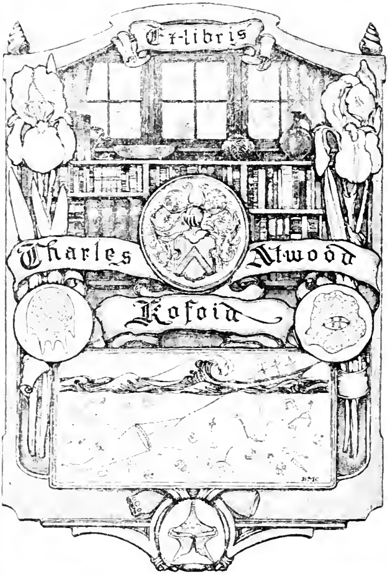
TREATISE ON MICROSCOPICAL DIAGNOSIS.

VON DUBEN.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GUSTAF VON DÜBEN'S

TREATISE

ON

MICROSCOPICAL DIAGNOSIS.

With 71 Engravings.

TRANSLATED, WITH ADDITIONS,

BY

PROF. LOUIS BAUER, M.D., M.R.C.S. ENG., &c.

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TO

J. MARION SIMS, M.D.,

THE FOUNDER AND SURGEON OF THE WOMEN'S HOSPITAL OF NEW YORK,

IN APPRECIATION OF HIS SURGICAL INGENUITY, AND HIS NOBLE QUALITIES AS A GENTLEMAN AND A FRIEND, THESE PAGES ARE RESPECTFULLY INSCRIBED BY THE

Translator.

PREFACE.

THE microscopical diagnosis, by Gustaf von Dueben, has acquired in a very short time an extraordinary popularity, and this fact alone is a sufficient evidence of its practical usefulness.

The want of so brief and practical a manual in German literature for the student and practitioner, has induced Dr. Tutschek to translate it. In Germany it has also been received with general favor and approbation. The German translation has materially enhanced the value of this little book by supplementary additions, derived from the progress made in microscopical diagnosis during the period intervening between its first publication in Sweden, and its subsequent translation.

With the desire to render this compendium accessible and serviceable to the profession of this country, I have undertaken its translation into the English language, and feel persuaded that it will contribute to increase the already existing interest in microscopical research, and aid in realizing the diagnostic value of the microscope.

As it is designed for incipient microscopists, I have taken pains to render it comprehensible by plain language, and have as much as practicable evaded the use of technical terms.

In conclusion, I must acquit myself of the pleasing duty of acknowledging the meritorious labors of Mr. Thomas Cuzner, a young artist of New York, who has furnished the carefully executed diagrams that illustrate the text.

LOUIS BAUER.

BROOKLYN, *August*, 1859.

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TREATISE

ON

MICROSCOPICAL DIAGNOSIS.

INTRODUCTION.

The great progress of Medicine in the present century is pre eminently the work of microscopical research. Our knowledge of the elementary structure of organisms is exclusively based on the Microscope, and modern Physiology is its obvious result. Again, the latter furnishes the essential premises to Pathology.

That organic chemistry has materially participated in this advancement cannot be denied, however imperfect its contributions may hitherto have been. But the microscope has, in practical usefulness, obviously excelled the chemical re-agents both in precision and facility.

The exaggerated hopes placed in the infallibility of the microscope have certainly not been realized; for its application has its optical limits, beyond which its scientific and practical utility cannot be extended. To place implicit reliance upon the microscope, to the exclusion of other channels of observation, would lead to as much error and disappointment as would its total neglect.

Whatever may be the present imperfections of Microscopy, and the errors propagated by this method of medical investigation, its usefulness has been fairly demonstrated, and its practical results are such as to invite the continuation of further researches.

Every method must naturally be defective at its beginning, and become gradually perfected by constant practice. The microscope, however, as well as the method, has, nevertheless, already attained an influence on the development of natural science far beyond original anticipation, although its use is of but comparatively recent date.

In both Histology and Physiology the microscope has firmly established its superiority. Through the medium of these fundamental branches it has benefited medical science at large, and of late it has begun to lend its material aid to Diagnosis. Possessed of accurate knowledge of the anatomical elements in health and disease, the microscope will frequently assist us in disclosing obscure or otherwise imperceptible morbid changes. Sometimes it may delude and give rise to erroneous inferences, although the observer and the instrument used may be more at fault than the method. Yet more frequently it will reveal the true state of elementary structure and its deviation from the normal state, and thus aid and correct our pathological knowledge.

The object of this Compendium is a brief compilation of *all microscopical facts* appertaining to medical Diagnosis, excluding all that is doubtful or hypothetical. And for such a compendium there is yet room in medical literature, notwithstanding the works of Hoefle, Beale, and others, which are either superseded by new discoveries, defective in their illustration, or too voluminous.

Minute technicalities, and detailed chemical analysis, have been excluded as not strictly belonging to the subject, although the author is fully sensible of their general importance; for satisfactory and correct conclusions can only be drawn from the controlling combination of all recognised methods of investigation.

The following general rules for microscopical examinations may be found useful:

1. The various parts of objects, presenting marked differences even to the naked eye, should be carefully examined.

2. Each examination should commence with as low a power as the object will permit, and the latter should be retained in as natural a position as practicable. The power should then be gradually increased, and even the highest should be tested, if the size of the object will admit of it.

3. Different specimens of the same morbid material should be successively placed under the microscope, until conclusive results have been obtained.

4. The objects for examination should be fresh, and should be observed in different conditions, so as to determine what is normal, morbid, or accidental. For the same reason false light and focus may be used in order to discern optical delusions. The greatest cleanliness is indispensable. The object-glasses and lids are best cleaned with soft linen and chamois, and should be examined for dust and fibres before being used.

5. The objects should be neither too large nor too thick.

6. The best light for microscopical examinations is derived from illuminated clouds, or a clear northern sky. Argand's lamp and sunlight may also be employed, when mollified by the interposition of a plate of ground glass.

7. At the first examination of wet specimens, the same fluid should be used with which they are naturally surrounded or endowed.

8. The following re-agents should always be kept in readiness for use: distilled water; concentrated and diluted acetic, sulphuric, and nitric acids; caustic potash, sulphuric ether, and oil of turpentine. For ordinary purposes these will suffice.

9. To the observer it is to be recommended that he make drawings of all objects, note down their size, character, position, the magnifying power employed, etc. In doing so all the details will be better understood and remembered.

I. THE SKIN.

The results of microscopical Examinations in general upon the structure of the Skin,the classification and diagnosis of cutaneous diseases, as well as its importance upon Therapeutics, belong to Dermatopathology, and are, therefore, no subject for our consideration. This essay has to deal with microscopical Diagnosis only. In this respect the microscope is invaluable for the perception of certain Parasites, vegetable and animal, infesting the skin and causing certain forms of cutaneous affections.

1. EPIPHYTES.

A great variety of vegetable parasites of the lowest tribes have been observed upon the integuments, but comparatively few only are of pathological importance. Most of them seem to have been deposited by mere accident. Thus for instance *Trichophyton Sporuloides* of *Robin*, observed in the secretion connected with plica polonica. *Beschorner's* very careful investigations into the nature of this endemic disease have removed all suspicion as to its communicability either by the said alga or the presumed morbid secretion. The *Tricophyton ulcerum* found in an atonic carious ulcer by *Lebert*, and the otherwise most remarkable *Aspergillus* species discovered in the *aural cerumen* by *Mayer* and *Pacini*, seem to be of no greater importance. In fine, the *Puccinia favi* may be mentioned as occurring upon the epidermal scales in *favus* (*Ardsten*). Yet all these parasites present no other practical interest than their accidental or harmless existence upon the skin. Very different is it with those described hereafter, acting, as they do, as direct causes of cutaneous diseases, entering the follicles, the folds or wrinkles of the skin itself; irritating the latter; destroying the hair bulbs and eventually the hair itself, unless counteracted in an effectual manner.

(a.) *Trichophyton tonsurans.*

This parasite belongs to the class of fungi (*Robin*), and its name is derived from "*trix*," *hair*, and "*phyton*," *plant* (*Malmsten*). The adjective *tonsurans* is figuratively chosen, on account of the specific peculiarity of the parasite in destroying the hair in the centre of the scalp, like the tonsure of monks. The disease caused by this tribe of Trichophyton is named by *Cazenave* "*Herpes tonsurans;*" by *Malmsten*, "*Rhizophyton Alopecia;*" by *Mahon*, "*Teigne tondante.*"

Both *Boeck* and *Hebra* are of opinion, that *Puccinia favi* and *Trichophyton tonsurans* are, pathologically speaking, the same parasites, and that the effects of both differ only in degree and not essentially.

The scalp, affected with this disease, exhibits one or more round, dry, grey, and slightly elevated spots, that seem to be thinly covered with fine dust. These spots are either bare or occupied by a few—mostly split—hair-stumps, and generally encircled by young hair and a moist, yellowish-brown ring. A magnifying glass will show a considerable number of hair-stumps, broken off above the skin, their ends divided like a brush. If a portion of the grey dust is scraped off and put under the microscope with some hair-stumps, it will be noticed, that the former consists of epithelial scales and fragments, besides innumerable spores of Trichophyton. In the interior of the hair-bulbs crowds of irregularly grouped spores (Fig. 1, *a a*) will be observed, which, however, occasionally join each other like strings of beads (Fig. 1, *b*). Their pressure upon the bulbs is so great, as to atrophy and destroy them. Where the sheath of the hair, and consequently its resistance, terminates, the parasite bursts the hair-cylinder and spreads luxuriantly over the surface. The hair is thus broken off and a fibrillated stump left, which in its turn is destroyed by direct pressure inside of the bulb.

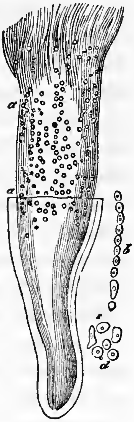


FIG. 1.

Trichophyton tonsurans consists of exquisitely minute spores of 0·003, 0·008, 0·010 Mm. diameter, each endowed with either nucleus or macula, some being constricted and branched, others putting forth regular buds. The spores located within the hair-bulbs are flattened, evidently from their mutual pressure, and the restraint of the fibrous sheath. Being, however, relieved from local restraint and subject to the action of distilled water, they distend to a globular form.

The *sebaceous* material of the follicles should first be dissolved by oil of turpentine, and a power of from 400 to 800 should be used for their examination.

(b.) *Microsporon Audouini.*

A fungoid growth of the same class and tribe as the former, but of distinct botanical species. The disease caused by this vegetable parasite bears great resemblance to herpes tonsurans, both as to its seat upon the scalp, as well as to its symptoms. It differs, however, widely from the latter in its rapid development and the destruction of the hair. Cases are related in which the disease, in the short space of from three to four days, had produced bare spots of from three to four Cm. in diameter. It is, therefore, considered a distinct morbid species, and severally termed Phytoalopecia (Gruby), Vitiligo (Cazenave), and Porrigo decalvans (Bateman).

According to Robin the spores of Microsporon Audouini are round 0·001—0·005 or oval 0·002—0·008 Mm. in size, consequently smaller than those of Trichophyton. They swell considerably in water. Moreover, the Fungus exhibits numerous undulated and branched fibrillæ, forming anastomosis and a complete network, within which the spores are placed. This network has its seat *upon* the hair, surrounds their stems about 2 Mm. from the epidermis, fastens itself about the hair and breaks it transversely off. Gruby opines, that on the average about eight days suffice to break an ordinary hair; thicker ones resist longer.

The microscopical examination of this parasite, the power to be used, and the rules to be observed, are the same as with Trichophyton.

(c.) *Microsporon mentagrophytes.* (Ch. Robin.)

This parasite possesses almost the same botanical character as Microsporon Audouini, exceeding it, however, in the size of its spores, filaments, and reticulated anastomosis. The Micr. mentag. originates in the hair follicles, outside of the hair bulbs, and is distinguished thereby from Micr. Aud., which encircles the hair above the epidermis, and from Trichophyton tonsurans, which grows within the hair bulbs.

Hitherto this fungus has been found in Mentagra (Sycosis menti) only, and Gruby ascribes the contagiousness of this disease exclusively to the parasite. Küchenmeister is inclined to believe, that the Mentagrum of Martial and the Pudendagrum of Pliny, so frequent among the ancient Romans, originated with

Miscrosporon ment. These cutaneous diseases had their seat between the chin and genital organs, and consisted in nodules and tubercles, and were of decidedly contagious character.

(d.) *Microsporon furfur.* (Ch. Robin.)

Microsporon furfur constitutes both the infectious and coloring medium of Pityriasis versicolor, and has its seat *between* the epidermal scales. In carefully scraping the so-called liver-spots and subjecting the substance thus obtained to a power of 400, it will be readily noticed that it is made up of corrugated and folded epithelial layers with interstitial groups of spores (Fig. 2) and a delicate network of fibrillæ (Fig. 2, *a*, *b*). A more distinct view, however, may be obtained by a drop of Solutio potassæ causticæ, which renders the epithelium transparent without injuring the parasite. The latter then exhibits numerous delicate fibrillæ of 0·001–0·002 Mm. diameter, branching and anastomosing with each other. Some are quite hollow (Fig. 2, *a*, mycelium); others contain nuclei and spores (*b*, receptacula); others again show cell-articulations of 0·006 Mm. Between the reticulated meshes the spores are imbedded. The latter are perfectly round, refract the light strongly, contain a delicate nucleus, measure from 0·001 to 0·002 Mm., and show two contours with a false focus.

FIG. 2.

A patient afflicted with Pityriasis versicolor, for four successive years, exhibited the small multangular bodies (Fig. 2 *d*) in great numbers, amongst which, however, only one specimen of Puccinia favi was found.

(e.) *Achorion Schönleinii.* (Remak.)

This fungus belongs to the class of Arthrospores, Tribus Oidiei, and forms, according to *Link*, a species of its own.

Bassis first directed the attention of the renowned *Schönlein*, then Professor in Zürich, to the Muscardine of the silkworm, which proved on careful examination to be caused by an Achorion fungus. The analogy led Schönlein to extend his researches to Porrigo favosa, suspecting the same Achorion to be the cause of that most abject cutaneous disease. And after a long search with an imperfect instrument, Schönlein finally succeeded in discovering the parasite (1839). Since then, encouraged by *Johannes Müller*, the Achorion has been repeatedly the subject of careful investigation, the results of which have been every way corroborative of Schönlein's statement, in honor of whom this epiphyte has been named after its first observer.

The seat of Achorion Schönleinii is chiefly on the scalp, but in solitary instances it is found on other parts of the body, such as the finger nails (*Meissner*). Its transmissibility has been positively demonstrated by inoculation (*Remak*, *Bennet*), even upon an apple (*Remak*), and Bennet has also observed it upon rats.

The most correct description of this achorion species has been given by *Robin*, to which the author can add nothing but confirmation.

According to *Wedl* this parasite originates in two ways. The ordinary growth is from the epidermis. Upon the delicate epidermal scales a very thin, mostly transparent, layer of exceedingly fine amorphous molecules is met with, which is the real matrix or stroma of the fungus (Fig. 3). From this layer the Mycelium (Fig. 3, *a*) puts forth its equally wide, unarticulated, curved, and hollow fibrillæ of 0·003. Mm. diameter. Often, the cylindrical cavity extends into the branches of the Mycelium, but occasionally their cavity is found to be separated from that of the primitive stem. Another, but very analogous, part of the fungus are the receptacles (Fig. 3, *b*), fibrillæ of different sizes, less curved and unbranched.

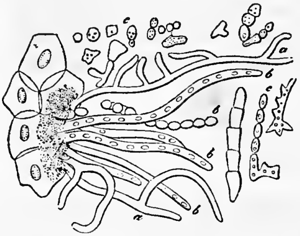


Fig. 3.

The smaller Mycelium-fibrillæ have only towards their ends one or two incipient spores, whilst the larger fibrillæ are filled with more developed ones, imperfectly separated from each other by contraction of the fibrillæ. Their size varies from 0·005 to 0·007 Mm. The third degree of development, or third part of the Achorion, are the spores themselves (fig. 3, *c*), either spherical in shape by 0·003 to 0·007 Mm. in size; or oval by 0·010 Mm. in length. Quadrangular forms with subdivisions may also be noticed. Moreover, they contain occasionally numerous exceedingly small granules with molecular motion.

In the larger and spherical spores there is one nucleus, and in the oval ones there is generally one to be noticed on either extremity. The examination should be made as previously suggested, and with a power of 400 to 600, although the larger fungi may admit a much lower power than that, and have actually been seen by a power of 150. The exceptional growth is in the shape of isolated or connected spores in the hair follicles, gradually encircling, and finally perforating the hair bulbs (Fig. 4).

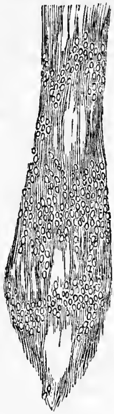


FIG. 4.

As has been already stated Achorion Schönleinii is now admitted to be the ostensible cause of Porrigo favosa, the medium of its transmission. Relief from this disease demands the total eradication of the parasite.

2. EPIZOES.

The same remarks appertaining to the various Epiphytes, observed upon the human body, are applicable to animal parasites. Among the latter there are specimens which have not the least pathological importance, being either accidentally deposited or attracted by uncleanliness. Pulex irritans, Phthirius inguinalis *Leach* (Pediculus pubis *Lin.*) Pediculus capitis and vestimenti, belong to this category.

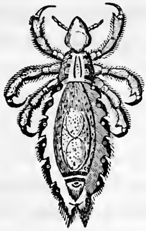
Older medical writers have variously alluded to and described a disease under the name of Phthiriasis, alleged to be caused by the presence of a peculiar species of pediculus (tabescentium), and even, of late, several cases have been related, purporting to confirm the ancients. Among others, an instance has been put on record by Dr. Ekmann of Calmar (Läk. Sällsk. Förhandl. 1851). However this may be, it does not seem as if in modern times a disease had been observed even approximately corresponding with the description of our professional ancestors, to wit, formation of small tubercles in which pediculi generate and multiply to an unlimited number, resisting cleanliness, baths, etc., and gradually leading to tabes and death. Some later observations under the head of Phthiriasis indicate the nature of the error formerly committed, and it is now well understood, that the parasitical Arachnoideæ of domestic animals transmitted to the skin of man will produce effects very similar to those ascribed to that disease. Thus *Vogel* (Path. Anat. pp. 414–15) relates as fact, that the various acarus species of horses, dogs, wombat, cats, rabbits, camels, etc., have produced cutaneous eruptions upon the human skin, not unlike Scabies, and *Bory de Saint Vincent* has described a peculiar acarus which was observed in great numbers on a woman without transmitting the infection to her husband. Furthermore, that the same acarus has been seen by *Busk* on the foot of a sailor. There are, however, indefinite representations, relating to cases in which parasites had infested the skin by accidental communication with animals. More positive is a case of Phthiriasis observed and related by Simon of Berlin.

A woman, despite the strictest cleanliness, and the application of remedies, had suffered for a long while from numerous small animals, very like the pediculus tribe. The parasite, when properly examined, was recognised as Dermanyssus avium, a peculiar acarus of birds, derived in this instance from chickens. Still more decisive is the case of *Erdl*, which could have been much easier mistaken for Phthiriasis. In examining some cutaneous nodules, not unlike Molluscum contagiosum, Erdl found them to contain Dermanyssus. Nitzsch presumes, that this parasite can enter the skin of birds, and believes to have once observed this fact in a green-finch.

But all this tends to demonstrate, that the louse-tribe lives *upon* the human skin, and not *within* its texture.

For comparison, however, the diagrams of the various pediculus species, and the Dermanyssus avium have been annexed (Figs. 5–8).

Fig. 5.

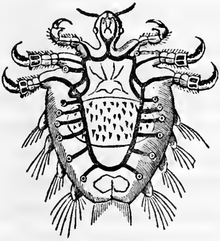


Pediculus vestimenti (female).

Fig. 6.

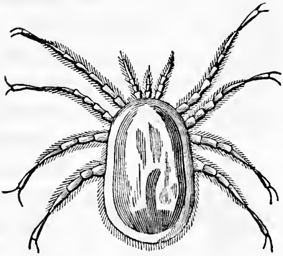
Pediculus capitis (male).

Fig. 7.



Phthirius pubis.

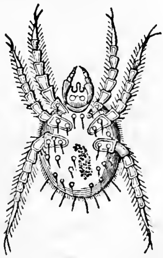
Fig. 8.



Dermanyssus avium.

Dr. Lorentz Tutschek, in conforming to the author's opinions, adverts to the so-called harvest-flea (Leptus autumnalis, Fig. 9), living on dry grass, berry bushes, etc. Coming in contact with the skin, they bore themselves in with their heads, and cause itching, nodules, pustules, and even superficial ulceration. *Prof. Emmerich* could discover no ducts under the epidermis, and *Jahn* is convinced that this insect inserts itself into the skin but for a day or two, and leaves it again spontaneously, without further consequences. Leptus autumnalis can be readily diagnosed by its yellow-reddish color.

Fig. 9.



There are, however, two parasitical Arachnoids, deserving special attention. One is the known cause of Scabies, and the medium of its diffusion. The other has been often observed as a resident of cutaneous follicles in Acne pustules, although its pathological relations have as yet not been clearly determined.

(a.) *Sarcoptes Hominis.*

(Figs. 10 to 13.)

The ancient Arabs seem to have had some knowledge of this parasite. Later zoologists have sometimes adverted to and described this arachnoid. *Linné* received it in his Systema Naturæ, and gave it the name of Acarus exulcerans. From numerous references, it can, however, be demonstrated that little was known of its significance in regard to the human body, until *Renucci*, the Corsican, in 1834 disclosed the mode of its detection in the skin. Since then Sarcoptes hominis has been the subject of numerous investigations, and both its natural and pathological history have been ascertained to a rare degree of perfection. The fact has thus been established beyond dispute, that the presence of Sarcoptes, or its sub-epidermal duct, are the only pathognomonic or reliable evidences of Scabies. In infants, or patients of delicate epidermis, these ducts can be easily found; not so in persons of advanced age, or laborers, whose skin has, by exposure, become firmer or discolored. The principal seat of the parasite is the hand (in 80 cases of every 100), but rarely on the foot, axillary cavity, and trunk (20 cases of 100—*Bourguignon*). The ducts can best be seen and examined between the fingers, or on the volar surface of the wrist, the skin being there comparatively more delicate. Frequently they can be seen with the naked eye, but more readily with the aid of a magnifying glass. The ducts appear as slightly curved and elevated lines of lighter color than the surrounding skin; sometimes with a bluish tint,

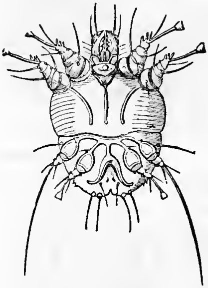


FIG. 10

and as if filled with water. Their length rarely exceeds a few lines. At one extremity of the duct there is mostly, but not always, a small vesicle or papula, and this is the place where the Sarcoptes enters. The other extremity terminates in a whitish point—which is the animal itself.

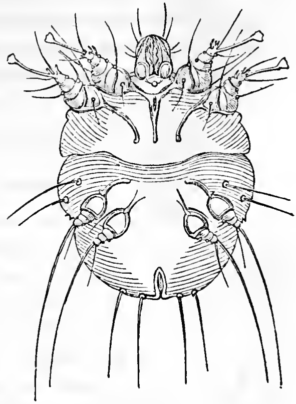


FIG. 11.

With an ordinary or cataract needle, the duct should be split towards its blind termination. On withdrawing the instrument, the parasite mostly adheres to the point of the needle, and when placed upon a black object, its locomotion may be discerned.

In this simple manner Sarcoptes may be found, and thus a reliable diagnosis secured. But for the study of the natural history of the parasite the method of *Eichstädt*, *Hebra*, and *Gudden* should be adopted, which consists in the removal of the epidermal wall of the ducts. For this purpose the skin should be superficially raised in a fold, and removed either by a pair of bent scissors or a sharp knife. The object is then spread upon a glass plate, the raw surface upwards, and thus gradually suffered to dry. So prepared, the object should be covered with concentrated mastic varnish, and examined under the microscope. The duct is then perfectly transparent, and its contour extremely delicate.

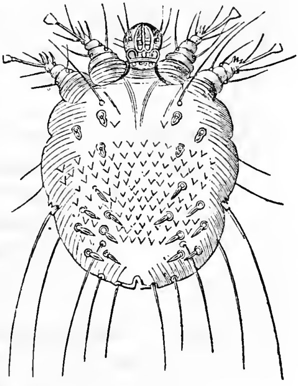


FIG. 12.

The ducts contain female Sarcoptes only. The males reside in their immediate vicinity (Worms); shine through the skin, and require, on account of their lesser size, the use of the magnifying glass. The male Sarcoptes causes less reaction of the skin than the female. To bring the former under the microscope the method of *Eichstädt* is indispensable. With a power of from 150 to 300, the locomotion and the anatomical construction of the parasite can be readily observed. The largest ducts are occupied by and filled with impregnated female Sarcoptes, ova, and excrementitious matter (Fig. 13). They measure $\frac{1}{3}$ Mm. in length, and $\frac{1}{4}$ Mm. in width, are of an oval form, with a flat belly (Fig. 11) and a convex spiny back (Fig. 12).

Fig. 13.

The head is short-set, has lightly dentated jaws, upper and lower lips, and eight legs, of which four are near the head, ending in sucking cups or discs, and four more posteriorly inserted, each terminating in a bristle.

Both size and shape vary according to the parasites being pregnant or not. The male is smaller ($\frac{1}{5}$ Mm. long, $\frac{1}{7}$ Mm. wide); his hind legs sit closer to each other, and two exhibit the same discs as the forelegs (*Bourguignon*, Fig. 10). It is further stated by the same author, that the males are not so numerous as the females (1 to 10), and that their mode of life differs from that of the latter. The locomotion of the male is more rapid; he creeps along the skin, and is capable of boring himself in, within the space of 15 minutes; digs no passages, and during the night leaves his hiding-place and visits the females in their respective nests.

The contagious nature of Scabies depends on the transmission of Sarcoptes of both sexes, or of a pregnant female, from individual to individual patient. It follows conclusively that a single virginal female or male Sarcoptes would not lead to a perfect form of itch, and hence the diagnosis might find some difficulties. For, as already stated, the non-impregnated female Sarcoptes makes but a short duct, and the male none at all; and a most careful examination of the whole body with the aid of a magnifying glass, is often necessary to find the parasite. *Bourguignon* suggests, with some probability, that Prurigo may be occasioned by single individuals, and *Boeck* of Christiania describes a crustaceous form of Scabies, characterized by thick whitish grey and hard scabs upon red and excoriated skin, extending even to the nails, in which he found numerous dead Sarcoptes, ova and excrements of the animal. Similar instances have been recorded by *Fuchs*, *Rigler*, and *Hebra*.

(b.) *Acarus folliculorum.* (Simons.)

(Fig. 14.)

Demodex follic., *Owen*; *Macrogaster platypus*, *Miescher*; *Simonea follic.*, *P. Gervais*; *Steazoon foll.*, *E. Wilson.*

This parasitical animal was discovered about the same time (1842) by *Henle* and *Simon*, and subsequently described in *Johannes Müller's* Archives of Physiology. At first it was found in the inflamed sebaceous follicles of the skin (acne), but subsequently in healthy follicles also, in which they seemed to be perfectly harmless. The question as to its morbid effects upon the human skin has as yet not been decided, although the case related by *Remak* (*Küchenmeister*, page 377) seems to indicate that the Acarus follic., under favorable circumstances, may now and then become the cause of morbid action.

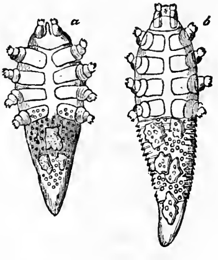


FIG. 14.

Most frequently the acarus follic. is found in the follicles of the nose, lips, forehead, cheeks, the external meatus of and behind the ear, the chest and back.

A well-developed follicle should be forced out, the sebaceous cylinder spread on glass, and observed with a power of from 150–300. They can be found most easily in bodies by taking vertical sections from follicles. Their form and the number of their feet vary from three to four pair.

(c.) *Infusoria.*

Of these microscopical epizoes a great variety are found in wounds and moist places of the skin. Their presence, as far as our present knowledge goes, has no pathological interest.

II. THE BLOOD.

(Figs. 15, 16.)

In the fresh blood three microscopical elements are discernible, namely, the red and white corpuscles and molicular granules (fat, proteïn ?), identical with those on chyle. One would suppose that a fluid so generally diffused throughout the body as the blood, from the fact of its being in constant contact with the various tissues and of its simple organic constitution, would readily participate in the morbid changes of the body, and therefore furnish an auxiliary basis of microscopical diagnosis. This, however, is not the case. In rare instances has the microscopical examination of the blood heretofore led to reliable results. Rudolph Virchow, Julius Vogel, Bennett, and others have, however, lately, successfully commenced establishing a pathology of the blood in which the microscope has taken a prominent part.

Before entering upon the exceptional changes which the microscopical elements of the blood may undergo, it will be desirable, first, to allude to the changes of blood when exposed to atmospheric air out of circulation, as being of great importance in both diagnosis and medical jurisprudence.

Above all, it is important to make out the presence of blood and its changes when dry. All microscopical examinations of blood require a magnifying power of 400 and reflected light. Blood serum or sugar-water are the best mediums for dilution.

Some hours after a meal the red blood globules preponderate considerably, whilst the white corpuscles and granules show a numerical increase immediately after food has been taken. By some authors it is furthermore stated that the white corpuscles augment during gestation, in Chlorosis, and after copious Hæmorrhage. The normal proportion between the white and red globules is said by Donders, Moleschott, and Köllicker to be 5 to 2·000.

When seen edgewise, the red blood corpuscles exhibit a biconcave shape; whilst flat, they are without exception circular in form, of 0·005 to 0·007 Mm. in diameter, opaque, light yellow, and without a nucleus. Within focal distance they appear to be clear and transparent; without their correct focus, dark and opaque. In the newly abstracted blood the red globules join each other, assuming the shape of a roll of coin (Fig. 15, *c*). If a drop of blood is permitted to dry upon a glass plate, the red corpuscles part from one another, first become larger and flatter, show within any focus a central nucleus, their margins shrink and become crenate (Fig. 15, *d*). Water will restore their original form, unless they have been too long in a dry state. If fresh blood is mixed with a liquid, which does not dissolve its red corpuscles, the latter will, by absorption, distend to a globular form and lose their color (Fig. 15, *f*); they burst, however, very soon and crumble to molecules, or they shrink, become darker and crenated. The latter is the usual condition in which they are met with in hæmorrhagic extravasation and dysenteric discharges, etc., and also in bloodstains. If they have not lost their hæmatine, they may yet be recognised by adding water. But, if the red globules have for a long period been in a dry state, all organization disappears, and all that remains is a little pigment. The latter may justify the supposition of blood, but cannot be taken as positive evidence.

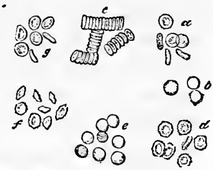


FIG. 15.

Of late *Funke* and *Kunde* have tried to appropriate the blood crystals for differential diagnosis, yet their meritorious efforts have thus far been without practical results. It should, however, be borne in mind, that under certain physical and chemical conditions and changes of the blood red crystals will form.

The colorless corpuscles are the identical chyle-corpuscles, 0·006—0·015 Mm. in size, and consequently larger than the red ones; they are moreover pale and finely granulated (Fig. 16, *a*). They contain one or more nuclei, often recognisable *without*, but certainly *with*, the action of acetic acid (Fig. 16, *b*) or solution of iodine; their number in normally constituted blood is but small and scarcely to be estimated. Their existence seems to be ephemeral.

Fig. 16.

The elementary granules (chyle-granules?) occur in the blood under the same circumstances as the white corpuscles, both physiologically and pathologically. The red corpuscles of man and most animals differing in both form and size, their discrimination from each other in fresh blood or bloodstains offers no difficulty whatever.

Simulation of Hæmoptysis by staining the sputa with pigeon blood, has thus been easily discovered by the microscope.

But it is far more difficult and *frequently impossible* to discriminate animal from human blood, in old stains, for reasons already stated.

The pathölogical changes of the blood, as far as the microscopical elements are concerned, have been, as yet, but imperfectly ascertained. All we know about them may be comprised under the following heads:

(1.) The form and aggregation of the corpuscles.
(2.) The relative number of the microscopical elements.
(3.) Foreign constituents.

1. FORM AND AGGREGATION OF THE RED CORPUSCLES.

It has been stated by Törneroth, Ilmoni, and others, that in Typhus and Tabes the red cells change their contours, become wrinkled, crenated, and shrunken. We are not prepared to say, whether this is an invariable condition of the red cells in the aforesaid diseases. In Asiatic cholera, however, these changes are often observed and have been attributed to the reduction of serum. In Purpura and puerperal disorders, the ordinary conglomeration of the red cells in rolls has been found absent. It is yet doubtful whether this observation is of any pathological value.

2. RELATIVE NUMBER OF MICROSCOPICAL ELEMENTS OF THE BLOOD.

(a.) *Preponderance of Elementary Granules.*

These molecules, as already stated, are very numerous after meals, long fasting, the use of spirituous liquors, and in certain physiological conditions, such as pregnancy. They are identical with lymph-granules, and essentially consist of fat (protein?). A very large number of these granules are found in the so-called white blood (Leucæmia, Galactæmia, Lipæmia), also in the blood of drunkards, and in patients afflicted with Bright's disease. The granules are chiefly in the serum on account of their lightness, and they impart to it a milky and turbid appearance. Their presence in the blood indicates imperfect Hæmatosis and assimilation, and, perhaps, inefficient purification of the blood by the secretory and excretory organs.

(b.) *Abnormal Preponderance of Colorless Blood Corpuscles.*

This is almost the only important change in the relative proportions of the microscopical elements hitherto ascertained with any degree of certainty. In 1845 Rudolph Virchow examined a corpse of a person who had died under circumstances not satisfactorily ascertained. The liver and spleen were found to be hypertrophied, and the blood exhibited an enormous number of white cells. He termed the disease "Leucæmia." In the same year Bennet of Edinburgh observed a similar case, and considered the colorless bodies as pus-corpuscles. Since then the same author has published an essay (1852) in which he admits those corpuscles to be an ordinary anatomical element of the blood, and denominates the decrease of their abnormal numerical proportions Leucocythæmia or white cell blood. Other inquirers have since affirmed the discovery of Professor

Virchow, and at this time a large number of cases are on record.

Virchow, who has since turned his first observation to profitable account for both Physiology and Pathology, holds—and with him Reinhardt—that Leucæmia and Leucocythæmia are not synonymes for the same disease, the former representing a real dyscrasy with structural alienations of spleen, liver, or the lymphatic glands and subsequent morbid nutrition, whereas Leucocythæmia is a mere transitory increase of white cells and mostly physiological in character (pregnancy).

The only diagnostic criterion of Leucæmia is, therefore, the permanent excess of white corpuscles.* The comparative number in all known cases has been various, but never exceeded the number of the red corpuscles. A simple puncture of the needle into the skin of the patient will furnish sufficient material for examination, and a power of from 200 to 400 should be employed.

(c.) *Change in the Number of Red Blood Cells.*

In his valuable treatise on the various changes of the composition of the blood, Prof. Julius Vogel has invited attention to the vacillation in the number of red blood corpuscles. But in the absence of a reliable method of counting the hæmatine corpuscles the terms of Poly- and Oligocythæmia used by Vogel have not as yet acquired practical usefulness.

3. FOREIGN ELEMENTS IN THE BLOOD.

There is no longer any doubt as to the occasional appearance of foreign material in the circulating blood having indisputably been observed at *post-mortem* examinations. Hitherto, however, these observations have had no diagnostic and practical application.

* A case of Leucæmia, lately under my charge in the Long Island College Hospital of Brooklyn, exhibited at one time almost exclusively white corpuscles, and on subsequent examination never less than $\frac{50}{100}$.—B.

(a.) *Epithelium of Bloodvessels.*

Epithelium cells of bloodvessels, Fig. 17, have been found in the so-called heart polypi, and Jos. Meyer has seen them in the circulating blood of a frog.

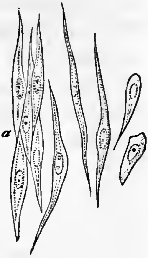


Fig. 17.

Virchow has observed oblong epithelial cells, containing fatty and pigment molecules in bodies which had died from intermittent fever and cancer of the womb. Meckel has seen pigment cells; Donders, oblong cells without pigment, in the blood of patients afflicted with puerperal fever, considering them the epithelial lining of bloodvessels. With the aid of Donders the Author has observed both oblong Epithelium and an excess of white corpuscles in such patients. Vogel speaks of caudated cells in a body which died from pyæmia, caused by onychia, and considers them to be epithelial cells.* From his own observations the author accepts the views of Donders and Vogel as to the nature of those cells, being the Epithelium of bloodvessels. Their diverse forms are confirmed by histology. Where pigment is so abundant, as in the blood, it cannot surprise us that we occasionally meet with it in Epithelium also.

Both Donders and Vogel suggest the feasibility of the epithelium in the current blood, where it causes obstruction, Thrombosis, and the formation of abscess of bloodvessels, so frequent in puerperal and pyæmic fevers. This is a step towards the mechanical causation of disease, which Virchow is zealously trying to propagate in every direction.

For practical diagnosis, no positive result has yet accrued from the discovery of epithelial cells in the current blood, but the subject is evidently of sufficient importance to excite general inquiry.

(b.) *Pus.*

Numerous and careful microscopical examinations of exqui-

* In the case of Leucæmia, already adverted to, I have noticed cells of different size and shape, some containing fat granules or pigment molecules, others but one nucleus.—B.

site pyæmic cases have proved the fallacy of the theory that large quantities of pus are absorbed by and circulate with the blood. That which has been taken for pus cells was probably white blood-corpuscles in unusual number. The best authorities on Microscopy agree that between the white blood and the pus-corpuscles there is no characteristic difference either in appearance, size, or chemical reaction. Moreover, their size is not calculated to obstruct the circulation, as has been hypothetically supposed.

(c.) *Cancer Cells.*

For a long time it has been insisted on, that cancer cells enter the circulation and thereby cause secondary cancerous growth. The fact of their occasional presence in the circulating blood has been indisputably established by such authors as Virchow, Bennet, Paget, Quekett, J. Vogel, and others. But the inference drawn from this fact has in no instance been borne out; for wherever the cancer cells had crowded together they had obstructed the capillaries, cut off the circulation, and initiated structural mortification, or, as Virchow terms it, *necrosis*. The formation of secondary cancer seems altogether fabulous, and devoid of anatomical evidence. Supposing the cancer cells to have encroached upon the blood, their very size, compared with the calibre of the capillaries, renders their arrest by the latter both obvious and inevitable. They will at once become the nucleus of a Thrombus, engrossed by fibrine, and thus cut off the supply from the circulation. Before they could organize their new bed of growth, their morbid effects, already adverted to, would manifest themselves, and lead to the structural disintegration of parts thus impeded. The morbid effects would be of the same nature, if the cancer cells had mixed with the venous blood, since the portal vein, and the pulmonary artery, form the same capillary network as the arteries in general. Nor does the author share in the hopes of J. Vogel in establishing a reliable diagnosis of cancer by a microscopical examination of the blood. For it is to be presumed that the blood of every patient afflicted with this malignant disease does not carry cancer cells, and at any rate not in such abundance as to exhibit them in every drop, and in all parts of the circulation. Hence their absence would prove nothing, and their accidental presence would only corroborate a diagnosis already clear by the advanced development of the disease.*

* The author's arguments, though conclusive, and indisputably correct in many points, are nevertheless susceptible of correction in others. Prof. Bamberger's observations of fungiform cancerous growths inside of the hepatic and portal veins in a case of cancer of the liver (Oestr. Zeitschrift für pract. Heilkunde, 1857,'58), demonstrate the feasibility of the cancer cells detaching themselves from their original seat, and reaching the heart and lungs unimpeded. The existence of cancerous tumors upon the walls of the heart, though of rare occurrence, has been recorded by Rokitansky; and I have lately observed a case of most acute and extensive encephaloid disease, which seems to bear strongly upon the question. A young man was attacked with encephaloid of the left testicle and spermatic cord, and had both removed by Dr. Buck of New York. Three weeks after the operation I was invited to see the patient, who then presented a tumor in front of the lumbar portion of the spine, leaning towards the left kidney. Liver, lungs, and heart were found to be intact. In a week the liver commenced to enlarge, and very soon became nodulated, lungs still healthy, and respiration perfectly easy and free. A fortnight before the death of the patient the left lung became involved in its inferior lobe, and from that time the disease extended gradually over the superior lobe and the right lung. On *post-mortem* examination the chronological progress of the disease could be clearly traced in the various organs affected, by the size of the cancerous nodules and their respective degrees of firmness and softness. In the right ventricle there was also a small tumor, organically and closely connected with the septum.

On exhibiting the respective specimens to the Pathological Society of New York, Dr. Crakowitzer justly remarked, that it had all the appearance of a fibrinous clot formed after death. A careful microscopical examination by Dr. C. and myself revealed, however, the true cancerous character of the growth, upon whose surface abundant fibrine and blood corpuscles had been deposited. The pathogenetic progress of the disease just related, leaves at least room for the conjecture that the cancer cells had been transmitted by the circulation from place to place, until they at last reached the lungs and heart. Another circumstance may be mentioned as likely to strengthen this position, namely, that the right lobe of the liver, being more easily supplied with portal blood, was comparatively three times as large as the left, and the cancerous nodules proportionately much larger and softer than in the former.

Another point in fact against the author's deduction is derived from the so-called Ostoid. Instances are known and have been observed by Johannes Müller, Gerlach, Schuh, Buhl, and others, in which, on the same subject, cancerous tumors had formed in remote localities with the same structural stroma as the original disease, otherwise devoid of osseous material.—B.

(d.) *Hæmatozoa.*

In the blood of certain quadrupeds Entozoa are constant elements. Thus Filariæ in dogs, Strongylus armatus in the horse, etc. The same has been said of human blood. Duval professes to have seen Fasciolæ in the portal vein. Most observations of this description are, however, not free from doubt, mistakes being easily committed. Thus, for instance, a caudated epithelial cell may be mistaken for Vibrio, aside from Infusoria dropping into exposed blood when not carefully covered.

In disease it seems to be different. Brauell (Med. Neuigkeiten, No. v., Jahrgang 9) states positively to have observed Vibriones in the blood of glandered horses, which, though not directly connected with the contagiousness of glanders, exercised, nevertheless, a marked influence upon its fatality. Their presence was therefore of prognostic importance. The observation of Distoma hæmatobium (Fig. 18) in the blood of dysenteric patients, by Prof. Bilharz of Cairo (Egypt), is another interesting fact in proof. This parasite occurs in the portal and mesenteric veins, less frequently upon the mucous membranes of the intestinal tract, in the vascular vegetations of the urinary bladder (frequent affection in Egypt), and in distended vessels close to the seat of the dysenteric process. Within the exuded material of the intestinal mucous membrane, the ova and other curiously formed bodies of the parasite are imbedded, exhibiting its various stages of development.

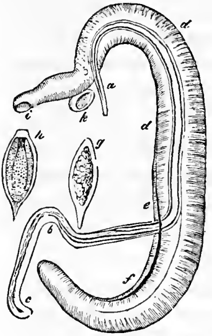


Fig. 18.

Distoma hæmatobium is from three to four Parisian lines in length. The male, according to Bilharz, carries the female in his canalis gynocopherus (Fig. 18, *a*, *b*, *c*), the latter protruding (*d*, *d*) in part; *f*, the opened fissure of the canal; *i*, mouth disc; *k*, belly disc for fastening; *g*, ovum from a vessel of intestinal mucous membrane; *h*, ovum with a live embryo.

In his "Comment on Diseases in Egypt," Professor W.

Griesinger has, from a clinical point of view, described the morbid processes engendered by this parasite—which he denominates Distoma disease—and has thus made a practical application of the discovery of Prof. Bilharz. The latter has recently resumed the subject and enlarged on this parasite (which hitherto was found in the portal, mesenteric, and hæmorrhoidal veins, and the venous plexus of the urinary bladder, whose ova had been met with in the parenchyma of the liver, the membranes of the small intestines, but chiefly in the submucous cellular tissue of the bladder, the ureters, seminal vesicles, and of the lower portion of the large intestine). And furthermore, he has considered its relations to pathological changes and particularly to its influence on vesical diseases and the formation of calculi—and thereby rendered more complete his own, as well as the earlier observations of Griesinger. He, however, no longer ascribes to this parasite any co-agency in the causation of dysentery, which prevails in Egypt—a question which had indeed been already settled by a private communication of Dr. Sendahl (who was in Egypt at the time—1856) to Prof. Bilharz. Without more particular reference to the two authorities named, we will mention, however, the modus in which Dr. Bilharz explains the deposits of the ova in the uro-genital organs, particularly in the polypous vegetations of its mucous membrane, sometimes encrusted with urinary deposits. He says, the male bearing an impregnated female in his canalis gynocopherus, forces itself against the current of the blood into the smaller branches of the venous plexus. With the aid of the sucking discs and minute bristles it works its way, and deposits in the capillaries the ova, which are united into lumps by a gelatinous substance. Passive hyperæmia, stasis, and effusion of plastic lymph ensues, the vessels burst, and thus the ova are placed into the cellular tissue, from which they pass to the surface of the mucous membrane of the bladder, or are discharged with the urine. In regard to the general prevalence of this parasite in Egypt, it is said to be very great; so much so, that it may be taken for granted, that one-half of the adult native population (the Fellahs and Copts) carry either the parasite or its effects. Out of Egypt, so Prof. von Siebold relates verbally, it has, thus far, not been found.

III. THE MILK.

Fig. 19.

The normal condition of Milk has been best described by Lammerts van Bueren, whilst Donné has most satisfactorily ascertained its microscopical constituents.

The milk consists of the following:

1. Plasma.
2. Innumerable, spherical, opaque, and light-refracting fat granules, and fat drops; and
3. Milk globules, containing the former in an investment of what is probably caseine.

In reference to the formation of milk, Lammerts van Bueren has laid down the following tenets:

1. The milk globules generate in the epithelial cells of both the lacteal ducts and terminal vesicles, but chiefly in the latter.
2. In perfect milk secretion both cell walls and contents of the milk globules dissolve and join the plasma.
3. In colostrum this metamorphosis is not perfect.
4. The colostrum corpuscles generate probably in the old epithelium of the lacteal ducts.

With these views the more recent inquirers coincide, amongst others Kölliker. The accompanying diagrams have been taken from women who had died respectively during, and soon after childbirth.

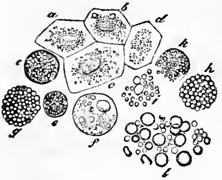


Fig. 19.

Fig. 19, *a–d* the secretory epithelium of the mammary gland: *a*, normal, *b*, incipient fat deposit; *c*, increased fat-granules; *d*, fat-granules without nucleus; *e*, milk globules, spherical, containing fat-granules; *f*, the same with larger fat-drops; *g*, *h*, colostrum corpuscle; *i*, *k*, the same in a state of disintegration, discharging its contents; *l*, perfectly matured constituents of the milk, isolated and confluent fat-granules and drops.

In reference to microscopical diagnosis, milk may become the object of interest in two ways.

1. THE RELATIVE PROPORTIONS OF THE MILK CONSTITUENTS.

Since Donné, Zettwach, and Girard have ascribed to the collostrum corpuscles in the milk obnoxious effects upon the suckling, they have been the subject of close examination. It should, however, be borne in mind, that a few collostrum corpuscles physiologically occur in the milk for some time after childbirth, without at all vitiating its nutritious or wholesome character. But a large number of those elements would be evidence of congestion or inflammation of the mammary gland. In some diseases of nursing women, the collostrum corpuscles generate in great abundance. Thus in rheumatism, exanthemata, and typhus lactantium. In the last, according to Lehmann, are occasionally found regular exudation corpuscles, with traces of fat-granules.

The presence of collostrum corpuscles in large numbers is important evidence of recent parturition, and therefore of great moment in a forensic point of view.

2. ABNORMAL SUBSTANCES IN THE MILK.

It is said that after contusions of the mammary gland the milk shows red blood corpuscles and fragments of blood-clots and pus cells in incipient mammary abscess. We have never observed those elements, whereas we have met in the latter instance with collostrum corpuscles four months after confinement. Nor have we any positive idea as to the obnoxious results of those abnormal elements upon the infant. Their observation may, however, assist in forming an early diagnosis of incipient abscess.

In Wagner's Encyclopedia of Physiology we read, vol. i., page 470, "Sometimes the milk, after having been exposed to the action of atmospheric air, assumes a *blue*, but rarely a yellow color, beginning at the surface and gradually extending over the whole liquid. When examined by J. Fuchs, he found infusoria to be the cause of discoloration; Vibrio cyanogenus being in the blue milk and Vibrio xantogenus in the yellow. The infusoria themselves are stated to be colorless; but they possess the quality of discoloring milk.

In red milk C. Naegeli has observed Protococcus. As far as known cancer cells have as yet not been found in the milk; whereas mammary cancer occasionally gives rise to the secretion of normal milk and collostrum. In a cancerous tumor of the breast, removed by Dr. Svalin, the Author had an opportunity of confirming the last-mentioned fact in addition to the development of milk secretion as demonstrated by Lammerts van Bueren.

IV. VISCERAL EVACUATIONS.

There are three apertures for visceral discharges: the mouth, the anus, and the genito-urinary openings. But the organs whose products and educts are eliminated through these apertures, are so numerous and so diversified, as to be subdivided under different heads in their respective anatomical order.

A. THE ORAL CAVITY.

Fig. 20 to 22.

In this peculiarly constructed cavity open the salivary glands and the lungs. By way of regurgitation the contents of the œsophagus and the stomach may be returned under certain morbid conditions. Although we may derive but little information from the microscopical examinations of the normal contents of the oral cavity, we should, nevertheless, thoroughly acquaint ourselves with their appearance, in order to discriminate between them and other accidental or pathological elements.

(1.) *Normal Contents of the Oral Cavity.*

The whole cavity is lined with pavement epithelium, consisting of many super-imposed layers of large, roundish, polygonal, more or less flattened cells, inclosing one or two nuclei and granules (Fig. 20, *a*). The epithelium cells form the principal and most numerous microscopical elements of the mouth. Besides these cells, there are about the teeth and at the base of the tongue, when scraped with the scalpel, delicate fibrillæ (Fig. 20, *a*; 22, *a*), partly detached from and partly adhering to a kind of stroma (Fig. 22, *b*), from which they seem to originate. This is the Leptothrix buccalis of Ch. Robin, a constant alga of the filiform papillæ. The dense epithelial lining at the apex of the latter, forms a cylinder upon which the stroma-like humus is inserted (Fig. 22 *b*).

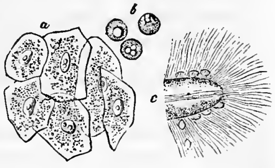


FIG. 20.

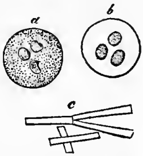


FIG. 21.

Between the filaments of the Leptothrix myriads of infusoria reside and move incessantly. They are round, cylindrical, and vibrionic. Among them there are also the so-called mucous corpuscles (Fig. 20, *b*; fig. 21, *a*, *b*, the latter magnified 800 times), rounded cells of 0·010 Mm. diameter, with from one to four nuclei, more numerous after meals. Formerly they were erroneously looked upon as the products of the mucous follicles or salivary glands. Kölliker considers them, however, the products of the irritated mucous membrane, as a kind of inflammatory corpuscle, and in their microscopical character, identical with lymph- pus- and white-blood corpuscles. They have, moreover, been found throughout the entire intestinal tract, and of late even in the peptic glands of the stomach.

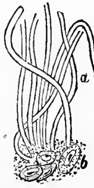


FIG. 22.

Aside from the microscopical elements before described, it is quite common to find in the mouth fragments of food, starch-granules, muscular fibres, fat-granules and drops, also dust of different origin; in infants—milk, caseine, etc. We shall enter more fully upon the consideration of alimentary remains when discussing the constitution of vomited material, and the dust we shall comprise with the sputa of which it is an ordinary constituent.

(2.) *Abnormal Contents of the Mouth.*

The abnormal contents of the mouth are, of course, of very different character, and more or less of pathological importance. We shall pass over the introduced substances, as not strictly belonging to the category under consideration.

The so-called *coating of the tongue* consists of macerated, highly developed, imperfectly detached pavement epithelium, with perhaps some coagulated mucus. The brown tint of the coating in typhus and similar diseases is made up of blood, derived from the fissures of the dried mucous membrane.

Eulenberg speaks of a black coating having been caused by pigment-granules of the epithelium. Inflammatory affections of the oral cavity, whether manifesting themselves in the circumscribed form of vesicles or pustules, or diffusing over a larger surface and different structures, are sufficiently marked by their form and appearance, so as to demand the aid of the microscope. The beginning of these affections is invariably accompanied by an excess of mucous corpuscles; its progress by the presence of pus. When their seat is hidden from the eye as in the pharynx, the microscope may be needful, when the pus-corpuscles will disclose the existence of an ulcerated surface. The true nature of one, heretofore obscure, affection of the mouth, has been found out by the microscope, namely:

The Aphthæ or Soor.

This peculiar disease of the mouth, which chiefly befalls infants, but often extends to adults when reduced by protracted illness, must, from the present scientific point of view, and in accordance with Prof. Berg's opinion, be regarded as dependent on the presence of fungus (Oidium albicans, Ch. Robin) discovered by himself, growing upon the mucous membrane and diffusing between the epithelial layers.

Aphthæ have consequently nothing in common with the various forms of stomatitis. They are peculiar coatings of the mucous membrane, comprising both the parasite and its immediate action upon the latter. The coatings are of variable form and size; white in the beginning and grey-yellowish in their progress; of soft and cheesy consistence, delicate as the thinnest paper and from that to the thickness of half a line; rather firmly adherent, but easily removed from, and without injury to, the subjacent structure. The seat of the aphthæ comprises the lips, cheeks, gums, palate, tongue, pharynx, and œsophagus down to the cardia. Robin states that he found it in the stomach, even in the small intestines and the rectum, whither it probably had been carried with food.

Ed. Martin, of Jena, observed exquisite aphthæ in the vagina of a pregnant woman, who confessed that her lover (a miller by trade) had introduced his finger, which was covered with flour-dust. The infection had consequently occurred in a similar manner as in infants who depend on mealy nutriment. It may happen that aphthæ and forms of stomatitis simultaneously occur in a patient, but they have no etiological connexion and do not depend on each other.

The direct consequences of aphthæ, being strictly a local affection and requiring local treatment only, limit themselves to impeded sucking and mastication, and additionally to hoarseness, if the epiglottis should be affected.

As already stated, this parasite vegetates upon the mucous membrane and distributes itself between the epithelial cells, whither it comes from the air, with food, the fingers, etc., giving rise to the formation of lactic acid, reacting itself sour, and spontaneously discharging carbonic acid.

The diagnostic discrimination of aphthæ from other diseases of the oral cavity has no difficulty. Coagulated caseine may present some striking resemblance with aphthæ, but its removal from the mouth is sufficient to solve all doubts. On the other hand true aphthæ on the tongue, if not well developed, may mislead to the supposition of their being an ordinary lingual coating. An early diagnosis being of great practical moment in all cases of doubt, the microscope should be promptly resorted to.

In scraping the aphthous patches and in bringing the object under the microscope, after adding potash to make the epithelium transparent, we find, besides the latter, some hair, and other accidental elements, the following vegetable forms:

FIG. 23.

(1.) Spores (Fig. 23, *a*, *a*), round oval, variously shaped cells of 0·015 to 0·002 Mm. diameter, some of which exhibit one or more nuclei with molecular motion, whilst others are entirely without them. The spores are either free and isolated, or grouped with others, closely connected with the epithelium. To all appearance the spores originate in the

(2.) Receptacles (Fig. 23, *b*, *b*), tubular and articulated filaments, which attain sometimes the length of 0·006 Mm. They firmly radicate in the epithelial cells, with a kind of bulbous root; their articulations are of different size, and contain extremely fine granules, sometimes in molecular motion. We also find very delicate, granulated filaments, not unlike

(3.) Mycelia (Fig. 23, *c*), in lesser numbers.

Both kinds of tubular organs multiply by budding laterally.

A magnifying power of 250 to 350 will afford a general view of the parasite; its details require, however, a considerable increase (400 to 800).

B. LUNGS AND SPUTA.

Under sputa we comprehend every secretion of the air passages and the respiratory organs, raised by forcible expiration. As the sputa have to pass through the mouth, they may incidentally be the exponents of the normal and abnormal contents of that cavity. On examining the sputa, great care should be taken not to confound the microscopical elements of the two anatomical provinces.

The presence of pus in the sputa, especially, may give rise to doubts as to its origin in one or the other of these provinces. Having already and repeatedly adverted to pus as a microscopical constituent in various secretions, we may at this juncture enter more fully upon its microscopical considerations.

In order to be impartial we have copied and annexed the diagrams from Lebert, Henle, and Vogel (Fig. 24), which represent the various phases and changes of the so-called pus-corpuscles. In comparing these with the mucous and white blood corpuscles (Fig. 16, 20, *b*, 21), irrespective of the variable number of nuclei and granules, we find no marked differences; they being all of from 0.005 to 0.010 Mm. in size; more or less finely granulated; rarely without, mostly with, from one to four nuclei; equally susceptible to acetic acid and other re-agents, otherwise pale and of delicate organization. It is, therefore, quite impossible to discriminate one from the other in an object containing two kinds of these corpuscles.

The only basis of diagnosis is the *number* and *locality* from which they have been derived. Thus, for instance, in the sputa the number of mucous corpuscles is comparatively small and scattered. Abundance and conglomeration of corpuscles, therefore, indicate pus.

Of pus-corpuscles we can recognise two stages of development: the young cells, the corpspyoides of Lebert (Fig. 24, *a*, *d*, *g*), and the matured corpuscles (Fig. 24, *b*, *h*). In the former the formation of nuclei and granules is yet imperfect, and the liquid contents preponderate; in the latter the corpuscles

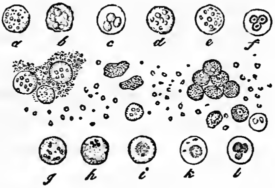


FIG. 24.

present themselves with an uneven surface, owing to their numerous nuclei and granules. These are the characteristic pus-corpuscles; they are, however, found under circumstances which do not admit of mistake.

In pus derived from an abscess or from copiously secreting mucous membranes, granules will be noticed that present dark contours and strongly refract light. Besides these, fat granules are sometimes visible. Both may be isolated or comprised in the pus corpuscles themselves. The presence of these elements may be considered additional proof of pus, except when they have passed the oral cavity, where such granules may exist as residues of food.

If the examination of sputa leaves no doubt as to the presence of pus, and furthermore, if the pus has not originated in the choanæ, or the mouth, we may rationally infer that an inflammatory affection of the respiratory organs is going on. The microscope alone, however, cannot define the nature and the seat of the affection.

But it is evident that microscopical examination will lend valuable assistance to auscultation and percussion in specifying the diagnosis.

In some cases the microscope alone may render diagnosis easier, and indicate the character of the disease in the absence of other guides. Hence its paramount utility.

(1.) *Catarrhal Affections of the Respiratory Organs.*

In either acute or chronic catarrh the expectoration comprises *pus*. In the former the sputa are thin, frothy, viscid, and mixed with small bluish lumps of gelatinous consistence. As microscopical elements we find:

Pavement epithelium in different stages of developement—from the mouth.

Cylinder epithelium from the nasal cavity; occasionally *ciliated epithelium* from either the latter, the larynx, or bronchia.

Oblong epithelium from the finer branches of the bronchi and the lungs themselves.

Pus corpuscles, mostly of recent formation, perfectly spherical, finely granulated, and through imbibition of fluid rather larger than usual; *Exudation corpuscles, Fibrinous particles, and fragments of the mucous membrane, as represented under the head of pneumonic sputa.*

Pickford states that he has seen pigmented cells in catarrhal expectoration.

In chronic catarrh the sputa are now and then, as in the acute form, thin and frothy; but we notice an element highly characteristic: namely, small bluish-white or yellowish-grey lumps, exceedingly cohesive and viscid, adhering to the vessel, and when immersed in water sinking to the bottom.

The microscopical forms, characteristic of those sputa, are about the same as enumerated, though with a decrease of pulmonary elements and an increase of highly matured pus corpuscles, and of fragments of bronchial mucous (basement) membrane.

Dr. Black* relates the presence of urate of ammonia in the sputa of capillary bronchitis and rheumatism; of oxalate of ammonia in Oxaluria; of Cholestearine and Biliphaeine in Icterus. Although these substances have no bearing upon the principal disease, yet they indicate the complication of the latter, and are therefore of semiotic interest.

(2.) *Croupous Affections of the Respiratory Organs.*

The chief characteristics of the Sputa in genuine laryngotracheal or bronchial croup, are fragments of coagulated fibrine, variable in size, shape, and firmness. Their appearance is so conspicuous as to be readily recognised by the eye. Besides the pseudo-membranes the sputa have some elements in common with pneumonic sputa, which will now engage our attention.

Sputum Pneumonicum.

The microscopical elements in this sputum are of a diversified description, comprising the matured epithelium from the oral cavity (Fig. 20, *a;* 25, *n*), *young epithelium* from the same place, round, not yet flattened (Fig. 25, *a*), *cylindrical epithelium* in great variety (Fig. 25, *b*), from the choanæ and pharynx, not unlikely deprived of their cilia (Fig. 25, *c*). This epithelium is not always as perfect as represented in the annexed diagram, but sometimes broken down, thereby increasing the number of granules in the pneumonic sputum.

* Monthly Journal of Med. Science, Edinburgh. Vol. 16.

Epithelium from the second layer of the bronchia below the ciliated cells (Fig. 25. *d*). Their number in pneumonia, acute and chronic bronchitis, is almost incredible. When oval and less granulated, the larger cells can be easily discriminated from pus corpuscles, whereas the smaller ones from the finer bronchial tubes, and especially when highly granulated, require the agency of acetic acid for discrimination, their nuclei showing themselves differently from those of pus corpuscles.

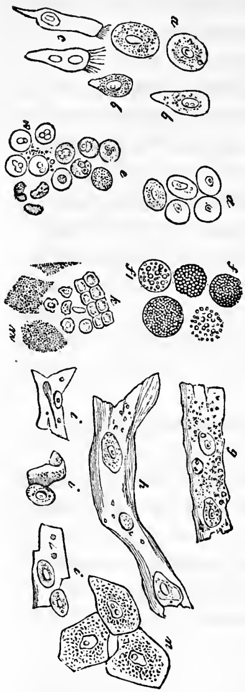


FIG. 25.

Pus corpuscles occur in all possible forms, large, small, transparent, with one or more and entirely without nuclei; dark, granulated (à aspect framboisé—Lebert), shrivelled, etc. (Fig. 25, *e*). The lower corpuscles of the group, after a longer submersion in distilled water, have been subject to the action of acetic acid.

Exudation corpuscles (Fig. 25, *f*. Inflammation corpuscles — *Gluge*). These elements were first observed in inflamed tissues, but since also under other circumstances, from which it seems probable that they are either conglomeration of fat (proteine?) granules, or fatty degenerated cells of tissue concerned in the decay. Those found in the pneumonic sputum are in all probability the fatty degenerated epithelial cells from the bronchi. The diagram (*f* 1) represents the cell in the first stage of degeneration. For analogy we refer to the article on *milk*.

Fibrinous particles (Fig. 25, *g*, *h*), consisting of cylindrical casts from the bronchial tubes, with embedded epithelial cells. The diagram (Fig. 25, *g*), represents an object removed from the mouth of a child suffering from capillary bronchitis; *h*, from an adult on the fourth day of pneumonia. These casts occur in some sputa abundantly, in others scantily, for which we are unable to account. The size of these casts is in proportion to the lumen of the bronchial tubes in which they originate.

Fragments of the mucous membrane (Fig. 25, *i*). Although it is yet questionable whether fragments of the mucous membrane detach themselves and mix with the sputum of Pneumonia, we have nevertheless observed rags and fragments, which correspond so closely with the anatomical nature of the mucous membrane, as described by Black, and are so much at variance with the other microscopical constituents of pneumonic sputa, that we are disposed to admit them as particles of that structure. In the annexed diagram (Fig. 25, *i*) we have exemplified a specimen of the said description. It presents no granules as in the fibrinous casts, is flatter and more irregular in form. The sharp dots seem to be young nuclei. (Black.)

Red Blood Globules occur constantly and in large numbers in sputum ferruginosum. They are either isolated or joined to each other; in the latter case they are of irregular form, almost quadrangular; some crenated, shrivelled, and partly decayed. (Fig. 25, *k*.)

Red Flakes (Fig. 25, *m*), minutely granulated, of variable and indefinite shape, consisting apparently of hæmatine.

All these form-elements are to be found in pneumonic sputum, however changeable in cohesion and density it otherwise might be.

We have purposely entered upon an extensive discussion on catarrhal and pneumonic sputa, in order to exemplify the direct utility of the microscope in defining both the extent and the nature of the disease, and the structure affected.

In either Bronchitis or Pneumonia the physical signs are pretty reliable clinical guides. But in lobular and occult Pneumonia the microscope is indispensable for early and correct diagnosis.

(3.) *Vomicæ and Tubercles.*

If a patient applies for professional advice, who has passed through Pneumonia, whose physical signs conform with the anamnesis and the rational symptoms of progressive destruction of the lungs, the diagnosis is extremely easy and plain. Not so easy, by far, is the diagnostic discrimination of such cases in young individuals, where all clinical methods of investigation prove a chronic pulmonary Catarrh *only*. And in these obscure cases, Prof. Schroeder van der Kolk has taught us to employ the microscope to advantage.

Strange enough, though evidently useful in differential diagnosis, the microscope has been in this respect totally ignored.

According to our personal and extensive experience in this point we can but affirm its high value in obtaining positive results where all other signs are of a mere negative character.

We know from pathological anatomy that, in Pulmonary Catarrh, only the mucous membrane of the bronchial tubes, and *that* but partially, becomes disintegrated. The same must be said of acute Pneumonia on its resolution and return to health. In none of these cases can other form-elements be anticipated than those which strictly belong to the mucous membrane. And experience has confirmed this expectation. If, however, Pneumonia assumes a chronic course, or suppuration has to perform the office of removing inflammatory obstruction in the Parenchyma of the lungs, the disintegration goes beyond the mucous membrane, and the microscope reveals the morbid changes of all the structures involved. The same we notice in Tuberculosis. In both eventualities we have to expect, and do find, in the sputa the essential fragments of the bronchial tubes. Thus, for instance, in Vomica we look for and meet with elastic fibrillæ in commensurate proportion to the size of the Vomica; we indeed never missed them under such circumstances. We refer our readers to the annexed diagrams (Figs. 26, 27) as good specimens. Fig. 26 was taken from a patient—in 1850—an inmate of the Seraphinian Hospital of Stockholm. His case was set down as acute Bronchitis, in which diagnosis all symptoms concurred. There were, however, elastic fibrillæ in the sputa, indicating

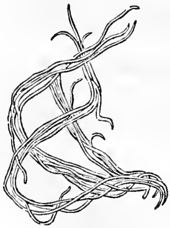


Fig. 26.

incipient Tuberculosis. Subsequent clinical observation has since verified the correctness of the diagnosis. Elastic fibres may be readily recognised by their regular, curved, dichotomatous, equally wide, sharply contoured anastomosing fibrillæ, still more distinct under the action of acetic acid. *These fibrillæ are, therefore, the structural evidence of Vomica;* their early discovery in dubious cases is the basis of an early and correct diagnosis.

Incipient Tuberculosis characterizes itself by a more or less chronic Catarrh, its sputa comprising a large number of pus-corpuscles, oblong and round epithelial cells of the second layer (Fig. 25, *d*), representing at the same time the peculiarities of sputa cocta. In taking, however, a small quantity of the paler portion of the lumps and extending it very thinly on a glass-slide, fragments of elastic fibrillæ will be found with a power of 250. For obvious reasons we find these fibrillæ much more readily in incipient than in advanced Tuberculosis, because the disease is of less extent and the Catarrh restricted to the bronchial tubes nearest to the deposits. Both the morbid action and the bronchial secretion are limited. The small lumps then exhibit the elastic fibrillæ in the best, i. e. the *least* disintegrated condition, being at the same time of large size, whilst in the advanced dis ease the structural elements are broken up in small particles and therefore less distinct and recognisable. Fig. 26 represents the elastic fibrillæ in Tuberculosis of recent origin. Schroeder van der Kolk and the Author have seen still larger fragments so as to exceed the optic field of the microscope. Fig. 27, *a*, *a*, are forms observed in a later stage of Tuberculosis, although scarcely in consummate Phthisis. In this as well as in Vomica terminating

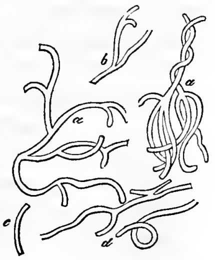


FIG. 27.

chronic Pneumonia, the elastic fibres in the sputa are much decayed, and therefore found and recognised with much more difficulty (Fig. 27, *b*, *c*, *d*). Their diagnostic importance decreases, however, in reverse ratio as the disease advances.

In order not to confound elastic fibres with the fibrillæ of linen (Fig. 28), silk (Fig. 29), or cotton (Fig. 30), their respective diagrams have been annexed.

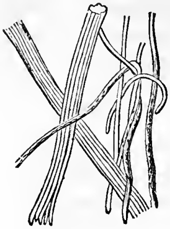


Fig. 28.

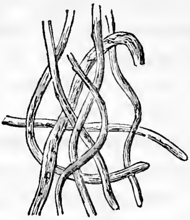


Fig. 29.

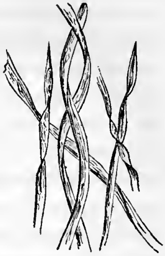


Fig. 30.

4. *Gangræna pulmonum.*

In well established cases of pulmonary Gangrene, the history, the physical symptoms, the characteristic quality of the sputa, and the peculiar offensive odor of the latter, as well as the breath of the patient, are reliable clinical guides for diagnosis. Sometimes, however, as for instance in inebriates, a simple bronchial Catarrh or Pneumonia may become associated with a fœtid breath and expectoration, indicative of Gangrene of the lungs; and in other instances the sputa may become discolored either accidentally or intentionally. In cases thus doubtful, the microscope, discreetly applied, will facilitate diagnosis. The sputa derived from this disease exhibit, under the microscope, the fragments of pulmonary structure, elastic fibres, particles of the mucous membrane, decayed epithelium, granulated cells, misformed pus corpuscles, black and other granules, and amorphous material. The elastic fibres in gangrene of the lung are usually very short but numerous, so much so as to occupy almost the whole field of the microscope (Fig. 27, *c*).

5. *Accidental Elements in the Sputa.*

The class of accidental elements in the sputa is rather large and diversified. It comprises all sorts of foreign bodies (fruit, kernels, and stones); also calcareous concretions from obsolete tubercles, of which we have seen some in the form of minute corals.

In this category belongs the case of Bennet, who found in the sputa, and subsequently in the caverns of a phthisical patient, an alg (penicillum glaucum), (Froriep's Notizen, 1843, vol. xxxiii.) Again, the case related in vol. civ., p. 160, of the same periodical, in which large quantities of red hair were expectorated, and on post-mortem examination balls of the same material were found in the lungs, some of the size of a hen's egg; and finally, the cases of echinococci in either sputa or lungs, whither they had been carried with the matter of a hepatic abscess. These cases are, however, so exceptional as not to employ our time here.

C. ŒSOPHAGUS, STOMACH, AND REGURGITATED MATERIAL.

In the vomited material epithelium, from the mouth, the œsophagus, and the stomach, is a constant element. The epithelium of the mouth has already been the subject of discussion. The epithelium of the œsophagus is in general the same as that of the mouth and pharynx, namely, a continuous pavement epithelium, but it exceeds the latter by its thickness and number. At the cardia the pavement epithelium terminates.

Besides epithelium in the vomited material, there are numerous mucous corpuscles, fat-granules, and fat-drops, and in fine the residues of aliments consumed, the latter being, of course, the most bulky part.

We annex, by Figs. 31 to 35, the microscopical diagrams of various articles of food, in order to avoid error.

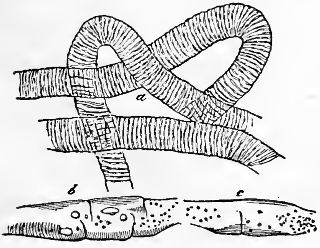


FIG. 31.

FIG. 32.

FIG. 33.

FIG. 34.

1. Muscular fibres (Fig. 31, *a*, *b*, *c*) in a more or less advanced state of digestive change.

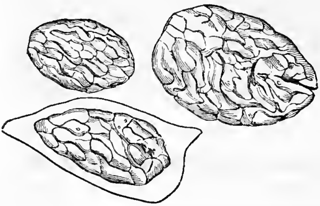


FIG. 35.

2. Starch granules of rye (Fig. 32). Those of wheat do not exhibit the same variety of size, and have rarely fissures or impressions (hilus) like the former.

3. Starch granules of barley (Fig. 33) may be easily recognised by their—in most cases—distinct hilus, their oval and irregularly angular form, and the angular form of their granulated contents. The granules of barley are comparatively smaller than those of either rye or wheat.

4. Starch granules of boiled potato (Fig. 35) may be easily discriminated from those of gramineæ and leguminosæ, by their size, as the comparison will show. The starch granules of rye and barley, and the others, are taken with a power of 450, those of potato with only 250.

5. Starch granules of peas (Fig. 34), changeable in form, often ribbed and fissured. The granules are scarce and very small. Doubts as to the presence of starch granules may be easily solved by the agency of iodine.

6. Cellulose and particles of vegetables, cellular and fibrous tissue of meat, are generally so bulky as not to require microscopic examination at all. If some particles should be doubtful, the statement of the patient will suffice to reveal their origin.

As to the different kinds of vomited material, and their microscopic discrimination, but few are of particular interest.

(1.) *Pyrosis and Green Vomit.*

The term Pyrosis, in general, comprises all disorders of the stomach, associated with sour or bitter vomit, with frequent eructation from an empty stomach. These symptoms may be of very different nature, but mostly originate in chronic gastritis. The substance raised in Pyrosis is generally a serous, opalescent liquid, of sour or alkaline reaction, containing, besides the various elements of food, but epithelial cells, and mucous corpuscles in abundance. The chemical reaction of the vomited fluid being of therapeutical importance, can easily be ascertained by litmus- and curcuma- paper.

The green vomit, symptomatically connected with some diseases, such as peritonitis, presents no peculiarity in a microscopical point of view, and its color is solely derived from the admixture of bile, as has been shown by chemistry.

(2.) *Vomited Material in Cholera.*

The material raised from the stomach in this malady has great resemblance to thin rice water. It owes this peculiarly characteristic appearance to a large number of cylindrical epithelial cells, crowding together in flakes—readily perceived by the naked eye—or isolated. Besides these, there are mucous and exudation corpuscles, and numerous granules in the liquid. The presence of these elements in cholera evacuation has led to the supposition of an inflammatory process (Pirogoff and others). Time and further investigation only can solve this question.

(3.) *Brown and Black Emesis (Coffee-Ground-like Material) in Cancerous Diseases of the Stomach.*

There was a time in which vomit of a black-brown substance was considered the most reliable sign of consummate cancer of the stomach. Pathological anatomy has taught us, however, that this symptom simply means extravasation of blood into the stomach. We may therefore expect, and we do actually observe, the like black material in hæmorrhagic erosions, in simple ulcer of the gastric coats, in the higher grades of acute gastritis, in epithelioma, in cancer, and so forth. The microscope has revealed red blood corpuscles, either in normal or somewhat wrinkled condition, especially when they have been in the stomach for some time. The dark color depends in part on pigment granules, either free or inclosed by the epithelial cells, most probably the simple result of the presence of hæmatine.

The hæmorrhagic erosion, as far as we know, gives to the vomited material no other microscopical criterion; but in ulcus ventriculi we have twice observed pus corpuscles. In one case the quantity of pus was so great as to form a thick layer on the filter. We have repeatedly adverted to the great resemblance of pus and mucous corpuscles; we have furthermore stated that the latter are constant elements of vomited material, and we may therefore again caution the observer. Pus can only be diagnosed when the number of corpuscles is *very large*, when they *agglomerate*, and when they are constantly present in the vomited material independent of meals and time.

In cancer of the stomach we have not yet been so fortunate in establishing any reliable microscopical character. It might justly be supposed, that if a cancerous ulceration communicates with the gastric cavity, the structural elements of the disease would invariably present themselves under the microscope. This may even occasionally be the case, thereby rendering the diagnosis clear and conclusive.

But for various anatomico-physiological reasons this expectation is rather uncertain: *firstly*, because there is *no specific criterion of cancer*. Large numbers of nucleated cells of great size and variable form, in comparison with the fundamental structure of their source, may be admitted as pretty sure indications of a cancerous disease. Single fragments of cancerous tissue cannot be admitted as conclusive evidence of cancer.

Secondly: It appears, even admitted that from a few scattered cancerous fragments, a general diagnosis of cancer might be formed by exclusion, but a cancerous ulceration does not follow unless the cancer cells appear en masse, because the disintegration of the cancerous structure may be effected by a fatty degeneration of isolated cells.

Thirdly: The surface of so-called cancerous ulceration is invariably covered with a striatum of cells undergoing fatty degeneration, and when in that condition they are so much like ordinary epithelium of the stomach, that it seems quite impossible to discriminate between the two. And yet those cells we have chiefly to expect in the raised material.

In fine, it should be remarked, though not strictly belonging to our subject, that neither emesis per se, nor the emesis of a brown-black material is in any way pathognomonic of cancer of the stomach, nor would its absence exclude that disease. For both presence and absence of vomitus are dependent on the diet and extent of the cancerous degeneration, the quality of the thrown off material, and on the general condition of the gastric coats.

(4.) *Vomit of Fermenting Substances,*

and the presence of *Cryptococcus cerevisiæ*, have no direct pathological importance. It may, however, be inferred, that there is some obstruction on the Pylorus, delaying the evacuation of the stomach into the duodenum, thus giving time to the generation of the ferment-alg. In chronic catarrh of the stomach (Lehmann's Physiol. Chemistry), mucus seems to be susceptible to fermentation and conversion into butyric, acetic, and lactic acids.

Cryptococcus cerevisiæ generates spontaneously in some liquids and bread, and numerous spores enter therefore the stomach with food. Unless the stomach is in a morbid condition, and contains material highly susceptible to fermentation, the spores pass out again without trace or molestation. Is the stomach, however, deranged, the alg multiplies by budding and dividing, and it both favors and causes gastric fermentation.

The ferment-alg consists of single oval spores, 0·003–0·007 Mm. diameter, with nuclei refracting light strongly (Fig. 36). The spores present ordinarily the form as illustrated above and left in the diagram. Their nucleus is very like a fat granule, sometimes, however, the nucleus is rather large and dark, but rarely absent. The highest state of development attainable by Cryptococcus cerevisiæ in the stomach is, that a few cells join each other and put forward some buds, likewise represented in the illustration. The diagram indicates also the history of those cells, one growing from the other, as can be observed in fermenting malt liquids and bread.

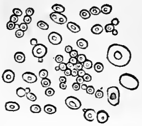


FIG. 36.

Once initiated in the stomach, the ferment-alg becomes a very obstinate customer, resisting almost all reagents that can possibly be borne by that organ. The only remedy against it, and well known by the populace, is whiskey, which chemically disturbs the formation of Alcohol.

In those fermenting and ejected substances yet another vegetable occurs; namely: Sarcina ventriculi (Goodsir), Merispodia ventriculi (Ch. Robin).

This parasite, belonging most likely to the family of algæ, was discovered and first spoken of by John Goodsir; it has since been frequently observed and examined. Since the author, in 1850, published all that was then known with reference to Sarcina ventriculi, we have not advanced one single step in our knowledge of this parasite, so that Simon has already mooted the question, whether the Sarcina was not often a mere transitory form of Cryptococcus cerevisiæ.

The vegetable is of a firm consistence and transparent; it is found in cubic, prismatic, and irregular masses: of 0·05 or 0·02 C.Mm., and is commonly composed of from 8 to 16–64 and even more (Edin. Med. and Surg. Journal, 1842, p. 438) cubically shaped cells with rounded angles and cruciated, each of 0·008 Cub. Mm. in size. They are held together by a sort of hyaline substance; sometimes, however, no intercellular material can be discerned. Most of those cells contain but one nucleus, being 0·003 Mm. in diameter, of rusty-brown color, which under the microscope gives the whole a yellowish hue.

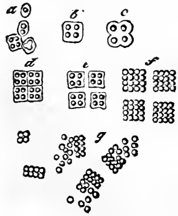


FIG. 37.

Sarcina occurs in all the diversified forms as represented in Fig. 37, *b–f*, and rarely smaller, and more frequently larger. The diagram has been copied from G. Simon's essay, "Ueber die Entwicklung der Sarcina aus dem Hefenpilz."

Fig. 37, *a*, shows the common Cryptococcus cerevisiæ, with one, two, or even with four nuclei. In the rudimentary cells, the division of the nuclei has been but imperfectly accomplished; in 37, *b*, the nucleus appears subdivided in four and eight; it has lost its round form and become cubical. Each nucleus in swelling suffers at the same time constrictions, whereby the cubic cell assumes a sort of dumb-bell shape.

Fig. 37, *c*. The nucleus again parts in eight new nuclei (*d*), which undergo the same process (*b* and *f*). The first cell gives therefore rise to four or eight, the second stage of development thirty-two to forty-six, and the third to 256–512 nuclei.

The same membrane, growing by this process thinner, at last bursts (*g*) and the daughter cells are thereby separated. It is easily perceived that this is a process of Sporotrych-development (Kützing).

Sarcina (merismopædia) is by far more frequent than is generally believed; but it has but once been observed (by Wedl) without the animal body. It is observed in men and mammalia, and chiefly in the intestinal tract. Virchow once met with it in a fresh stomach, and once in a vomica or in a pulmonary cavern, Keller in urine, and other observers in fæces. According to our experience in four cases we have found Sarcina in fæces, after having observed it previously in vomitus. In a fifth case the fæces were not examined.

(5.) *Fat in Vomit.*

As has been already stated, fat is a common constituent of vomited material. It is of course more copious after rich meals. Cases are, however, recorded, as for instance that of Dr. König, in which the patient abstained from all fatty articles of food and yet vomited large quantities of oleaginous substances. The patient referred to by Dr. König suffered from (cancerous?) ulceration of the stomach. His food was but milk. Early in 1851 he regurgitated copious quantities of chocolate-colored material, the surface of which presented a glossy appearance like dish-water or weak beef-tea. Later, the vomited material was entirely covered with a layer of yellow fat, which on cooling hardened like tallow. This symptom was frequently accompanied by a rancid taste and a burning sensation along the throat. No chemical or microscopical examination was made.

The like cases are exceedingly interesting as to the effects of gastric juice, and we have adverted to them in order to excite attention and further inquiry.

(6.) *Accidental Substances in Vomit.*

The most miscellaneous substances have been found in vomit, such as the larvæ of insects and intestinal worms, having passed either through the mouth or from the intestinal tract to the stomach, hair-concrements, etc. We cannot, however, enter upon a description of the like substances, being too diversified and too foreign to our subject.

This, however, should not deter from their most careful examination, as some most valuable discoveries may result therefrom. Fæces, in connexion with obstructions of the intestinal canal, will casually give rise to these appearances in vomit, but they are readily recognised.

D. DISCHARGES PER ANUM, FÆCES.

The fæces ordinarily consist of:

(*a.*) Decaying epithelium from all parts of the intestinal tract.

(*b.*) The indigestible residues of food.

(*c.*) Excretions of all those glands belonging or annexed to the alimentary canal; they are either liquid and intimately mixed with the other constituents, or they supply the coloring matter of the fæces, and are either amorphous or in a crystalline form.

It is therefore obvious that countless microscopical elements should be found in fæces. There is scarcely a better microscopical exercise than their examination, but their miscellaneous composition is equally prone to mistake and error. The only practical purpose for which fæces have hitherto been examined, was to ascertain the presence of entozoa in the alimentary canal. There are, however, still other investigations proposed and carried on of sufficiently great importance to demand our close attention.

In certain forms of chronic diarrhœa, for instance, when there is suspicion of ulceration of the mucous membrane, we have to direct our investigation upon

(1.) *Pus in Fæces.*

In large quantities of fæces it is obviously difficult to find and to discern pus. Numerous mucous corpuscles are produced upon the mucous membrane of the alimentary canal; and in still larger number, if any irritation is going on. This circumstance renders the diagnosis of pus corpuscles exceedingly precarious and unreliable, and even more so than in vomit. The pus corpuscles should be sought for in the viscid mucus which often covers fæces, or in such parts, which differ from the rest of the fæces by their respective appearance. It is, moreover, obvious, that repeated examinations should be instituted before inferences can be drawn. As in other secretions, the number alone is the basis of our diagnosis of pus corpuscles.

We have twice succeeded in proving pus mixed with the fæces. In one case it was derived from tuberculous ulcerations of the small intestine, in the other from coloproctitis. At different times, however, we have failed in perceiving pus corpuscles, when the post-mortem examination disclosed such lesions that pus could not have been absent. An established method for examining upon pus does not exist.

(2.) *Blood in Fæces.*

In so-called Melæna, red cholera discharges, and in Dysentery, the blood can be easily discerned by the naked eye, and in most cases the microscope is hardly required; for the red blood-corpuscles are very numerous. Despite the great changes they undergo through the contact with fecal matter, they retain their characteristics in a certain measure, so as to be easily recognised.

There are, however, circumstances, in which it is desirable that their presence or absence should be positively ascertained. Thus it is known that the use of Calomel gives to the stools a green color, although the cause of this peculiar action of Calomel has not yet been disclosed; still, this much we know, that blood has no part in it. Some say that a sulphuret of quicksilver is formed, which endows the fæces with the green color. Dr. Alfred Vogel is, however, of the opinion, that the Cholepyrrhine in contact with Calomel oxydizes into biliverdine, which is said to be the identical coloring matter of Calomel-stools, whilst the formation of Quicksilver-sulphide could only be supposed if Calomel was administered in large doses.

Other green alvine evacuations may derive their color from the superabundance of bile (Polycholy) provided the secretion of bile does not go beyond the formation of biliverdine (Lehmann, vol. ii. page 118). Whereas in Typhus, Dysentery, and some other intestinal lesions, the green color of the stools is evidently connected with the presence of small quantities of blood, and its microscopical recognition lends us an important insight into the condition of mucous membrane.

In other cases black or red fæces excite the apprehension of the patient. The fæces turn black from the use of iron, consequent upon its combination with sulphur. Indigo colors the stools green; Rhubarb, Gummisguttæ, and Crocus give them a high yellow color. Some articles of food exercise also a certain influence upon the color of fæces; as, for instance, the blackberry, etc. These accidental influences upon the coloration of fæces may be easily ascertained, so far as the agency of blood corpuscles is excluded.

(3.) *Gelatinous, Mucous, and Rice Bodies*

Occur sometimes in alvine evacuations. Both are secreted by the follicles of the large intestine, and they characterize themselves by the presence of small, round or oval, pale and granulated cells, besides numerous isolated granules, imbedded in the amorphous mucus. The microscopical discrimination of these elements from ingesta may have some interest and value in the treatment of infants.

4. *Pseudo-membranes, Exudations, Scabs from Typhus and Tuberculous Ulcerations of Follicles, and Fragments of the various Structures of Intestines.*

The products of inflammation and intussusceptions are generally discernible by the naked eye; but even if this should be the case, the microscopical examination should not be neglected, for experience teaches us that the eye is not always to be relied upon in such things. Moreover, confusion is possible.

The fragments of typhus-scabs characterize themselves by densely grouped molecules, derived from decaying cells and nuclei, besides crystals of phosphate of ammonia-magnesia; the discharges in Dysentery by blood and pus-corpuscles either isolated or connected in membranes by a coagulable material.

(5.) *Changes which Certain Articles of Food Sustain by the Digestive Process.*

The public is readily disposed to take everything that passes the anus for intestinal worm, which presents an unusual appearance; and we have received many objects, for examination, which had been sent with this view. In two cases we found fragments of linen imbedded in mucus and fæces. Mere washing revealed their nature. A pretty thick linen-thread, cut in inch-long pieces, had been swallowed by a child, and passed off in three or four days. The frightened parent was, however, comforted by our showing the fibrillæ of the thread.

In another case cellular tissue was the cause of alarm, which was, of course, at once recognised by the microscope. Again the same element, derived from meat balls, was presented to us. In another instance a number of small, white, equally wide pieces were handed us, which by appearance looked as much like tapeworm as could be imagined. The magnifying glass, however, sufficed to destroy the supposition, and the microscope disclosed the true nature of lichen islandicus. In one case, Prof. Buhl observed mucus to have undergone such changes as almost to simulate tapeworm. But these exemplifications will suffice.

To such delusions we can hardly count the case of Prof. Huss, who observed for a period the discharge of fibres, which proved to be adipose tissue, very like that of lipomas. We doubt whether these elements had been introduced from without, and, indeed, if they were, we should be unable to account for their true nature. Perhaps they originated in a lipoma of the intestinal canal, disintegrating and passing off in fragments.

6. *Entozoa.*

The entozoa hitherto found in the alimentary apparatus of men, consist, as far as we know, of the following:

1. Nematodes: Trichocephalus dispar, Oxyuris vermicularis, Ascaris lumbricoides and alata (?) and Ancylostomum duodenale.

2. Trematodes: Distomum heterophyes, Pentastomum constrictum.

3. Cestodes: Tænia solium, nana and mediocanalata, finally Botryocephalus latus.

Of these, Trichocephalus dispar, Oxyuris vermicularis, Ascaris lumbricoides, Tænia solium, and Botryocephalus latus occur in Sweden.

Trichocephalus dispar has been but rarely observed. The case related by Valleix, in which the cœcum was found to be filled with this species, offers no particular diagnostic interest.

Oxyuris is frequently noticeable in alvine discharges; at times it escapes spontaneously from the rectum, and is then found on the bedsheets. Ascaris lumbricoides, Tænia solium, and Botryocephalus latus usually pass, either entire or in part, with the alvine discharges, and in such cases there is no difficulty about the diagnosis. But in cases where symptoms only exist, which indicate the presence of Entozoa, without their discharge, the microscope only can solve the doubt.

The Entozoa appear to be constantly generating and discharging ova and even those which are pregnant are covered with them. Thus the ova in the fæces are positive evidence of the presence of Entozoa. The attendant should therefore administer a drastic purgative, and submit the excrements to microscopical examination. The ova are usually found in the mucus, which should be examined by a power of 150 in order to obtain a sufficiently large optical field. Having discovered an object resembling an ovum a higher power (300 and upwards) is required to examine its structure and thereby to determine its species. The annexed diagrams were drawn on a scale of 320. Fig. 38 represents the ovum of Tricocephalus dispar, 0·040 by 0·020 Mm. in size. It is characterized by a distinct cylindrical termination at each-end, while its transparent membranes and the dark granular contents are like those in the ova of other species of Entozoa.

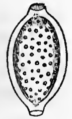


FIG. 38.

Fig. 39. The ovum of Oxyuris, larger than the former, about 0·056 by 0·030 Mm., of oval form without cylindrical termination.

Fig. 40. Ova of Ascaris lumbricoides from an ovary, 0·056 by 0·050 Mm.; coats very thick, vitreous, and covered with spines. Other ova are without them, as shown in Figs. 41, 42, the latter of which predominate in the fæces. They all have thick shells.

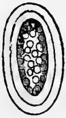


FIG. 39.

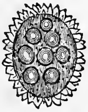


FIG. 40.

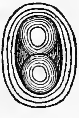


FIG. 41.


FIG. 42.

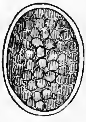


FIG. 43.


FIG. 44.

Fig. 43. Ova of Botryocephalus latus, 0·050 by 0·040 Mm. The membranes extremely thin and fine; for the rest like ascaris ova.

Fig. 44. Ovum of Tænia cucumerina. We have taken and drawn this ovum from an individual which had passed from a child.

Fig. 45. Ova of Tænia solium, almost circular, of 0·033 Mm. in diameter. The membrane, upon the application of a low power and false focus, shows parallel lines which cross each other at right angles; with considerably increased power we notice that the exterior coat consists of hexagonal parallel plates with dark spots in the centre. In most of them we found embryonic hooks. The presence and the general structure of the ovum are sufficient for the practical purposes of diagnosis.

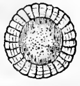


FIG. 45.

Figs. 46, 47. Ovum of Tænia solium, according to Wedl.

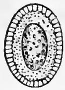


Fig. 46.

Fig. 47.

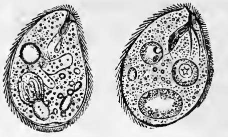


Fig. 48.

Fig. 48. Ovum of Tænia lata from an ovary, by Dr. Lorenz Tutschek.

The majority of the diagrams are taken from specimens in the excellent collection of Dr. Höks, to whose liberality we are greatly indebted.

The vitellus of these ova is various in form, which, however, depends on the stages of their respective development, and, therefore, presents no particular characteristics. The Author assumes that the development of the vitellus is the same in the ova of the different Entozoa species.

The microscopical recognition of the ova of Entozoa is of no special difficulty. On the one hand they have acutely shaped and very firm coats; they are elastically resistant and therefore compressible, so as to be almost indestructible; nor are they affected by iodine or diluted acids.

(7.) *Infusoria of the Intestinal Canal.*

Prof. Malmsten of Stockholm found in two cases of chronic diarrhœa a peculiar species of infusoria which he has called Paramæcium coli, and described in the Hygiea, 1857, page 491, and in Virchow's Archiv, 1857, Numbers 2, 3, page 302. In both cases they occurred in great numbers and existed independent of any ulceration of the mucous membrane, and were for months observed in the passages. In the other case they were even found after death throughout the large intestine, but none in the small. The Infusorium is of oval form, 0·100 Mm. in length, its exterior membrane is covered with ciliæ and interiorly provided with a nucleus. In addition to these we notice contractile vesicles of fragments of food, apparently, and fat granules. Malmsten is of opinion that this species of Infusoria and their immense number (20 to 25 in a fragment of mucus) are well calculated by their restless activity to cause increased peristaltic motion and intestinal secretion, and consequently diarrhœa. That they have not been noticed more frequently before, is probably no evidence of their rare occurrence, but owing to their rapid decay after they leave the rectum.

It is therefore a material condition in respect to microscopical examination that the fæces should be submitted to it without delay; unless—and this is preferable—mucus from the rectum be taken.

(8.) *Fat in Fæces.*

Fat is met with in all fæces. It shows itself microscopically as granules, drops, cholesterine and margarine crystals. In cases in which the liver or pancreas perform their functions insufficiently, the quantity of fatty accumulation in the fæces is so great that it may be readily discerned with the naked eye. It may then be found in drops or larger masses, assuming when cooled the consistence of butter or tallow.

(9.) *Accidental Components of Fæces.*

The accidental components of fæces may be of various kinds; most usually they are, however, undigested substances, although larvæ of insects are often met with by the observer.

Often they may have accidentally joined with the fæces, but not rarely they pass with the food into the alimentary canal. To our knowledge no insect has yet been discovered as indigenous to the intestinal canal; a close examination of the larvæ would, however, be advisable. Among other accidental components we may name the concretions of the intestinal canal. They are partly formed therein—Holm's anatomical museum possessing a fine specimen of them—and partly they originate in the glands, adjacent to the intestinal canal. Those most frequently met with come from the gall-bladder, but on account of their size they are not of microscopical importance.

E. THE UROGENITAL ORGANS.

The secretions of these organs in both sexes are discharged through the same excretory ducts; they are consequently more or less intimately mixed. For the purpose of greater distinctness, we shall consider them in different groups.

(1.) *Organized Substances derived from the Urinary Bladder and the Kidneys.*

Assuming an accurate histological knowledge of these organs on the part of the reader, we may, nevertheless, be permitted to call special attention to certain points highly important for the correctness and completeness of microscopical diagnosis.

The curved uriniferous tubules of the cortical substance possess an approximate diameter of 0·010 Mm., and are lined with either oval- pavement- (Fig. 49, *a a*) or circular- and polygonal- epithelium, the cells of which measure from 0·003 to 0·006 Mm. in diameter. At the basis of Ferrein's pyramids the uriniferous tubules are lessened in size (0·004 Mm.), in which, of course, the epithelium participates (0·001 to 0·002 Mm.); but in the pyramids they rapidly increase in diameter, so as to measure in the middle 0·020 Mm., and close to the papillæ as much as 0·030 Mm. The epithelium continues, however, to be flat and small.

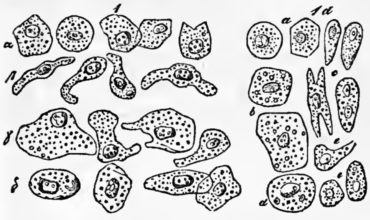


FIG. 49.

From the measure of the curved uriniferous tubules that of the epithelial lining should be deducted, so that their actual lumen does not exceed 0·005 to 0·003 Mm.

The renal pelvis, calices, and ureters present three layers of epithelial cells. The most external consists of pavement-formed polygonal (Fig. 49, *b*) or circular (Fig. 49 *d*); the middle one of cylindrical (Fig. 49, *c*), being sometimes endowed with stellated points, the innermost of oval or globular epithelium (Fig. 49, *e*), all of them with one, rarely with two, eccentric nuclei, and large granules of nearly half the size of the latter.

The epithelium of the bladder shows pretty much the same arrangement as the renal pelvis, with the difference, however, that the granules do not acquire the same size.

The short female urethra is lined with the same epithelium as the urinary bladder, while in the male urethra it is chiefly cylindrical, with a subjacent layer of round and oval cells.

Uterus, nymphæ, and the large labia are endowed with ciliated epithelium, approaching the form of epidermal cells the more it advances towards the rima pudendi.

Of all the forms of epithelium the urine may exhibit specimens, but with the exception of menstruation and lochial discharges they are not its normal constituents. Wherever they are found they indicate morbid conditions, or at least an unusual irritation of the organs from which the epithelium is derived.

For whatever microscopical elements the urine is to be examined, it should be done soon after its passage, and again twenty-four hours later. To postpone the examination to a still later period is not practicable, as an ammoniacal urine would dissolve or destroy the organic constituents which are produced in renal catarrh. Meanwhile, the urine should be kept in a cool place, of 10° to 15° C., in an inverted cone-shaped vessel (champagne glass, funnel, or the like), so that the epithelium as it settles may be more easily collected. A drop of this is then put on the objective glass, and is first examined with a power of 150, which is afterwards increased. It is scarcely necessary to go beyond 450,—350 being mostly sufficient.

Besides the forms of dust, just spoken of, various others are met with in urine, and we therefore annex diagrams of several of these foreign particles, which, unless properly recognised, may induce error. Fig. 50, sheep's wool from felt; Figs. 51, 52, cat's hair (51, the fine ends; 52, the thicker part); Fig. 53, bed feather; Fig. 54, pine wood splinter from a floor.

The affections of the urinary organs, which cause separation of epithelium, and thus furnish objects for microscopical observation, are


FIG. 50.


FIG. 51.


FIG. 52.


FIG. 53.


FIG. 54.

(a.) *Urethral and Vesical Catarrh.*

In both of these disorders we find separation of the epithelium from their beginning and later formation of pus corpuscles. The epithelium often occurs in considerable quantity; the large pavement epithelium, as well as the subjacent, cylindrical and oval, from the bladder, and the cylindrical from the (male) urethra. Mixed with it, we find numerous exudation- and mucus- corpuscles, and an enormous quantity of large and small granules. In an advanced stage, when the catarrh has so widely spread as to affect, for instance, the entire bladder or the whole urethra, or any distinctly circumscribed portions of either of them, the epithelium rarely occurs of normal form; but in its place we find newly formed oval, neoplastic epithelial cells (mucous-corpuscles) which are imbedded in the tough, viscid mucus, peculiar to chronic urethritis or cystitis.

In this stage, particularly, we come across pus (although at times it may be found much earlier), and sometimes in such abundance that it soon decomposes and thickens the urine, and even now and then produces an alkaline fermentation prior to its discharge. In catarrh of this character, blood is sometimes exosmosed, and the urine with or without such admixture of blood is slightly albuminous.

(b.) *Catarrh of the Uriniferous Tubules and "Bright's Disease."*

We have placed the acute as well as the chronic catarrh of the uriniferous tubules in the same category with Bright's disease, not that like some other authors who have preceded us, we assume as certain that the latter affection is but the consequence of the former, nor that we think they are identical, but because the microscopic elements which we recognise, when found in urine, as pathognomonic of these affections of the kidneys, may be more easily compared in their characteristics, and better comprehended when placed alongside of each other.

We believe with Johnson, and for good pathologico-anatomical reasons, that the definition of Bright's disease requires narrower limitation, and we have, therefore, followed his precept in the enumeration of the microscopical elements appertaining to different renal diseases.

In acute, more rarely in chronic Catarrh, in cases of Nephritis and Cancer, extravasation of blood occurs in the uriniferous tubules. It is obvious in what way the extravasated blood can fill the uriniferous tubules, how it coagulates, and how it forms thrombi and obstructions there. In a case of Hæmaturia we found the clot represented by Fig. 55, besides others composed of blood and fibrin; Johnson also mentions similar observations. The patient, who was under treatment at the Seraphinian Hospital, recovered, and we cannot, therefore, more closely determine the diagnosis by Autopsy, though it will probably have to be designated acute desquamative Nephritis. (Johnson.)

FIG. 55.

Aside from the bloody coagulation, this case presented numerous epithelial coagula (Fig. 56), and epithelial cells from the uriniferous tubules, and a goodly portion of albumen. These are the microscopical elements which characterize acute catarrh of the uriniferous tubules (for so we shall have to entitle the disorder), and they agree, mutatis mutandis, with what has been said of the components of sputum in acute Bronchitis.

FIG. 56.

Many writers (*Frerichs* among others) consider these the characteristics of the acute form of Bright's disease.

When Bright's disease assumes a chronic character, the urine shows, besides a constant lower specific gravity and albumen, the presence of tubular casts,* which present themselves in various forms, totally different from those we have just described.

Figs. 57, 58, are formations which frequently occur. They somewhat resemble in point of width the curved uriniferous tubules after their epithelial lining has been cast off. They are partly dark and granular, as in Fig. 57, partly clear and wrinkled, as in Fig. 58. In the former case Johnson calls them granulated epithelial cylinders, and considers them to be a coagulation of fibrine from the uriniferous tubules, which, in coming away, have carried with them the last remnants of the epithelial lining. In the other case he calls them large waxy cylinders, and looks upon them as coagulation of fibrine from the tubules previously deprived of their epithelium. In both cases they belong to his "chronic desquamative Nephritis," and correspond with what may otherwise be called chronic Catarrh. In the cases described, the albumen, according to Johnson, is wanting in the urine. The only remaining microscopical element found in it is an abundance of amorphous granules being perhaps decayed epithelium from the renal passages. We have never seen these coagulations under such circumstances, but very often in Bright's disease, and from a case of it we have drawn the diagrams.


FIG. 57.


FIG. 58.

Johnson also mentions a smaller species of waxy cylinders, which we have copied from him under Fig. 59, and of which he says that they come from the uriniferous tubules which have as yet retained their epithelium. For our part we have never seen any of them.

* The Swedish original, in speaking of these formations, uses the term Afgjutningar, literally: that which is cast off. J. Vogel (Analysis of the Urine by Dr. C. Neubauer and Dr. J. Vogel, 2nd edition, 1856, page 214–216) distinguishes, after Lehmann, between three principal classes: 1. Epithelial tubes composed of epithelium from the Bellinian tubules; 2. Granulated renal cylinders, solid, of finely granulated structure, comprising severally single epithelial cells, frequently blood- and pus-corpuscles, and various forms of crystals; and 3. hyaline renal cylinders (Johnson's waxy cylinders), also solid, but extremely pale and not readily discernible unless colored by iodine. (Tutschek.)

Fig. 60 represents a form of tubular cylinders, which seems always to occur, in greater or less completeness, in Bright's disease. It resembles that observed in ordinary Catarrh, but varies from it, that it contains fat granules and fat drops, and that the epithelium, which adheres to it, contains fat.

FIG. 59.

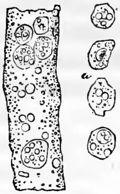


FIG. 60.

FIG. 61.

We even find such epithelium, though rarely, in a disconnected state in the urine. In other cases we have observed similar, but less granulated, thinner and clearer cylinders. Owing to their thinness and transparency they are often overlooked; but they are of great importance as, in our own experience, they seem to indicate an early state of the disease. (Fig. 61.)

In all the last-named forms of tubular cylinder fat is found. It is therefore not to be wondered at, if in fatty kidneys we also meet with

(c.) *Fat in Urine, Galacturia,*

which we sometimes find mentioned, although chemically and microscopically examined cases are rarely recorded. Such have been observed, however, by Christison, Rayer, Lehmann, and Isaacs. Bence Jones gives (in Med.-Chir. Transactions, 1850, xxxiii.) a masterly description of a case of Galacturia. Smaller quantities of fat in the urine in some diseases (Icterus, pulmonary cancer, etc.) have been observed, which result in rapid attenuation; or after the administration of oleaginous remedies and. s. f. The causes of this phenomenon are, however, as yet not even remotely ascertained. Small fat-drops are not uncommon in the urine of women, but they undoubtedly are derived from the sebaceous follicles of the great labia. Sometimes the fat may have been introduced with the catheter, or in a similar manner, and cases are related in which patients had added milk to the urine to misguide. In former years a fatty membrane was described, as covering the surface of the urine; and Nauche once attached much importance to the so-called kyestine in the urine of pregnant women. But it seems as if foreign particles, dust, alg-fibrillæ, and crystals of phosphates are the constituents of either, but no fat. Whenever there is fat in urine, the microscope will promptly disclose its presence; but before it is accepted as a morbid constituent of urine, all practicable precaution should be used, so as to preclude the possibility of mistake. And, at any rate, the physician should be present and see the passage of the urine himself which he intends to use as test.

As a peculiar affection of the kidneys, different from those already discussed, Johnson describes an inflammation in which the products, without detachment of epithelium, are rapidly converted into pus. He terms that disease

(d.) *Nephritis suppurativa*,

corresponding with acute Nephritis of other authors. The urine contains, in such instances, free pus in abundance and purulent tuberculous fragments.

We have observed such a case, complicated with Icterus, in the practice of Prof. Malmsten. The number of pus-corpuscles was not particularly large, but there were many fragmentary coagula, both being yellow from the coloring matter of bile (Fig. 62 is copied from this case).

FIG. 62.

In diseases of the kidneys the microscope is the most important diagnostic auxiliary, and by no other means can we so accurately determine the nature, seat, and extent of renal affections. In fact the microscope often alone reveals the actual condition of the organs. In all the renal diseases before discussed, we had to deal with either the ordinary elements of the organs or the ordinary inflammatory products both in the progressive and regressive stage. There are, however, two forms of renal degeneration, for which, likewise, the microscope is of great importance, namely,

(e.) *Cancer and Tuberculosis.*

The former manifests itself by frequent admixture of blood with the urine, which of itself is, however, no characteristic of malignant disease. But in both the possibility exists of small fragments of the cancerous or tuberculous structure being found in urine, more especially when the respective diseases have advanced to the Malpighian pyramids or the renal pelvis.

In the absence of specific characteristics, both of cancerous and tuberculous matter, the microscope alone cannot be relied upon for diagnosis; though its aid will prove of value even in these instances. Observations on this point are rather scanty, and even at that they are not reliable, and we have no experience of our own. Possibly all that appertains to cancer of the stomach is equally applicable to the same disease of the kidneys.*

(2.) *Accidental Organic Elements in the Urine.*

This class comprises Entozoa, Entophytes, and especially

(a.) *Echinococcus hominis.*

A case in which this parasite has been found in the urine Frerichs has reported.†

* Dr. Lampl (Prager Vierteljahrschrift, xiii., 1856) has published seven cases of cancer of the urinary bladder with the results of his careful and detailed microscopical examinations. Prof. Wagner, in referring to them (s. Schmidt's Jahrbücher, vol. 92, page 40), justly doubts the reliability of conclusions based upon the microscopical elements of urine, in as far as the diagnosis of cancer is concerned. In fact he admits the same axiom laid down by our author when discussing the microscopical diagnosis of gastric cancer, namely, that only the fragments of the carcinomatous mucous membrane give any certainty to diagnosis.

Something similar may have occurred in cases of epithelioma and polypus of the urinary bladder, related by Dr. von Dueben (since the publication of this essay), in which he succeeded in diagnosing those affections by the microscope. According to Julius Vogel (l. c. page 213) the cancerous mass usually forms clusters or aggregations of cells (parent and daughter cells) with their cell-walls caudated, and spindle-formed elongated cells.

Tubercular mass, presenting itself to the naked eye as pus, consists, as the same author states, of irregular pus-corpuscles, besides an indefinite detritus, fragments of cells, incompletely developed nuclei and granulæ, and indefinite finely granulated substance, occasionally comprising fragments of cholestearine-crystals.

† Medico-Chirurgical Review, 1842. Kingdon's case belongs likewise to this category, in which ascaris lumbricoides passed with the urine, being in more than one point of great interest. A boy seven years of age had swallowed a darning needle; it stuck in the vermiform process, causing inflammation and subsequent adhesion

The Echinococcus characterizes itself by its gelatinous vesicle, swimming about in the urine, and its hook may be even then recognised when it has suffered some changes. The like cases have been observed by Creplin (Mueller's Archiv, 1840, page 149), by Fiane (Compt-Rend. Société Biolog. ii. page 8), and by Barker (Med. Times and Gazette, 1855, page 63). In the last case, examined by John Quekett, 150 vesicles passed with the urine. The patient in question, had chiefly relied on pork and sheep's brain as articles of food.

(b.) *Strongylus gigas.*

This Entozoon, though but seldom found on the human body, has now and then been observed, and should therefore be mentioned here.

(c.) *Spiroptera hominis*

has twice been found in urine, namely, once by Barnett of London, and at another time by Brighton of New York. The examination in either case was imperfect however.

(d.) *Infusoria.*

Besides the species of Trichomonas vaginalis, Fig. 63,* first observed by Donné in the vaginal secretion, there are many infusoria generating in the vagina, under the favorable influence of warmth and moisture, which mix with the urine. It does

with the urinary bladder. Having perforated both and entered the latter it became thus the nucleus for a calculus. Through this passage several ascarides entered the bladder and were discharged with the urine.

* Trich. vag. has an oval, pear-shaped, slightly ciliated body, of 0·008 Mm. diameter, with double filiform appendages (tails); its movements are very rapid. Scanzoni and Kölliker have observed this infusorium species in great numbers, and in the different forms of Blennorrhœa, but never in the secretion of the womb. When the mucous membrane of the vagina is in a state of perfect health, Trich. vag. is not met with. It follows, therefore, that this animalcule depends on morbid secretion, which needs not necessarily to be of specific character.

not seem, however, that they possess any pathological importance, and therefore do not call for any particular notice from us.*

In urine in which, after exposure to atmospheric air, alkaline fermentation has set in, we have seen infusoria in great number and variety. They are partly round, a species of monades (crepusculum?) partly vibriones. It is well to notice all such details, although they are probably of no significance in regard to diagnosis of disease.

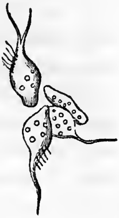


FIG. 63.

(e.) *Cryptococcus cerevisiæ.*

This alg—which we have in the preceding pages both described and represented—or rather a smaller species of it, as some authors assert, is frequently noticed in urine.

In cases of Diabetes, under our notice, which terminated fatally, no opportunity was afforded us to trace the ferment-alg into the urinary bladder, nor have we noticed it in urine immediately after its passage. But a few hours later the ferment-alg had become a *constant* microscopical element of saccharine urine.

From this statement the inference should not be drawn, that Cryptococcus is not generated in diabetical urine before its discharge from the bladder, as a few spores and filaments in recent urine may easily escape notice. But this much is certain, that very soon they multiply at a rapid and surprising ratio. Indeed, our numerous examinations of urine led us to suppose, that Cryptococcus cerevisiæ generated only in saccharine urine, and where it is found, it should at once induce an analysis upon grape sugar.

There are occasionally some other species of algæ in urine, generating upon either the uterine or vaginal mucous membrane, which we, however, omit to discuss, as they are of no pathological interest.

* The presence of infusoria (Vibrio rugula) is of pathognomic, that is, diagnostic importance, when found in the recently passed urine of advanced Bright's disease.

(f.) *Sarcina (Merismopædia) ventriculi*

in the urine has been found three times by Heller, twice by Johnson, twice by Beale, and once by Mackay.

The facts, that Rud. Virchow has discovered Sarcina in a pulmonary cavern, and Jenner, in a lateral ventricle of the brain (?), seem to intimate that this Phytozoon is of common occurrence even in healthy individuals, and thus no particular importance can be attached to its presence in the urine.

How sarcina should have found its way into those localities is, without the resumption of generatio equivoca, as yet incomprehensible, and it must be reserved for future investigation to throw light upon this subject.

As Wedl has found sarcina in water, it may be surmised that its occurrence in urine is of mere extraneous significance, and it may not be far from the truth, that the urine-chamber contained it prior to the reception of urine.

At any rate all observers agree, that the alg is of no pathological moment, wheresoever it may have been found.

(g.) *Hair.*

The urine may contain hair from various portions of the body, which, as accidental components, are of no interest to us; unless they are hair-like formations, in great number, and partly incrusted, from the urinary bladder itself. This uncommon and highly remarkable phenomenon has as yet not been sufficiently explained, and we have to refer those of our readers, who may feel disposed to investigate this subject more thoroughly, to the excellent monograph of Rayer, "Sur le trichiasis des voies urinaires et sur la pili-miction."—Mem. de la Société de Biologie, vol. ii. 16.

(3.) *The Male Genitals.*

Of entirely different, and vastly greater significance than the real infusoria, which for a time were classed with the latter, and have even retained their name, but which may now properly be included in the order of ciliated epithelium, are the:

Spermatozoa.

It may be readily comprehended that spermatic animalcules are *sometimes* found in the urine of a healthy and vigorous male, and they certainly are found in it after coition and pollution. If no opportunity is at hand to obtain material for examination from a subject, we should avail ourselves of such as have just been mentioned to make ourselves acquainted with spermatozoa.

Their diagnosis is of particular interest in what is called Spermatorrhœa. By descriptions of the consequences of masturbation, and the number of quack publications which have been put into circulation on "secret diseases," many persons are led to believe that they suffer from loss of semen, and despair consequently of their propagating power. In other cases symptoms set in, which lead the physician to suspect Spermatorrhœa, and in which a correct diagnosis can only be arrived at by the discovery of Spermatozoa in the urine. Such persons, and particularly those belonging to the former category, sometimes experience sensual emissions of small drops of mucus, be it in the form of a pollution or during the act of evacuation from the bowels. The material obtained from, and immediately after such discharges, is best suited for the purposes of examination. It is recognised as either mucus and epithelial cells (from the prostate gland, Cowper's mucous follicles) or as Spermatozoa.*

In other cases in which no such marked discharges occur, semen may imperceptibly pass out with the urine, and then be collected and treated as we have indicated above.

By taking a drop from the bottom of the vessel and placing it upon the objective slide, Spermatozoa may be easily recognised by applying a power of 250; at the same time it should not be neglected to examine them with the highest power which the instrument may permit.

* In cases of Spermatorrhœa, and especially in those where discharges of semen simultaneously take place with alvine evacuations, I have frequently succeeded in obtaining material by pressing the prostate gland per anum—sometimes a teaspoonful in quantity. In these instances the liquid was both milky and thin.—B.

The diagrams (Fig. 64) represent them as they appear in the urine by a power of 250, and again of 650. They consist of a cell* and its cilium (tail). The cell approximates the length of 0·009 Mm., by 0·003 Mm. in width, and 0·002 Mm. thick. The shaded parts of the cell are true to nature, but we will not venture to determine whether or not they depend on the unevenness of the surface. The nearly straight cilia of the cells are about 0·04 to 0·05 Mm. long. The entire object has a peculiar bluish, fatty lustre, so peculiar indeed as to instantly attract the eye, even though the cell should not lie completely within the focus. Fig. *e* represents a spermatozoon, lying on its side. The specimen, fig. *d*, is drawn as it sometimes appears in the urine, with its cell at an angle to the cilia, giving it the appearance as if the cilia were jointed to the cell.

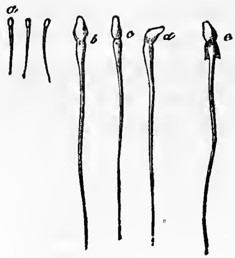


FIG. 64.

Although the cilium in the majority of cases is nearly straight, we now and then find curved specimens; we represent such a one by fig. *e*, which also shows an appendage to the cilium immediately below the cell, which not rarely assumes different shapes (remnants of parent-cells). The diagnosis of spermatozoa is important not only in Spermatorrhœa, but in medical jurisprudence even; examinations to establish their presence are necessary, sometimes in cases of rape, or suspicion caused by spots, etc., and we will mention, although it does not strictly belong here, that we readily discerned Spermatozoa ten days after pollution, by moistening the linen.

(4.) *The Female Genitals*

Furnish, both in health and disease, various secretions, the

* The spermatozoa, according to Kölliker, are completely homogeneous soft corpuscles (not cells) on which we distinguish the body or head, and the filament or caudal seminal-cells and cysts. He calls those cells and cysts which show themselves particularly in the testicles and in the superior part of the epididymis during puberty, which inclose, according to their size, a varying number of from 1 to 10, and even up to 20 bright nuclei (with nucleoli) in which a spermatozoon is generated.

examination of which, however, has thus far not produced any diagnostically important results, mainly, it would seem, owing to the difficulty of obtaining material.* We have examined only a few cases of fluor albus, and these but very imperfectly, for which reason we must confine ourselves in the following remarks to the statements of other writers.

(a.) *Menstrual Discharges*

Are said to be composed of blood without fibrine, and therefore not coagulable, besides epithelial fragments from the uterine cavity. As it seems to be generally conceded that every menstrual discharge ensues upon the detachment of ova, it follows that they must pass out with the menstrual flux, although if found, it is by mere accident. It is, moreover, asserted that menstruation causes the formation of decidua, and that dysmenorrhœa is sometimes accounted for by the presence of the latter or of another pseudo-membranous formation; and some observers allege even to have seen them come away with the catamenia. If this is the case, particles of it can of course be recognised.

(b.) *Lochiæ.*

Those of the earlier period, the red lochiæ, are chiefly composed of blood which is discharged from the interior of the womb. When the lochiæ become serous, both the blood and the detached fragments of the mucous membrane of the uterus disappear from them and are replaced by mucous and pus corpuscles.

The white (milky) lochiæ contain pus in abundance and epithelium in the process of regeneration.

(c.) *Fluor Albus, Leucorrhœa.*

This appellation, which is derived from a former period, com-

* See examinations of mucus from the vagina and cervix uteri in healthy or non-pregnant, as well as in diseased and pregnant women. By Kölliker and Scanzoni. (Scanzoni, Beiträge, etc., vol. ii. 1855.)

prises the muciform discharges from the female genitals. A closer examination into the nature of this symptom has shown that it may be caused by affections of the most heterogeneous character, such as congestion, inflammation, suppuration, and tumors. It is obvious, therefore, that the combined examination with the hand, eye, and microscope, must necessarily prove a different constitution of the morbid secretions.

In the absence of careful and reliable investigations of this nature we can only hint at the great variety of secretions which fall into the province of microscopical diagnosis, and leave a closer description of them for future consideration. In the different formations of the epithelium of the various parts, we find ample suggestions in regard to the sources of morbid secretions.

Although pus accompanies granular vaginitis, we are justified to infer ulcerations when finding it in abundance. Structural elements, when found in the secretion, determine the seat and the extent of the affection.

(5.) *Inorganic and Crystalline Constituents of Urine, Urinary Sediments.*

Under the term of urinary sediments we comprise all the constituents of the urine that sink to the bottom of the vessel by virtue of their greater specific gravity. Some of the microscopical elements already considered, likewise belong to this section. We therefore consider it practical to enter more particularly upon the discussion of the urinary sediments, irrespective of their organic or inorganic origin, and shall thereby complete our essay in a point purposely reserved for this title. An accurate description of all characteristics of urinary sediments will enable the reader to recognise the most prominent ones by the naked eye with an approximative degree of certainty.

In comparing the urinary sediments of different persons, it will be found that they present themselves in three forms.

1. Light and flocky, commonly translucent and in large quantity.
2. Dense and opaque, likewise voluminous.

3. Granulated, crystalline, in small quantity, adherent to the walls and bottom of the vessel.

The *first* category consists of mucus, epithelium, semen, infusoria, algæ, tubular thrombs, cylinders, foreign bodies as: fat, cotton, feathers, and dust.

The *second* embraces pus, phosphates, urates, starch, and also different foreign bodies.

The *third* comprises uric acid, carbonate and oxalate of lime, cystine, small portions of triple phosphates, blood, and foreign bodies, such as sand, bread-crumbs, etc.

Having already described the organic constituents of the urine dependent on certain pathological conditions of the uro-genital organs, as well as most foreign bodies accidentally coming in contact with the urine, we may at once turn our attention to the inorganic and crystalline substances of the urine, which form and precipitate themselves in consequence of the fermentative process ensuing.

Lehmann says, in reference to the fermentation of normal urine:

"In perfectly clean vessels, normal urine does not readily decompose. Left undisturbed it usually forms a light nubecula, like suspended mucus; if exposed for some time to the ordinary temperature, its normal sour reaction increases—sour fermentation —forming yellowish-red rhomboidal crystals (uric acid). Subsequently, sometimes not until after several weeks, but sooner in higher temperature, and when containing much fluid or mucus, the urine covers itself with a membrane of glossy, iridescent, or fatty appearance, consisting of dust, algæ, vibriones, urate of soda, and phosphates, of which some fragments precipitate; dirty, white yellowish flakes mix with the mucous sediment; the urine becomes pale and its reaction alkaline—alkaline fermentation. At this epoch an offensive odor developes itself simultaneously with white granules (urate of ammonia), and colorless, light, strongly refracting prismatic crystals (phosphates of ammonia and magnesia).

The fermentation of abnormal urine within or without the affected uropoietic organs, and irrespective of its morbid constituents, differs from it in time only, that is, it developes and terminates more rapidly. A premature sour fermentation in the renal pelvis or urinary bladder, gives rise to gravel. The latter, or a primary cystic catarrh, prematurely superinduces alkaline fermentation within the bladder, whereby the mucus acts as a ferment (Scherer). And this fermentation accounts for the alkaline reaction of recent urine and the formation of urinary calculi.

We cannot, however, enter upon the chemical bearing of this otherwise interesting subject, which has certainly derived great elucidation from chemistry, but we have to proceed at once to the

SEDIMENTS OF SOUR URINARY FERMENTATION.

(a.) *Urate of Soda.*

This urinary salt, of which it has been said, that the mere cooling of the urine was sufficient to precipitate it, has since been recognised as the product of sour fermentation connected with the chemical decomposition of urinary pigments. It is one of the first, if not *the* first of the sediments, and is never wanting in normal urine, though its quantity may be but small. Urate of soda shows itself as a light, white cloud, suspended in the midst of the fluid, descending gradually to the bottom of the vessel. Under the microscope this sediment exhibits, by a power of 250, forms like those represented in Fig. 65. They are irregular clusters of fine granules, sometimes joined in a network like finely branched moss.

FIG. 65.

We do not know as yet whether this urinary salt has any other significance than that of indicating the fermentable tendency of the urine, although it occurs usually in large quantities in cases of impeded oxydation of the blood.

(b.) *Uric Acid.*

Aside from those cases where the sour fermentation already takes place within the bladder, uric acid does not easily separate from recent urine and certainly not before sour fermentation sets in. In certain pathological conditions this may ensue very soon and even in a few hours.* Uric acid is never found in an amorphous but always in a crystallized state. Its crystals are of a pale yellow or red color. Their simplest forms are represented by Fig. 66; *a*, *a*, semi-transparent rhomboidal plates; *b*, traces of the formation of small plates; *c*, the small plates fastened upon a larger crystal.

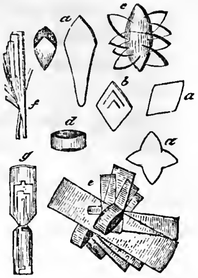


FIG. 66.

Another form resembles that of the grindstone. The crystals of these various forms are partly free, partly joined in clusters as shown by *e*. This sediment possesses so characteristic a color (brick-dust color) that its recognition is not dependent on the microscope.

(c.) *Oxalate of lime*

is observed in the sediments of normal urine in the earliest stages of its sour fermentation, and is most probably its product. Its crystals, though small and scanty, are constant ingredients of urine. Our investigations render it probable, that no crystals are as frequent in the urine as those of oxalate of lime, though on account of their minuteness they may often be overlooked.

In certain morbid affections the crystals of oxalate of lime are very numerous, and so large as to induce the proposition of a specific Oxaluria. Whether this new form of blood-disease is accepted or not, the diagnosis of the crystals is an acceptable guide for the treatment. Crystals of this salt are moreover coincident with Spermatorrhœa, and in such cases we have the best opportunities for examining them.

They are discernible with a power of 250, but they should also be examined by a higher magnifying power. Fig. 67,

* In newly born infants we find, on the second or the third, and on subsequent days, gold-colored or red-brown stains on the diapers not unlike blood. This is the normal excretion of uric acid and urate-infarcts.

a a, represents the crystals of oxalate of lime, observed with a low, and *b*, with a high power. They look very like a letter envelope of square form, are rectangular or oblique, and octahedral.

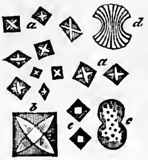


Fig. 67.

English authors also speak of dumb-bell crystals, but we have never yet seen oxalate of lime in that form. We nevertheless have added illustrations of them, Fig. 67, *c*, after Robin and Verdeil, *d*, after Golding Bird, and *e*, when dried upon glass, after Bowman.

(d.) *Cystine.*

This substance, discovered by Wollaston, contains in its chemical composition a considerable portion of sugar (25 p. c. Lehmann). He observed it first in a calculus, then, although not often, it has also been observed in urinary sediments, particularly in England. In Sweden, to our knowledge, Cystine has never been found, nor have we observed it in its original state, that is in sedimentary form, but only as a calculus, or crystallized from its solution in ammonia.

As a sediment it is said to possess the form represented by Fig. 68, *a*, which Golding Bird surmises to be composed of numerous plates lying upon one another. From a solution in Ammonia, the cystine deposits in colorless, transparent hexahedral discs (not prisms) partly solitary, as in *b*, partly overlapping each other, as in *c*, which form diversified figures, for instance the rosettes of Bird.

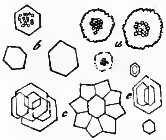


Fig. 68.

In order to distinguish the similar crystals of triple-phosphates and chloride of sodium from cystine, it should be borne in mind, that the first dissolve in acetic acid, the second in water, and cystine in neither.

SEDIMENTS OF ALKALINE FERMENTATION.

(e.) *Phosphates*

form a considerable ingredient in urine and especially in connexion with ammonia, soda, lime, and magnesia. The ordinary and most prominent combinations are the "earthy phosphates," or the phosphates of lime and magnesia, the so-called triple-phosphates. This salt occurs only in alkaline urine, and it is immaterial whether the alkaline fermentation has taken place within or without the urinary bladder. In the former case it is observable immediately after the passage of the urine, in the latter not until some time has elapsed. Sometimes it is combined with other ingredients, as in the membrane which covers the fermenting urine, or mixed up with flakes of urate of soda and mucus, and the sediments of phosphates of lime and urate of ammonia, the latter by complete fermentation of the urine. These compounds might easily be mistaken for mucus or pus, but for the microscope, which readily reveals the components.

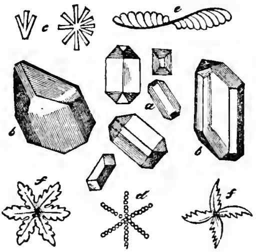


FIG. 69.

The ordinary forms of the triple phosphates are given in Fig. 69. Their crystalline prototype is the prism; they show, however, innumerable modifications with reference to the formation of their ends. In stale urine they are still more irregular and larger, *b*, *b*. In *c*, we see stellated combinations of plate-formed crystals, the radiation of which clearly exhibits articulations, as in *d*, and at *f*, *f*, stars composed of single and double wings.

All these forms present themselves under the microscope in still greater variety and modification in urine from affected organs. Their chemical composition is not satisfactorily understood. With the most frequent form of triple phosphate crystals we find numerous amorphous granules of phosphate of lime.

(f.) *Urate of Ammonia*

is observed only in urine undergoing alkaline fermentation. We then find it, either in the form of small granules, Fig. 70, *a*, or staff-shaped, free, or connected, partly as fine crystals differently grouped; the more frequent forms are annexed in the diagram. When the urine has become strongly alkaline, we notice in the sediment the peculiar crystals of a ball with numerous transparent points of urate of soda, as represented by Fig. 70, *b*, *b*. (Keller.)* They are observed in clusters, as well as in solitary crystals.

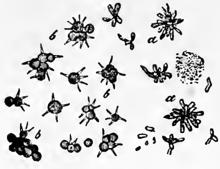


FIG. 70.

The granules of the urates of ammonia and soda cannot be microscopically discriminated from each other; but irrespective of the chemical reagents, they occur in the urine under very different circumstances.

(g.) *Carbonate of Lime*

is frequently an ingredient of sediments, caused by alkaline fermentation, in which it becomes mixed with triple-phosphates, urate of ammonia, and phosphate of lime. Like the latter it occurs as amorphous powder, and neither can therefore be discerned from each other. In a case of Urethritis and Cystitis in a child, we have observed, twenty-four hours after the passage of the urine, and while but of weak alkaline reaction, large masses of carbonate of lime. Its form, in that instance, was that of small heaps and stars, partly isolated, partly in agglomeration, and consisting of fine needle-crystals, connected with each other. Not rarely does it appear in the shape of dumb-bells, with a great variety of form (Fig. 71). This sediment is rarely considerable, and we do not recollect one solitary instance, where it had been found already deposited within the bladder.

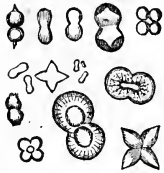


FIG. 71.

* To the naked eye these crystals appear white; under the microscope, dark and scarcely pellucid.

THE END.