this malady, much of the abortion and sterility may be brought under control, and a long-standing, unfortunate odium of inefficiency in reference to these common diseases removed.

The clinical proof of the seriousness of the malady, and its connection with abortion and sterility, is well supported by our observations, as well as by the testimony of the highest European writers. The relation of the granular venereal disease to abortion and sterility is supported by the following data, already enumerated above:

1. In each herd where abortion and sterility are causing, or have caused, serious losses, the granular venereal disease is very prevalent, and of medium or severe degree.

2. The amount of loss from abortion and sterility is in harmony with the intensity of the visible lesions. If the general average of the lesions in the herd is intense, the losses are severe; if the lesions are mild, abortion and sterility are rare or may be absent.

3. In infected herds, when the animals are kept in separate groups in different stables, and the disease varies in intensity in the different stables, abortion and sterility show like variations.

4. In affected herds, adult animals which show no lesions in the vulva, without exception breed regularly and do not abort.

5. No other tangible explanation for the occurrence of the abortion, or of the ovarian, uterine or tubal disease leading to sterility, has yet been offered.

The prognosis of the disease, based upon European observations and those thus far made in America, is very unfavorable unless vigorous prophylactic and curative measures are instituted. Some believe in spontaneous recovery, and there is much to support this belief. In one stable in Herd 2, there is a number of aged cows, which are apparently sound, breed regularly and promptly, and give birth annually to healthy, vigorous calves. These animals stand side by side with diseased cows year after year, and are served by the same bull, and the diseased and healthy cows are groomed with the same utensils and handled by the same persons without precautions. These facts combine to indicate either that these cows have always possessed immunity or have at one time been diseased, have recovered, and acquired immunity against the malady.

How long a time is required for such spontaneous recovery is purely speculative. In most of the herds observed, 50 to 80% of the aged cows are now affected, and the history of most of these herds indicates that they have been infected four or more years. If these assumptions are correct, the outlook for early spontaneous recovery is certainly poor. A pregnant affected cow brought to the college has now been under observation five months, is not exposed to fresh infection, and is well kept; but the lesions are now as pronounced as they were when first examined.

Our observations indicate, however, that diseased animals, after a time, acquire a degree of immunity against the effects of the disease. A cow aborts one year, perhaps a second year, and possibly a third, and then proceeds to carry her calf full time, and it is born vigorous and healthy. In an aborting herd, the body of the herd largely ceases to abort. New cows introduced into the herd very largely abort. Heifers raised in the herd, and probably infected at the first breeding, abort the first calf; and, if they remain fertile, probably abort the second calf; and, passing this ordeal, may breed regularly.

The prevalence of sterility is apparently somewhat analogous. If the cow continues to breed for the first few years after she has become diseased, she will probably continue to breed permanently. Sterility is very common and ruinous in herds where the disease is already present in the virgin heifers, and the basis for the sterility is laid prior to coition. Such sterility defeats the breeder and dairyman wholly.

The acquired immunity to abortion affords the charlatan his opportunity to play upon the credulity of the owner and profit by the sale of his nostrums. If he sells his nostrums at the opportune moment, the owner believes a cure has been effected, when in fact there is an acquired immunity to abortion in the animal, though the actual disease is still there, ready to spread to other susceptible animals, or, upon provocation, to again flare up and cause abortion, sterility, or other disagreeable consequences.

Intelligently handled, the prognosis is good. Such is the general view of European authors, and such are the indications based upon our observations. Our experience is too brief, however, to warrant unqualified acceptance of any of the conclusions to which we may have come. The cure of the disease is no idle task.

The germs, being deeply imbedded among the epithelial cells and in the follicles of the genital mucosa, can neither be readily washed away nor killed in position. Evidently the basis of treatment is disinfection, but the thorough destruction of disease-producing organisms so deeply entrenched is a difficult task. Yet the experience of others, and our brief efforts, indicate that it is by no means a hopeless task, but one which promises definite and satisfactory results, at a very small expenditure of labor and material, when compared with the benefits to accrue.

The prophylaxis is simple. The handling of sterility following the malady is quite satisfactory.

The treatment of the disease is based fundamentally upon disinfection. Four important questions arise, none of which are fully decided. It has not been determined what disinfectant is best, in what degree of concentration the disinfectant shall be used, the extent of the area requiring disinfection, or the manner and frequency of application. Richter (B. T. W. No. 42, p. 774) advises bacillol ointment, and reports cures in 28.6% of cases in 4–6 weeks. Diem, (W. f. T., Vol. LI, p. 181), prefers irrigations to ointments, and commends ½-1% formalin. Wohlmutter (Thierartzliche Centralblatt, 1906, No. 2, p. 4) favors bacillol ointment in capsules, and considers two months the minimum time for healing. Raebiger (B. T. W., 1906, No. 13, p. 241) advises a 6-10% bacillol ointment as the best method, and applies this with a special syringe. This he would alternate with a 2-3%

iodine ointment. Poschel (B. T. W. 1906, p. 323) advises a mixture of lard and bacillol enclosed in gelatine capsules and inserted with the fingers twice weekly into the vagina. Blau (Allatorvosi Lapok, 1906, No. 2) recommends 3% creoline injections, with which he claims to induce a cure in 8–10 days (?).

Ostertag (Monatshefte f. Prakt. Tierheilkunde, 1901, p. 532) would handle the malady with a 2 to 5% solution of lactic acid or 2 to 5% solution of creolin. He warns against stronger solutions than 2.5%, because they irritate greatly and cause continued straining. He excludes silver nitrate as a disinfectant on account of its cost. He warns veterinarians to use care in prescribing to laymen, and to get the measurements precise. Such irrigations of the vagina should occur 2 to 3 times daily.

Ostertag, in harmony with the recommendations of R. Fröhner, Martens and Ellinger, recommends the following measures for control and eradication :

1. The isolation of the sound from the diseased, as far as possible.

2. Disinfection of the stables, especially of the stanchions, floors, gutters and passage ways.

3. Cleansing the vulva and neighboring parts from the accumulated vulvar discharges.

4. Withdrawal of affected cows from breeding.

The same rule should be applied to breeding bulls. If there are evidences of preputial discharges, the bull should not be used for breeding until apparently cured.

In infected herds, the penis and sheath should be disinfected. Ostertag is of the opinion, also, that the disease should be officially recognized, and dealt with as contagious by the veterinary police service.

Without noteworthy exception, all investigators report the malady very obstinate to handle, requiring vigorous and persistent treatment, but finally yielding.

Our experience in handling has been confined to Herd 2. In this herd, a stable containing 38 cows and heifers was placed under treatment on March 6th, or the following days.

Two cows were placed upon vaginal injections of 0.5% carbolic acid on March 7. From March 7–15 inclusive, No. 1 apparently improved. On March 16, she strained severely, and the straining was continued after each irrigation, along with increased irritation and injection of the genital mu-

cosa, and increased discharge, until the 18th, when treatment was omitted. On the 19th, 1% solution of soda bicarbonate was injected, which caused no straining, but the irritation and increased vaginal discharge continued until April 4th, when she was placed upon daily vaginal irrigations with 0.75% bacillol. Since that date there has been gradual improvement, and no further change has been made.

In No. 2 no irritation appeared until March 20th, and then only slight, but it persisted to some extent, and the irrigations were continued until April 4, when the improvement was slow and unsatisfactory, and the treatment changed to 0.75% bacillol.

A third cow was handled by inserting into the vagina, once daily, a gelatine capsule containing two drams of powdered iodoform. This treatment was continued from March 7–17th, with constantly increasing irritation of the vulvar mucosa and increasing muco-purulent discharge. At this time a change was made to 0.5% carbolic acid, which caused much irritation, and another change to 1% soda bicarbonate solution, which was continued until March 30th. A return was then made to 0.5% carbolic acid, which was continued with little improvement till April 4, when a change was made to 0.75% bacillol, since which time progress has been satisfactory.

A group of 7 cows, 5 on March 6 and 2 on March 7, were placed upon daily vaginal irrigations of 0.75% bacillol. Each cow improved markedly and satisfactorily from the first. The irrigation caused no straining, the vaginal discharge decreased, the injection of the vulvar mucosa receded until, on April 26, they had so far recovered that it was advised to breed them whenever in estrum. The granular elevations were still present, but very inconspicuous, flattened and pale. One of this group had been served by 4 different bulls, in all 8 services, and aborted at 8 months on February 2, 1909. At beginning of handling, pyometra was present, and the uterus contained about 1 gallon of pus. The os uteri was firmly closed. The ovaries could not be grasped per rectum. The uterus was massaged per rectum from before backwards April 4, the uterus was normal. The right ovary contained a yellow body ¾ inch in diameter, which was pressed out. The left ovary was normal. Between April 26 and May 23, the cows in this group had been bred. Inspection on May 23 showed irritation, apparently as a result of copulation, in but one animal, the cow which had suffered from pyometra.

On March 6, a group of 5 cows was handled by introducing deeply into the vagina of each a gelatine capsule containing 2 drams of powd. iodoform. This was continued daily until March 17th, or 10 days. The muco-purulent discharge, the irritation, and the prominence of the granules increased, but the patients did not strain.

On March 17, each animal in the group received an application of ointment containing 5% each of iodoform and tannin. This caused intense straining, and the experiment was discontinued.

On March 18, the group was placed upon 0.75% bacillol, since which time the animals have slowly improved, but, after more than 5 weeks under bacillol, did not show such improvement as those which had been placed on bacillol from the first had shown after 3 or 4 weeks of handling. Appar-

ently the iodoform treatment had proven harmful, and interfered with the progress after the cases had been placed on bacillol.

A group of 4 virgin heifers received, March 6, one gelatine capsule each, containing 10% bacillol ointment, introduced deeply into the vagina. For a few days they appeared to bear the ointment well, and it was repeated daily. Gradually irritation appeared and increased, the discharge became more conspicuous, the vulva became swollen, straining began and loss of appetite occurred. On March 12, the irritation had become so marked that treatment had to be suspended. In place of bacillol ointment, we used, for a day or two, a 0.1% permanganate of potash solution, and on the 17th changed to 5% bacillol ointment. This could not be borne, and we again used 0.1% potassium permanganate, under which the irritation abated, but no marked progress was made. On April 5, two of the heifers were removed, and the other 2 were changed to 0.75% bacillol.

A 2½ year heifer, after having been served 9 times and by 5 different bulls, presumably conceived, and later aborted. This conclusion was predicated upon suspension of estrum for 4 months, after which it returned. On March 6, 1909, she received an irrigation of 1% carbolic acid, tannin and glycerine, which caused severe straining for 1½ hours. On March 7, the vulvar mucosa was much irritated. She received a 1–4000 corrosive sublimate solution, which caused severe straining. The same was repeated on the 8th. March 9 she received a 2% solution of lactic acid, which caused very intense straining. On March 10, she received an application of 10% carbolic acid ointment, which caused some straining. This was continued for 5 days. On March 15 and 16, she received 10% bacillol ointment, which caused slight straining. From March 17 to April 5, she received daily a 2% iodine ointment, with little straining or irritation. On April 6, she was placed upon 0.75% bacillol, since which time she has improved slowly.

A group of 5 cows received, on March 6, vaginal injections of 1% carbolic acid; all strained violently for 1½ hours. As all were in somewhat advanced pregnancy, it was deemed dangerous to continue so irritant an application.

On March 7, each animal in the group received in the vagina a gelatine capsule containing 2 drams iodoform. This treatment was continued till March 16, accompanied by little or no straining, but the irritation and discharge did not improve. On March 17, a change was made to 5% carbolic acid ointment, which caused straining and irritation.

On March 18, a change was made to irrigations with 0.1% potassium permanganate solution, under which there was slight, but unsatisfactory improvement until April 6, when they were placed upon 0.75% bacillol solution, from which date slow improvement has occurred.

A group of 5 affected animals was placed upon daily vaginal irrigations of 0.1% potassa permanganate on March 6. All seemed to do well and improved slowly for 3 or 4 weeks, when they began to show irritation and increased discharge, without any marked decrease in the number or size of the granules in the vulva. One, well advanced in pregnancy, showed signs of approaching parturition on April 7, and the vaginal irrigations were suspended on April 14th. Another, also pregnant, showed increased irritation, and on April 4 the potassium permanganate solution was reduced

to 1-2000, but the irritation continued, and the irrigation was stopped. A third animal behaved similarly to the two preceding; treatment suspended because of approaching parturition. Calved March 22, returned to stable March 29 and treatment resumed. The animal was ill April 1, apparently from overfeeding. On April 17 she was removed to another stable, and treatment suspended. The two remaining animals made little or no progress up to April 4, or one month, and the experiment was abandoned. The general result from potassium permanganate irrigations had proven unsatisfactory. At first it was deceptive, the animals apparently improving and straining none, but later irritation became marked, more or less straining appeared, and there was a decided increase in the muco-purulent vaginal discharge. At the end of the experiment the granules were as numerous and prominent as ever, Three of the group were placed upon bacillol at the close of the experiment, but after three weeks of handling were not nearly so much improved as new cases placed upon the bacillol at the same time.

A group of 5 animals received, March 6, vaginal injections of 2% bacillol solution, which induced severe straining for one hour. A change was made on March 7, to 10% bacillol ointment in capsules, which by March 17 was causing so much straining that it was abandoned, and for one day a 0.75% bacillol solution used. On March 18th a 5% bacillol ointment was tried, but again caused irritation, and on the following day 0.1% potassium permanganate solution was substituted, and continued with indifferent and unsatisfactory results until April 19, when a change was made to 0.75% bacillol.

Owing to many inquiries concerning the efficacy of various proprietary abortion nostrums, it was decided to test one of them alongside other remedies for comparison. For this purpose, one of the best known was selected, and a supply ordered. A group of 4 cows was placed upon this remedy, each animal receiving the treatment daily, according to directions, from March 17 to April 18, without any improvement in the symptoms If any change, they were worse than at the beginning. They were then placed upon 0.75% bacillol solution, since which their progress has been slow, but definite.

On April 4, a group of 40 cows, all in milk, some pregnant, were placed upon daily vaginal irrigations with 0.75% bacillol solution, vulvar irrigations with 2% bacillol and daily washing of the tail, perineum and buttocks, with 2% carbolic acid solution. Inspection 22 days later, on April 26, showed uniform and satisfactory improvement.

Inspection of this group on May 23, or 49 days after commencement of the treatment, revealed a very satisfactory condition. All had greatly improved. Quite a number had been bred without causing any visible relapse. In 3 or 4 cows the breeding had apparently retarded the progress toward recovery, though only slightly. In general the granules were decreased in number, flatter, less conspicuous, the vulvar mucosa slightly or not visibly irritated. Some animals, badly affected at the commencement of the handling, 7 weeks before, were to all visible appearances wholly recovered. Everything indicated a complete recovery at an early date.

In all the foregoing experiments, the cows received daily washings of the tail, buttocks and perineal regions with 2% carbolic acid solution, except for a short interval when, in the absence of carbolic acid, lysol or bacillol was used instead. It was found, however, that 2% bacillol or lysol on the skin proved irritant, causing much switching of the tail and stamping with the feet. It was consequently reduced, for external washing, to 1%.

In the foregoing work we limited ourselves, at the beginning, to the external washings and the introduction of the ointments, powders, solutions, etc., deeply into the vagina. The latter caused much irritation and straining whenever even moderately strong antiseptics were introduced.

Above we have quoted European authors as using and recommending vaginal irrigations with 2–3% bacillol, creolin or lysol solutions, or other antiseptic solutions of similar strength. We were quite unable to use these, because of the straining and irritation. But we found that we could use concentrated antiseptic applications in the vulva without serious difficulty.

European authors do not definitely record the amount of irritation induced by 2% vaginal injections. We do not understand how good results could be obtained under such violent irritation as we induced with concentrated solutions. In our experience, the irritation retards recovery. After the use of irritant injections, we have found that not only has no progress toward recovery been made while they were used, but, after their abandonment, the application of otherwise efficient remedies induces a much more tardy improvement than in cases which have not been touched. Possibly the quoted European authors do not differentiate between the vulva and vagina, and introduced the antiseptic solutions into the vulva only. If so, our experience thus far coincides, as we can use similarly concentrated solutions in the vulva.

Hess, speaking of sterility, intimates that much harm is done by using too concentrated vaginal injections, inducing thickening of the vaginal walls, adhesions and other lesions which may cause insurmountable sterility.

Based upon our limited experience, we advise daily vaginal irrigations of 0.75% bacillol solution, preceded by disinfection of the tail, perineum and buttocks with a 2% carbolic acid solution and followed by a vulvar irrigation

with 2% bacillol or carbolic acid. The solution should have a temperature of approximately 100° F.

We advise that a suitable galvanized iron, or other pail, of about 5 gallons capacity, be procured, and fitted with a metal faucet. A 10 foot pure gum horse stomach tube should be attached to the faucet. The stomach tube is by all means the best appliance known to us for conducting the fluid from the container to the desired part. When washing the external parts, the operator can shut off or control the rate of flow by placing a finger over the outlet of the tube. The tube is smooth and pliable, so that its introduction deeply within the vagina can work no injury, and yet has enough rigidity that it can be introduced through the vulva into the deepest part of the vagina without introducing the hand.

A heavy wire is tightly stretched just behind the row of cows, and a pully and hook placed upon it. The wire should be stretched by means of a heavy screw bolt, so that the track can be so tightly stretched that it will not materially sag in the middle when loaded with the five gallon pail. The pail containing the solution for washing or for irrigating the vulva or vagina is then suspended from the pulley, the stopcock opened, and the work carried out.

We believe it desirable as a rule, to introduce the remedy to the deepest part of the vagina, and not content ourselves with irrigating the vulva only. The findings of Ostertag and others, that the infection sometimes gains the uterine cavity, suggest that in some cases the irrigations must extent into that cavity. After the outside is well washed, the operator may open the vulva with a thumb and finger, and flush it with the same solution, but it is better, in our judgment, to disinfect the vulva *after* the vagina has been irrigated. The vaginal irrigation is to be performed by inserting the tube, by a somewhat rotary movement, through the vulva, deeply within the vagina, where it is gently maintained until the vagina is well filled. When the vagina becomes thoroughly distended, the fluid obliterates the mucous folds and reaches every part. This sometimes requires 2 or more quarts of solution. Ordinarily about 5 gallons are required for washing the external parts or irrigating the vaginæ of 15 cows. The complete handling of 50 cows for one day can be accomplished by one man in about 2 hours. The cost per day for disinfectants by this plan is about 2.5 cents per cow.

Bacillol appears to possess some very important advantages as a disinfectant in this disease. The saponaceous solution breaks up and washes away the vulvo-vaginal discharges apparently more completely than any other disinfectant we have tested. Permanganate of potash seems to precipitate the muco-purulent discharge and cause it to remain in place, and other disinfectants behave somewhat similarly. Lysol, cresol, and some other drugs of this group, may prove quite as efficient. One party reports good results with 0.01% corrosive sublimate. Ointments, highly recommended by European writers, have failed in our hands. Perhaps we have introduced them too deeply into the vagina, when they should have been placed in the vulva only. Apparently 60–90 days are required for successful treatment.

The handling of bulls should be similar to that advised for cows. With a gravity apparatus, we irrigate the sheath of the penis daily with 0.75% bacillol. We use, for inserting into the sheath, a pure gum horse catheter. We direct that after the insertion, the preputial orifice be held shut until the sheath is fully distended and all mucous folds obliterated, so that the fluid shall reach every part.

In the presence of pyometra, the vaginal irrigations with warm bacillol solutions seems to favor the normal contraction of the uterine walls and emptying of the cavity. This may be aided by massaging the distended, paretic organ, from before, backwards, through the rectum. As soon as the ovaries can be reached per rectum, any cysts or persistent yellow bodies should be crushed out. When an affected cow calves or aborts, the uterine cavity should at once receive careful attention. It should be thoroughly irrigated with the warm, 0.75% bacillol solution, three or four times daily till the afterbirth comes away. When the afterbirth is easily detached, it may be manually removed.

After the expulsion of the afterbirth, the uterine cavity should be irrigated once or twice daily as long as the cervical canal remains open and uterine discharge continues. Any neglect in this respect may lead to a chronic uterine infection to be followed by sterility or abortion. For a full discussion of retention of the afterbirth see page 791.

The prophylaxis of the disease is important and economic. In introducing new animals into a sound herd, precautions should

be taken against the entrance of the infection. There is every reason why the buyer of cattle should resort to the same expedient in guarding his interests as has long been common among horsemen--a veterinary examination for soundness. In cows and heifers, the disease is usually easily detected. At present, any examination of a bull may be unreliable. Of more value are the examinations of the cows which he has recently served. A bull calf, which has not been used, but has been kept in a herd where the disease exists, should be regarded as dangerous for introduction into a clean herd until subjected to quarantine with daily disinfection.

The prevention of the extension of the disease to heifer calves in an infected herd is apparently a simple matter. In Herd 8, 66% of all females are diseased, while of virgin heifers but 17% are affected. In Herd 2, the percentage of infection was 61 among heifer calves. In Herd 2, during the time elapsing between inspection in January and inspection on May 23rd, each heifer recorded as sound by the first inspection had become infected, without having been bred. From our investigations, it appears highly probable that the disease is transmitted to heifer calves largely by grooming with utensils befouled by use on diseased animals. Caretakers may carry the disease to calves in other ways, which prudence would suggest should be avoided. If practicable, they should be kept in separate stables or enclosures, and not groomed with utensils used on diseased animals. They should on no account be served by suspicious bulls.

In Herd 2, are some very young infected heifer calves which have not been groomed. Having drawn the attention of the manager to the dangers of grooming with infected utensils, no further grooming occurred. Still the calves were infected. Inquiries revealed the fact that the calves had suffered from diarrhae and the feces had been washed from the tail, vulva, etc, with a sponge used for sponging away the muco-purulent vulvar discharges of neighboring diseased cows. The sponge had been used in water containing a little creolin, far too little to disinfect,

The bull is the fundamental transmitter of the disease, through copulation. A herd bull should not be allowed to serve strange cows, unless they are regarded sound by a competent examiner. Even then, it is good economy to regard the cow as suspicious and disinfect the prepuce and penis of the bull immediately after coïtion.

When the disease exists in a herd, all breeding should be suspended during treatment. When it is deemed safe to resume breeding, the sheath and penis of the bull should be disinfected by irrigating, immediately before and after each service, as advised above. The vulva of the cow should be carefully inspected daily after service, and antiseptic irrigations resumed at any time conditions may so indicate.

The attitude of veterinary sanitary authorities toward the disease in this country is yet to be determined. In Europe, many investigators recommend listing it among the serious infectious diseases, and controlling it by quarantine.

It is to be hoped that a careful study of this malady will now be made by numerous practitioners, and its nature and best mode of handling promptly determined.

APPENDIX II.

THE VENEREAL DISEASE OF SHEEP.

Without having been aware of its existence in America, we have inserted on page 108, a brief description of a venereal disease occuring in sheep in Great Britain.

According to a recent communication from Mohler of the Bureau of Animal Industry, this venereal disease of sheep prevails in certain portions of the sheep raising section of the West, especially in Montana and Wyoming. His investigations, as yet unpublished, indicate that the bacillus necrophorus is the causative agent, and that the infection may be transmitted to healthy sheep by injecting pure cultures of this organism into the sheath or vulva, if a slight abrasion or catarrhal condition of the mucosa is present. The disease is apparently identical to that described by McFadyean, Flook, and Williams, and is most frequently observed in this country during the fall, winter and early spring. It is not uncommonly found to co-exist with similar ulcerations and wart-like crusts on the legs, lips and muzzles of sheep (necrotic dermatitis). The latter affection is known locally as lip and leg ulceration. Bucks with infected lips are said to contaminate the vulvæ of ewes by nosing them, and the sheath and penis of the bucks in turn become involved by copulation.

The treatment will be found very efficacious if the disease is handled like contagious abortion. The healthy sheep should be separated from the diseased, and the sheath and vagina irrigated with mild antiseptic solutions, while the external ulcers should be covered with vaseline containing five per cent carbolic acid.

ERRATA.

On page 129, in description of Fig. 14, for "CC," read "UC."

On page 687, for "**Vaginal Hysterectomy.**" read "**Vaginal Hysterotomy.**"

On page 855, Page Heading, for "Evorsion," read "Eversion."

On page 244, 3d line, for "Uuder," read "Under."

On page 149, Page Heading, for "Phymosis," read "Paralysis."

On page 104, Title, for "Granulamota," read "Granulomata."

On page 141, Heading, for "Overwork," read "Over-feeding."

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