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WILLIAM BLACKWOOD & SONS, EDINBURGH AND LONDON.

THE

LIVE-STOCK OF THE FARM

BY

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The Highland and Agricultural Society's Prize Essay (30 Sovereigns)
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THIRD EDITION, EDITED AND REVISED

BY

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PREFACE TO THE THIRD EDITION.

THE first edition of this work was published in 1874 the second in 1875. These two editions met with so much favour amongst stock-owners, that it has been thought desirable to leave the text as nearly as possible in its original form. Only such modifications and additions as seemed to be necessitated by the altered conditions of British live-stock interests have been introduced. The greater economy now happily practised in the feeding of roots to stock has been kept in view, and so also have the questions of early maturity and the extended use of prepared foods, such as grain, cake, and meal. Ensilage and Villa Dairying form the subjects of some fresh notes.

J. M.

August 1886.

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CHAPTER I.

INTRODUCTION.

THE production of animal food is a matter of great importance to all classes of the community, yet it has received scant attention even from those it directly concerns. That there is ample room in this country for improvement in the breeding and rearing of farm live-stock, and for increased production of meat, must be evident to all who have given the subject the slightest consideration, especially when the defective systems of stock management prevalent in many parts of the kingdom are taken into account. Although the importation of foreign live-stock and dead meat has increased very considerably in recent years, we must bear in mind that the population of the British Islands still depend chiefly for their supplies of animal food upon their home resources. For this and other reasons the increase of home-bred stock is a matter in which the community at large, as well as the agriculturists of the United Kingdom, have a deep interest.

The production of animal food, or, as it may be termed, the *meat manufacture*, embraces a wide field of investigation. It must be owned, however, that the rearing and fattening of our domestic animals is too often looked upon as something of which every one naturally possesses a sufficient amount of intuitive knowledge to enable them at once, and under any circumstances, to become proficients, without the formality of previous study, or that acquaintance with the subject which, in any other occupation, would be deemed indispensable, in order to ensure even a probability of success. To this cause we may easily trace most of the failures which we meet with, the imperfect state in which what ought to be the finished article is frequently brought to market, and the consequent disappointment as to results we sometimes hear expressed. So far from being easily understood, the entire subject, which is summed up under the name of the "meat manufacture," including the breeding, rearing, and final preparation of animals for use as human food, is perhaps the most complicated department in agricultural science, requiring the exercise of rare skill and judgment in order to be successful in the prosecution of it. In many respects we are as yet only groping our way, and further investigation is necessary before we can be in full possession of all the facts which serve to throw light on the science and practice of this important subject. A sufficient amount of research, however, has been made to enable us to understand the general principles of the matter, and, in some degree, that waste of material which must arise from the indiscriminate use of the substances we employ as the food of animals, without reference to their fitness for the purpose they are intended to serve; and also the nature of those agents which exert an influence, whether favourable or otherwise, on the full development of the nutritive powers of those substances. In treating the subject, therefore, we purpose not only to take the different stages of the "meat manufacture" in detail, but also to notice certain points which materially affect the production of meat.

CHAPTER II.

BREEDING.

A KNOWLEDGE of the principles of breeding lies at the foundation of the meat manufacture. The richest kinds of food may be used in feeding stock; but these will be comparatively useless if the animals are of a description which do not readily assimilate food, or are ill-thriving animals, as such are designated in practical phraseology. But, important as a knowledge of the principles of breeding undoubtedly is, it must be confessed that it is an intricate subject, and one upon which a variety of opinions are entertained. We shall, however, confine our remarks to certain points regarding which, we believe, there exists sufficient evidence to prove their practical value.

That "like produces like" has long been recognised as a settled fact with relation to the breeding of animals. A draught stallion will not produce a colt fit to run for the Derby, nor will a Derby winner beget a colt that would suit a brewer's dray. If we have a sire, whether stallion, bull, ram, or boar, which is ill-shaped, and put the same to a female similarly defective, the produce will most probably inherit the defects of the parents. But we may go further; for if one or other of the parents is defective, the probability is that the particular defect will be repeated, more or less, in the offspring. It is true the influence of the sire is often so great as to overcome that of a defective female. Peculiar characteristics are inherited both from sire and dam, and hence the necessity for careful selection in breeding-stock. The offspring of many sires present the characteristics of their male parent; while in other cases the female appears to possess the property of impressing her own characteristics, or those which she has inherited, on her offspring. As a rule, it is advisable to select a sire which possesses qualities or points in respect to which the female to which he is to be put is defective. Thus, if a cow is light-fleshed and delicate, the most suitable sire to put her to will be one that is fleshy, and possesses a vigorous constitution. But it may prudently be added that a "light-fleshed and delicate" cow ought never to be bred from at all.

In selecting a sire, the influence which the dam exercises on the character of her progeny should receive due consideration. In many cases the selection of a bull is determined chiefly, if not altogether, by his own character, or that of the sire. The same principle guides many persons in the selection of stallions, rams, and boars. Hence the disappointment which has not unfrequently been experienced where a good-looking and very promising sire, or one which has been got by a "crack" bull or stallion, has got very unsatisfactory stock. On the other hand, a well-bred but plain sire has often got very superior animals. These contrarieties are usually due to the influence of the sire's dam. The prudent breeder should therefore endeavour to ascertain the character of the dam of the sire he intends to use. Much more depends upon this point than is generally supposed; and, unfortunately, the male produce of very worthless females is frequently retained, to be used for breeding purposes. The male produce of a female which has a delicate constitution, a narrow chest, and weak loins, should be rigidly rejected.

A writer in 'The Farmer,' discussing the question of the influence of sex in perpetuating distinctive qualities, says: "We confess we are somewhat sceptical as to the avowed great prepotency of the male. A great deal has been assumed of late, and there has been little fresh investigation into the influence of sex. We agree with Mr Clare Sewell Read and Mr John Thompson, that the most impressive breeding animal will be found to be the one most purely bred, of whatever sex it may be. Prepotency, as it is called, will be found to be strongest in those animals, whether male or female, into whose breeding certain distinct characters have been thoroughly worked by pure breeding, by doubling up over and over again within itself a certain character, so as to produce a specially strong inherent force which shall leave well-marked outlines on all impressionable material with which it comes in contact. The influence of the male is readily seen from the abundance of his produce, whilst the individual force of the female is overlooked in her few offspring. Mr Edward Tattersall, in the meeting of the Club, Christmas 1871, stated that most great studs had arisen from one mare. Peel's stud came from Vulture, Sir Joseph Hawley's stud from Mendicant, winner of the Oaks, the dam of Beadsman, the sire of Blue Gown and Rosicrucian. Mr I'Anson, he said, had the good luck to buy in Scotland a mare named Queen Mary, from whom were descended Blinkbonny and Blair Athol; and Colonel Pearson's stud was descended from Paradigm, the dam of Lord Lyon and Achievement."

An important point in breeding is selection. This requires good judgment, but it is essential where it is the intention of the breeder to establish and perpetuate certain desirable characteristics. It was this principle upon which Mr Thomas Booth acted when he commenced, early in the present century, to improve the then existing breed of shorthorns, and to lay the foundation of those characteristics which are now universally recognised as belonging to the Booth herds of the present day. Mr Carr states, in his history of these herds, that Mr Thomas Booth "appears to have proceeded on the principle that whilst the general similitude and mingled qualities of both parents descend to the offspring, the external conformation—subject, of course, to some modification by the other parent—is mainly imparted by the male, and the vital and nutritive organs by the female. . . . Having judiciously selected the best animals procurable of both sexes, Mr Thomas Booth was careful to pair such, and such only, of the produce of these unions as presented in a satisfactory degree the desired characteristics, with animals possessing them in equal or greater measure; and unsparingly to reject, especially from his male stock, all such as were not up to the required standard." Mr Bates and other noted breeders pursued the same system in establishing and perpetuating those characteristics which they considered desirable.

It is much to be regretted that careful selection, especially in the case of males, is not so closely attended to by many breeders of the present day as it ought to be. Bull-calves are not unfrequently kept for breeding purposes chiefly because they have fashionable pedigrees, rather than for their merits, considered merely as breeding-stock. Of course such bulls sell, for the pedigree sells them; but however important a pedigree is—and it is a most important point—still a fashionable pedigree will not make up for decided want of merit in a bull. One of the worst shorthorn bulls we have ever seen had an exceedingly fashionable pedigree, and on that account the breeder had charged a long price for him. But he was a narrow, flat-ribbed, light-fleshed, delicate animal; fortunately for the purchaser, he died before he had time to do much mischief. This does not prove that pedigree is not an important point to be taken into consideration in the selection of breeding-stock; it merely proves that occasionally, and in spite of a long line of good blood, an animal will crop up which does not possess sufficient merit to render it desirable to retain that animal for breeding purposes. In fact, when such occurs, a prudent breeder should not permit a defective animal to go forth as a specimen of his herd, but should at once banish it to the bullock-yard. Lord Rivers, who was a most successful breeder of greyhounds, attributed his success, Mr Finlay Dun tells us, to his rule of "breeding many and hanging many." Breeding from the "weeds" of a herd, no matter how high the pedigree, is most injudicious, and a certain cause of permanent mischief.

The results of judicious selection soon become manifest in the breeding of a flock of sheep. A distinctive type, or family likeness, becomes impressed upon the flock, which is never seen where the principle of selection is not carefully carried out. The same takes place in other varieties of animals, and no breeder who wishes to attain or to retain excellence can safely neglect it.

Returning to the question of pedigree as affecting the selection of breeding-stock, we would remark that whilst a bull which is obviously defective in important points should not be selected merely on account of his pedigree, at the same time we believe it is even more dangerous to select a well-shaped, stylish-looking animal, whose pedigree is defective.

We have known bulls of this description to be awarded prizes, and consequently held up as presenting the best specimens of their kind, although no prudent breeder who knew how those animals were bred would think of using them. Such animals are exceedingly dangerous, as inexperienced breeders are apt to be led astray by their outward appearance, and in most cases, by the low price at which they can be obtained, compared with that of really well-bred bulls. That experienced breeder of shorthorns, Mr Grove, referring to this very point, says: "An animal has certain qualities apparent to the hand and eye; it has also hidden qualities that neither the hand nor the eye can detect, but which hidden or latent qualities descend to the offspring, and when the animal has been crossed with another animal of different blood, will produce new combinations palpable and unexpected. The above maxim [*i.e.*, that "like begets like"] is true then in this sense, that though the offspring may appear unlike either parent, yet the peculiar properties of the parents are not lost in the offspring—they are inherited, but in combination may have produced effects that probably had not, and could not with any degree of certainty have been foreseen. That these qualities are not lost would appear evident, as it is found that peculiarities of even remote ancestors will from time to time, more or less frequently, according to the skill and perseverance of the breeder, show themselves, or crop out, to use a geological expression."

Mr William M'Combie, another veteran breeder, in recording his experience, says that "pedigree is of the utmost importance. We ought always to prefer a bull of high pedigree, with fair symmetry and quality, to another bull, though much superior in appearance, but of questionable pedigree. If the latter be turned to a herd superior in blood to himself, incalculable mischief may be done. Breeders have not given the subject the attention it deserves. I have paid dearly for my experience in the matter." And again—"If pedigree be ignored, and the sire be of doubtful antecedents, except in an accidental case, the progeny will be at best of medium quality."

Apart altogether from the mischief which a bull of questionable pedigree would do when put to a herd of well-bred cows, the evil is even greater when a badly-bred bull is used in breeding ordinary stock of shorthorn blood, such as are to be met with at fairs and markets. The evil is greater in this case, because more persons are engaged in breeding ordinary market shorthorns than in breeding high-pedigreed stock. The result of using cross-bred mongrel bulls with common cows is to depreciate the value of the offspring to the extent of from £4 to £5 a-head, even when the young cattle are not more than one year and a half old—compared with the prices obtained for the produce of well-bred bulls, from cows of the same kind. Although we desire to enforce the importance of pedigree in sires, we would at the same time wish it to be understood that mere length does not always constitute a valuable pedigree. It would be an easy, although perhaps a somewhat invidious matter, to point out certain pedigrees whose chief, if not in a great measure their sole merit, consists in their length. Such pedigrees merely show that a mass of incongruous materials has been heaped together; while a much shorter pedigree, which some persons might overlook or undervalue on account of its shortness, will show an amount of potent impressiveness that renders it of infinitely more value than the other, notwithstanding its much greater length. If really bad, the longer the pedigree the more dangerous would be the use of the animal. Careful study of recorded ancestry should teach what to avoid as well as what to select.

In the extract given above, showing the views on breeding entertained by Mr Grove, it is stated that "peculiarities of even remote ancestors will from time to time show themselves, or crop out." This leads us to the consideration of what is technically termed "breeding back," or *atavism*, which occasionally produces some very curious and unexpected results.

Experienced breeders will have no difficulty in recalling various examples of this peculiarity. A few illustrations, however, will be found interesting. The late Mr Boswell of Balmuto stated in a prize report on Breeding, which appeared in the seventh volume of the 'Transactions of the Highland and Agricultural Society,' that "a great many years ago the father of the present Sir Alexander Ramsay of Fasque brought a few of the Lancashire cattle to Scotland—a breed then much in fashion, and, as every one knows, remarkable for having uncommonly wide-spreading horns, and all with some white, especially on the back. These cattle were intermixed with the cows of the country; and when Sir Alexander came to his estate, the cattle were all horned. About that time the polled or dodded came greatly into vogue in Angus, and Sir Alexander purchased, from time to time, jet-black polled bulls, so that in a short time all his cows were of this sort. Nevertheless every year, even to this day [1825], one or two calves 'cry back' to the Lancashire, having white and horns; and—what is singular—it is almost invariably in the male that this takes place."

A more recent illustration of atavism has come under our own notice. In the early part of 1871, a cow which had at least six crosses of high-class and well-known shorthorn bulls in her pedigree, produced a calf which was a perfect West Highland in colour, &c. There could be no mistake about the breeding of the calf, for there was not a Highland bull in the district, and probably not a single animal of the Highland breed within many miles, while the bull to which the cow had been put was one of the most noted prize shorthorn bulls of the day. The explanation given by the breeder was simply this: About twenty-five years previous to the birth of this calf, he became the owner of a very handsome black West Highland heifer, which he put to a highly bred shorthorn bull. Since that time the descendants of that West Highland heifer have been regularly bred, in their successive generations, from first-rate shorthorn bulls, and had presented every characteristic of the pure-bred shorthorn, until, in the seventh generation, the produce bred back at a bound to the original. We have repeatedly seen the polled head, with its characteristic tuft, of the polled Angus come out after several generations got by shorthorn bulls; and there is little reason to doubt that the black noses which occasionally "crop out" in highly bred shorthorns have come down from the Kyloe, Galloway, or Dutch blood which had been infused into their ancestors.

Some years ago an extensive landed proprietor in Scotland purchased a thorough-bred stallion in England, of which he allowed his tenants to have the service for their mares. This horse was a dark bay, having a very small star on his forehead, and a few white hairs round one fetlock. He was put to his owner's mares, and to all that were sent to him; and as he bore a high character on account of his blood, the number of country mares sent was considerable. They were, of course, of all the usual shades of colour,—black, brown, and grey; and yet, with very few exceptions, nearly all the foals got by that horse were light chestnuts, having white legs, and in many cases also white bellies. In consequence of this undesirable and unlooked-for result, the owner set on foot a strict inquiry in England into the history of the stallion's ancestors, when it was ascertained that his great-great-grandam, a famous mare in her time, had been a light chestnut, with white legs and white belly. The objectionable markings, however, had never appeared in any intermediate generation. The horse was from a celebrated stud, and there was not the slightest doubt about the matter, inasmuch as his ancestors had all belonged to the same stud.

It is well known that pure white ewes that have been served by pure white rams of the same breed occasionally produce black lambs; and in such cases, although two or three generations, or more, may have been quite free from the objectionable colour, yet it will be found, when the case is traced back, that there existed in the same family a black ancestor, generally a female. The same peculiarity is observable in swine; and thus we sometimes find black Berkshire sows producing pigs which have the yellow colour with black spots which marked some of the remote ancestors of the present improved breed.

Breeding back is not, however, the sole disturbing cause which has been experienced by breeders, and there is one which merits a larger share of attention than it has received from breeders in general. It is this—that the sire which is first used, and to which the mare, heifer, or other female, produces offspring, may, as Dr Harvey of Aberdeen pointed out several years ago, "so influence her future offspring begotten by other males, as, to a greater or less extent, to ingraft upon them his own distinctive features." In support of this view, Dr Harvey stated, among other things, that "in several foals in the royal stud at Hampton Court, got by the horse Actæon, there were unequivocal marks of the horse Colonel, by which the dams of these foals were covered the previous year. Again, a colt, the property of the Earl of Suffield, got by Laurel, so resembled another horse (Camel) that it was whispered, nay, even asserted, at Newmarket, that he must have been got by Camel. It was ascertained, however, that the only relation which the colt bore to Camel was, that the latter had served his mother the previous season."

The case of the Earl of Morton's mare has been often quoted. She had been served by a quagga, and the offspring bore distinct marks of the sire, both in the cross bars which distinguish that species, and also in the formation of different parts of the body. This was, of course, to be expected; but when the same mare was afterwards put to a stallion of her own kind, the progeny still bore the distinctive marks of the quagga.[1] Evidence of a somewhat similar case has come under our notice. A superior Clydesdale mare was served two years successively by a large Spanish ass, and in the third year by a Clydesdale stallion. The foal by the latter resembled a mule in every respect, having very long ears, long and narrow hoofs, and a thin and scanty tail, exactly like that of a mule.

Again, black polled cows, which had, when heifers, been put to a shorthorn bull, and in after-years to black bulls of their own breed, have produced calves by the latter similar in colour and otherwise to the offspring of the shorthorn bull. One notable instance of this kind came under our own observation. A black polled cow, descended by sire and dam from a herd well known in Angusshire, had been crossed, when a heifer, by a well-bred shorthorn bull. She subsequently became the property of a gentleman who exhibited her successfully on various occasions; and being desirous to have a black polled calf from her, she was sent to a prize polled Angus bull. The produce, however, was a nice roan horned calf, exactly resembling a cross-bred calf. The owner of the cow was highly indignant, believing that some fraud had been practised upon him; but it was fully ascertained that the owner of the black polled bull to which the cow had been sent had no other bull about his

[1] An account of this case will be found in the 'Philosophical Transactions' for 1821.

place; and as the cow had travelled by rail between the two places, it was at least improbable she could have been served in the interval by any other bull than the polled bull. After we discussed the matter with the owner of the cow, he became satisfied that the peculiar appearance of the calf was due to that singular feature in the physiology of breeding to which we have been alluding.

Dr Harvey stated, on the authority of Mr William M'Combie, that six very superior pure-bred black-faced horned ewes were tupped, some of them by a Leicester and others by a South Down ram. Next year the same ewes were put to a very fine pure black-faced horned ram, of the same breed as the ewes themselves, and the lambs thus begotten were all without exception polled, and brownish in the face. The same occurred the year following, the ram used being another of their own breed. If we take a lot of aged Cheviot ewes, which have previously produced lambs two or three years successively, to pure Cheviot tups, and put them to a Leicester ram, we shall find that whilst many of the number will produce lambs which present the characteristics of the sire, there will be some whose lambs will show a closer resemblance to the pure Cheviot—so much so, indeed, as scarcely to mark them as distinct in any way from the pure breed. If, on the other hand, we take a lot of Cheviot gimmers, and put them to pure Leicester rams, the lambs thus begotten will run to the Leicester side, almost without exception. Again, if we take a lot of aged West Highland cows, which, in like manner, have produced a succession of calves to bulls of the same breed, and put these cows to a pure shorthorn bull, the progeny will not be so equal in appearance as the produce of West Highland heifers which had been put for the first time to a shorthorn bull. Such, at least, have been the results of our observation and experience in this matter.

It is evident that, although such results as those which are detailed in the foregoing cases do not, perhaps, occur in so regular a manner as to enable us to lay down any general rule, nevertheless they do occur in such a way as to afford a good reason why we should be exceedingly cautious with respect to the character of the sires we employ, more especially when such are used for the first time with females of any class of stock. Since it is the case that the female system, at least occasionally, "imbibes certain influences from the male, which modify her future progeny with other males," it will be seen that the use of cross-bred or impure sires with purely bred females has an injurious effect, not only in the case of the immediate offspring, but may also extend its influence to the produce of pure sires which are afterwards used. Hence the mischief produced by the use of impure sires is not confined to one generation, or even to their own produce, but is spread over and affects other generations, and the breeder's expectations are defeated in what usually appears to be a very mysterious manner. Nay, more, the character of the pure sires used afterwards may be seriously impaired, if the breeder is ignorant of the effects produced by the impurely bred sires that were first used, and had ingrafted their own distinctive features on the future offspring of the female.

Another disturbing influence which leads to certain distinct results in breeding, arises from the power of imagination. This influence, however, is to some extent under the control of the breeder, and may be made subservient to his purposes. There are few breeders who have devoted attention to the subject who are not in possession of the knowledge of certain occurrences which seem to confirm the opinion that the female is susceptible of certain influences, arising from imagination, during the time she is in season, which afterwards manifest their power in her offspring. For example, nearly every one who has had experience in the breeding of stock can cite some case or other which shows that the colour of the offspring of some animals has been affected by certain trivial external circumstances. We have already quoted from Mr Boswell's prize essay on Breeding, and we shall give another short extract from it, illustrative of the point now under consideration. He says:—

"From what my own experience, as well as the information of trustworthy men, has taught me, I am inclined to think that the calf very often takes after the beast that has been jumping on the cow (whether ox or cow) previous to her being taken to the male. One of the most intelligent breeders I have ever met with in Scotland, Mr Mustard, an extensive farmer on Sir James Carnegie's estate in Angus, told me a singular fact with regard to what I have now stated. One of his cows chanced to come in season while pasturing on a field which was bounded by that of one of his neighbours, out of which an ox jumped, and went with the cow, until she was brought home to the bull. The ox was white, with black spots, and horned. Mr Mustard had not a horned beast in his possession, nor one with any white upon it. Nevertheless, the produce of the following spring was a black and white calf with horns."

Mr Finlay Dun says, in an article on the "Hereditary Diseases of Sheep and Pigs,"[1] that "it can be easily shown that mere sensuous impressions acting on the female at the time of impregnation, or even during pregnancy, are sometimes capable of affecting the offspring. Mares and bitches frequently produce offspring differing from the sire, but resembling in colour and appearance those animals with which the mother has been kept, or of which she has been fond. George Combe mentions a case in which two horses were got with pretty markings of a very uncommon kind, by leading a horse having such markings before two mares just prior to their being covered. The parents in each case were different, but the young horses were so similar in colour that they could scarcely be distinguished from each other, and both had the same markings as the horse that was led before the mares at the time they were impregnated."

At one period, from some cause or other, the breeding of grey horses was fashionable in Ireland, and a gentleman who resided in Meath was in the habit of having a white horse led before each mare when she was about to be served by the stallion. The result was, a large proportion of grey foals. A late eminent breeder of shorthorns made it a rule that a red cow should be placed in front of the cow that was being served when either the bull or the cow in season was of a white colour; and notwithstanding that he frequently used white bulls for lengthened periods, he had comparatively few white animals in his herd. "Old Mr Bates, of shorthorn celebrity, was wont to state that colour was very much under the control of the breeder; and in so saying may possibly have believed it to be thus modified by the imagination of one or both parents, especially at the excitable period of impregnation. The liberal use of whitewash

[1] Journal Royal Agricultural Society of England, vol. xvi.

in the premises occupied by a large northern herd was some years ago discontinued, as the staring white walls appeared, year by year, to multiply the number of white calves dropped. At a recent sale of fashionable shorthorns, the number of light-coloured young animals was similarly accounted for by the fair owner's natural love of seeing her favourites in well-lighted places, frequently cleaned and freshened by the whitewash."[1] Mr Dun also cites "the case of a pure-bred shorthorn cow, which, as it was being taken to the bull, got accidentally into a yard with a large lot of black oxen, with whom she remained for a short while, until the herdsman got the assistance of a boy to drive her along to the shorthorn bull by which she was impregnated. The calf born was marked with black spots, had large coarse horns like those of the black cattle, and was very unlike a pure shorthorn." Many similar cases could be cited; and it is quite evident that no prudent breeder of pure stock will omit the consideration of the disturbing influence arising from imagination that may affect his breeding animals, whether injuriously or otherwise.

Mr E. A. Fawcett, a well-known breeder of shorthorns, described in 'Bell's Messenger,' March 11, 1872, a very curious illustration of the power of imagination, from the experience of Mr J. K. Fowler, Prebendal Farm, Aylesbury. Mr Fowler informed Mr Fawcett that a bear on one occasion had been exhibited in a farmyard in his neighbourhood, in which was a sow considerably advanced with young; and to the astonishment of the owner, when the little pigs arrived, they not only resembled the bear in the hair, but sat upright in the same manner that the bear was exhibited when seen by the astonished sow.

Breeding from near relations, or breeding "in-and-in," as it is termed, is a question which involves very important considerations. There is no doubt whatever that in-breeding, when injudiciously pursued, is productive of many evils. Constitutional defects become more strongly marked, and if pursued for a succession of generations, vigour is lost, and both males and females become sterile. Even

1 "Some of the Principles concerned in the Breeding of Stock," a Paper read by Mr Finlay Dun at a meeting of the Midland Farmers' Club, June 1, 1871.

when females so bred become impregnated by sires of their own blood, the produce seldom live. At the same time, breeding from animals nearly related should not be condemned in a wholesale manner. Were it not for this principle, our modern improved breeds would not have attained their present excellence. This is well known to those who are conversant with the breeding of shorthorns, as recorded in 'Coates's Herd-Book'; and therefore we cannot approve of the practice pursued by some breeders of shorthorns, who, in order to avoid in-breeding, of which they have a profound, and, we might say, an unreasonable dislike, invariably select their bulls of opposite strains of blood. This is going to the other extreme; and if at any time breeders who pursue this system "make a hit," it is more a matter of chance than the result of sound management. "In-and-in" breeding judiciously and skilfully pursued is the speediest and most certain means of achieving great success, just as this system unwisely carried out is the "shortest cut" to disastrous failure.

On the question of breeding from animals nearly related Mr Grove says: "It is this continued relationship in blood which gives character to a stock, and fixes its qualities, either good or bad, according to the skill and perseverance of the breeder. . . . If there be any error in breeding in-and-in, as it is called, from good animals—and I confess I think there is—it can only be in carrying the practice to an extreme, or continuing to breed from the closest affinities. The laws of nature have limits which cannot be passed with impunity; what is good in certain quantity is not necessarily so in double that quantity. What is good in moderation is invariably bad in excess."[1]

The propriety of occasionally introducing a cross of a different strain of blood into one which has been produced by allying animals of similar descent—as, for instance, introducing a "Bates" cross into a "Booth" family—is a question which admits of much being said both for and against it. The general opinion, as shown by the prices obtained for animals having an admixture of this kind compared with those realised for animals in which there is little or no admixture, is in favour of keeping the strains distinct.

[1] Carr's History of the Booth Herds.

Some, however, argue that the difference in price is the result merely of fashionable prejudice, and that certain distinct strains of blood, such as those above mentioned, may be crossed, and have been crossed, with advantage. We know that such has been the case, but it has been done with great judgment, and the fresh blood has been introduced in a diluted state. We must also observe, that the regular or continuous use of bulls of a certain strain of blood is not necessarily in-breeding. For example, a breeder has a number of well-bred shorthorn cows, descended from mixed or different strains of blood, and he wishes to ingraft a "Booth" or a "Bates" character on their produce. For this purpose he procures a bull of as pure Booth or Bates blood as he can get, and after a time he gets another bull of the same blood to put to the produce of the first cross, and so on. It is in this way that herds of acknowledged excellence have been bred; and it is, moreover, a safe system, when carried out with judgment and perseverance.

The next point is *Cross-breeding*—a system of management which has done much to add to the home-supplies of meat. Cross-breeding, in the true sense of the term, means putting a pure-bred male of one breed to a pure-bred female of another breed—the offspring produced in this way being a cross-bred animal. By means of crossing, followed by a strict and judicious system of weeding or selection, and liberal feeding, several varieties, particularly among sheep, have been created of late years, which are now recognised as distinct breeds. Amongst these we may instance the Hampshire Down, the Oxford Down, the Shropshire Down, the improved Lincoln, &c. Those breeds, however, were not created in every instance by the simple plan of crossing with two animals of two distinct breeds; and in some of them, at least, several crosses were introduced before the breed, as it is called, attained its present position. Thus, the foundation of the Hampshire Down was a cross of the South Down on the old Hampshire breed, which was a large-sized, short-woolled breed, with large heads, Roman noses, and large curly horns. Under successive crosses of the South Down the latter disappeared, and the animal became more compact and more easily fed, yielding also a better class of mutton. It has been stated that in carrying out the system of crossing with the South Down ram, the largest, coarsest, and blackest-faced rams were selected, which resulted in altering the colour of the face, changing it from white to black, besides causing the horns to disappear; and the chief traces of the old breed which are still retained by the modern Hampshire sheep are to be found in their large heads and Roman noses. The origin of the Oxford Downs was the cross of a Cotswold ram with Hampshire Down ewes, and the Cotswold owes its improvement as a breed to an infusion of Leicester blood; and as Mr Spooner has remarked—"The Leicester was notoriously a cross of various breeds in the first instance, although the sources which supplied the cross is a secret buried in the 'tomb of the Capulets.'"

It must be evident that to establish new varieties, such as the above, by crossing, requires the possession of great skill and judgment as well as much perseverance and a good deal of capital. In the more simple system of putting a male of a distinct but improved breed to a female of another breed which is inferior to that of the male, when the object is merely to produce a first cross for the butcher, the mode of procedure is less intricate. It is this system which has done so much to increase the production of meat of a high quality by Scotch breeders, and we shall therefore notice briefly some points connected with it.

What may be called the original breeds of cattle and sheep in Scotland possess, for the most part, many valuable properties, particularly in the quality of the meat when the animals have been fully fattened; but their progress in former times was comparatively slow, and it required a considerable time to bring them to maturity. Other breeds matured more rapidly, but this precocity was accompanied with a certain degree of inferiority in the quality of the meat, there being generally too much fat in proportion to the lean, and the fat and lean were not mixed in the most economical or pleasant manner for the use of consumers. Hence the union of these properties—that is, the amalgamation in one animal of the quality and early maturity possessed by two other animals—is evidently a matter of great importance. This is precisely what was effected when cows or heifers of the West Highland or

Scotch polled breeds were put to shorthorn bulls, and females of blackfaced and Cheviot breeds to Leicester rams; and year after year we find the strongest testimony borne to the superiority of the Scotch cross-bred cattle over all the breeds sent to supply the London markets, and especially the great metropolitan Christmas markets. The records of the fat-stock shows at Birmingham and Islington afford the strongest possible evidence in favour of the Scotch crosses. Those cattle are full of the best points for the butcher and consumer; and it is this qualification which places them so high in the estimation of those who supply that class of consumers who will have the best quality of meat that can be procured, and who are willing to pay liberally for the gratification of their tastes.

It is absolutely necessary that at least on one side—that of the male, in particular—the animals selected for crossing shall be pure of their kinds. We frequently see people buying shorthorn bulls or Leicester rams of an indifferent description for crossing, alleging that such are good enough for the purpose. Experience has taught us that such animals ought never to be used for crossing; that, in fact, it is almost as necessary to have the purest blood in the males selected for crossing purposes, as it is when the object of the breeder is to keep up a pure-bred herd or flock. Some of the finest cross-bred cattle we have ever seen were got by shorthorn bulls of the highest character—royal show winners, in fact, or bulls from famous herds. When mongrel sires are used—and a great deal of what are called shorthorns and Leicesters nowadays are nothing but mongrels—we have all their bad properties imparted to their offspring, with few, if any, of whatever good qualities they may possess. Those bad properties may not even be apparent in the sire—he may, on the whole, appear tolerably good—but nevertheless the stain is latent in him, and from the propensity to "breed back" which has been already noticed, it will come out. Any one who desires to be safe, and who wishes to succeed in crossing, must use only such sires as are of pure blood, and the best strains of blood that can be obtained; for although such animals will doubtless cost more money at the outset, the final results will prove that it has been the wisest course.

But in order that the crossing may be completely successful, it is requisite that the females shall also be of a pure and distinct breed. We shall no doubt improve the produce of cross-bred cows by putting them to pure-bred bulls ; we may, indeed, go on crossing with such bulls, and with each successive generation we shall find the produce assimilating more and more to the breed of the sire; but this has not been found desirable. That hardiness of constitution, with the disposition to form a valuable and economical class of meat-producing animals, which are such prominent features in the first cross, become lost to a considerable extent; and in order to regain them, it has been found needful to go back to the original variety from which the females were selected.

Such has been the experience of those who breed crosses in the northern counties of Scotland, where the system is perhaps more systematically carried out than in any other part of the kingdom. We have seen in those districts cattle which to all appearance were thorough-bred shorthorns, and sheep which would be taken anywhere for pure Leicesters, although in both cases the result of repeated crossing. But the cattle had become rather inclined to be delicate, and had lost weight of carcass; while similar results were noticeable in the sheep, combined with a light fleece, and a tendency to become bare of wool on the belly and other parts.

These remarks apply to crossing two pure breeds. The result is somewhat different when we use pure-bred bulls to improve the produce of cows of mongrel blood. For example, the ordinary class of cows in Ireland some years ago chiefly consisted of animals of mixed blood. Long-horned cattle prevailed in, perhaps, most parts of the country; but generally a mixture of blood was the rule, and the cattle were coarse and slow in coming to maturity. The general character of Irish cattle, however, has improved much of late years, wherever it has been the rule to use pure shorthorn bulls, and to keep up the supply. The cattle so produced fatten more readily, and their flesh is finer in the grain than it used to be.

"Among the small, scraggy, old-fashioned Irish cows, shorthorn bulls have produced results truly wonderful. Stock from an ordinary Irish cow and a good shorthorn bull will, it is estimated, reach maturity at least a year sooner than unimproved cattle—at two and a half or three, instead of from three and a half to four, years old. Moreover, the cross, besides being far superior in quality, will also show an increase in weight of from one to one and a half cwt. per head. It is certainly within the mark to place the increase in the value of one-year-old Irish cattle, due to the use of shorthorn bulls, at from £2 to £3 a-head on an average. In many instances it has risen as high as £5, and in few cases has it failed to reach £2—that is, above the value of the corresponding class got by native or cross-bred bulls." [1]

Some breeds do not "nick" when crossed. For instance, we have seen a very extraordinary animal produced by a cross between a Highland bull and an Alderney cow. The Leicester or South Down ram is the best cross that can be employed to give fineness to sheep; but a Shropshire ram put to Scotch black-faced ewes or to Cheviots, or to inferior mongrel white-faced ewes, will produce a class of lambs for the butcher which we believe to be superior to any other cross. Altogether, the crossing of different breeds of stock is a most important subject, considered as a meat-producing system. Liebig has said that "the most urgent problem which the present day has to solve is, the discovery of the means of producing more bread and meat on a given surface, to supply the wants of a continually increasing population;" and it is not too much to assert that the system of crossing has done much towards affording the means of solving this all-important problem.

Before closing our remarks on Breeding, there is a point of much interest which we shall notice.

It not unfrequently happens that a well-bred and well-cared-for herd occasions the owner much disappointment and loss from a failure in the reproductive powers of some of the animals. The females are either hopelessly barren, or so uncertain that the owner cannot reckon upon them as regular breeders. It must be confessed that less is known on this subject than is desirable, and it certainly affords a wide field for inquiry, as unfruitfulness is not confined to the

[1] Shorthorns in Scotland and Ireland, by James Macdonald—Journal of Royal Agricultural Society of England, vol. xix., Part I.

female portion of the herd, but is also found to occur occasionally in the males.

A very able paper on this subject was contributed by Mr Henry Tanner, Professor of Rural Economy, Queen's College, Birmingham, to the 'Journal of the Royal Agricultural Society of England.'[1] Mr Tanner has made the causes which affect the reproductive powers of domesticated animals a subject of special inquiry, and the article to which we refer well deserves to be carefully studied by breeders. In the course of his investigations, Mr Tanner examined the ovaries of several heifers which had been condemned and slaughtered as hopelessly barren; and from the facts he observed, he was led to the conclusion that barrenness in these instances had been caused by the ovaries having become overcharged with fatty matter. This arose, of course, from excessive and injudicious feeding, whereby the natural disposition of the animals to fatten rapidly had been unduly stimulated. It is well known that much difficulty is usually experienced in getting heifers or bulls to breed which have been over-fed, and the same principle extends to other classes of live-stock. Hence the objectionable nature of the "condition" which fashion requires in show animals. Many animals renowned in their day for the number of show-yard honours awarded to them, have not left a single descendant to perpetuate their names. Some heifers will not breed until they have been made to endure hardship in some way or other, combined with stinted food. Taking this in connection with what Mr Tanner has observed, it is clear that the ovaries, and the tubes leading to them, become relieved by hard living from the accumulated fatty matter which had previously prevented impregnation; and a similar result has followed when an unfruitful bull has been put to work in a plough. The exercise given to the animal in this way reduced the unhealthy accumulation of fatty matter, which was the main cause of his infertility, and invigorated his constitution.

Mr Tanner gives, on the authority of Mr Henry Strafford, editor of 'Coates's Herd-Book,' certain instances "in which apparent sterility has been overcome. The late Mr Jonas Webb purchased a valuable cow from the herd of the late Lord Spencer (Lord Althorp) for a moderate sum of money,

[1] Vol. i., Second Series, 1865.

in consequence of her being condemned as barren. After the purchase she was driven from Wiseton to Babraham, a distance of between 100 and 120 miles, and within a short time she bred. Dodona, the cow in question, when a heifer produced twin calves, and subsequently she produced another calf; but as she then ceased to breed, she was sold. A change of climate, however, brought her again into breeding condition, and at the time of her decease no less than 160 valuable animals could be traced to this cow, which had been sold on two occasions as barren. Mr Webb had an almost parallel case in Celia, which, under somewhat similar treatment, after being condemned as barren, had a progeny of over 180 traced to her at the time of her death. These results were all gained by somewhat severe treatment, whereby unhealthy accumulations of fatty matter previously existing in the body, and impeding generation, were taken up into the system for the support of life."

Constitutional debility in the male or female, arising from too close breeding or injudicious management, is also a cause of infertility. It would almost seem that climatic agencies exercise an influence on the breeding powers of animals, as it happens that barrenness occurs more frequently in some seasons than in others.

The nature of the food given to animals exerts a considerable amount of influence upon their reproductive powers. Sugar holds a high place among the fat-producing elements of food, and there is strong reason to believe—so strong, indeed, as almost to amount to absolute certainty—that food which is unusually rich in saccharine matter, while highly conducive to the formation of fat, exercises a direct and injurious influence on the breeding powers of animals. Molasses, or treacle, has been used extensively by some feeders in fattening stock for market; and as it has been found highly efficacious in promoting the accumulation of fat, certain breeders who have been desirous to secure high condition in their young bulls or heifers destined for exhibition or sale, have been led to use it freely for that purpose. There are, however, as we have said, good grounds for believing that molasses, when used freely as part of the food of animals intended for breeding, has caused them to become barren; and this has been the case in both males and females. We believe that breeders, when giving molasses to their young bulls and heifers in preparing the same for show or sale, have not been aware of the consequences likely to follow that system of feeding; and they may, we doubt not, have been sometimes at a loss to account for the sterility of animals they have disposed of, when that barrenness has been made the subject of complaint by those who purchased their young stock.

Various instances corroborative of this view have come under our observation; and we have no doubt that in several cases, where young bulls especially have been condemned as either malformed or naturally defective, the true cause of their unfruitfulness lay in the nature of the food which had been given to promote their "condition" for the show-yard. Nor is the evil one which time and change of food will remedy. Mr Tanner holds—and we quite agree with him—that it is very doubtful if any stock which have been fed for a length of time upon food largely mixed with molasses ever regain their breeding powers. When the object is merely to prepare the animal for the butcher, a mixture of molasses with other food will be found very beneficial. Mr Tanner states that it has also "the effect of suppressing these periodical returns of restlessness which prevent heifers feeding as well as steers;" and in a case of this kind which he cites, molasses had the effect of keeping heifers "so steadily progressing during the whole period of their fattening, that the result was highly satisfactory." He therefore comes to the conclusion that "whilst avoiding it for breeding animals, we may encourage its employment when cows or heifers have to be fattened."

The food best suited to promote constitutional vigour in breeding animals consists of those kinds which are rich in phosphates and nitrogenous or flesh-forming ingredients, such as beans, peas, and other leguminous seeds, oats, &c. Mr Tanner also quotes certain eminent physiologists, who have stated that the moderate use of salt has a powerful and favourable effect upon the breeding powers of animals. "Moleschott states that the favourable effect of common salt upon the formation of blood and upon nutrition, also produces an influence upon sexual life. Boussingault found that bulls, which in their food receive a large addition of common salt show a greater inclination to cover; and Roulin states that the females of our domestic animals are rendered less productive by want of salt." Mr Tanner appends to these statements the very necessary caution—"When salt is used for any animal producing milk, care must be exercised not to allow it to be taken in such quantity as to check the production of milk; for a free supply would speedily stop this secretion."

Mr Bowly, an eminent breeder of shorthorns, refers, in a prize essay 'On the Management of Breeding Cattle,'[1] to a remedy which, it is alleged, has an effect in securing conception in a cow, and allaying that irritable excitement not unusual in cows, which is fatal to impregnation. Mr Bowly says: "I have for nearly twenty years possessed the knowledge of a remedy which is said to be certain to secure conception in a cow, but fortunately I have never had occasion to put it in practice till last year. It consists in removing the clittoris from the vulva, which may either be done with caustic or the knife; the latter was used in this case. The cow operated upon produced twins in July 1856, and was served by the bull within the usual time, but did not stand, and became what is called a 'perpetual buller,'—that is, always in a state to take the bull, which is generally considered a hopeless case. She is a very favourite cow, and I was unwilling to subject her to what I supposed would be considerable suffering; therefore I delayed the operation till last July, and was glad to find that it caused little pain or inconvenience. It was performed immediately after the cow had been served by the bull; she took the bull again in three weeks, and has since produced a heifer-calf at the proper time."

Altogether, this is a department of the general subject of breeding which requires and deserves further investigation; for if it is true, as some assert, that natural defects are rarely, comparatively speaking, the cause of unfruitfulness, it is clear that we have, to a certain extent, the power of lessening, if not of overcoming, the risk of infertility. How far this is the case remains to be seen. The subject is certainly one which calls for patient investigation.

[1] Journal of the Royal Agricultural Society of England, vol. xix., First Series. 1858.

CHAPTER III.

FOOD.

In building up the structure of an animal, it is necessary to bear in mind that the elements of which food is composed are of two different classes: First, those containing nitrogen, which enter into the composition of bones, hair, horn, wool, skin, blood, and muscle or flesh; and, second, those in which nitrogen does not exist, and which fulfil the office of supporting respiration and animal heat, and the production of fat. The former are classed as the nitrogenised or flesh-forming constituents of food; the latter as the non-nitrogenous constituents, or the elements of respiration and fat.

All the elements which produce the flesh and fat of animals are found in their food, and ready to be converted to their several uses without undergoing any material change. In vegetable bodies we have vegetable albumen, gluten, and casein, which are identical with flesh, the curd of milk, and blood. The phosphates, common salt, &c., which exist largely in the bones, muscles, blood, and milk of animals, exist also in plants; whilst the starch, gum, sugar, and oils which constitute fat, and are the elements of respiration, are likewise found, ready formed, in vegetables. The proportions, however, in which those substances exist, vary in different classes of plants, and hence the different results which we experience from the use of different kinds of food.

Growing animals require a different dietary from those which are being fattened for the butcher, in order to effect the results we desire to produce. Thus, in the former, we wish to build up the bony structure, and to ensure a full muscular development; whilst in the case of the animal preparing for the butcher, we must draw largely not only on the flesh-producing elements of food, but also on the non-nitrogenous or fat-forming constituents. There must, however, at all times be a proper mixture of the elements of nutrition and of respiration or fat-producing, otherwise there will be a failure. If an animal is fed exclusively on one description of food—one, for example, which contains merely the elements of nutrition,—that is to say, if the food is only adapted to the production of flesh—the animal so fed would gradually sink and waste, in consequence of the absence of those elements which are required to maintain animal heat and to produce fat. In like manner an animal cannot exist solely on non-nitrogenised food, such as starch or sugar, which consists merely of the elements of respiration.

The following tables exhibit the elements, first, of nutrition, as existing in plants, and in the flesh, blood, skin, wool, hair, and horn of animals; and next, the elements of fat and respiration. The similarity which exists in the composition of the substances in each class shows the close affinity they bear to each other. In the composition of fat there is, indeed, a considerable difference in some respects from that of starch, gum, and sugar; the reason being, that whilst the three last-named substances—starch, gum, and sugar—do promote the production of fat, it is only when in excess they have that effect, their primary operation being to support respiration and animal heat. They all agree, however, in being non-nitrogenous.

ELEMENTS OF NUTRITION.

100 parts of	Vegetable Fibrine from Wheat.	Vegetable Albumen.	Vegetable Casein.	Muscle.	Blood.	Skin.	Wool.	Hair.	Horn.
Carbon	54.2	59.99	54.138	51.83	51.96	50.99	50.65	51.53	51.99
Hydrogen	7.5	6.87	7.156	7.57	7.25	7.07	7.03	6.69	6.72
Nitrogen	13.9	15.66	15.672	15.01	15.07	18.72	17.71	17.94	17.28
Oxygen	24.4	22.48	23.034	21.37	21.30	23.22	24.61	23.84	24.01

The composition of bones is nearly identical with that of skin, &c.

100 parts of	Mutton-Fat.	Potato-Starch.	Gum.	Sugar of Milk.
Carbon	78.996	44.250	42.682	40.01
Hydrogen	11.700	6.674	6.374	6.73
Nitrogen	...	...	...	...
Oxygen	9.304	49.076	50.944	53.27

Before proceeding to describe the different articles which are used as the food of live-stock, we shall notice some points which have a practical effect upon the results produced by the food.

One of the most common practical errors which we meet with in the care of animals is the total absence or insufficiency of shelter allowed to them. It is an error, because it involves waste of food. This will be seen when we consider what *respiration* implies, and the effects which it produces.

In respiration, or the act of breathing, the animal inhales and exhales the atmospheric air. The air drawn in, or inhaled, if dry, consists nearly of—

Nitrogen	79.16
Oxygen	20.80
Carbonic acid	0.04
	100.00

After the air has passed through the lungs, it then consists of—

Nitrogen	79.16
Oxygen	16.84 to 12
Carbonic acid	4.00 to 8
	100.00

The amount of carbonic acid, therefore, is much greater after the air has passed through the lungs than what it was when first inhaled. On an average, the natural proportion of carbonic acid in the air is found to be increased 100 times after it is expelled by breathing from the lungs. Whence, then, is this excess of carbon derived? It must evidently be from some other source than the atmospheric air.

Carbonic acid is formed by the union of carbon and oxygen, in the proportion of one part of the former with two parts of the latter. Water is a compound of one part of oxygen and two parts of hydrogen. Starch, gum, and sugar consist almost wholly of carbon and water. The oxygen of the air inhaled combining with the carbon contained in the starch and sugar existing in the food of the animal, produces carbonic acid, which is expelled from the lungs in breathing; and the union of the oxygen with the hydrogen of the food, in like manner, produces water, the excess of which passes off in the urine, in a vapour exhaled in perspiration, which is visible at a low temperature, and in the respiration. The reason is evident, therefore, why the amount of carbonic acid in the air is so much greater after it has passed through the lungs than what it was previous to being inhaled.

This consumption of carbon in the process of respiration is precisely similar to what takes place in combustion. A union takes place of the carbon and oxygen of the substance which is being burnt, and their dispersion is accompanied by the production of heat. From the consumption of carbon, therefore, which takes place in respiration, heat is evolved and diffused throughout the body, and thus the starch, gum, and sugar of the food produces that degree of temperature which is necessary for sustaining the life of the animal. When, therefore, the animal is exposed to a lower temperature than the natural heat of the body, a larger quantity of the elements of respiration are required to maintain the necessary degree of heat; hence animals which are exposed consume more food with less profitable results in the production of fat than those which are kept in a temperature at least not less than the natural heat of the body. In the former case, owing to the deficient supply of the elements of respiration, caused by an insufficiency of suitable food, or their more rapid consumption or dispersion, in consequence of the coldness or low temperature of the surrounding atmosphere, there is no excess of these elements—nothing to spare towards the production of fat; and if the substance of the animal does not actually waste from the strong combustion which is going on in the system, it at least remains stationary. Warmth, therefore, is equivalent to an increase of food, inasmuch as it prevents unnecessary waste of the elements of respiration and fat.

To those who have always been accustomed to the sleek, fine coats of carefully tended cattle, the shaggy winter covering of the Kyloe appears grotesque, and perhaps more ornamental than useful; but they overlook the fact that the shaggy covering is an economiser of food, and that by means of the additional warmth which it affords, the scanty food which the Kyloe procures during winter in its natural state, and which would be insufficient of itself to sustain the animal—that is, to evolve a sufficient amount of heat to enable the animal to undergo the rigour of the winter—becomes equal to the purpose, in consequence of this covering. There is a less demand on the combustible materials stored up in the food, and thus the shaggy covering becomes essential to the existence of the animal.

Insufficient house accommodation is a serious loss to the owner of cattle, entailing as it does an extra expenditure of food without an equivalent return; but how much greater is the loss in the case of those whose cattle are exposed during the entire winter, without any shelter beyond that which is afforded by a hedge! When cattle on a cold winter day

> "Mourn in corners where the fence
> Screens them, and seem half petrified to sleep
> In unrecumbent sadness,"

there is a waste of material going on as surely as if the owner wilfully undertook the office of the incendiary, and set fire to his hay-ricks. On the approach of winter, all cattle ought to be put either into properly constructed houses or covered yards, where their food will be expended in promoting their growth and development, and not wasted in meeting the extra demand for animal-heat-producing material which exposure creates.

But there is in the construction of cattle accommodation one important essential to be attended to—namely, perfect ventilation, combined with an entire absence of cold currents of air.

We have alluded to the change which takes place after the air has passed through the lungs, by which the amount of carbonic acid becomes greater than when first inhaled. If there is no means of escape provided, the carbonic acid will accumulate to such an extent as to be most prejudicial to the animals breathing an atmosphere which is saturated with it. It is, in fact, a deadly poison; and when we bear this in mind, we can have little difficulty in tracing to their true source many of those inflammatory diseases to which cattle confined in ill-ventilated houses are subject, and the origin of which often appears so very mysterious.

A man consumes about a gallon of air per minute. "A horse," according to Boussingault, "throws off daily forty-five pounds of carbon in the form of carbonic acid gas; and in the case of the cow, four-ninths of the carbon contained in the daily food is consumed during the process of respiration." This shows us how very soon the air in a closely shut-up stable or cow-house becomes vitiated, and rendered utterly unfit to support life in a healthy state. If, therefore, it is necessary to prevent waste of food by providing proper shelter, it is no less requisite to the healthy condition of the animals that the air which they breathe shall always be kept in a state of purity.

Ample space should be secured over the heads of the animals, and hay-lofts and other obstructions to a free circulation of air ought never to be permitted. Ventilators should be inserted in the apex of the roof to permit the heated exhaled air to escape, and means taken to secure a constant supply of fresh air from beneath, without creating a thorough draught, the effect of which would be to check the perspiration, and thus lay the foundation of catarrh and other diseases.

The exercise which an animal takes causes a corresponding amount of waste of food. By exercise the respirations are not only rendered more frequent, but are also increased in force; hence there is a greater consumption of carbon—that is, of starch and sugar, the elements of respiration and fat—consequently the animal requires a larger amount of food to enable it to fatten, or if this is withheld, it becomes wasted or leaner. It is well known that fattening animals become more rapidly fat when kept perfectly quiet, and free from everything which excites their attention and renders them restless. The growing animal, indeed, requires a certain amount of exercise in order to promote muscular development and strength of constitution. If sufficient exercise is prevented in this case, the young animal will, no doubt, accumulate fat freely, but its constitution will be enfeebled; and if the same treatment is pursued through several successive generations, although the animals will gradually acquire a greater aptitude to fatten at an early age, they will also become less to be relied upon for breeding purposes. Growing and breeding animals should therefore be always permitted a sufficient amount of exercise to secure a healthy system, whilst those which are fattening for the butcher must be kept quiet and undisturbed.

We shall now proceed to notice the different articles used as the food of animals, and their respective value for that purpose.

Milk.—We have already observed that there must be a proper mixture of the flesh-forming elements along with those of respiration and fat to form perfect food. We find a perfect illustration of this mixture in milk, the first description of food upon which the young animal subsists. It contains, 1st, Casein or curd, which is precisely the same as the *fibrin* or lean part of the flesh; 2d, Fat in the shape of butter; 3d, Sugar, which is required in the process of respiration; and 4th, Certain substances which are converted into the earthy part of the bones and the saline matter of the blood. The saline or earthy portion of milk consists of the phosphates of lime, magnesia, and iron, chloride of potassium, and common salt. In its ordinary state the milk of the cow consists of about 4½ per cent of casein or flesh-forming matter, 3 per cent of butter, oil, or fat; 5 per cent of sugar; ½ per cent of saline matter; and 87 per cent of water. Everything, therefore, which is required to promote the development of the growing animal is contained in the milk, blended together in proportions suited for the purpose.

Wheat.—The following represents the average composition of the grain of wheat—

Water	15.00
Flesh-formers	12.00
Fat-formers	68.50
Woody fibre	2.75
Mineral matter (ash)	1.75
	100.00

Formerly wheat was usually too expensive to be used in feeding stock, but unfortunately it has declined so greatly in price, that it may now be advantageously employed for that purpose. A few years ago a case came under our notice where the produce of a field of sixty acres, which had been sown with wheat, was so damaged by mildew, just when near maturity, that it was useless trying to dispose of it in the ordinary way as grain. The owner, however, had the wheat crushed, and with it he fed cattle and sheep, and also his farm-horses. The result was that, although an experienced and extensive feeder, he had never turned out such highly finished beasts or sheep as he did that season; and, at the same time, his farm-horses were in the highest condition. Nor were his cattle and sheep finished merely outwardly, for they "died well," as the butchers call it, being full of tallow; and all who bought and slaughtered them declared they never had killed better meat in the whole course of their experience. The result was, that the farmer believed he had got more for his wheat after he had converted it into beef and mutton, than if the crop had been sound, and he had sold it as grain in the market. His bill for cake that year was very low. Owing to the unusually wet weather which prevailed during the harvest of 1872, much wheat was damaged by sprouting. The damaged grain was, however, turned to good account by first kiln-drying it, and then mixing it with finely chaffed hay or straw.

The 'Chamber of Agriculture Journal' reported the experience of two correspondents on the use of wheat for cattle-feeding. Mr Badcock, of Stogumber, says: "I grind the wheat to fine meal. At present I am feeding ten beasts on grass, with half a peck per day, mixed with straw-chaff, and cart-horses receive one-third peck each per day, and chaff with grass. When I take my horses in house I shall give one peck of meal and two pecks of oats mixed with chaff, and a few cut mangels to every three horses per day. I do not give it to hack horses. Fatting beasts in house receive it with roots and a plentiful supply of water, and if I feed them very high, I mix linseed-cake. I think there is nothing better for pigs. For sheep I have never used it except with cut roots, then I shake it over the roots in the troughs." Mr Wilcox, of Almondsbury, Gloucestershire, says: "I have been in the habit of feeding stock with wheat for some years past. I consider it to be more nutritious than any other food I have ever used. My plans are as follow: Cut straw and hay to fine chaff—the greater proportion being straw, thrown over a given quantity (4 lb. or 5 lb.) of meal, with as much pulped root as you feel disposed to put, mixing it together. Give it twice a-day. To sheep I always give it crushed or bruised—say a pint or a pint and a half each per day; it is the finest food for sheep I have ever used."

Bran.—In preparing wheat for use as human food, the bran is usually separated from the flour. Bran is much used as food for live-stock, sometimes in the form of mashes, and at other times mixed with other kinds of foods. When used by itself, or mixed with cold water, it has a slightly laxative effect, which renders it useful in preparing horses for physic, and in some cases may so act as to obviate the necessity of giving purgative medicine. The ash of bran contains a large proportion—75 per cent—of phosphates, or the earth of bones. Hence it is useful as part of the food given to milch cows, when such are "in profit," or full milk. The following is an average analysis of bran:—

Water	13.00
Flesh-formers	4.00
Fat-formers	55.00
Woody fibre	12.00
Mineral matter (ash)	6.00
	100.00

Barley.—Barley in its natural state, as dry whole grain, is seldom used in feeding animals; but when steeped in water, or when ground into meal, or boiled and given along with other feeding-stuffs, it is a valuable, and, in some parts of the country, a rather extensively used article of food. The following is its average composition:—

Water	16.00
Flesh-formers	10.50
Fat-formers	67.00
Woody fibre	3.50
Mineral matter	3.00
	100.00

Barley is therefore a very fattening description of food. Bere is slightly inferior in composition to barley. The ash of barley consists chiefly of silica, potash, and phosphoric acid.

When barley is cooked, it must be allowed to simmer slowly at least twelve hours, until the whole forms a mass of rich pulpy matter, perfectly free from whole grains; and in cooking, the greatest care must be taken to prevent the barley from becoming burned, by adhering to the boiler in which it is prepared. When thoroughly cooked, it becomes a most valuable ingredient in the food of fattening animals, and horses thrive remarkably well upon it—so much so, that a course of boiled barley given at least once a-day will very soon renovate horses that have been knocked up with hard work. Boiled barley is used by some of the most successful exhibitors of shorthorns in the preparation of their cattle for the showyards. Along with a little oil-cake, it gives that finish, and brings out that mellowness in handling, which is so much desired in such cases. When ground into meal, barley is excellent food for fattening pigs, poultry, &c. Indeed it is perhaps the most complete food available for pig-feeding, and now that farmers in some parts of the country have to sell their barley at less than £5 per ton, it might with advantage be extensively used in the fattening of stock. Unground barley should be steeped at least twenty-four hours before being used, but even the steeped grain is all the better of being boiled for a time.

Malt is prepared by first steeping the barley, and then allowing it to sprout or germinate. There is no doubt malt is a valuable description of food for live-stock, but that it is superior to unmalted barley has been questioned. Those who hold that it is not superior to unmalted barley are for the most part chemists, and appear to be led chiefly by the results of certain experiments made some years ago by Mr J. B. Lawes of Rothamsted; while practical feeders generally support the opinion that malt is superior as an article of food to the plain grain. As this is a matter of considerable importance, we shall give the opinions on both sides of the question. The following, therefore, is a summary of Mr Lawes's report to the Government on this subject:—

THE LOSS AND CHEMICAL CHANGES WHICH THE GRAIN UNDERGOES BY MALTING.

1. In malting barley of fair malting quality, in the usual way, there was a loss of nearly 19 per cent of its weight, about 12 of which was water, the remaining 7 being solid matter or food-material.

2. In malting barley of good feeding but inferior malting quality, there was a loss of about 22 per cent of its weight, of which 15 was water, and 7 solid matter or food-material.

3. The loss of solid matter consisted chiefly of starch or other non-nitrogenous substances, but comprised also a small amount of nitrogenous or "flesh-forming" and mineral matters.

4. The most characteristic change which the grain undergoes by malting is the conversion of a portion of its starch into dextrine, and the further conversion of a portion of the latter, amounting to from 8 to 10 per cent of the grain, into sugar.

5. By malting, the grain acquires properties by virtue of which, when the malt is digested with water, much of its own remaining starch gradually changes into dextrine and sugar; and if the digestion be aided by heat, not only the whole of the remaining starch of the malt itself, but the starch of a considerable quantity of unmalted grain or other starchy substances mixed with it, may become so converted.

6. Owing to the great loss of moisture and non-nitrogenous substances—in fact, of total weight—which grain undergoes by malting, a given weight of the malted grain contains a larger quantity of nitrogenous or flesh-forming substances than an equal weight of the unmalted grain; but as there is an actual loss of those substances by malting, a given weight of malt will, of course, contain less of them than the amount of barley from which it was produced.

MALTING, AND THE USE OF MALT FOR FEEDING.

7. It is probable that if grain were malted extensively for feeding purposes, the growth would not be carried so far as in the manufacture of malt for brewing, and the loss

of solid matter or food-material would, of course, be less accordingly.

8. As the "malt-dust" contains a considerable amount of food-material, abstracted from the grain during growth, when malt is used for feeding, the "dust" should either not be separated, or, if separated, should be given to the animals along with the screened malt.

9. Owing to the loss of weight which grain undergoes by malting, equal weights of malted and unmalted grain should not be employed in comparative feeding experiments, but only so much malt (with the dust) as would be produced from the amount of raw grain given, or to be substituted, in the parallel experiment.

10. Malt given as food to animals may be supposed to act simply by supplying more or less of the starch of the grain from which it was produced in the more soluble, and, perhaps, therefore more easily digestible, conditions of dextrine and sugar, or also by aiding the conversion into dextrine and sugar of the starch of other foods given with it.

THE EXPERIMENTS WITH MILKING COWS.

11. A comparative experiment was made in which, besides other appropriate food, ten cows received, for a period of ten weeks, 3 lb. of fair malting barley per head per day, and other ten received the amount of malt (with its dust) produced from 3 lb. of barley from the same stock.

12. In the experiment in which the malt was given, it contributed about 7½ per cent of the solid matter of the total food.

13. The result was, that almost exactly the same amount of milk was yielded for a given amount of food with the unmalted and with the malted barley, but that the milk from the cows having the unmalted barley contained the higher proportion of cream.

THE EXPERIMENTS WITH FATTENING OXEN.

14. A comparative feeding experiment was made for a period of twenty weeks, in which, with other appropriate food, ten oxen received 4 lb. of good feeding barley per head

per day, and other ten the amount of malt (with its dust) produced from 4 lb. of barley from the same stock.

15. In the experiment with malt, it contributed about 13½ per cent of the dry or solid substance of the food.

16. Both lots of oxen gave more than an average amount of increase, whether reckoned in proportion to a given live weight within a given time, or to a given amount of food consumed; but the ten having the unmalted barley gave rather more than those having the malted.

17. The barley-fed oxen also gave rather the higher proportion of dead weight to live, and although neither lot was fully ripe, the barley-fed animals were more even in condition and quality than the others; but the beef of some of the malt-fed ones was decidedly superior in point of ripeness and quality, and that of others decidedly inferior, to that of any of the barley-fed oxen.

18. It would seem, therefore, that the effect of the malt as food was more dependent on the constitution and condition of the individual members than was that of the barley; and it should be remarked that the oxen which fattened the best upon the malt were not the most backward or weakly animals, but those which were the heaviest and in the best condition at the commencement.

THE EXPERIMENTS WITH FATTENING SHEEP.

19. Comparative experiments were made for a period of twenty weeks with five lots of sheep of twelve each. Besides other appropriate food given equally to all, the allowance per head per day was—to Lot 1, from ¾ to 1 lb. of fair malting barley; to Lot 2, the malt (with its dust) from an equal amount of the same barley; to Lot 3, from ¾ to 1 lb. of good feeding barley; to Lot 4, the malt (with its dust) from an equal amount of the same barley; and to Lot 5, an equal amount of the same barley, two-thirds unmalted and one-third malted.

20. In experiments 2 and 4, the malt contributed about 22½ per cent, and in experiment 5 about 7½ per cent, of the dry or solid substance of the food.

21. All five lots of sheep gave about an average amount of increase; there was very little difference in the result

obtained with the unmalted and the malted grain, but such as it was, it was rather in favour of the unmalted.

22. The mutton of all five lots was of very good quality—there was no appreciable difference between the lots in this respect; but the barley-fed animals gave slightly the higher proportion of dead weight to live weight.

THE EXPERIMENTS WITH FATTENING PIGS.

23. The appropriate food of the fattening pig contains a larger proportion of starch than does that of either cows, oxen, or sheep. If, therefore, the starch of food be rendered more digestible and assimilable by its artificial conversion into the more soluble forms of dextrine and sugar, it might be supposed that it would be peculiarly advantageous to malt a part, or the whole, of the characteristically starchy food of the fattening pig.

24. Experiments were made for a period of ten weeks with six lots of pigs of eight each. Besides 1 lb. of pea-meal per head per day given to all—Lot 1 had crushed malting barley; Lot 2, the crushed malt (with its dust) from the same barley; and Lot 3, the unmalted and the malted barley, each separately, *ad libitum;* Lot 4 had crushed feeding barley; Lot 5, the crushed malt (with its dust) from the same barley; Lot 6, the same barley, four-fifths unmalted and one-fifth malted, *ad libitum.*

25. In experiment 2 the malt contributed 87½, in experiment 3 about 13, in experiment 5 about 89, and in experiment 6 about 16½ per cent of the dry or solid substance of the food.

26. The pigs having pea-meal and entirely unmalted barley (Lots 1 and 4) gave a full average amount of increase, both in relation to a given live weight within a given time, and to a given amount of food consumed: those having only a small proportion of malted barley (Lots 3 and 6) increased in both respects nearly, but not quite, as well; but those having the pea-meal and entirely malted barley (Lots 2 and 5, more especially Lot 2) gave less increase in relation to a given live weight within a given time, and required the expenditure of considerably more barley to produce a given amount of increase.

27. The pigs having the unmalted barley (Lots 1 and 4) also gave the best average proportion of dead weight to live weight, and their pork was of very good quality; the pork of the other lots was also of very good quality, but the more evenly so where a small proportion of malt was given (Lots 3 and 6).

On the other side of the question an immense amount of evidence has been brought forward, showing the advantage of malt in feeding cattle. It would occupy a large space were we to attempt to give even a summary of what has been stated by practical men of large experience in favour of malt-feeding, and we shall therefore confine ourselves merely to one or two facts, which, however, may be considered sufficient for the purpose.

The late Mr Richard Booth of Warlaby stated that "malt is superior to any other article for feeding cattle up to the very tip-top condition to which they require to be brought when they are intended for the show-yard." The late Mr Hudson, of Castle Acre, instituted an experiment between cattle fed on malt and a lot of similar cattle fed upon barley-meal. The result was decidedly in favour of the malt-fed animals. The butcher who slaughtered Mr Hudson's cattle stated that the cattle which had been fed on malt "were of a much better quality than the others; the grain was finer, and altogether of a superior description." An experienced breeder of shorthorns, residing in Northumberland, told us that he sold his barley and bought malt for the purpose of feeding his calves and young cattle, as he could not do without it. All kinds of farm-stock thrive on malt, and it has the best effects when given to animals which are delicate, recovering from an illness, or "off their feeding." It has been found that the addition of malt to other food prevents "scour" in sheep. Malt evidently assists digestion, and thus it is not only a useful article of food in itself, but, by the manner in which it acts, it tends to render other kinds of food, along with which it is given, more useful than they would be without it. Dr Voelcker has stated that "when an animal has got into fine condition, and has to be supplied with a large amount of food in order to its rapid development, the addition of malt is most useful. It seems to help the digestion remarkably—it might be said, wonderfully. Now we can easily understand this; for it is not only the sugar of malt which acts usefully, but it has also the peculiar power of changing the starch in barley-meal rapidly into sugar. This shows there is something in malt, over and above the ready-made sugar, which accounts for its efficiency in certain circumstances."

In former years the enormous duty charged upon it by the Government prevented the extensive use of malt in the fattening of stock, and the repeal of the malt-tax was long a favourite political cry in farming circles. But, strange enough, now that the tax has been repealed, malt is employed by the cattle-feeder only to a very limited extent.

It may be interesting to know, in connection with this subject, that a mode has been devised for converting barley into malt without germinating the grain. In 1872, H. Fleck, a German chemist, published the results of his experiments on this subject. He stated that barley, when steeped for seventy-two hours in warm water containing 1 per cent of sulphuric, muriatic, or nitric acid, is converted into malt. An experiment made upon a small scale produced good kiln malt; but it was not ascertained whether or not the wort made from such malt would be sufficiently fermentable for the purpose of the brewer. There is, however, but little doubt that barley might be sufficiently malted for agricultural purposes by this method; and as muriatic acid is cheap, and is converted into common salt by the addition of a little soda, it would be best to employ this acid. It is probable that for feeding purposes the barley might be steeped in water containing only 1 gallon of acid to 200 gallons of water.

When barley is converted into malt, the effect of the steeping process is to cause the grain to throw out young shoots, just as the seed does when put in the soil. These young shoots are afterwards separated from the malt, and are known as "*malt-combs*," or "*cummins*," or "*malt-dust*." The combs are used as feeding-stuff, and have been found useful, along with other articles, as food for milch cows. The following analysis of malt-combs was made by Dr Cameron of Dublin:—

Water	8.42
Flesh-forming substances	21.50
Digestible fat-forming substances	53.47
Woody fibre (indigestible)	8.57
Mineral matter (ash)	8.04
	100.00
Yielding nitrogen	3.44
Containing potash	1.35
" phosphoric acid	1.74 [1]

Dr Cameron says that "its composition indicates a high nutritive power, but it is probable that its nitrogenous matters are partly in a low degree of elaboration, which greatly detracts from its alimental value." As a feeding-stuff he considers it probably worth from £4 to £5 per ton.

Grains, or "draff," as the article is called in Scotland, consists of the refuse malt after it has undergone fermentation. The grains left in the distillation of spirits are said to be richer than those left in brewing ale or porter. The following is an analysis of brewers' grains :—

Water	75.85
Flesh-formers	0.62
Fat-formers (gummy matter)	1.06
Other organic matter (husk)	21.28
Ash	1.19
	100.00

The ash consists chiefly of phosphate of lime and silica.

A process of preparing grains by drying and other modes of manipulation has been invented, and the article so prepared is sold under the name of "*Desiccated Grains.*" The grains in this state are more concentrated than they are in the ordinary state, and may be given to all kinds of live-stock as follows: For horses, substitute at first 3 lb. of grains for 3 lb. of oats, and increase proportion until half the feed is composed of grains. Cattle—the grains may be mixed with other food, and should be damped where oilcake is used: the animals should be supplied with water when equal parts of grains and cake are used. Milch cows—damp with boiling water, and allow the grains to swell; 10 to 15 lb. per day may be given. Sheep—to be given alone, or with an equal weight of corn or cake. Pigs—damp well

[1] The Stock-Feeder's Manual, p. 228.

with boiling water as much as will be required for a day's use.

"*Dreg*" or "wash" is a liquid residue from malt used in distilleries. It consists of a thick and a thin liquid. The thin part of the liquid is about half the nutritive value of its weight of common turnips, and the thicker or sedimentary portion about equal to its weight of the average composition of turnips. Dr Anderson considers that 15 gallons are equal in nutritive value to 100 lb. of turnips. This liquid is chiefly used by dairymen; but cattle fattened at distilleries get large quantities of it, as well as of grains.

Oats.—This description of grain is more extensively used as the food of live-stock than any of the other cereals. It enters largely into the dietary of horses, and is also used in feeding cattle and sheep. The following is an average analysis of the whole grain of the oat:—

Water	14.00
Flesh-formers	11.50
Fat-formers	64.50
Woody fibre	7.00
Mineral matter (ash)	3.00
	100.00

The inorganic matter of the oat consists chiefly of silica, potash, and phosphoric acid. The oat is highly favourable to the formation of muscle. The nutritive value of oats, however, is by no means regular, some varieties being one-third more nutritive than other kinds. Oats ought always to be bruised before being given to animals, as the food then becomes not only more thoroughly masticated, but also much less liable to produce inflammatory action, which sometimes arises from the over-liberal or inconsiderate use of the whole grain. In the form of meal it is seldom used as cattle-food, except as nourishing drinks or gruel; but when ground into meal, the more thoroughly it is sifted the more nutritious it becomes. This is exactly the reverse of what takes place in the case of flour, because a large proportion of the flesh-forming and also the fat-forming substances contained in wheat is removed in the bran. Fine oatmeal contains nearly double the amount of nitrogenised matter found in fine flour.

Rye.—Rye is generally used in this country in a green state when given to cattle. The grain is useful for feeding purposes, although somewhat inferior to barley. Dr Cameron gives the following as an analysis of the grain of rye grown in Ireland:—

Water	16.00
Flesh-formers	9.00
Fat-formers	66.00
Woody fibre	8.00
Mineral matter (ash)	1.00
	100.00

Rye-meal is given with advantage to milch cows.

Indian Corn.—This most useful addition to our list of feeding-stuffs we owe to the abolition of the corn-laws. It is of a highly fattening nature, and forms an excellent description of food for all kinds of farm live-stock, including poultry. The following is an average analysis of Indian corn or maize:—

Water	14.50
Flesh-formers	10.00
Fat-formers	69.00
Woody fibre	5.00
Mineral matter (ash)	1.50
	100.00

Buckwheat.—This plant is comparatively little grown, being easily susceptible of injury from frost if the seed is sown earlier than the middle of May. The crop is sometimes cut green, and used for soiling. The grain is used chiefly for feeding game or poultry. The following is an analysis of the grain of buckwheat:—

Water	14.19
Flesh-formers	8.58
Fat-formers	51.91
Woody fibre	23.12
Mineral matter (ash)	2.20
	100.00

It may be mentioned that in Ireland the term "buckwheat" is sometimes locally applied to some of the varieties of common wheat, with which the true buckwheat has no connection.

Rice.—Rice is used in feeding poultry, and is of a very fattening nature. The refuse of rice, which is left in preparing the article for sale as human food, is given to milch cows. The following is an average analysis of rice:—

Water	14.00
Flesh-formers	5.30
Fat-formers	78.50
Woody fibre	1.50
Mineral matter	0.70
	100.00

Dari or *Durra.*—This is the seed of the plant called Indian millet or Guinea corn, which is largely cultivated in India, China, Africa, Italy, the West Indies, &c., where it is used for feeding horses, pigs, and poultry. Its value as a feeding-stuff will be seen from the following account which was given of it by the late Professor Johnston:[1]—

"It weighs upwards of 60 lb. a bushel, is more highly prized than maize, and brings a higher price than this grain in the Levant, where they are both abundant. It is of the size of a large millet-seed, is covered with a husk or envelope, and gives, when crushed, a beautiful white flour; when analysed it was found to consist of—

Water		11.96
Starch		68.70
Sugar		1.84
Gum		1.23
Cellular fibre (husk		4.66
Casein	4.71	11.19
Other protein compounds	6.48	
		99.58

"This analysis shows that it has a nutritive quality almost equal to that of the average of our samples of wheaten flour. It may therefore be mixed or ground up with wheaten flour, without any deterioration in the quality of the flour. It differs from wheat in containing a larger percentage of the substance above called casein—a variety of protein matter, which occurs more abundantly in the oat. This, however,

[1] Proceedings of the Agricultural Chemistry Association of Scotland, Part vii.

does not affect its nutritive quality, though it may, in a slight degree, modify its flavour. The total percentage of protein compounds, 11.19, is about equal to what is contained in our best wheaten flours. This seed might be prepared and eaten as millet is, and it may be used with advantage in its unprepared state in feeding cattle or poultry." Dr Voelcker, who has reported on the composition of Dari seed at a more recent period, says, however, that while it "is rich in starch, and contains an appreciable quantity of oil, it is poorer in albuminous compounds than barley-meal, and scarcely as valuable for feeding purposes."[1]

Beans, Peas, and Lentils.—These belong to the same class of plants—the leguminous—and closely resemble each other in their composition. From their nature they are better suited to be used as a portion of the food of working or growing animals, rather than of those which are fattening for the butcher. At the same time, when used along with other kinds of food, particularly such as are of an oily nature, they may be given with much advantage to fattening stock. Lentils are chiefly imported, but they may be profitably grown in this country on light, dry, sandy, or calcareous soils. The following table gives the average composition of beans, peas, and lentils :—

	Field-beans.	Peas.	Lentils.
Water	13.5	14.0	13.0
Flesh-formers	25.5	23.5	24.0
Fat-formers	48.5	50.0	50.5
Woody fibre	10.0	10.0	10.0
Ash	3.0	2.5	2.5
	100.0	100.0	100.0

Lupin.—The cultivation of this plant, which is so well known as a garden flower, is extensively carried on in the northern parts of Germany, and it has also been partially introduced into England. The stems make excellent hay, and the seeds are found to be very superior food for sheep, lambs, and fattening wethers. They are also given to horses and cattle, mixed with oats or beans; and lupin-meal is

[1] Journal of the Royal Agricultural Society of England, vol. ix., Second Series. 1873.

given with milk to calves. The following is an analysis of the seeds :—

Water	14.15
Flesh-formers	33.36
Fat-formers	32.37
Woody fibre	11.12
Mineral matter	3.04

The seeds of the lupin contain, therefore, a larger proportion of flesh-forming substances than either beans, peas, or lentils. The cultivation of the plant is quite simple, and it grows well on poor, sandy, and gravelly soils.

Linseed.—Whether in the building up and development of the young growing animal, or the enriching of the produce of the dairy cow, or the final preparation of the animal for the butcher, linseed is an article of the highest importance to the agriculturist. By its aid he is materially assisted in his operations, and without it he is often obliged to work under a disadvantage. Linseed, as will be seen from the subjoined analysis, is an exceedingly rich description of food. It is not advisable, however, to use it in its natural state, as, when so used, a considerable proportion of the seeds will be found to pass undigested. Being of a laxative nature, it requires to be used with caution, and in combination with other articles which have a counteracting effect. The seed is sometimes boiled in order to prepare it for use as the food of animals, but a better mode of preparation is to grind it. When this is done, chaff, or the husks which are separated from oats in the process of milling, should be passed through along with the linseed, as either of these articles helps to prevent the linseed from "clogging" the millstones ; and besides, they absorb a portion of the oil which exudes from the seed in the grinding, and thus they become useful articles of food, although they are of little value in their natural state.

Owing to the importance of the linen manufacture in Ireland, the chief object in growing flax in that country is the production of a fine class of fibre, which is incompatible with a large crop of seed. If the value of the seed as a fattening material were inculcated more strongly than it has been by those who advocate the extension of flax-cultivation, it is probable that flax-growing would be more largely practised throughout the kingdom than it is at present. As it is, we have to depend upon foreign sources of supply for the linseed required for various purposes. Irish flax-growers in general are averse to separate the "bolls" or seed-capsules from the plants, alleging that when this is done the fibre is injured, and consequently they steep the flax without first removing the seed. The result is that the seed is lost; and the loss of feeding material from this cause alone which takes place in Ireland cannot be estimated at much less than £500,000 per annum. The prevalent idea entertained in Ireland on this subject has been combated by Mr Charley, who is a grower of flax as well as a manufacturer. Mr Charley describes "the old-fashioned system of taking the flax to a watering-place with its valuable freight of seed unremoved," as being wanton waste of rich feeding material.[1] When the "bolls" are saved, they are dried on a loft in a strong current of air, and then ground up with the outer husk or chaff. Even when the seed is extracted from the bolls, the residue, or chaff, makes excellent food for milch cows when prepared in the form of a hot mash. The bolls are also steamed along with other materials, and given as a mash to horses as well as to cattle. The following analysis of linseed is by Dr Anderson :—

Water	7.50
Oil	34.00
Flesh-formers	24.44
Gum, mucilage, sugar, &c., woody fibre	30.73
Mineral matter (ash)	3.33
	100.00

Linseed of fine quality, weighing 52 lb. per bushel, readily yields from 11 to 12 gallons of oil per quarter (8 bushels), weighing 9 lb. per gallon, or about 25 per cent of its weight.

Meal made of pure linseed may be given, as stated above, in combination with other kinds of food, such as bean-meal, barley-meal, Indian meal, &c., but it is also frequently prepared for use by boiling it. When the seed is prepared in this way, it is generally steeped for some hours in hot water and then boiled, but it is very apt to burn during the process of boiling unless it is carefully watched. In order to prevent burning, it has been found better to raise the water to the

[1] Flax and its Products in Ireland, by William Charley. 1862.

boiling-point before putting in the linseed, instead of putting the linseed into cold water and then boiling it. When the linseed is put into boiling water, add a little cold water, and then let it again come to the boil, and allow it to remain boiling for twenty minutes, stirring it occasionally. This mode of preparing linseed has the effect of splitting the seed, and thereby rendering the operation much more effectual than it is when the skin does not burst, as is usually the case when the linseed is put first into cold water which is afterwards brought to the boiling-point.

Linseed-cake.—The oilcakes are formed of that part of the seed which remains after it has been subjected to pressure for the purpose of extracting the oil. Linseed-cake is, therefore, the refuse part of the seed left in the process of extracting linseed-oil. Formerly, although most part of the oil was extracted by crushers, there always remained from 10 to 12 or 14 per cent; but the machinery now employed in extracting the oil does its work so efficiently, that from a fourth to a third less oil is left. Linseed-cake is a highly concentrated description of food, and is suited for the use of all kinds of farm live-stock, with the exception of swine, and the objection to its use in their case is that it imparts an oily flavour to the meat, and makes it soft or flabby. Horses become extremely fond of oilcake, and we have given 3 lb. per day to farm-horses with great good effect. The dung of cattle fed on oilcake is very rich, nearly half the weight of the ash of oilcake consisting of phosphate of lime; and one result of giving cake to cattle or sheep feeding on grass land during summer and autumn is to improve the pasture, besides hastening the fattening of the animals. The following is an average analysis of linseed-cake of the good old type:—

Water	10.05
Flesh-formers	22.14
Mucilage	39.10
Oil	11.93
Husk	9.53
Mineral matter (ash)	7.25
	100.00

Dr Voelcker remarks—and this is a point of the very greatest importance—that "the nutritive value of feeding-cakes depends not merely upon their proximate composition, but likewise upon their physical condition. Like all other perishable articles of food, linseed-cake, when kept in a damp or badly ventilated place, rapidly turns mouldy, and after some time becomes unfit for feeding purposes."[1] Unfortunately it has become so much the practice to adulterate cakes of all kinds in the process of manufacture, that the greatest caution is necessary in purchasing any article of the kind. Impurities also exist in the seed, varying from 1¾ per cent to 70 per cent, and these impurities are sometimes added artificially. Dr Voelcker states that "occasionally barges laden with siftings" (*i.e.*, impurities) "are sent out a little way to sea, to meet ships having on board linseed, and coming from one of the ports in the north. An amalgamation of the siftings with the linseed is effected on the high sea, and the mixture, containing a greater or less quantity of siftings, is then imported, and sold as linseed 'genuine as imported.' A good deal of so-called genuine linseed-cake is made from such seed. It is well to bear in mind that a guarantee which describes a cake as made from linseed 'genuine as imported,' in point of fact is no guarantee at all; for it is well known that very dirty seed, not unfrequently containing more than half its weight of foreign weed-seeds, is freely imported into Hull and other ports."[2]

As compared with pure linseed in feeding stock, 1 lb. of mutton or beef will be produced by 3 lb. of pure linseed made into meal, against 6½ lb. or 7 lb. of best cake.

The following substitutes for linseed-cake have been found economical and useful:—

1. Mix 4 bushels of crushed linseed with 4½ quarters (36 bushels) of feeding barley ground into meal; the meal absorbs all the oil from the linseed.

2. Mix 4 bushels of crushed linseed with 4 quarters (32 bushels) of wheat-meal made from sprouted or inferior wheat. Equal parts of wheat and barley may also be used along with linseed, as above.

The use of these mixtures obviates all risk of paying for adulterated cake, and, especially since grain has become so cheap, they cost less than genuine cake.

[1] Journal of the Royal Agricultural Society of England, vol. ix., Second Series. 1873.

[2] Ibid.

Rape-cake.—When genuine, rape-cake is a valuable description of cattle-food. The best kind is green German or Rubsen cake. Rape-cake is sometimes refused by cattle when it is given to them in a fresh state; but this has been obviated by covering the cake for some time with sawdust, chaffed straw, or any substance that will prevent it from becoming damp or moulded. It is also of advantage to pour boiling water over the crushed cake, and allow the mixture to stand for a time before it is used. Steaming the cake along with chaffed straw is also a good mode of preparing it for cattle; and in so preparing it, bean-meal or bran is added, in the proportion of 4 lb. of cake to 2 lb. of bran or 1 lb. of bean-meal. With these articles, 16 lb. of chaffed straw should be blended before steaming. On a mixture of this kind, with 50 lb. to 60 lb. of swedes or mangels given in the natural state, cattle make satisfactory progress.

Dr Voelcker states that Indian rape-cake is generally "contaminated with so much wild mustard or charlock (*Sinapis arvensis*), that it is not safe to feed animals upon it. Several actions having been tried in our law courts in which the plaintiffs obtained verdicts for damages caused by feeding cattle upon cake which turned out to be Indian rape-cake, it is now seldom sold for feeding purposes, but is either bought for manuring purposes or employed for adulterating linseed-cake, or preparing mixed feeding-cakes." From ¼ lb. of Indian rape-cake, Dr Voelcker obtained enough essential oil of mustard to convince him that half a cake of it, if not a smaller quantity, might kill a bullock. Even the best rape, when mixed with linseed-cake, imparts a turnip-like flavour to the latter, which of course reduces its value.

Dr Voelcker gives the following analysis of an excellent sample of green German rape-cake, which shows that it is fully as rich in nitrogenous or flesh-forming matters as the best linseed-cake:—

Water	10.82
Oil	8.72
Flesh-forming substances	33.81
Mucilage, sugar, &c.	28.05
Woody fibre	11.49
Mineral matter	7.10
	100.00

The following simple tests, given by Dr Voelcker, will be found useful by purchasers of linseed-cakes and rape-cakes :—

1. Examine a bit of the cake as to its taste and smell; observe that it is fresh, and free from any mouldiness.

2. Examine another piece with a common pocket-lens. This examination will show whether the cake is a linseed or a rape cake, inasmuch as the form of the linseed and rape-seed are widely different. Much more difficult is it to distinguish by the lens mustard from rape cake.

3. Mix in a tumbler about one ounce of the cake, broken into small pieces, with six ounces of cold water. Good linseed-cake will form, under these circumstances, a stiff, agreeably tasting jelly, without separating any water. Rape-cake will become less gelatinous, and separate a yellowish or brown rather bitter-tasting liquid. Mustard-cake, likewise, will become a little gelatinous, and separate a brown liquid which possesses the characteristic taste and smell of essential oil of mustard. Rape-cake, fraudulently or naturally mixed with mustard-seed, under these circumstances will exhibit a similar behaviour to that of mustard-cake, and by the degree of pungency of taste and smell, when compared with pure mustard-cake, will afford the means of estimating approximately the amount of mustard which the cake contains.

Cotton-cake.—Of this cake, which is made from the seeds of the cotton-plant, there are two varieties: the decorticated, from which the husks have been completely removed; and the undecorticated variety, which contains a considerable proportion of the dark-brown husks of the seed. The decorticated variety is of a uniform yellow colour, while the presence of the husks in the undecorticated at once indicates its nature. The latter is not only the least valuable of the two, but it is also apt to produce inflammatory symptoms in the animals fed upon it, and death has frequently been the result. This arises from the quantity of cotton which adheres to the seed. Although undecorticated cotton-cake may be employed as food for cattle when used cautiously, it is generally safer to use the decorticated variety, which is also superior as a feeding material, as will be seen from the following average analysis of the two varieties, as given by Dr Voelcker :—

	Decorticated.	Undecorticated.
Water	9.28	11.46
Oil	16.05	6.07
Flesh-forming matters[1]	41.25	22.94
Mucilage, sugar, &c.	16.45	32.52
Woody fibre	8.92	20.99
Mineral matter	8.05	6.02
	100.00	100.00
[1] Containing nitrogen	6.58	3.67

As decorticated cotton-cake contains a large percentage of flesh-forming matters, it is therefore a proper food for young stock and milch cows. The ash of cotton-cake is also rich in phosphates or bone-forming materials. Cotton-cake imparts a high value to the manure of animals fed upon it. In Sir John B. Lawes's table showing the manurial value of the various foods, cotton-cake stands at the top of the list.

Palm-nut Meal.—This material has been somewhat extensively introduced of late years as food for cattle, &c. It is made by grinding palm-nut cake, or the cake left in pressing out the oil from the palm-nut. There are different qualities of palm-nut meal or cake in the market, some of which are of little value, and are chiefly used for the purpose of adulterating linseed-cake. The following is an analysis by Dr Voelcker of the best variety (Smith's) in the market:—

Water	5.92
Oil and fatty matter	20.01
Flesh-forming matters[1]	13.87
Mucilage, sugar, &c.	38.24
Woody fibre	18.56
Mineral matter	3.40
	100.00
[1] Containing nitrogen	2.22

In practice, palm-nut meal has been found most advantageous when given to young calves, after being steeped for some hours in hot water; and also to milch cows and pigs, mixed with other food. When given to milch cows, it sensibly increases the quantity of milk, and at the same time renders it richer. When used in feeding pigs, it should be used in combination with other foods, such as barley-meal, Indian meal, beans or peas, &c. An equal mixture of palm-nut meal and decorticated cotton-cake is equal in feeding properties to linseed oilcake, at considerably less cost.

Cocoa-cake.—This cake is manufactured from the outer shell with fragments of the kernel of the cocoa-bean. It is a wholesome food, and cattle take easily to it. It is, however, inferior to pure linseed-cake, as the following analysis by Dr Voelcker will show:—

Water	14.95
Oil	8.02
Flesh-forming matters [1]	19.87
Woody fibre	18.26
Mucilage, sugar, &c.	32.46
Mineral matter	6.44
	100.00
[1] Containing nitrogen	3.18

The ordinary cocoa-nibs, as sold by grocers, are occasionally employed to supply a feeding material for young calves. This is done by boiling the nibs over a slow fire for two or three hours. The nibs are then strained out, and the liquid is mixed with milk and given to calves. The proportion of nibs to water is 1 lb. of nibs to 6 or 8 quarts of water. When given it should be milk-warm.

Poppy-cake.—Poppy-cake must be used when quite fresh, as the oil is apt to become soon rancid. When fresh, it is a useful feeding material. The following is Dr Voelcker's analysis of poppy-cake:—

Water	11.63
Oil	5.75
Flesh-forming matters [1]	31.46
Mulcilage, gum, and woody fibre	38.18
Mineral matter [2]	12.98
	100.00
[1] Containing nitrogen	5.11
[2] Containing sand	7.58

There are two varieties of poppy-cake,—one a light-coloured or whitish cake, made from white poppy; the other a dark or brownish cake, made from common poppy-seed.

Locust or *Carob Beans.*—This feeding material consists of the beans or pods of the locust-tree (*Ceratonia siliqua*). They are either roughly crushed or ground into meal, and either way are much liked by cattle, sheep, &c. Dr Voelcker has given the analysis of three samples of locust-meal as follows :—

	No. 1.	No. 2.	No. 3.
Water	17.11	12.61	14.22
Oil	1.19	1.08	0.96
Sugar	51.42	50.30	54.07
Mucilage and digestible fibre .	13.75	20.13	14.41
Flesh-formers[1] . . .	7.50	5.87	7.72
Woody fibre . . .	6.01	7.14	5.88
Mineral matter . . .	3.02	2.87	2.74
	100.00	100.00	100.00
1 Containing nitrogen .	1.20	0.94	1.25

Locust-meal contains, therefore, fully half its weight of sugar, but it is deficient in albuminous compounds or flesh-formers ; consequently it should be given to cattle, &c., in combination with peas or bean-meal, or with decorticated cotton-cake.

Molasses or *Treacle.*—The supposed injurious effects of molasses when used freely as the food of breeding animals have been noticed in the previous chapter, but there are conditions in which it may be employed with advantage. It may be given mixed with bran or gruel to sick animals, also amongst milk to calves, and it may be mingled with hot water and sprinkled over cut or pulped roots or chaff. Being of a laxative nature, from 2 lb. to 3 lb. per day is the most that can be given even to full-grown beasts, and from ½ lb. to 1 lb. to a calf, according to the age of the animal. The late Dr R. Thomson of Glasgow found that about 3 lb. of molasses mixed with 9 lb. of barley-meal, and given along with 25 lb. to 30 lb. of hay, kept milch cows in full milk, and did nearly as well as 12 lb. of either linseed-cake or bean-meal. A few ounces per day, mingled first with hot water and then sprinkled over the dry food of fattening sheep or of horses, will be found highly serviceable. Three-fourths of the weight of molasses consist of sugar.

Turnips.—Roots constitute an important part of the food of live-stock; and turnips, of which the swede is the principal variety, supply the largest proportion of this description of food. The nutritive value of turnips varies with the variety, the climate, soil, and also the manures used in their cultivation, so that any description of their constituent elements can only be regarded as an approximation to the truth, even in the case of the same kind of turnips if grown under different circumstances. All the varieties of the turnip contain a large percentage of water—namely, from 86 to 94 per cent, and from 6 to 14 per cent of dry matter. Turnips grown in some parts of the kingdom, particularly in the north of Scotland, will, with the aid merely of fresh oaten straw, be found to fatten cattle without using much artificial food of any kind; whereas large quantities of cake and hay must be given along with the same kind of turnips to effect that object, when such turnips are grown in other districts. This is more especially the case with turnips grown in the south and east of England. Turnips become more nutritious after they have been stored for some time than they are when taken fresh from the field. By storing they lose a proportion of the water which they naturally contain; and there are also some chemical changes which take place in them tending to render them more nutritious. When turnips are allowed to remain in the field until the leaves begin to put forth a fresh growth, as they will be found to do early in spring, a decided deterioration in their quality is the result, owing to certain of their elements becoming changed into indigestible woody fibre. Hence the necessity for storing turnips at the proper season, or say in November and December. The following table gives the average composition of five varieties of turnips, as deduced by Cameron from the results of the analyses of Anderson and Voelcker :—

	Swedes.	White Globe.	Aberdeen Yellow.	Purple-top Yellow.	Norfolk Turnip.
Water . .	89.460	90.430	90.578	91.200	92.280
Flesh-formers .	1.443	1.143	1.802	1.117	1.737
Fat-formers .	5.932	5.457	4.622	4.436	2.962
Woody fibre .	2.542	2.342	2.349	2.607	2.000
Ash . .	0.623	0.628	0.649	0.640	1.021
	100.000	100.000	100.000	100.000	100.000

There is no doubt that in former years many farmers pursued a wasteful system in relying so largely upon turnips as they did in the rearing and feeding of their stock. Recent experience has shown this unmistakably. The root-crop has become risky as well as costly, and substantial advantage has been derived from the lessening of the daily allowance of turnips given to stock. And in many parts of the country there is room for still greater economy in this respect.

Turnip-tops contain considerably more nutritive matter than some would imagine, and are useful when scattered on a green field for the use of young cattle or sheep. When given too freely, turnip-tops are apt to produce scour. The ash contains a large quantity of phosphate of lime and potash.

Mangel-wurzel.—Of this valuable description of root the orange globe and long yellow kinds have been found to contain a larger amount of the respiratory or fat-forming elements than the long red variety, which agrees with the practical results obtained by the use of those varieties in feeding cattle. The tendency in fresh mangels to produce scour when these are given to cattle is well known to all who have used them, and also the fact that this property disappears after the roots have been stored for two or three months. On this account, as well as from the keeping quality of mangel, and for other good reasons, the roots are not used until turnips have become scarce. In comparison with turnips, it has been considered that 75 lb. of mangel are equivalent in feeding value to 100 lb. of turnips. The leaves of the mangel are also very useful, especially for milch cows. Dr Voelcker gives the following as the average composition of mangel-wurzel :—

Water	87.78
Flesh-formers	1.54
Sugar	6.10
Gum, &c.	2.50
Woody fibre	1.12
Ash	0.96
	100.00

Sugar-beet.—The cultivation of this root as food for cattle is very limited: it has been found, however, to be a very superior description of food for milch cows. Of late years considerable attention has been given to the cultivation of sugar-beet for the production of sugar, and Dr Voelcker has published the results of some very elaborate investigations made by him as to the composition of sugar-beets grown under different circumstances. It is worthy of notice that roots grown in Ireland had the largest proportion of sugar. We give the composition of one of the specimens which showed this result:—

Water	76.58
Flesh-formers	2.10
Crystallisable sugar	14.81
Pectin and extractive matters	0.66
Crude fibre (pulp)	5.01
Ash	0.84
	100.00[1]

Dr Voelcker says—"The farmer will run very little risk in trying the experiment to grow sugar-beets instead of common mangels; for although he may not get so heavy a crop as he does when he plants common mangels, it has to be borne in mind that 1 ton of sugar-beets is equivalent, in nutritive qualities as cattle-food, to at least 1½ ton of good common mangel." Farmyard-dung should not be used in growing sugar-beet, as it renders the roots coarse and less nutritious. From 3 to 4 cwts. of superphosphate are sufficient to produce an average crop.

Beet-root pulp is the refuse left in extracting the sugary juice from the beet-root. It is much esteemed on the Continent for its fattening properties. It is, however, deficient

[1] Journal of the Royal Agricultural Society of England, vol. vii., Second Series. 1871.

in flesh-forming compounds, and requires the addition of some cake or meal to supply this deficiency. Dr Voelcker recommends cotton-cake for this purpose. Milch cows fed on beet-root pulp and a fair allowance of bean-meal or cotton-cake produce abundance of milk of good quality. Pigs also thrive on it if they get some barley-meal or pea-meal mixed with it. Dr Voelcker considers beet-root pulp at 12s. a ton a cheap and valuable food. The following analysis, as given by Voelcker, shows its average composition :—

Water	70.0
Sugar	1.5
Flesh-formers	2.5
Crude fibre, &c.	24.0
Ash	2.0
	100.0

Carrots.—The white Belgian variety has been analysed by Dr Voelcker, who found it to contain—

Water	88.50
Flesh-formers	0.60
Fat-formers (including woody fibre)	10.18
Ash	0.72
	100.00

The carrot does not contain any appreciable quantity of starch, but this deficiency is counterbalanced by its having about 6½ per cent of sugar.

Parsnips.—Parsnips contain starch, but a less proportion of sugar than there is in the carrot. The starch in parsnips exists only in the external layers of the root, none whatever being found in the heart. Compared with turnips, there is nearly double the quantity of solid matter in parsnips to that in turnips; consequently 1 ton of parsnips ought to go as far, as a fattening material, as 2 tons of white turnips. The following is the average composition of the parsnip :—

Water	82.00
Flesh-formers	1.30
Fat-formers	7.75
Woody fibre	8.00
Ash	0.95
	100.00

Kohl-rabi.—This is a valuable plant, considered as feeding material, especially for milch cows, as it not only increases the milk, but does not impart to it any particular flavour of a disagreeable kind, such as is produced by turnips. The leaves of kohl-rabi form an excellent description of food for sheep and cattle. The following analysis of the bulbs and tops of kohl-rabi is given by Dr Anderson :—

	Bulb.	Top.
Water	86.74	86.68
Flesh-formers . . .	2.75	2.37
Fat-formers	8.62	8.29
Woody fibre . . .	0.77	1.21
Ash	1.12	1.45
	100.00	100.00

The Cabbage.—Considered as a fattening material, Dr Voelcker holds that, "weight for weight, cabbages and swedes possess nearly the same nutritive value." Cabbages are excellent food for sheep and other stock, and ought to be grown much more extensively than they are. Few other crops will give as good a return per acre as cabbages. The following analysis of the cabbage was made by Dr Anderson :—

	Outer leaves.	Heart leaves.
Water	91.08	94.48
Flesh-formers	1.63	0.94
Fat-formers (including fibre) . .	5.06	4.08
Ash	2.23	0.05
	100.00	100.00

The Potato.—The value of the potato as an article of human food is well known. As a feeding material for live-stock it is equally valuable; but the demand which usually exists for it for the use of man, generally renders it too expensive to be employed largely in feeding animals. Practical Scotch farmers, however, who have discussed the value of the potato as cattle-food, have stated that so long as potatoes can be purchased for £2 or £2, 10s. per ton, they will pay to be employed in feeding stock. Second and small-sized potatoes are equally useful for this purpose; and as the potato is a bulky and therefore an expensive article to send a long distance to market, those who grow potatoes to some extent in remote districts will be able to turn their crops to better account by converting them into meat than by selling them in the natural state. Of late years a new variety, especially suited for cattle-feeding, has been introduced. This is Paterson's "Bovinia," which produces heavy crops of large tubers. Potatoes vary in composition, but the general results will be gathered from the following analyses given by Dr Anderson :—

	Regents.	Dalmahoys.	Skerry Blues.	White Rocks.	Orkney Reds.	Flukes.
Water	76.32	75.91	76.60	75.93	78.57	74.41
Starch	12.21	12.58	11.79	12.77	10.85	12.55
Sugar, &c.	2.75	2.93	3.09	2.17	2.78	2.89
Flesh-formers	2.37	2.25	2.06	2.12	1.69	2.18
Fibre	5.53	5.21	5.41	5.55	5.93	6.71
Ash	0.88	0.81	0.94	1.04	0.98	0.98
	100.06	99.69	99.89	99.58	100.80	99.72

It will be observed the chief value of the potato as a feeding material is derived from the respiratory or fat-forming elements, which constitute the largest part of the dry matter, the flesh-forming elements being deficient. Potatoes should therefore be used in combination with cotton-cake, bean-meal, or pea-meal, in the ordinary course of feeding stock upon them.

When the potato is attacked with disease, it is the flesh-forming constituents that are destroyed; these are converted into ammonia, and hence the offensive smell which is emitted from diseased potatoes. The starch, &c., remains intact, and advantage is taken of this by employing diseased potatoes in the manufacture of starch. Diseased potatoes may, for the same reason, be turned to account for feeding animals, particularly swine. In order to this, it is necessary to thoroughly cook the potatoes either by boiling or steaming —the latter, when practicable, being the better way—and then pack the cooked potatoes into flour-barrels or casks, ramming them well down, and sprinkling some salt occasionally through the mass. When the barrel or cask is filled to the top, it must be closed from the air, and the potatoes will keep for some time fit for use. When raw potatoes are given freely to horses, they are apt to produce colic; and water should not be given to animals fed on potatoes, either raw or cooked, for some time after the meal.

Green Rape.—The rape plant in a green or growing state is usually fed off with sheep, or cut and used as soiling food for house-fed cattle. It is a nutritious and valuable plant for the purpose to which it is applied, and for spring and autumn food it should be grown much more extensively than it is. Voelcker gives the following as the composition of green rape, and the analysis may be compared with that of turnips :—

Water	87.050
Flesh-formers	3.133
Fat-formers	4.649
Woody fibre	3.560
Ash	1.608
	100.000

Furze, Whins, or *Gorse.*—The young shoots of the furze plant are cut green and given to horses and cattle, who evince a great partiality for this kind of food. In various parts furze is specially cultivated as green food for stock during the winter months ; and as the young shoots of such "furze meadows" are cut regularly every year, the plant is never allowed to become hard and woody. Previous to use, the young shoots are passed through a machine invented for the purpose of bruising them ; or, failing this, through a common chaff-cutter, set close so as to cut the material into short lengths. When the chaff-cutter is used, it is necessary to put the cut furze three or four times through the machine, and it is advisable to pass some straw or hay through it along with the furze. Horses are frequently kept through the winter on furze without hay, and only a moderate allowance of oats ; and the use of furze as the food of horses has the effect of giving them fine coats of hair. When given to milch cows, it not only produces a full yield of milk, but the butter made from the milk of furze-fed cows possesses the quality and natural rich colour of the best summer butter. Young cattle also thrive very well upon cut furze, with or without turnips. Sheep do not eat it freely, unless there is much snow on the ground. Being so common a plant, the value of furze is not so generally appreciated as it should be. The cultivation under any circumstance is very simple, but where it is intended to have a permanent "furze meadow," it should be sown with oats after a well-manured root-crop. An imperial acre of well-grown young furze, which is regularly cut, will keep four or five horses or cows during the winter and early spring months with very little assistance in the shape of hay or roots. The following is an analysis by Cameron of green furze cut in August:—

Water	72.00
Flesh-formers	3.21
Fat-formers	9.38
Woody fibre	13.33
Ash	2.08
	100.00

The Grasses.—We have now arrived at a very important and interesting branch of our subject—namely, the amount of nutrition contained in the different varieties of grasses. The subject is a wide one, and we shall therefore confine our remarks chiefly to some of the common kinds. Until recently, our knowledge of the nutritive qualities of the grasses was very imperfect, and based chiefly on speculative opinions rather than on ascertained facts. Drs Way, Anderson, and Voelcker have, however, of late years devoted considerable attention to the subject, and the analysis which these distinguished chemists have made from time to time afford clearer data to guide us than those we possessed previous to their investigations. In a very valuable work on 'Permanent and Temporary Pastures,' recently issued, from the pen of Mr Martin J. Sutton, of Reading, there is an exceedingly interesting and instructive series of chemical analyses of the principal agricultural grasses, which Dr J. Augustus Voelcker made expressly for that work. These analyses are very exhaustive, and convey much useful information as to the chemical composition and character of the various grasses.

The value of the grasses, both artificial and natural, depends very much on their cultivation, and also on the soil and climate.

The clovers are the chief of the artificial grasses, and we shall therefore direct our attention, in the first place, to their composition, as follows :—

	Common Red Clover.	Perennial Red Clover (Cow-grass).	White Clover.	Common Yellow Clover.
Water	81.01	81.05	79.71	76.80
Flesh-formers	4.27	3.64	3.80	5.70
Fat-formers	9.14	8.82	9.03	8.67
Woody fibre	3.76	4.91	5.38	6.32
Ash	1.82	1.38	2.08	2.51
	100.00	99.80	100.00	100.00

The plants which gave the above results on being analysed were cut from the 14th to the 18th of June. Alsike clover appears to possess, by analysis, rather more nutritive qualities than either of the above varieties.

The composition of lucern and sainfoin closely resembles that of the clovers. The same may be said of green vetches in flower.

The composition of rye-grass in a fresh state is as follows :—

	Annual Rye-grass.	Perennial Rye-grass.	Italian Rye-grass.
Water	69.00	71.43	75.61
Flesh-formers	2.96	3.37	2.45
Fat-formers	13.58	12.99	14.91
Woody fibre	12.47	10.06	4.82
Ash	1.99	2.15	2.21
	100.00	100.00	100.00

We shall now take a few of the leading natural grasses as analysed in a fresh state :

	Meadow Foxtail Grass.	Cocksfoot Grass.	Hard Fescue Grass.	Smooth-stalked Meadow Grass.	Rough-stalked Meadow Grass.
Water	80.20	70.00	69.33	67.14	73.60
Flesh-formers	2.44	4.06	3.70	3.41	2.58
Fat-formers	9.11	14.24	13.48	15.01	11.51
Woody fibre	6.70	10.11	11.83	12.49	10.11
Ash	1.55	1.54	1.66	1.95	1.95
	100.00	100.00	100.00	100.00	100.00

The foregoing analyses of different varieties of grasses will give a general idea of their nutritive value in a fresh state at an early part of summer. When the clovers and other grasses are converted into hay, various chemical changes take place, and these are affected by a variety of accidental circumstances which tend to render the dried grasses or hay more or less valuable, as the case may be. A valuable paper by Dr Voelcker, on the changes which take place in hay during the process of curing, and afterwards in the rick, was published some time ago in the 'Journal of the Royal Agricultural Society of England,' and we shall give here a summary of the conclusions arrived at by the learned Professor.

Dr Voelcker states, that if grass or clover could be converted into hay without undergoing any change in composition, the hay would be quite as valuable as the green plant from which it is obtained. This result is obtained when the drying process takes place with such rapidity that the cut grass loses hardly anything except water; but in ordinary farm practice there is always more or less waste in the feeding substance of hay, in consequence of exposure to unsettled weather, bad management in the field, and subsequent heating in the rick, and to mistakes in cutting the produce either too early or too late in the season. He considers it, however, scarcely worth while to seriously entertain suggestions for drying grass by artificial heat or dry currents of air, or the combined action of those agents—at least with regard to haymaking on a large scale, and in ordinary farm practice.

With reference to the effect of unpropitious weather during the haymaking season, Dr Voelcker states that rain may fall for days on newly cut grass without serious injury to it, provided the grass is left untouched; but that when it is repeatedly turned, causing the crop to become more or less bruised, rain washes out the gum, sugar, and other soluble matters, and causes fermentation, which leads to further loss. For this reason, recently cut grass should not be turned in showery weather more than is absolutely necessary; and in all circumstances the crop should be handled as lightly as possible, so as to avoid bruising the plants.

In order to subject the value of hay which had been damaged in the field by rain to a practical test, some experiments were made in feeding sheep with clover-hay made in wet weather, which had also lain long on the ground before it was carted and stacked. Experiments previously made by Messrs Lawes and Gilbert had shown that sheep fed on well-made hay alone increased in weight; but in the course of Dr Voelcker's experiments with bad hay the animals lost weight. The experiments were continued for more than three months. The result shows the folly of expecting that cattle or sheep which are fed on damaged hay will improve; and it also proves that hay can be deteriorated by rain, long keeping, and frequent turnings in the field, to such an extent that any amount which sheep can consume is barely sufficient to maintain their original weight; while, with an ordinary allowance of such hay, say 1½ lb. or 2 lb. per day, the loss of weight is considerable.

With respect to loss by bad management in the field, and subsequent fermentation in the rick, Dr Voelcker adverts to the folly of spending labour in turning hay on overcast days, when a dew-point hygrometer shows the air to be saturated with moisture; and he states that in such a condition of the atmosphere it is not only useless, but positively injurious, to knock about half-made hay, as such treatment tends to bruise it, and to render it more liable to be injured by the rain of which the hygrometer had given previous warning. Badly made hay also loses subsequently in the rick, both in weight and quality. In explanation of this, Dr Voelcker says that "hay, whether produced from clover or natural grass, contains a good deal of ready-formed sugar, or soluble organic matter having an analogous composition, and readily convertible under the influence of ferments, first into sugar, and afterwards into alcohol and carbonic acid. These constituents are essential elements in all liquids and moist substances capable of entering into fermentation. No less essential are albumen, gluten, and other nitrogenous compounds. Some of the nitrogenous matter in hay occurs in a soluble, some in a condition insoluble in water. Soluble albumen and all albuminous compounds, exposed for a short time to air and moisture, are readily transformed into ferments—that is to say, agents which play the same part as yeast in setting up fermentation in sugary compounds. It appears that when a vegetable juice ferments, the admission of air is necessary to the commencement of the change which then goes on, even if the air be afterwards excluded. Ferments almost invariably contain the germs of minute fungi, which become rapidly developed and multiplied in the measure in which the fermentation proceeds. Albuminous compounds that have been exposed for a short time to the influence of the air, as in ordinary ferments, are only capable of acting as inducers of fermentation when in a state of decomposition. This explains satisfactorily why hay that has been subject to excessive fermentation generally is very innutritious, such a great loss of flesh-forming as well as sugary constituents being implied by fermentation."

Dr Voelcker does not object to a slight degree of fermentation in the haystack, as certain peculiar aromatic principles are thus generated which render hay more palatable, and perhaps more nutritious. It is when hay loses the green colour and becomes brown, that it is in danger of deterioration from the loss of feeding matter, as such hay contains scarcely any sugar, but a considerable amount of acetic acid, which is produced at the expense of the sugar present in unfermented or only slightly fermented hay. Highly fermented hay, which has passed through the acetous fermentation, on prolonged keeping in the rick, undergoes a slow combustion, in consequence of which compounds like those present in peat are formed, and much valuable feeding matter is entirely resolved into gaseous products. Brown hay is preferred in some parts of England for draught-horses, from an opinion that because it is more consolidated in consequence of heating, it is therefore more nutritious; and it is almost impossible to convince people who entertain this opinion that overheated hay is the reverse of being nutritious—in fact, that it is positively injurious. It is very apt to lead to broken wind, and other diseases of a kindred kind.

In pointing out the loss incurred by cutting grass either too early or too late in the season, Dr Voelcker properly remarks that "hay crops are frequently seen in the fields which might with advantage have been cut down a week or a fortnight earlier, and occasionally others are gathered too soon; though a single week's difference in the time of cutting may affect very materially both the quality and quantity of the produce." With the view of ascertaining some well-defined data as to the loss occasioned by premature as well as by late cutting, Dr Voelcker instituted some experiments, the results of which prove the correctness of a well-established opinion held by enlightened agriculturists—namely, "that, by allowing clover-hay to get over-ripe, it diminishes in quantity, and gets more woody and less nutritious the longer it is kept on the land." It is a well-known fact that much hay is lost annually through bad management. We cannot control the weather, but we may at least avoid those errors in practice which result in a serious waste of cattle-food.

Mr W. A. Gibbs, of Chilwell Park, Essex, has invented a mode of drying hay artificially, which obtained the gold medal and prize of £50 from the Society of Arts in 1868, the judges being Mr J. C. Morton, Mr Clare Sewell Read, M.P., and Mr Chandos Wren Hoskyns. The principle of Mr Gibbs's invention is to subject the wet grass to a strong current of highly heated air—namely, from 300° to 380°, whereby the moisture is rapidly driven off. Mr Gibbs's invention has also received medals from the Highland and Agricultural Society, and other associations of a similar kind. It would occupy too much space to give details, but these will be obtained from Mr Gibbs's Prize Essay.[1]

The Neilson system of drying hay, by drawing air through the stack by means of an "exhaust fan," attracted a good deal of attention a few years ago; but it has been found to be of little practical value.

The system of ensilage (storing green food by pressure) has been found more useful, and it deserves treatment by itself.

Straw.—The value of straw as a feeding material depends not only on the kind of grain to which it belongs, but also on its condition as regards ripeness when it is harvested. The straw of grain which is cut just as the grain is ripe, while there still remains a tinge of green in the straw, is much more nutritious than that which has been allowed to become over-ripe. The nature of the soil also affects the feeding value of straw, coarse straw being less relished by

[1] On Harvesting Corn in Wet Weather, by W. A. Gibbs, Esq. London: Bell and Daldy. 1868.

cattle than that which is finer in the growth. The following analyses of different kinds of straw are by Voelcker:[1]—

No. 1.

	Wheat just ripe.	Wheat over-ripe.
Water	13.33	9.17
Flesh-formers	2.93	2.12
Oil	1.74	0.65
Sugar, mucilage, &c.,	4.26	3.46
Woody fibre (digestible)	19.40	82.26
" (indigestible)	54.13	
Mineral matter	4.21	1.34
	100.00	100.00

No. 2.

	Barley dead ripe.	Barley not too ripe.
Water	15.20	17.50
Flesh-formers	4.43	5.73
Oil	1.36	1.17
Sugar, mucilage, &c.	2.24	
Woody fibre (digestible)	5.97	71.44
" (indigestible)	66.54	
Mineral matter	4.26	4.52

No. 3.

	Oats cut green.	Oats fairly ripe.	Oats over-ripe.
Water	16.00	16.00	16.00
Flesh-formers	8.49	4.08	3.65
Oil	1.57	1.05	1.25
Sugar, mucilage, &c.,	16.04	10.57	3.19
Woody fibre (digestible)	26.34	30.17	27.75
" (indigestible)	24.86	31.78	41.82
Mineral matter	6.70	6.35	6.34
	100.00	100.00	100.00

No. 4.

	Bean-Straw.	Pea-Straw.
Water	19.40	16.02
Flesh-formers	3.36	9.86
Oil	1.02	2.34
Sugar, mucilage, &c.	4.18	8.32
Woody fibre (digestible)	2.75	17.74
" (indigestible)	65.58	42.79
Mineral matter	3.71	4.93
	100.00	100.00

[1] Journal of the Royal Agricultural Society of England, vol. xxii., 1862.

When straw is used as feeding material, it is given either in its natural state, as it comes from the thrashing-machine, or it is cut into very short lengths by a machine constructed for the purpose, in which state it is known as straw-chaff or chaffed straw. In order to render this more palatable to animals, it is either moistened with treacle mixed with water, or it is employed to absorb a quantity of linseed-meal gruel. The dry chaff is also mixed with the oats given to horses, as such admixture has the effect of causing the horses to masticate their oats more fully than they might otherwise do.

Mr Samuel Jonas, Chrishall Grange, Saffron-Walden, has described, in the 'Journal of the Royal Agricultural Society of England,'[1] a plan which has been adopted by him and his neighbours "of cutting and storing chaff in a large mass, and using it when from six to twelve months old." Mr Jonas's plan of cutting and storing is as follows:—

"I use a 12-horse-power engine by Hornsby, which enables me (when used on home premises) to thrash, dress, and sack the corn ready for market, and cut the straw into chaff. I use one of Maynard's powerful chaff-cutters, which sifts and puts the chaff into bags ready for being carried into the chaff-house. The straw, when delivered from the thrashing-machine, is carried by rollers to the height of 9 feet; it then comes down an inclined plane. Three men get in the straw and hand it to the chaff-cutter: it is then cut and carried into the chaff-barn, and well trodden down, mixing about a bushel of salt to every ton, and also a certain quantity of green-stuff. Tares or rye cut green into chaff are sown by the hand as the chaff is brought in. This causes it to heat: and adding the amount of green stuff required to give it a proper heat is the secret of the successful operation of storing chaff.

"Respecting the quantity of green chaff to be mixed with straw-chaff to cause a proper fermentation, I use about 1 cwt. to the ton of straw-chaff, and 1 bushel of salt (56 lb.) to the ton of chaff. But some judgment is required as to the state of the green-stuff. If it is green rye on the ear, a full cwt. is required; if very green tares, a rather less quantity will do, as the degree of fermentation depends upon the quantity

[1] Vol. vi., Second Series. 1870.

of sap contained in it. This is done in spring and summer, —the chaff is not used till October and the winter months. I can thus thrash and dress the corn crops, and cut the straw into chaff, in one process, the expense of cutting and storing the same being about 1s. per acre: the principal additional expense is for about 4 cwts. of coal per day, and we thrash and cut from 8 to 10 acres per day."

Mr Jonas states that this mode of preparing and preserving straw-chaff "has in two seasons, with no turnips, enabled me to winter my sheep and fold the land, leaving sufficient folding to produce a good crop of barley, not from the chaff alone, but from its being the means by which I enabled my sheep to consume with it large quantities of bran, malt-culms, and oilcake, sufficient to keep them in health and good condition, and to leave the land in a good state for the following crop of barley, which I could not have done by any other means. The turnips were such a failure that, the same two winters, all my fat cattle were fed without having a root to eat. I had two coppers hung in the mixing-house, ground my corn, and broke my cake with an American mill. These were mixed together with malt-culms and boiled, and, after a certain time, were emptied, boiling-hot, into a prepared bed of very old straw-chaff: these were stirred over and mixed well together, and used for the stock in a warm state. They did well so fed, and became good fat bullocks, and paid for the expense of food and attendance, which they very seldom do." Mr Jonas prefers the chaff of wheat or oat straw, as "these may be cut without loss in a far greener state than is generally done: but barley, to be of good quality, cannot fairly be cut too ripe."

Straw-chaff, as prepared by Mr Jonas, formed the subject of a paper read by Dr Voelcker which appeared in vol. vii. of the 'Journal of the Royal Agricultural Society of England.' Dr Voelcker ascertained by analysis — 1. That fermented straw-chaff (wheat) is one-fourth richer in flesh-forming compounds, or the materials which produce the lean fibre of meat, than ordinary wheat-straw; 2. That fermented straw-chaff contains nearly two and a half times the amount of sugar, gum, and similar compounds, which is found in common wheat-straw; 3. That nearly 51 per cent of the woody fibre in fermented straw-chaff was soluble, whilst the soluble portion of vegetable fibre in common wheat-straw does not amount to more than 26.48 per cent. "The fermentation to which the straw is submitted in Mr Jonas's plan," says Dr Voelcker, "thus has the effect of rendering the hard and dry substance which constitutes the bulk of straw more soluble and digestible than it is in its natural condition." He also notices "the extremely delicate flavour and the palatable condition which is conferred upon the straw in the process of fermentation" as another recommendation. The prepared straw-chaff has "all the agreeable smell which characterises good green meadow-hay;" and the liquid produced by pouring hot water upon it "could hardly be distinguished from hay-tea."

Dr Voelcker recommends that about 2 cwts. of decorticated cotton-cake, ground into meal, should be added to 1 ton of fermented straw-chaff, by means of which admixture the proportion of flesh-forming compounds in fermented straw-chaff could be brought up to what it is in good meadow-hay.

We have dwelt upon this mode of preparing and storing straw, because we consider it a matter of great importance. We have known of its being practised with much success by various advanced agriculturists, who are able to show that they have derived substantial advantage from it. It is a simple and at the same time a cheap process of turning to account for feeding purposes material which is, for the most part, of little value to the farmer beyond increasing the bulk of his dung-heap.

Condimental Cattle-food.—Of late years a variety of compounds have been offered to farmers, horse-keepers, &c., under the name of "condimental cattle-food." Some of these compounds are useful, while others are decidedly injurious to the health of animals. Of the latter, Dr Voelcker gives an example in his paper on "Pure and Mixed Linseed Cakes."[1] He states that a sample of "cattle-food" which had been submitted to his inspection contained the following ingredients: Irish moss, cotton-seeds, and bits of cotton-seed cake; fragments of locust-beans, earth-nut cake,

[1] Journal of the Royal Agricultural Society of England, vol. ix., Second Series. 1873.

and broken earth-nuts ; bits of linseed-cake, linseed, vetches, Indian corn, beans, lentils, Dari grains, barley, hempseed, wheat, oats, niger-seed, peas, rape-seed, white and black mustard, rye, clover, grass-seeds, bran, and a great deal of dirty-looking meal or dust. This "cattle-food" was evidently the sweepings of a cake and general grain and seed warehouse. It had caused the death of fourteen sheep, three horses, and a pony; and this result Dr Voelcker attributed to the fact that a good many of the bits of cake, and of the grains of broken wheat, oats, and barley, were full of the spores or germs of fungi. Great caution is therefore required in using "cattle-food" of which the composition is unknown. There are compounds of this kind which have obtained a certain degree of reputation as sound and wholesome food, and in such cases the chief objection urged against their use is, that the price charged for them is very much more than the original cost of the materials would warrant. It has been proved that in some instances the price charged has been from 300 to 400 per cent above the cost price of the materials of which the cattle-food was composed. Much stress has been laid on the stimulating effects of a properly prepared cattle-food, where the digestion has been impaired—and there is no doubt that such foods have this effect. A person possessing the necessary skill will administer ordinary stomachics and tonics where such are required; but others may not possess sufficient skill, and they may find that condimental foods afford them the means of supplying some special need of the system. But, although such may be the case, it is "paying too much for the whistle" to be compelled to give 40s. or 50s. for an article that only cost 10s. Various formulæ have been given for the purpose of enabling the farmer to compound a condimental cattle-food for himself; and as it is a subject of some interest, we give the following formula, which represents a safe mixture :—

		cwts.	qrs.	lb.
Locust-beans, finely ground .	at £6 per ton	6	0	0
Indian corn " .	£7 "	9	0	0
Linseed-cake " .	£10 "	3	0	0
	Carry forward,	18	0	0

			cwts.	qrs.	lb.
	Brought forward,		18	0	0
Powdered turmeric	8d.	per lb.	0	0	40
Sulphur	2d.	"	0	0	40
Saltpetre	5d.	"	0	0	40
Liquorice	1s. 0d.	"	0	0	27
Ginger (ground)	6d.	"	0	0	3
Aniseed	9d.	"	0	0	4
Coriander	9d.	"	0	0	10
Gentian	8d.	"	0	0	10
Cream of tartar	1s. 8d.	"	0	0	2
Carbonate of soda	4d.	"	0	0	6
Levigated antimony	6d.	"	0	0	6
Common salt	½d.	"	0	0	30
Peruvian bark	4s. 0d.	"	0	0	4
Fenugreek	8d.	"	0	0	22
			20	0	20

A ton of condimental food compounded of the foregoing materials at the price given, will only cost £13, 4s. 11d., which is much less than the prices charged for certain much-advertised articles. It is but right, on the other hand, to say that prepared foods and meals of undoubted value are extensively sold by some well-known firms, who have deservedly obtained popularity in the production of these useful commodities.

Effects of Food on Manure.—Before closing this department of our subject, we would call attention to the relative value of different kinds of food in the production of manure. Whilst a large proportion of the elements of food are assimilated by the animal, becoming "bone of its bone, and flesh of its flesh," there is still a proportion which passes off in the dung and urine. Rich food produces rich dung; and poor food, dung of much inferior value as a fertilising material.

The well known tables drawn up many years ago by Sir (then Mr) John B. Lawes were lately revised by desire of the Royal Agricultural Society of England, and in the Journal of that Society—Part II., vol. xxi., Second Series, 1885—Sir John gives the tables in revised form. These are of so much importance to farmers, that we produce the figures here :—

SIR J. B. LAWE'S REVISED TABLES OF COMPOSITION AND MANURIAL VALUE OF FOODS.

TABLE I.—Average Composition Per Cent and Per Ton of Cattle-Foods.

No.	Foods.	Per Cent.					Per Ton.		
		Dry Matter.	Nitrogen.	Mineral Matter (Ash).	Phosphoric Acid.	Potash.	Nitrogen.	Phosphoric Acid.	Potash.
		%	%	%	%	%	lb.	lb.	lb.
1.	Linseed . .	90.00	3.60	4.00	1.54	1.37	80.64	34.50	30.69
2.	Linseed-cake	88.50	4.75	6.50	2.00	1.40	106.40	44.80	31.36
3.	Decorticated cotton-cake	90.00	6.60	7.00	3.10	2.00	147.84	69.44	44.80
4.	Palm-nut cake	91.00	2.50	3.60	1.20	0.50	56.00	26.88	11.20
5.	Undecorticated cotton-cake	87.00	3.75	6.00	2.00	2.00	84.00	44.80	44.80
6.	Cocoa-nut cake	90.00	3.40	6.00	1.40	2.00	76.16	31.36	44.80
7.	Rape-cake .	89.00	4.90	7.50	2.50	1.50	109.76	56.00	33.60
8.	Peas . .	85.00	3.60	2.50	0.85	0.96	80.64	19.04	21.50
9.	Beans . .	85.00	4.00	3.00	1.10	1.30	89.60	24.64	29.12
10.	Lentils . .	88.00	4.20	4.00	0.75	0.70	94.08	16.80	15.68
11.	Tares (seed) .	84.00	4.20	2.50	0.80	0.80	94.08	17.92	17.92
12.	Indian corn .	88.00	1.70	1.40	0.60	0.37	38.08	13.44	8.29
13.	Wheat . .	85.00	1.80	1.70	0.85	0.53	40.32	19.04	11.87
14.	Malt . .	94.00	1.70	2.50	0.80	0.50	38.08	17.92	11.20
15.	Barley . .	84.00	1.65	2.20	0.75	0.55	36.96	16.80	12.32
16.	Oats . .	86.00	2.00	2.80	0.60	0.50	44.80	13.44	11.20
17.	Rice-meal[1] .	90.00	1.90	7.50	(0.60)	(0.37)	42.56	(13.44)	(8.29)
18.	Locust-beans .	85.00	1.20	2.50	..	..	26.88	..	..
19.	Malt-coombs .	90.00	3.90	8.00	2.00	2.00	87.36	44.80	44.80
20.	Fine pollard .	86.00	2.45	5.50	2.90	1.46	54.88	64.96	32.70
21.	Coarse pollard	86.00	2.50	6.40	3.50	1.50	56.00	78.40	33.60
22.	Bran . .	86.00	2.50	6.50	3.60	1.45	56.00	80.64	32.48
23.	Clover-hay .	83.00	2.40	7.00	0.57	1.50	53.76	12.77	33.60
24.	Meadow-hay .	84.00	1.50	6.50	0.40	1.60	33.60	8.96	35.84
25.	Pea-straw .	82.50	1.00	5.50	0.35	1.90	22.40	7.84	22.40
26.	Oat-straw .	83.00	0.50	5.50	0.24	1.00	11.20	5.38	22.40
27.	Wheat-straw .	84.00	0.45	5.00	0.24	0.80	10.08	5.38	17.92
28.	Barley-straw .	85.00	0.40	4.50	0.18	1.00	8.96	4.03	22.40
29.	Bean-straw .	82.50	0.90	5.00	0.30	1.00	20.16	6.72	22.40
30.	Potatoes .	25.00	0.25	1.00	0.15	0.55	5.60	3.36	12.32
31.	Carrots . .	14.00	0.20	0.90	0.09	0.28	4.48	2.02	6.27
32.	Parsnips . .	16.00	0.22	1.00	0.19	0.36	4.93	4.26	8.06
33.	Swedish turnip	11.00	0.25	0.60	0.06	0.22	5.60	1.34	4.93
34.	Mangel-wurzels[1]	12.50	0.22	1.00	0.07	0.40	4.93	1.57	8.96
35.	Yellow turnips	9.00	0.20	0.65	(0.06)	(0.22)	4.48	(1.34)	(4.93)
36.	White turnips	8.00	0.18	0.68	0.05	0.30	4.03	1.12	6.72

[1] In the case of neither rice-meal, locust-beans, nor yellow turnips, have records of ash-analyses been found. For rice-meal the same percentages of phosphoric acid and potash as in Indian corn, and for yellow turnips the same as in Swedes, are provisionally adopted; but in all the Tables the assumed results are given in parentheses. For locust-beans no figure has been assumed, and the columns are left blank.

TABLE II.—SHOWING THE DATA, THE METHOD, AND THE RE- OF CATTLE-FOODS

No.	DESCRIPTION OF FOOD.	Fattening Increase in Live-weight (Oxen or Sheep).		NITROGEN.								
				In Food.		In Fattening Increase (at 1.27 per cent).		In Manure.				
		Food to 1. Increase.	Increase per ton of Food.	Per cent.	Per ton.	From 1 ton of Food.	Per cent of total consumed.	Total remaining for Manure.	Nitrogen equal Ammonia.	Value of Ammonia at 6d. per lb.		
			lb.	°/₀	lb.	lb.	°/₀	lb.	lb.	£	s.	d.
1	Linseed	5.0	448.0	3.60	80.64	5.69	7.06	74.95	91.0	2	5	6
2	Linseed-cake	6.0	373.3	4.75	106.40	4.74	4.45	101.66	123.4	3	1	8
3	Decorticated cotton-cake	6.5	344.6	6.60	147.84	4.38	2.96	143.46	174.2	4	7	1
4	Palm-nut-cake	7.0	320.0	2.50	56.00	4.06	7.25	51.94	63.1	1	11	7
5	Undecorticated cotton-cake	8.0	280.0	3.75	84.00	3.56	4.24	80.44	97.7	2	8	10
6	Cocoa-nut-cake	8.0	280.0	3.40	76.16	3.56	4.67	72.60	88.2	2	4	1
7	Rape-cake	(10)	(224)	4.90	109.76	2.84	2.59	106.92	129.8	3	4	11
8	Peas	7.0	320.0	3.60	80.64	4.06	5.03	76.58	93.0	2	6	6
9	Beans	7.0	320.0	4.00	89.60	4.06	4.53	85.54	103.9	2	11	11
10	Lentils	7.0	320.0	4.20	94.08	4.06	4.32	90.02	109.3	2	14	8
11	Tares (seed)	7.0	320.0	4.20	94.08	4.06	4.32	90.02	109.3	2	14	8
12	Indian corn	7.2	311.1	1.70	38.08	3.95	10.37	34.13	41.4	1	0	9
13	Wheat	7.2	311.1	1.80	40.32	3.95	9.80	36.37	44.2	1	2	1
14	Malt	7.0	320.0	1.70	38.08	4.06	10.66	34.02	41.3	1	0	8
15	Barley	7.2	311.1	1.65	36.26	3.95	10.69	33.01	40.1	1	0	1
16	Oats	7.5	298.7	2.00	44.80	3.79	8.46	41.01	49.8	1	4	11
17	Rice-meal	7.5	298.7	1.90	42.56	3.79	8.91	38.77	47.1	1	3	6
18	Locust-beans	9.0	248.9	1.20	26.88	3.16	11.76	23.72	28.8	0	14	5
19	Malt-coombs	8.0	280.0	3.90	87.36	3.56	4.08	83.80	101.8	2	10	11
20	Fine pollard	7.5	298.7	2.45	54.88	3.79	6.91	51.09	62.0	1	11	0
21	Coarse pollard	8.0	280.0	2.50	56.00	3.56	6.35	52.44	63.7	1	11	10
22	Bran	9.0	248.9	2.50	56.00	3.16	5.64	52.84	64.2	1	12	1
23	Clover-hay	14.0	160.0	2.40	53.76	2.03	3.78	51.73	62.8	1	11	5
24	Meadow-hay	15.0	149.3	1.50	33.60	1.90	5.65	31.70	38.5	0	19	3
25	Pea-straw	16.0	140.0	1.00	22.40	1.78	7.95	20.62	25.0	0	12	6
26	Oat-straw	18.0	124.4	0.50	11.20	1.58	14.11	9.62	11.7	0	5	10
27	Wheat-straw	21.0	106.7	0.45	10.08	1.36	13.49	8.72	10.6	0	5	4
28	Barley-straw	23.0	97.4	0.40	8.96	1.24	13.84	7.72	9.4	0	4	8
29	Bean-straw	22.0	101.8	0.90	20.16	1.29	6.39	18.87	22.9	0	11	6
30	Potatoes	60.0	37.3	0.25	5.60	0.47	8.39	5.13	6.2	0	3	1
31	Carrots	85.7	26.1	0.20	4.48	0.33	7.37	4.15	5.0	0	2	6
32	Parsnips	75.0	29.9	0.22	4.93	0.38	7.71	4.55	5.5	0	2	9
33	Swedish turnips	109.1	20.5	0.25	5.60	0.26	4.64	5.34	6.5	0	3	3
34	Mangel-wurzels	96.0	23.3	0.22	4.93	0.30	6.09	4.63	5.6	0	2	10
35	Yellow turnips	133.3	16.8	0.20	4.48	0.21	4.69	4.27	5.2	0	2	7
36	White turnips	150.0	14.9	0.18	4.03	0.19	4.71	3.84	4.7	0	2	4

SULTS OF THE ESTIMATION OF THE ORIGINAL MANURE-VALUE AFTER CONSUMPTION.

Phosphoric Acid.						Potash.						Total original Manure-value per ton of Food consumed.
In Food.		In Fattening Increase at (0.86 per cent).		In Manure.		In Food.		In Fattening Increase (at 0.11 per cent).		In Manure.		
Per cent.	Per ton.	From 1 ton of Food.	Per cent of total consumed.	Total remaining for Manure.	Value at 3d. per lb.	Per cent.	Per ton.	From 1 ton of Food.	Per cent of total consumed.	Total remaining for Manure.	Value at 2½d. per lb.	
°/₀	lb.	lb.	°/₀	lb.	s. d.	°/₀	lb.	lb.	°/₀	lb.	s. d.	£ s. d.
1.54	34.50	3.85	11.16	30.65	7 8	1.37	30.69	0 49	1.60	30.20	6 3	2 19 5
2.00	44.80	3.21	7.17	41.59	10 5	1.40	31.36	0.41	1.31	30.95	6 5	3 18 6
3.10	69.44	2.96	4.26	66.48	16 8	2.00	44.80	0.38	0.85	44.42	9 3	5 13 0
1.20	26.88	2.75	10.23	24.13	6 0	0.50	11.20	0.35	3.13	10.85	2 3	1 19 10
2.00	44.80	2.41	5.38	42.39	10 7	2.00	44.80	0.31	0.69	44.49	5 11	3 5 4
1.40	31.36	2.41	7.68	28.95	7 3	2.00	44.80	0.31	0.69	44.49	9 3	3 0 7
2.50	56.00	1.93	3.45	54.07	13 6	1.50	33.60	0.25	0.74	33.35	6 11	4 5 4
0.85	19.04	2.75	14.44	16.29	4 1	0.96	21.50	0.35	1.63	21.15	4 5	2 15 0
1.10	24.64	2.75	11.16	21.89	5 6	1.30	29.12	0.35	1.20	28.77	6 0	3 3 5
0.75	16.80	2.75	16.37	14.05	3 6	0 70	15.68	0.35	2.23	15.33	3 2	3 1 4
0.80	17.92	2.75	15.35	15.17	3 9	0.80	17.92	0.35	1.95	17.57	3 8	3 2 1
0.60	13.44	2.68	19.94	10.76	2 8	0.37	8.29	0.34	4.10	7.95	1 8	1 5 1
0.85	19.04	2.68	14.08	16.36	4 1	0.53	11.87	0.34	2.86	11.53	2 5	1 8 7
0.80	17.92	2.75	15.35	15.17	3 9	0.50	11.20	0.35	3.13	10.85	2 3	1 6 8
0.75	16.80	2.68	15.95	14.12	3 6	0.55	12.32	0.34	2.76	11.98	2 6	1 6 1
0.60	13.44	2.57	(19.12)	10.87	2 8	0.50	11.20	0.33	2.94	10.87	2 3	1 9 10
(0.60)	(13.44)	2.57	(19.12)	(10.87)	(2 8)	(0.37)	(8.29)	0.33	(4.00)	(7.96)	(1 8)	(1 7 1)
..	..	2.14	..	..	..	..	..	0.27	..	..	..	..
2.00	44.80	2.41	5.38	42.39	10 7	2.00	44.80	0.31	0.69	44.49	9 3	3 10 9
2.90	64.96	2.57	3.96	62.39	15 7	1.46	32.70	0.33	1.01	32.37	6 9	2 13 4
3.50	78.40	2.41	3.07	75.99	19 0	1.50	33.60	0.31	0.92	33.29	6 11	1 17 9
3.60	80.64	2.14	2.65	78.50	19 8	1.45	32.48	0.27	0.83	32.21	6 8	2 13 5
0.57	12.77	1.38	10.81	11.39	2 10	1.50	33.60	0.18	0.54	33.42	7 0	2 1 3
0.40	8.96	1.28	14.28	7.68	1 11	1.60	35.84	0.16	0.45	35.68	7 5	1 8 7
0.35	7.84	1.20	15.31	6.64	1 8	1.00	22.40	0.15	0.67	22.25	4 8	0 18 10
0.24	5.38	1.07	19.89	4.31	1 1	1.00	22.40	0.14	0.63	22.26	4 8	0 11 7
0.24	5.38	0.92	17.10	4.46	1 1	0.80	17.92	0.12	0.67	17.80	3 8	0 10 1
0.18	4.03	0.84	20.84	3.19	0 9	1.00	22.40	0.11	0.49	22.29	4 8	0 10 1
0.30	6.72	0.88	13.10	5.84	1 5	1.00	22.40	0.11	0.49	22.29	4 8	0 17 7
0.15	3.36	0.32	9.52	3.04	0 9	0.55	12.32	0.04	0.32	12.28	2 7	0 6 5
0.09	2.02	0.22	10.89	1.80	0 5	0.28	6.27	0.03	0.48	6.24	1 4	0 4 3
0.19	4.26	0.26	6.10	4.00	1 0	0.36	8.06	0.03	0.37	8.03	1 8	0 5 5
0.06	1.34	0.18	13.43	1.16	0 4	0.22	4.93	0.02	0.41	4.91	1 0	0 4 7
0.07	1.57	0.20	12.74	1.37	0 4	0.40	8.96	0.03	0.34	8.93	1 10	0 5 0
(0.06)	(1.34)	0.14	(10.78)	(1.20)	(0 4)	(0.22)	(4.93)	0.02	(0.34)	(4.91)	(1 0)	(0 3 11)
0.05	1.12	0.13	11.61	0.99	0 3	0.30	6.72	0.02	(0.30)	6.70	1 5	0 4 0

CHAPTER IV.

ENSILAGE.

SINCE the previous edition of this work was issued, a new variety of food for stock has come into use. The system known as Ensilage, which was introduced into this country only a few years ago, is already extensively practised in many parts of the kingdom. The pitting of green fodder is metaphorically as old as the hills; but modern enlightenment has applied the principle in a wider and more serviceable manner than in former times. Ensilage promises to become an important and useful factor in British agriculture, and it is hoped that it may help farmers to tide over the severe trials which, unfortunately, they are experiencing.

The term Ensilage designates the system of storing green food by exclusion of air. The most general method is to store the food by compressing it in a silo; but many are now successfully making stack-silage—green food built into an ordinary open-air stack, and pressed by mechanical or other pressure so as to expel and keep out the air. The silo is usually lined in the sides and ends with concrete; and while some have erected wholly new silos at considerable outlay, others have transformed pre-existing buildings into excellent silos at very little expense.

The food is put into the silo, either chaffed or long, in a green condition, full of its natural sap. It is spread evenly over the silo, and tramped firmly by men as the filling goes on. The original plan was to lay on the weights as soon as the silo was filled; but the experience of Mr George Fry in making sweet silage, has induced many to delay weighting until the mass reaches a heat of about 122° Fahrenheit.

This heat is sufficient to kill the bacteria, which causes fermentation, and the silage, undergoing no further change, comes out in a sweet savoury condition. Sour silage, weighted immediately after filling, is still the most largely used; and while, after the opening of the silo, it stands exposure better than sweet silage, it is relished by nearly all kinds of stock, no matter how sour and black it may be.

The amount of pressure applied has varied greatly—from 70 to 200 lb. per square foot. From 120 to 150 lb. would seem to be most general. Stones, bags of sand, concrete blocks, pieces of iron, loose earth and sand, and various other commodities, have been used in weighting, and some ingenious mechanical contrivances have been designed for the purpose.

Crops of great variety, and several of them differing essentially in character, have been tried in the silo, and, as a rule, the results have been satisfactory. Soft "fleshy" substances—such as prickly comfrey and turnip-tops—have not done well; but grasses, clovers, vetches, maize, all kinds of cereals, hop-vines, and other crops, have all been ensiled with complete success. Clovers and grasses should be cut for ensiling when in bloom, but cereals should be allowed to reach more nearly the ripened stage, as the fattening properties of cereals are not fully developed until they are almost ripe.

The more enthusiastic advocates of ensilage contend that it will do away with hay-making, and thus save the great losses sustained to the hay crop in bad seasons. The system, apparently, is well enough fitted to take the place of hay-making; but it is hardly likely that it will, to any great extent, supplant that practice. In wet districts, and in showery seasons, ensilage will no doubt be extensively pursued; and in the saving of the second and third growths, which could not be made into hay, it will be specially serviceable. And in another way, the silo will likely prove a useful adjunct to the farm. It will enable the farmer to provide for his stock a larger quantity of green food than he can otherwise grow with safety and advantage. Crops can be specially grown for ensiling, and when pasture, hay, or other food is deficient, the silage can be resorted to. We have taken much interest in the system—have watched it in its crude state and in its more perfect forms—and have been deeply impressed with its importance and probable usefulness to the struggling farmer. It seems to us to place great possibilities within the reach of the skilled agriculturist. It will assist in the economising of roots, which are both expensive and risky, and it will be of great use in providing cheap, wholesome, and nutritious winter food for sheep as well as cattle. It is not likely to supplant either hay-making or root-growing; but it will make us much less dependent than hitherto on both, and that in itself is a good deal.

Silage, even when very sour, and almost black, seems to be eaten readily enough by cattle, sheep, and horses; and although it should be given sparingly to breeding stock, it is a fairly wholesome food. It is specially well adapted to dairy cows and young store stock. Sir John B. Lawes, at first rather sceptical, but now convinced of the efficiency and value of ensilage, has supplied important evidence as to the feeding value of silage. With his ever-active public spirit, he has included ensilage amongst the many subjects he has under investigation at Rothamsted, and thus far the results are decidedly favourable to the system. At a Dairy Conference, held at Dublin, under the auspices of the Royal Agricultural Society of Ireland, in April last (1886), he read a paper "On Silage as a Winter Food for Dairy Cows," from which we make the following extracts:—

"If we exclude roots as unsuitable for silage, all the other crops grown on the farm can be used for the purpose. Crops which produce large seed appear to store up larger quantities of nutritive matter after they come into bloom than those which produce smaller seeds. Red clover and tares are upon this supposition more suitable for silage purposes than beans or peas, and meadow-grass would be more suitable than the cereal crops, such as oats and other grain crops. Red clover is perhaps the best of all for silage purposes, as it suffers much from wet weather, and in drying it loses a good deal of its leaf, I should therefore advise those who wish to make silage to be content, in the first instance, to use clover and meadow-grass. Both crops should be cut at the same period as they would be cut for hay, and although not absolutely essential, it is much better to pass the crop through a chaff-cutter. I may mention that chaff-cutters are now made with elevators to deliver the chaffed material direct into the silo. But whether the crop is chaffed, or is delivered without being chaffed, it must be spread as evenly as possible over the bottom of the silo, where it must be well trodden by men.

"Our own silos—of which we have two, divided by a party-wall—are each 15 feet wide by 13 feet 10 in. long Their depth is 22 feet, 17 feet being below the surface of the soil, and 5 feet above it. Each silo was estimated to contain about 100 to 120 tons of crop when pressed. It would take three or four days to fill one of these pits—according to the number of horses and carts employed—and when the pit is filled, planks are put on the top, which cover the whole surface. On the planks we placed Staffordshire bricks, the weight upon each square foot being about 90 lb. Stones, or any other heavy material, may be used for the purpose. Soon after the pressure is applied, the substance will begin to sink, and it will continue to do so for some time; the pit may then be again filled up by a second crop of clover or grass; but if no more material is to be added, the weights may remain on until the silage is required for use. As far as our experience goes, the whole of the chaffed silage consists of perfectly good food, which can be taken out day by day for several months without deteriorating. The silage we made was what is called sour silage: there is another kind which is described as sweet silage. The difference between the two consists in allowing more time to elapse before the pressure is applied after filling the silo. By this means more fermentation takes place, a much higher temperature is obtained, and the result is a substance which has a more agreeable smell than the sour silage. It is, however, to be feared that this result is obtained at the expense of some considerable loss of the food-ingredients. We found that our oat silage approached more to the character of sweet silage; but although it has been pronounced to be excellent by some of those who are experienced in these matters, speaking as a farmer, I by no means approve of it as a food for stock, and I should be disposed to advise those who are intending to make silage, to fill the pit as soon as they can conveniently do so, and further, to put the pressure on the material as soon as the pit is full.

"For three months we fed twenty cows on clover silage, and twenty cows upon mangels, the rest of the diet, which consisted of 4 lb. of decorticated cotton-cake, 4 lb. of bran, and 10 lb. of chaff (half hay, half straw), per day, being given equally to the lot. The daily amount allotted to the twenty cows which received clover silage was 50 lb., and for those fed on mangels, 90 lb. The 50 lb. of silage contained about the same amount of dry food as the 90 lb. of mangels. The average amount of milk yielded per cow by those which received the silage was 25 lb. 12 oz. per day, and that of the cows which received the mangels, 27 lb. 5 oz.; they had therefore rather the advantage of the two lots. The cows were all weighed at the beginning and end of the experiment, and the silage cows showed the larger increase; it was also evident to the eye that they showed more tendency to fatten. When the clover was finished the cows were fed with silage made from meadow-grass, the result being, that although the milk did not decline, the cows began to lose weight. As regards the quality, both to the eye and the taste, the silage milk had the preference, but careful analysis showed a slight superiority in the butter-fat of the milk yielded by the cows fed on the mangels.

"These experiments were carried out in the winter of 1884-85, and a second year's experience does not alter the general conclusions. The cows have been fed all through the winter with clover silage and mangels—not separately, as was the case last year, but together—and careful observation leads us to the conclusion that the addition of silage to mangels has a tendency to lay on flesh, more than would be the case if the cows were fed on mangels alone. It will be observed that the silage and mangels formed but a small part of the whole of the food consumed by the cows, which were large shorthorns, weighing about 1200 lb. each, and consuming daily about 25 lb. of food, calculated as dry. Of this amount the silage did not supply more than 10 or 11 lb. A very considerable amount of the home-grown food—the hay, straw, roots, or silage—was consumed by the animals for what we call existence purposes, that is to say, to keep life and warmth in the body, while purchased food furnished the material to form the milk. I may say that it would be impossible to keep up anything approaching to an average yield of 3 gallons of milk per cow, over the whole number, during the winter months without having recourse to purchase foods.

"It will be well now to explain that the statement of all the cows, both in silage and mangels, receiving 4 lb. each of cotton-cake, and 4 lb. of bran, is not strictly correct. It is true that 80 lb. of cake and 80 lb. of bran were set apart for each lot of twenty cows; but at the time when so much of our attention was directed to the weighing of the food and milk, we thought that the opportunity should be taken to ascertain whether a considerable saving might not be effected in the more costly foods, by regulating the amount each week to the yield of milk of the previous week. In every large dairy there will be newly calved cows coming in, which may yield possibly 5 gallons of milk per day, while others which may be coming nearly dry may not be yielding more than half a gallon. From an estimate of the composition of milk, we calculated that it would require nearly the whole of the 4 lb. of cake, and 4 lb. of bran to furnish the ingredients contained in 3 gallons of milk. Such being the case, we decided that while each cow yielding 3 gallons of milk per day should receive 4 lb. of cake and 4 lb. of bran, one quarter of a pound of each of these foods should be added, or taken off for each rise or fall of 2 lb. of milk. By this means a cow which yielded only 2 gallons instead of 3 would have 1¼ lb. less food, or, altogether, only 2¾ lb. of each food; while a cow which yielded 4 gallons, would receive 5¼ lb. of each food.

"For the last two years the whole of the milk and foods of our dairy of from fifty to sixty cows has been weighed daily, and the purchased food has been regulated in accordance to the yield of the milk in the way I have mentioned. The mass of figures accumulated is exceedingly large, and no attempt has been made at present to prepare them for publication. There is, however, evidence of a very considerable saving of food having been effected; and it could hardly be otherwise, when we consider the vast differences in the yield of milk in different cows, and the large amount of nutritive ingredients in the milk itself.

"A practical farmer cannot be expected to weigh all his milk and food day by day; still he might, without any great trouble, adopt some scale by which his more costly foods could be used with economy. The engine-driver regulates his fuel to the work done by his engine: why should not the farmer regulate the food of his cow by its yield of milk? In these times of severe competition and low prices more accurate methods of feeding must be introduced, and each pound of food given to our stock must be made to do its full amount of work. Owing to the large amount of nitrogenous matter in milk, and the fluctuation which necessarily takes place in the yield of each cow, from the time of calving to that of dryness, there is far more scope for economy in the feeding of a milking cow than there is in the fattening of a bullock.

"On two occasions I have given evidence before the Ensilage Commission, and I was much pressed to give an opinion in regard to the comparative value of hay and silage. This I declined to do, as at present we have no reliable information on the point. It is probable, however, that when both are of the very best quality that can be made, if part of the grass is cut and placed in a silo, and another part is secured in the stack without rain, one might prove as good a food as the other. But it must be borne in mind, that while the production of good hay is a matter of uncertainty—from the elements of success being beyond the control of the farmer—good silage, by taking proper precautions, can be made with a certainty.

"To sum up—although I am unable to adopt the views of those who think that silage will take the place of roots, or that by silaging corn crops, and all the crops we grow, that arable farms can be profitably carried on exclusively by the sale of animals and their products, I still think that, where a dairy of cows is kept, a silo may be a useful adjunct to a farmer. Roots may still be grown, hay may still be made, and silage may be used as an addition, rather than as a substitute for these valuable foods. Such are the views I am at present disposed to entertain on the subject."

The evidence of Sir John B. Lawes as to silage as food for dairy cows is borne out by the experience in the Duke of Manchester's large herd of dairy cows. From the opening of the silo in November 1885 until the end of May 1886, when the silage was exhausted, the cows received daily, in two feeds, a mixture composed of 9 lb. of tail wheat and oats, ground into meal, 30 lb. of cut mangels, and

44 lb. of silage each, 7 lb. of long hay being allowed in addition. With this treatment the cows gave more milk, and maintained a much higher condition than in previous years when fed on roots, grain, and cake, at a greater cost than that entailed by the above mixture. The mixture of meal, mangels, and silage was allowed to lie in a heap for twelve hours before being given to the cows. The silage consisted of tares and oats sown together, which were cut, chaffed, and put into the silo at the end of July. The cows evidently relished the flavour of the silage, and rarely have we seen dairy cows in such high condition as these in the month of April last (1886), when they were all milking heavily. The cost of the above feeding, reckoning the silage at £4 per ton, and including attendance, is estimated at 10d. per head per day.

An Ensilage Commission, appointed by the Agricultural Department of the Privy Council, collected a great mass of evidence as to the working of the system, and in their final report, issued in May last (1886), they pronounce emphatically in favour of ensilage. The Commission classify the advantages claimed for ensilage under these three heads: "1. In rendering the farmer independent of weather in saving his crops. 2. In increasing the productive capabilities of farms: (*a*) in greater weight of forage saved, (*b*) in greater available variety and rotation of crops, (*c*) in increased facility for storage. 3. In connection with feeding: (*a*) dairy stock, (*b*) breeding stock, (*c*) store stock, (*d*) fattening stock, (*e*) farm-horses." Taking each of these points in order, the Commission remark upon them, as follows:—

"1. *Independence of Weather in Saving Crops.*—In this respect it has been abundantly proved to us that ensilage is of great economic value. In Scotland, in Ireland, and in the north and west of England, few seasons occur in which more or less difficulty is not experienced in reducing green fodder crops to a sufficiently dry condition for stacking in the ordinary way. This is especially the case with second crops of clover and aftermath. The loss occurring through ineffectual attempts to dry such crops, or through their inferior condition when carried, is often very considerable; and it is obvious that any system which enables a farmer to store these in good condition for future use must be a great saving of expense and anxiety.

"2. *Advantages in increasing the Productive Capabilities of Farms: (a) In greater Weight of Forage saved.*—It is obvious that unless the forage in a weighty condition be of more feeding value per acre than when saved in a less weighty form, there can be no gain to the farmer. It has been contended that the loss of weight in the process of drying is simply loss of water by evaporation, and that by avoiding this nothing is saved. If such were truly the case, dry forage should give the same feeding results per acre as green forage. No practical farmer would contend that it does so, and the difference is especially noticeable in the case of dairy stock. So far as we have been able to ascertain the opinion of competent men on this subject, we estimate the value of green forage well preserved in a silo at somewhat more than one-third, weight for weight, of the value of the same material made into hay under favourable conditions. The very wide difference of value between good and bad silage cannot be too strongly insisted upon. It is found that grass well preserved in a silo, after deduction for loss, will yield approximately five times the weight of the same grass made into hay. We have therefore, say, five tons of silage, which, taken at one-third the value of hay per ton, yields a profit of over 60 per cent as compared with one ton of hay. If we take it at one-fourth, it still leaves a profit of 25 per cent. Any waste that may occur to reduce the weight of nutritious forage, whether by evaporation or by excess of chemical change, must necessarily affect this calculation, which is based upon the highest degree of perfect preservation so far known to be attainable.

"*(b) In Available Variety and Rotation of Crops.*—By the process of ensilage many crops can be preserved which would not otherwise be found profitable if used in the form of green forage. Rye, oats, millet, maize, barley, and even wheat, if cut about the time of attaining their full development, but before the seed begins to harden, have been successfully used as food for cattle through the medium of the silo. Such of these crops as are found to reach the required condition before the middle of June, if cut before that time, will leave the land free for a second sowing, and thus increase its capabilities of annual production, while maintaining the fertility of the soil. Where land is well treated, maize, buckwheat, or, in some parts of England, also turnips, can be sown after green rye or oats are cut and carried, and thus a second crop may be secured for preservation in the silo, or for consumption by sheep on the land.

"(*c*) *In Increased Facility for Storage.*—This advantage has been forcibly impressed upon us. It enables farmers to guard themselves against emergencies, such as frequently arise in our climate through prolonged cold in February, March, and April, causing great scarcity of food for cattle and sheep, where the supply of roots is inadequate.

"3. *Advantages connected with Feeding: (a) Dairy Stock.*—We have received the strongest evidence of the undoubted advantage of the system for the feeding of dairy stock. The effect of dry winter food given to such stock has always been to reduce in quantity and to deteriorate in quality milk, cream, and butter, as compared with the same products resulting from green summer food. Although the degree of perfection attainable in summer has not been reached, it has been at least much more nearly approached by ensilage than by the use of hay and other dry foods, while at the same time the objections inseparable from the employment of roots for this purpose have been overcome. A sensible improvement in the colour of butter has been especially noticed.

"(*b*) *Breeding Stock.*—Green fodder preserved by ensilage has been successfully employed in feeding sheep and cattle at the time of breeding, and as it has been shown to increase the flow of milk, it will undoubtedly be found useful for this purpose, although the proportion of its admixture with other kinds of food must always require care and judgment.

"(*c*) *Store Stock.*—It forms a complete and wholesome food for store stock.

"(*d*) *Fatting Stock.*—The value of this process for the purpose of forming flesh and fat has not yet perhaps been so widely demonstrated as in the case of dairy produce. At the same time the results attained show that it compares favourably with the use of roots, and, if given in proper proportions with other food, it affords a cheap substitute for the same bulk, which would otherwise be required in some different form. The advantage of its use is most apparent in the degree to which it enables a farmer profitably to consume straw-chaff, rough hay-chaff, and other dry materials, which, without admixture with some kind of moist food, would not be palatable or advantageous to the growth of stock.

"(e) *Farm-horses.*—Strong as the evidence has been of the advantage of ensilage for keeping all stock in healthy condition, farm-horses have by no means been excepted. We have received highly satisfactory accounts from several quarters of the health of working teams when given a limited proportion of silage mixed with other food."

In conclusion, the Commissioners state that they endeavoured to discount all exaggerated estimates, as well as to make allowance for a considerable amount of prejudice and incredulity which they met with, and they add: "After summing up the mass of evidence which has reached us, we can without hesitation affirm that it has been abundantly and conclusively proved to our satisfaction that this system of preserving green fodder crops promises great advantages to the practical farmer, and, if carried out with a reasonable amount of care and efficiency, should not only provide him with the means of insuring himself to a great extent against unfavourable seasons, and of materially improving the quantity and quality of his dairy produce, but should also enable him to increase appreciably the number of live-stock that can be profitably kept upon any given acreage, whether of pasture or arable land, and proportionately the amount of manure available to fertilise it."

A competition for £100, offered by Sir Massey Lopes, "For the best Silo in England and Wales in actual work during the winter of 1885-86," was conducted by the Royal Agricultural Society of England, and the judges intrusted with this award reported quite as strongly in favour of ensilage as did the Ensilage Commission. The judges who examined the silos in the northern districts of England thus summarise their experience: "We are of opinion that the great question of satisfactorily ensiling green crops has received ample confirmation. It has been proved to us, incontestably, that its success has been manifested in every district. We have seen silos of brick, of stone, and of wood;

we have seen old barns and other buildings converted into silos; we have seen them sunk into the ground and built on the level; we have seen them containing 20 tons, and we have inspected others capable of containing 700 tons; we have found silos constructed at a little over £20, and others at £400; we have found them filled with all sorts of green crops, and we have found some sour and some sweet—the latter in by far the greater proportion; we have seen them weighted with bricks, with stones, with slates, with sand, with earth, and also with ingenious mechanical contrivances; we have inspected some chaffed, and in others the fodder spread out and put in whole;—in all cases the practice was successful, and in every instance cattle of all descriptions did well on the silage, and in many instances the opinion was conclusive that decidedly more stock could be carried per acre with silage than with hay. . . . In conclusion, we would say that we consider the system of ensiling will probably affect the future of agriculture on strong land, as in most instances, especially in such where it is necessary to obtain winter foods for the stock, a crop of winter-grown tares or trifolium, or other strong-growing green crops, may be sown in the autumn at little expense, and mown and put in the receptacle by the first week in June, and thus do away with the immense expense and great uncertainty of the cultivation and consumption of roots on such land."

The judges wind up their verdict as follows: "The chief advantages of silage-making against hay-making is its comparative independence of the weather; that the fodder is handled, while green, without any risk of the tender and nutritious leaves being lost on the ground, as in hay-making; that the resulting silage is succulent and palatable; and that on purely grazing farms it is now possible to obtain a portion of the grass crop for winter in such a state as to equal the effect of summer-fed grass for the purposes of the dairy."

As yet the evidence as to the value of silage in the fattening of stock is somewhat conflicting; and until more extensive and more exact experience is obtained, it would be unwise to speak definitely on this point. Enough, however, has been said to indicate the importance of ensilage as a new and useful factor in British stock-raising.

CHAPTER V.

PREPARATION OF FOOD.

ALTHOUGH roots and other kinds of food are still given to cattle, &c., by many persons in their natural state, it is usually considered advisable, in most cases, to prepare the food in some way or other previous to use. We shall therefore briefly describe the principal modes by which the food of cattle is prepared.

Turnip-cutters.—Fully matured cattle or sheep can consume turnips and other roots without having them sliced, but slicing is indispensable in the case of young stock, and especially young sheep, whose teeth are apt to become loosened, and thus prevent them from breaking the whole bulbs. There are various machines constructed for the purpose—roots intended for sheep being cut into much smaller pieces than for cattle. It is not advisable to cut more turnips or other roots at once than will be used at a meal, as along with the water which exudes from the cut roots some of their soluble nutritive constituents are also lost, and the slices, when allowed to lie long and become withered, are not relished by stock.

Pulping.—Of late years the practice of pulping roots instead of slicing has greatly extended, and it is justly looked upon as a better mode of preparing the roots for the use of cattle. Pulping consists in rasping down the roots into minute pieces, which are then mixed with straw-chaff, and other commodities. The pulping-machine may be driven by steam, water, or horse power.

Mr Thomas Duckham, M.P., Baysham Court, Ross, describes the advantages resulting from pulping roots in the following terms :—

"1. Economy of food; for the roots being pulped and mixed with the chaff either from thrashing, or cut hay or straw, the whole is consumed without waste, the animal not being able to separate the chaff from the pulped roots, as in the case when the roots are merely sliced by the common cutter; neither do they waste the fodder, as when given without being cut.

"2. The use of ordinary hay or straw. After being mixed with the pulp for about twelve hours, fermentation commences; and this soon renders the most mouldy hay palatable, and animals eat with avidity that which they would otherwise reject. This fermentation softens the straw, makes it more palatable, and puts it in a state to assimilate more readily with the other food; in this respect, I think the pulper of great value, particularly upon corn farms where large crops of straw are grown, and where there is a limited acreage of pasture, as by its use the pastures may be grazed, the expensive process of haymaking reduced, and, consequently, an increased number of cattle kept. I keep one-third more, giving the young stock a small quantity of oil-cake, which I mix with the chaff, &c.

"3. Choking is utterly impossible, and I have only had one case of hove in three years, and that occurred when the mixture had not fermented.

"4. There is an advantage in mixing the meal with the chaff and pulped roots for fattening animals, as thereby they cannot separate it, and the moisture from the fermentation softens the meal and ensures its thorough digestion; whereas, when given in a dry state without any mixture, frequently a great portion passes away in the manure."

As additional practical testimony to the value of pulping roots, we give the following remarks from a communication addressed to the 'North British Agriculturist,' January 1, 1873, by Mr E. S. Douglas of Riddleton Hill, St Boswells, Scotland. Mr Douglas says:—

"My answer to the question, Is pulping the best way of using turnips for fattening cattle? is emphatically an affirmative—at least my experience leads me to hold this opinion; and I intend to stick to the practice till I meet with a better, or till some one find out a plan for dispensing with turnip-culture altogether. Pulping commends itself to me by two reasons—one *a priori*, and the other *a posteriori*; in other words, it ought to succeed, and it does succeed. My first argument is based on the facts that cattle are, at temperatures perceptibly above the freezing-point, inordinately fond of turnips, to the prejudice of all other kinds of food, and that this desire must be kept in check. No one who makes turnips part of the fare on which he feeds cattle can gainsay me here; for the evil effects of too many roots make themselves manifest to the most casual observer. This being the case, the question arises—How is the consumption to be checked, and the necessary supplementary amount of solid matter supplied? The most obvious method is to curtail the amount of roots given, and to make the animal satisfy himself with fodder—hay or straw—eaten either in its rough state or chopped *au naturel*, or steamed and flavoured with such condiments as may be found to tickle the palate and stimulate the appetite of the somewhat capricious gentlemen we have to deal with. And I have found that although beasts may be induced to partake of these messes, yet they always seem dissatisfied with such treatment, and await with eagerness their supply of sliced roots. I think that if we can avoid this, and keep, so to speak, their minds at ease, we shall have gained a great point. If, then, they are determined to have turnips *ad libitum*, and we are determined that they shall not so be indulged, the only way of solving the difficulty is by resorting to a compromise, and arranging matters so that, while getting turnips at every meal, they shall not get too many. This is accomplished by passing the roots through a pulper (I use Bentall's) which reduces them into very small fragments, and then mixing them with chopped straw. The quantity of straw may be equal in bulk to that of turnips, but this must depend on the forwardness of the animals, and on the amount of artificial food they are allowed. I may add, in passing, that unless intelligence and judgment are brought to the task, aided by constant and careful supervision, the results will not be satisfactory. In this mixture a little salt may be put, and any concentrated food which the animals may be receiving, provided that they will not take it in any other way; but if they evince a preference for it separately, there can be no harm, but rather good, in humouring them.

I can testify that cattle, with very rare exceptions, never refuse the mixture when not more than two days old, and consequently not sour. They may be fed three times a-day, but of course that depends on circumstances, and symptoms of a desire for a change being watched for and at once gratified. When I add that their troughs must be kept scrupulously clean, and that plenty of water must be supplied, I think that I have indicated all the leading points in practice. It only remains to give the result of an experiment which I have made on two animals. They are steers of as nearly as possible the same age, size, breeding, and condition. They were not far advanced, and therefore had good appetites. They were weighed on November 9th, and one of them, which then turned the scale at 8 cwt. 2 qrs., or 68 stones, got 270 lb. of sliced turnips *per diem*, along with a quantity of hay, and was allowed besides 2 lb. linseed-cake and the same quantity of cotton-cake. On December 3d, or at the expiry of three weeks and a half, he weighed 9 cwt. 14 lb., or 73 stones, showing a gain of 5 stones. The other animal weighed on November 9th 8 cwt., or 64 stones, and received 140 lb. of pulped turnips *per diem*, mixed with equal parts by measure of chopped oat-straw, and the same allowance of cakes as his neighbour. By December 3d he had laid 6 stones additional, and then stood at 70 stones, or 8 cwt. 3 qrs., having gained 1 stone upon the other with a consumption of little more than half the food. I am sorry that I found it impossible to include in the trial a third similar animal, giving him 140 lb. of sliced roots and straw *ad libitum;* but from daily inspection of animals which are receiving somewhat analogous treatment, I am satisfied that such a regimen would not have afforded results so satisfactory as pulping. As the expenses would not be alike to any two men, I have said nothing about them.

"It will be perceived that the only use of the pulper is to adapt the roots for mixing with straw, and I have no hesitation in recommending the plan to any one who has a sufficiency of good oat-straw. Should this be scarce, then hay may be used, its greater feeding value being kept in mind in the apportionment of artificial food. Should neither hay nor straw be available, then in that case it is to be feared that when the turnips come to an end the cattle must be considered as finished. A friend informs me that he makes very few turnips go a great way among his ewes by using the pulper."

When Mr Douglas states that he mixes the pulped roots with "equal parts by measure of chopped oat-straw," he refers to measurement by the bushel. Others mix 4 bushels of pulped roots with 5 bushels of cut chaff for fattening cattle; and for store beasts, 3 bushels of pulped roots to 6 bushels of chaff. When roots are scarce, the proportion of cut chaff may be increased when the mixture is intended for store cattle, but it will be advisable to add some decorticated cotton-cake or other cake to the mixture, at the rate of 1 lb. to 2 lb. per head. The cake, after being broken or ground into rough meal, should be well mixed with the pulped roots and cut chaff. The mixture should be allowed to lie from 14 to 24 hours before it is given to the cattle. It will then be pretty warm. By using a mixture of pulped roots and chaff, the saving in the quantity of roots consumed is fully one-fourth, and when cake is added, the saving is still greater, which is an important consideration when roots are scarce. We are convinced that animals will thrive as rapidly on 70 or 80 lb. of pulped roots as upon 112 lb. sliced or given in the natural state, because with the former a larger proportion of dry food is consumed.

Mr David Buttar, Corston, Coupar-Angus, has for several years pursued the pulping system, and by it he has been able to economise his turnip crop to a remarkable extent. He found it more advantageous in the rearing of store cattle than in the fattening of stock. "He buys in lean cattle when about eighteen months old in the autumn, selling off the majority in spring, in good condition, but not fat, and retaining a number of the best for feeding on grass in summer. For the first two months they are in the house, the lean cattle get the following:—

Mixture for 10 *Store Cattle for One Day.*

	Weight. lb.	Value. s. d.
Straw	110	...
Turnips	112	0 6
Linseed-meal, or 1 lb. linseed-cake	5	0 7½
Decorticated cotton-cake	20	1 8
Treacle	7½	0 7½
Totals	254½	3 5

"After the first two months the mixture is increased by about one-third, or to the value of, say, 5s. 2d., making the average maximum cost about 6¼d. per day. The mixture is given in three meals when it has been raised to the maximum quantity. The following shows the relative cost of the pulping and the ordinary systems of feeding store-cattle:—

One Store Steer, two years old.

	Food.	Cost.
Ordinary system . . .	150 lb. turnips,	9d.
Pulping system	34 lb. mixture,	6¼d.

"The pulped mixture is made up each forenoon and allowed to lie till next day before being used. A layer of straw is laid down first, then turnips, then cake, and lastly the diluted treacle. The heap is at once turned over three times and then left untouched for close on, but never more than, twenty-four hours. In two hours two men and a boy make up a mixture for a day's feed for over 120 head of cattle. The pulping and bruising apparatuses are driven from the turbine-wheel of the thrashing-mill, so that there is no extra cost for motive power. The cattle relish the mixture very much, and thrive admirably upon it. The straw in the mixture and the supply always within reach of the cattle, is balanced by the manure." [1]

Cooking.—Food is cooked by means either of a large boiler, heated by a fire underneath, or by steam. Various forms of apparatus have been constructed, both for boiling and steaming food. Cooking food is very desirable in the case of milch cows and swine, and occasionally in preparing food for farm-horses. At one time cooking was practised to some extent in fattening cattle for the butcher, but of late this plan of preparing food in such cases has been superseded by pulping. Mr Gilbert Murray, Elvaston Castle, Derby, than whom there is no better authority, says: "By far the best method of using home-grown cereals is to steam or cook the grain. This can be done at a trifling cost, rendering the food more nutritive, and entailing less exertion on the organs of digestion and assimilation." [2]

[1] The Agriculture of the Counties of Forfar and Kincardine in the Transactions of the Highland and Agricultural Society. By James Macdonald. Vol. xiii., Fourth Series. 1881.

[2] Live-Stock Journal Almanac, 1886.

Chaff-cutters.—One great advantage of cutting straw or hay into short lengths of half an inch or an inch, is that it prevents waste. Straw or hay when cut or chaffed is also brought into a condition which renders it convenient to mix with meal, linseed-gruel, pulped roots, &c.; and in this way straw or hay which is of inferior quality is turned to good account, instead of being wasted or used merely as litter. Several manufacturing firms have devoted much attention to the construction of chaff-cutters, and machines of this class have therefore been brought to a high pitch of perfection. Chaff-cutters may be driven by hand, but it is much more economical to use water, steam, or horse power.

Corn-bruising mills.—The decline in the price of grain has led to the more extensive use of home-grown grain as food for stock. It is found advisable to have all kinds of grain bruised or ground before being given to animals. Grain may be crushed for the use of stock at any ordinary mill, but it is frequently more convenient to have a machine constructed for bruising or grinding, fitted up in connection with steam or water power employed on the farm. Machines of this kind are now manufactured in great numbers, and mills can be procured which bruise linseed as well as corn, &c.

Cake-crushers.—The large cakes, as obtained from the manufacturer, are broken into pieces suitable for the use of cattle or sheep by means of machines, which, although usually driven by hand, may also be attached to power.

CHAPTER VI.

CATTLE—CHARACTERISTICS OF DIFFERENT BREEDS.

Shorthorns.—The most widely diffused breed of cattle at the present day is the shorthorn, either in a pure state or intermixed by crossing with other breeds. This has arisen chiefly from the readiness with which it amalgamates with other breeds, its great aptitude to fatten, and to the fact that by using shorthorn bulls for the purpose of crossing other breeds, the crosses so produced inherit the early maturity of the sire, attain greater weights than cattle of the breed to which the cows belong usually arrive at, and if the latter possesses any marked superiority in respect to quality of meat, that characteristic is still retained by the cross-bred produce. When the breed to which the cows belong is of a coarse description, successive crossing with well-selected shorthorn bulls removes the coarseness, and in this way improves the quality of the meat produced by cattle which are descended, on the female side, from coarse and inferior stock.

There is no doubt that in many purely bred herds of shorthorns the beef-making properties of the breed have been carefully cultivated, to the detriment of the milk-producing qualities. This has been so much the case that many persons do not hesitate to assert that the pure shorthorn is useless as a dairy cow. It is no doubt quite true that many high-bred shorthorn cows have not yielded sufficient milk to rear their own calves; but this has occurred chiefly in herds well known in the show-yards of the kingdom, and in animals descended from cows which have been over-forced for show purposes. In any fairly kept herd of pure-bred shorthorns, families will be found which have been long noted for the combination, in a high degree, of both beef and milk producing properties, and certain well-known tribes of shorthorns are famous for their properties as dairy stock. Cows which have this property are generally very lean while in milk; but no sooner do they become dry than the beef-making characteristics of the breed become manifest, even upon very moderate diet. We know several herds of high-pedigreed shorthorns which are kept where the production of milk for dairy purposes is considered so important, that any marked deficiency in the milking properties of a cow would cause her to be at once put up for the butcher.

Again, if the cows kept in the principal dairy districts—with the exception, perhaps, of the south-western portion of Scotland—are examined, it will be found that the majority of them are either pure shorthorns or that they have several crosses of shorthorn blood. The fact is, extraordinary milking properties formed a distinguishing characteristic of the early shorthorns; and if this feature has subsequently been impaired, it is owing to the forcing system which has been employed in order to fully develop the early maturity of the breed, partly for show purposes and partly to meet the views of graziers. Culley, who was thoroughly acquainted with the early shorthorns, has left on record that "the most essential difference" between the shorthorns of his day and other breeds existing at that time, consisted "in the quantity of milk they give beyond any other breed;" and he has further stated, that "they excel in three valuable particulars—viz., in affording the greatest quantity of beef, tallow, and milk."

It will not be disputed that shorthorns have been the most active agents in the improvement of British cattle. Indeed, "the peculiar mission of the improved shorthorn would seem to be to remove or make up for the deficiencies of other breeds. Its own meat-producing powers are of the highest order, and if it had been kept within itself and turned solely to this purpose, it would no doubt have attained a creditable position. The breed, however, possesses in an eminent degree another property, which has raised it far above the mere direct butcher and dairy standards, and that is its remarkable adaptability for crossing with and improving other varieties of cattle. The value of this special power of transmitting its good points to other varieties, and thus raising their usefulness, greatly exceeds the breed's own meat-producing faculties, or any other excellence which, if it had been kept within itself, it could possibly have developed. The great bulk of improved shorthorns have therefore, during the existence of the race, been employed as indirect, rather than direct, agents in the production of meat—in bringing meat out of other races rather than raising it upon their own frames. It was for this far-reaching purpose that the breed was first introduced into various parts of Scotland and Ireland about fifty or sixty years ago. To this great object it has ever since been in the main devoted. How well it has fulfilled the mission an attempt will now be made to show." [1]

Mr William Housman, an authority of high standing, writing in 'Bell's Weekly Messenger,' has made the following apposite remarks on this subject:—

"Shorthorns—we mean especially shorthorns with Herd-book pedigrees—may be divided into three classes; beef-making, milking, and beef-and-milk-producing shorthorns. It is for breeders to study the requirements of the country, and to say which class is most needed, and to note of which class the bulls are in readiest demand among practical farmers. There are sorts of light-fleshed, wedgy-shaped animals, of which the flesh-growing tendencies have been either sacrificed to an aim for milk alone, or lost, by ignorance and carelessness of the principles of breeding. These should be indeed considered as having lost the caste of the improved shorthorn, and their bulls should never be used in good herds. The class of mere beef-makers may supply useful sires for the improvement of grazing stock; but in a country where milk and butter are largely wanted, the majority of farmers will select bulls of the unimproved or degenerate shorthorn type, rather than the sons of 'dry' dams. The correspondent of an American paper declares that 'the high-bred herds of beefing cattle in the middle and eastern States have been nuisances.' He continues—

[1] Shorthorns in Scotland and Ireland, in Journal of Royal Agricultural Society of England. By James Macdonald. Vol. xix. Part I. 1883.

'Mixing these herds with the common cattle of the country has probably reduced the milk of the average of cows from one-fourth to one-half.' Similar testimony might be given by stock-breeders on this side of the Atlantic, who, having heedlessly taken bulls from tribes which do not milk, have turned from 'pedigree sorts' and selected their bulls from common market stock. As we have past and living instances, not rare but numerous, of shorthorns which can both supply the dairy abundantly and produce the primest grazing stock, should we not urgently endeavour to fix their united good properties upon the entire shorthorn race, rather than adopt the lazy system of aiming at success by attention to one desideratum alone?"

It would be an easy matter to adduce proof, from the history of well-known herds of shorthorns, of the great milking qualities possessed by certain highly bred families, but we shall limit ourselves to one instance, which, although perhaps an extreme case, proves that a shorthorn cow may be well bred, and at the same time a first-rate dairy cow. The 'Irish Farmers' Gazette' of March 14, 1857, contained a letter from Mr Thomas Willis, Manor House, Bedale, in which he says:—

"It is frequently said in derogation of shorthorn cattle, that they are very deficient in milking properties. In proof that such a charge is unfounded, I send you an account of the produce of my cow Eleanor, 'Herd-Book,' vol. x. p. 345:[1]—

"'In 1851, when three years old, from one week's cream, 18 lb. of butter (16 oz. to the lb.)

"'In 1855, when seven years old, from one week's cream, 21 lb. 4 oz.

"'In 1857, when nine years old, from one week's cream, 24 lb. 8 oz.

"'In the same year, the second week after calving, 24 lb. 8 oz.'"

In recent years renewed interest has been manifested in the extension of dairy farming, and this has induced breeders

[1] The following is the pedigree of Eleanor: Calved December 23, 1847, bred by and the property of Mr T. Willis, Carperby, Bedale; got by Wilberforce (9380), dam (Ellen) by Ascough's Symmetry (11120), g.d. by Champion (3323), g.g.d. by Orpheus (473), g.g.g.d. by Ambo (746).

of shorthorns, as well as of other varieties of cattle, to give more attention to the milking properties of their stock. In selecting sires for their herds, breeders of shorthorns now make a point of inquiring as to the milking properties of the dam, and already symptoms of improvement are discernible. As indicating the spirit of the times, it is worthy of mention that Mr T. N. Edwards of St Albans, who owns a famous dairy herd of pure-bred shorthorn cattle, and who holds an annual sale of young bulls, prints in the catalogue, beneath the pedigree of each bull, the exact produce of milk of the dam, with the percentage of cream it was found to contain.

The following are the "points" of the shorthorn, as given by the late Mr Henry Strafford, editor of 'Coate's Herd Book':[1] "The head of the male animal is short, but at the same time fine, very broad across the eyes, but gradually tapering to the nose, the nostril of which is full and prominent—the nose itself of a rich flesh-colour, neither too light nor too dark; eyes bright and placid, with ears somewhat large and thin. The head, crowned with a curved and rather flat horn, is well set on to a lengthy, broad, muscular neck; the chest wide, deep, and projecting; shoulders fine, oblique, and well formed into the chine; fore-legs short, with the upper arm large and powerful; barrel round, deep, and well ribbed up towards the loins and hips, which should be wide and level; back straight from the withers to the setting on of the tail, but still short—that is, from hip to the chine—the opinion of many good judges being that a beast should have a short back with a long frame. As a consequence of this, the hind-quarter must itself be lengthy, but well filled in. The hair is plentiful, soft, and mossy, with a hide not too thin, and, in fact, something approaching the feeling of velvet. The female enjoys nearly all the same characteristics as the above, with the exception of her head being finer, longer, and more tapering; her neck thinner, and altogether lighter; and her shoulders more inclined to narrow towards the chine. Like most well-proportioned animals, the shorthorn often looks smaller than he really is." We may add to the foregoing description that a feminine appearance in the male, especially in the style of the

[1] Art. "Shorthorned Cattle" in Morton's Cyclopædia of Agriculture.

head and horn, is most objectionable; while a masculine, or, as it is technically termed, a "steerish" appearance in the female, is equally so. There are also some "points" which Mr Strafford has not brought out so strongly as they should be. The horn should be stout at the base; the under line of the belly should be straight; the thigh should come well down; and the "twist" abundantly developed. It is of importance that the "fore-flank" should drop even with the arm, so that, as Mr Carr has said when describing the "Booth" cattle, "when the animal walks the elbow-joint is scarcely if at all seen, and there is no hollow behind it." When the animal shows an open space between the elbow-joint and the fore-flank, it is defective in a very important point.

Herefords.—This may be regarded as essentially a beef-producing breed, possessing great aptitude to fatten, and attaining great weights, while the flesh is of the best description. In its native districts the Hereford is more prized than even the shorthorn, but it has not been so widely diffused as the latter. Numbers of Hereford cattle have been sent to the colonies; and lately the breed has attained much popularity in America, where it has been found admirably adapted for improving the rough cattle on the western ranches. There are a few good herds in Ireland, and for some time the Earl of Southesk had a herd of highly bred Hereford cattle at Kinnaird Castle, Forfarshire. Altogether the Hereford is one of the most valuable breeds of cattle for the grazier which we possess.

Mr Smith, who was one of the Stewards at the Warwick meeting of the Royal Agricultural Society of England, has given in his report of the show, which was published in the Society's Journal, the following description of the "points" of the improved Hereford cattle: "The face, mane, throat, the under portion of the belly, the inside and lower part of the legs, and the tip of the tail, are beautifully white; the other parts of the body are rich red, usually darker in the male than in the female; the horn is white or light yellow, of a waxy appearance, sometimes tipped with black. The forehead is broad with spreading horns; those of the bull straight and level with the poll, and of the ox and cow slightly curved, with an upward tendency. The eye is full, yet of a passive expression, denoting the quietness of disposition and temper characteristic of the Hereford, and which is of paramount importance to ensure the profitable feeding of all ruminating animals. The cheek is fine, the head small in proportion to the carcass, which is long, level, and cylindrical. The hide is thick, yet mellow, and well covered with moderately long, soft hair, having a tendency to curl. The brisket is prominent, the chest well expanded, and the breed is pre-eminently distinguished for neatness of shoulder, the bone; being thin and flat, the kernel full up, the outside shoulder well covered with mellow flesh; the chine good, the loin broad, the hips wide and level, the whole back displaying a straight line, well covered with flesh from the neck to the tail. The twist, flank, and fore-flank are good; the outside thigh is perhaps the most defective part. The whole body is well covered with rich, mellow flesh, yielding with pleasant elasticity to the touch. The legs are short, and the bones small, and the whole contour displays great constitution, and exhibits perhaps a larger amount of flesh in proportion to bone than any other breed."

Devons.—The North Devon breed of cattle is a very symmetrical class of animals. They are of a peculiar deep blood-red colour, which once seen is easily recognised. The hair shows a natural tendency to become curly or wavy. They are good handlers, kindly feeders, and produce tender, juicy, and well-mixed beef. Devon oxen are admirably adapted for farm-labour, having a quick active step, and considerable muscular power, combined with a docile temper. The South Devons are larger and coarser than the North Devons, and fatten less readily. Devon cows give rich milk, but their yield of milk is small, and they soon run dry.

The Galloway Polled Breed.—Galloway, which includes the south-west angle of Scotland, comprising the shire of Wigtown and the stewartry of Kirkcudbright, has long been famed for its breed of black polled cattle. A writer in 'The Journal of Agriculture'[1] says: "The black cattle of Galloway have at all times formed a leading feature in its landscape. . . . They are less stately, less magnificent than the Angus-shire oxen—the pride of Aberdeen and northern feeders,

[1] No. 89, New Series, 1865.

and with which Scotch farmers astonished the Parisians at the great International Exhibition—but they are, perhaps, more characteristic, and more distinctly stamped by nature as an original breed, than their weightier rivals. The Galloway ox, like a good hunter, is long and low, having a well-rounded body upon short legs. His hair is long, soft, and glossy; the ears are large and shaggy, and well supplied with hair inside,—the excellent provision of nature to meet the wetness of the climate. When slaughtered, the flesh and fat are found distributed in a manner fitted to produce the most satisfactory roasts and rounds." The same writer adds: "This worthy, ancient, and remarkable animal . . . is invariably found to be the slowest of all well-bred animals in laying on flesh; and the extra price which he undoubtedly commands when fat, will not compensate for the greater length of keep."

This latter opinion is corroborated by Mr M'Combie, "that standing menace to vegetarians," as "the Druid" called him, and well known as perhaps the highest authority on the merits of Scotch grazing breeds. Mr M'Combie says:[1] "As to the Galloway cattle, they also have had a fair trial with me. . . . On poor land they are unrivalled, except, perhaps, by the small Highlanders. . . . Although the Galloways are such good cattle to graze, they are not so easily finished as our Aberdeen and Angus or cross-bred cattle. They have too much thickness of skin and hair; too much timber in their legs; they are too thick in their tails; too deep in their necks; too sunken in the eye, for being very fast feeders. It is difficult to make them ripe. You can bring them to be three-quarters fat, and there they stick; it is difficult to give them the last dip. If, however, you succeed in doing so, there is no other breed worth more by the pound-weight than a first-class Galloway."

When a female of the Galloway breed is crossed with a well-bred shorthorn bull, the produce arrives sooner at maturity, and attains greater weight, than the original breed. Cattle of this kind are, in fact, amongst the most highly prized of the "Scotch crosses," which are so great favourites with London West-end butchers. Professor Low has indeed

[1] Cattle and Cattle-Breeders. By William M'Combie, Tillyfour. William Blackwood & Sons.

stated[1] that efforts to cross the Galloway breed with "the modern shorthorn" have been failures. It seems to us, however, that this remark does not refer so much to the production of crosses for the grazier as to introduction of shorthorn blood into Galloway cattle which are intended to be kept for breeding purposes. In this view of the matter we coincide. The Galloway breed should be kept pure as a breed, leaving its improvement to be effected by judicious selection of the breeding animals, and liberal feeding of the young stock.

Of late years, dairy-farming has been extended very much in Galloway, and as the native breed is quite unsuited for the dairy, it has been superseded in such cases by the Ayrshire. Shorthorns have also been introduced into the district; but latterly increased attention has been given to the improvement of the Galloway breed, whose good name has travelled to the lonely ranches of the Far West, where they are now to be met with in considerable numbers. Considering the special adaptation of the breed for a middling class of land and a wet climate, it appears to us that the Galloway cattle are better fitted for many parts of the west of Ireland than the cattle which are usually bred in those districts. The spare heifers could be used by breeders in other localities for producing crosses with the shorthorn, and in this way a very material addition would be made to the meat-producing capabilities of Ireland, which is so great a nursery of store cattle for Great Britain.

Polled Aberdeen — Angus Breed.—This celebrated beef-producing race of cattle is exhaustively treated of in Macdonald and Sinclair's 'History of Polled Aberdeen or Angus Cattle,'[2] from which the following extracts are taken: "The improved breed is derived directly from the ancient polled cattle of Angus and Buchan—two varieties of the same type, known in the former as 'Doddies,' and in the latter as 'Humlies.' . . . We have good reason to believe that in both Aberdeen and Angus the systematic efforts to improve the breed had been begun some time before the advent of the present century." The late Mr Hugh Watson, farmer, Keillor, Meigle, Forfarshire, was the most successful

[1] Domesticated Animals of the British Islands.

[2] History of Polled Aberdeen or Angus Cattle. By James Macdonald and James Sinclair. William Blackwood & Sons. 1882.

of the early improvers of the breed; while in Aberdeenshire, the work so well begun by Mr Watson, was taken up heartily and methodically by the late Mr William M'Combie of Tillyfour, who, in the volume just mentioned, is described as the "great deliverer of the polled race." Describing the characteristics of the northern polls, the authors of the history of the breed say:—

"In general form a model polled animal differs considerably from a model shorthorn. Both should be lengthy, deep, wide, even, proportionate, and cylindrical. The polled animal, however, should be more truly cylindrical in the body than the shorthorn. Its points should be more quickly rounded off; or, in other words, the frame of the polled animal is not so fully drawn out to the square as that of the shorthorn. Critics have pointed out in some of the best polled animals now or recently living, a tendency to approach too nearly to the square type of the shorthorn. In a beef-producing animal, a broad, square frame can hardly be said to be a blemish; for if it is thoroughly well covered all over, it will carry more beef than a rounder frame. A compact, well-rounded frame, however, has always been a leading characteristic of the polled breed; and the main reason why a square shorthorn-looking frame is objected to in a polled animal is, that such a form is foreign to the breed, and therefore apt to arouse suspicions of impurity. The admirers of the breed claim for it valuable natural properties not found to an equal extent in any other breed; and they fear that should the breed lose its characteristically natural appearance, it may also lose its superiority in those valuable properties—'the genuine article should always bear its trade-mark.' Careful improvers of the breed are specially particular as to the hind-quarters. While they aim at developing long, level, thick, deep quarters, they also strive to retain the rounded appearance which was originally one of the dominant characteristics of the breed.

"The head of the polled male should not be large, but should be handsome and neatly set on. The muzzle should be fine; the nostrils wide; the distance from the nostrils to the eyes of only moderate length; the eyes mild, large, and expressive; the poll high; the ears of fair size, lively, and well covered with hair; the throat clean, with no development of skin and flesh beneath the jaws, which should not be heavy; the neck pretty long, clean, and rising from the head to the shoulder-top, and surmounted by a moderate "crest," which contributes to masculine appearance—a desirable point in a bull. The neck should pass neatly and evenly into the body, with full neck-vein. The shoulder-blades should lie well backwards, fitting neatly *into* the body, and not lying awkwardly *outside* it: they should show no undue prominence on the shoulder-top, on the points, or at the elbow. An upright shoulder in cattle is generally accompanied by a light waist—an important, and in all breeds a much too common, defect. The chest should be wide and deep, so as to give plenty of room for lung-development. The bosom should stand well forward between the fore-legs, and underneath should be well covered with flesh and fat. The crops should be full and level, with no falling off behind them; the ribs well sprung, springing out barrel-like, and neatly joined to the crops and loins; the back level and broad; the loins broad and strong; the hook-bones not too wide—narrower than in an average short-horn; the quarters long, even, and rounded, with no hollow from the hooks to the tail; the tail should come neatly out of the body, not too far up the back, and not higher at the root than the line of the back. A high tail-head was to some extent characteristic of the ancient polled breed, but it is one of the defects that are being gradually removed by the more scientific systems of breeding now pursued.

"Some good polled cattle, too, have been found to show a development of soft worthless flesh and fat on the rounds behind; but that defect, which is disliked very much, is also almost obliterated. The tail should hang straight down, close to the body all the way till it comes near to the level of the flank. On both sides of the tail the quarters should turn away in a rounded manner, swelling out downwards, and ultimately passing into thick deep thighs. The twist should be full, and the hind-legs set well apart, and not detached from the body until the level of the flank is reached. The flank should be full and soft, so that a good handful may be got out of it. The bottom line should be as even as the top and side lines; and the bones of the legs fine, flat, and clean, with plenty of muscle and flesh above the knees on the fore-legs. The body should stand neatly and gracefully on the legs; and when the animal is stationary, the fore-legs should be perfectly straight, and the hind-legs very slightly bent forwards below the hock. All over the frame there should be a rich and even coating of flesh. Even the hook-bones, and other prominent parts, should be well covered; and above all, there should be no patchiness—no hollows, and no rolls of hard flesh, with spaces of soft useless fat between them, such as are always found in a patchy animal. Except in rare cases, the skin is fairly thick, but soft and pliable: it ought to be so free over the ribs, as that one could fill one's hand of it. The hair is, as a rule, not long, but fairly thick and soft; and in the best animals shows two growths, or rather two lengths—one short and thick, and the other longer and thinner. When walking, a good animal of the breed presents a very compact, graceful, and symmetrical appearance. Indeed it is fairly enough claimed for the breed that in these and in some other respects it has hardly any equals, and no superiors. The above description refers more correctly to bulls than to cows. The latter, of course, differ considerably in character. The head is much finer, the neck thinner and cleaner, with no crest; the shoulder-top sharper; the bone altogether finer; the skin not quite so thick; the udder large, and milk-vessels large and well defined.

"In appearance, as well as in other characteristics, the polled Aberdeen or Angus breed differs substantially from the polled Galloway race. The former has lived under a dry cold climate, and has been fed in the house during a large part of the year. The latter has its home in a moist climate, and has spent much more of its time in the open fields. The differences between the two are just such as might be expected from their different conditions of life. The Galloway, as already noted, has a thicker skin and stronger coat of hair, and has altogether a slightly more shaggy appearance than the northern polled cattle, and does not mature quite so quickly.

"It is claimed that the northern poll surpass all other races of cattle in the production of beef. On that point there is of course considerable difference of opinion; for at the present day, when the beef-producing properties of our other leading breeds, notably the shorthorn and Hereford, have been developed to so high a degree, it could not be expected that with anything like unanimity any one breed would be accorded the premier position. Be that as it may, we think the polled Aberdeen or Angus breed may safely be said to be inferior to none as all-round beef cattle, and superior to all others in some respects. The brilliant and unequalled position it has latterly taken, alike in the show-yard and market-place, sufficiently establishes its claim to that description. Its show-yard achievements will be fully noticed afterwards. Here it may be noted, that at the Paris Exhibition in 1878 it carried off every single honour for which it was entitled to compete, including the £100 prize for the best group of beef-producing cattle in the Exhibition; and that in British show-yards, both fat stock and breeding, it has attained to a leading position. In a strictly butcher's point of view, it has very seldom to yield to any other race of cattle.

"The superiority over most other breeds, for the butcher's purpose, lies mainly in the excellent quality of beef, and in the high percentage of dead meat to live weight. As a rule, the beef of the northern polls is very well mixed, and contains a greater proportion of compact, finely grained flesh, and less soft, coarse fat, than most other kinds of beef. Inside, the carcass is usually well lined with fat of the finest quality; while in the density and quality of the carcass itself, the breed may fairly enough claim the premier position among all our leading breeds of cattle. Some place the small Devon breed alongside, if not even before it, in this respect; but with that exception, we do not think that any other breed in the British Isles will on an average yield so high a percentage of dead meat to live weight. In butcher's phraseology, it 'dies' well and 'cuts up' admirably. In all the leading fat-stock markets in the country the breed is held in high estimation, and, as a rule, commands the very highest prices — in fact, generally a higher price in comparison to its size and live weight than any of the other leading breeds. This is especially the case at the great Smithfield Christmas Market in London, where the plump compact polls from the north never fail to find a ready sale at the highest quotations."

The West Highland Breed.—This breed, which is also known as the "Kyloe" breed, is found in great excellence in Argyleshire, the Highlands of Perthshire and Inverness-shire, in Skye, and the larger islands of the Hebridean group. They are very hardy, have thick mellow hides, and shaggy coats of soft hair. "The neck should be strong and muscular, the forehead rather broad, and the nose, from the eyes to the muzzle, somewhat short; a dewlap should exist as a character of the breed; the eyes should be prominent and clear; the horns should be of a good length, without approaching to coarseness, spreading, and tipped with black. . . . Their limbs are short, though muscular, their chests wide and deep, their ribs well arched, and their backs as straight as in any other breed. The neck, indeed, and dewlap, seem somewhat coarse in the bull, but these are characters indicative of their mountain state; and almost all their other points are what breeders would term good. They are of various colours. A disposition exists in the Highlands to cultivate the black colour, as conceiving it to be more indicative of hardiness; and hence the greater number of cattle of the Highlands are black. But the brown colour, or the mixed black and brown, or the mouse-dun, are yet more generally indicative of a disposition to fatten. The brown is attended with that orange tone of the skin which is valued in other breeds, and there is a constant tendency in the best-bred cattle of the Highlands to assume it." [1] The milk given by cows of the West Highland breed is very rich, but they soon run dry, and being naturally of a wild disposition are not well suited for the dairy.

West Highland cattle are slow in arriving at maturity; but when they have attained a proper age, say four or five years old, nothing can excel the quality of their beef. From their handsome appearance, and the mixture of colours which may be obtained in a selected lot, cattle of this breed are much sought after for grazing in the parks of noblemen and gentlemen, where they form a picturesque feature.

When females of the West Highland breed are put to well-bred shorthorn bulls, the cross reaches maturity sooner than the original breed, and is altogether a valuable class of animal, although not of such weight as crosses of the polled

[1] Low's Domestic Animals.

breeds with the shorthorn. It has been repeatedly proved, however, that, considered as "commercial beasts," the first cross is the best; and certainly shorthorn blood should not be introduced into a herd of West Highland cattle kept for breeding purposes. There is no breed so suitable as the West Highland for mountain pastures, and under such circumstances the breed must be kept pure. West Highland cattle are much more scarce than they were thirty years ago, owing to the extension of sheep-farming in the Highlands, and the gradual abolition of the small-farm system in that portion of the kingdom. The nature of the country and of the climate is such, that no breed of cattle can supersede the West Highland in its native districts. The cattle of the North Highlands and the Lewis, for the most part, are inferior to the cattle of Skye and Argyleshire. Much improvement has, however, been made by using bulls of the best West Highland breed. The famous "Dunrobin" cattle, belonging to the Duke of Sutherland, are descended from the best description of Argyleshire West Highlands.

Welsh Cattle.—There are several varieties of Welsh cattle, such as the Pembroke, the Glamorgan, the Anglesea, and the Merioneth cattle. Of these the Pembroke has been considered the best. Welsh cattle have a strong affinity to the West Highland breed, being hardy, and possessing the property of thriving on poor keep, and withstanding a wet climate. Their beef is of excellent quality, and they are moderately good feeders. The cows are better milkers than West Highland cows, and therefore more useful for the dairy. Welsh cattle are usually longer in the leg than the West Highland, and a light hind-quarter is a prevailing characteristic. It is evident that Welsh breeders have not given much attention to the improvement of their cattle, and we believe that it is not unusual amongst Welsh farmers to sell the best heifers, as they bring most money, retaining only the worst for breeding. Where a system of this kind is pursued, it is useless to expect improvement.

Ayrshire.—The Ayrshire is essentially a dairy breed. "For this," says Mr Wilson, Edington Mains, "they are unsurpassed, either as respects the amount of produce yielded by them in proportion to the food they consume, or the faculty which they possess of converting the herbage of poor exposed soils, such as abound in their native district, into butter and cheese of the best quality."[1] Brown and white spots in patches used to be considered the orthodox colours of the Ayrshire breed; but, latterly, there are Ayrshires which are pure white, and others so dark as almost to be black. For example, a prize cow exhibited by Mr J. Stewart, Burnside, at the Ayr Cattle Show, April 1873, was white; while the first prize aged bull at the Highland and Agricultural Society's Show held at Stirling in 1864, was nearly as black as a Kyloe.

The "points" of Ayrshire cattle were laid down in 1853 by a committee of the Ayrshire Agricultural Association as follows:—

"Head short, forehead wide, nose fine between the muzzle and the eyes, muzzle moderately large, eyes full and lively, horns wide set on, inclining upwards and curving slightly inwards.

"Neck long and straight from the head to the top of the shoulder, free from loose skin on the under side, fine at its junction with the head, and the muscles symmetrically enlarging towards the shoulders.

"Shoulders thin at the top, brisket light, the whole forequarters thin in front, and gradually increasing in depth and width backwards.

"Back short and straight, spine well defined, especially at the shoulders, the short ribs arched, the body deep at the flanks, and the milk-veins well developed.

"Pelvis long, broad, and straight; hook-bones (*ilium*) wide apart, and not much overlaid with fat; thighs deep and broad; tail long and slender, and set on level with the back.

"Milk-vessel capacious, and extending well forward; hinder part broad, and firmly attached to the body; the sole or under surface nearly level. The teats from two to two and a half inches in length, equal in thickness, and hanging perpendicularly; their distance apart at the sides should be equal to about one-third of the length of the vessel, and across to about one-half of the breadth.

"Legs short, the bones fine, and the joints firm.

"Skin soft and elastic, and covered with soft, close, woolly hair.

[1] Wilson's British Farming.

"The colours preferred are brown, or brown and white; the colours being distinctly defined."

It will be seen that the points of the Ayrshire breed of cattle are, in many respects, exactly the opposite of those which would please the eye of the grazier.

Mr Sturrock says, in his "Report of the Agriculture of Ayrshire,"[1] that "it is the opinion of many old experienced dairy-farmers that too much stress is laid on mere beauty or handsomeness of form and colour, and too little attention paid to milking power. A step was made in the right direction at Ayr Show, at the suggestion and expense of the late Duke of Athole, when a large prize was offered for that cow which gave the best pecuniary return from the aggregate of several successive milkings. . . . As a general rule amongst Ayrshires, the larger cows yield more milk than the smaller ones; but for several years back the tendency of selection by the judges at cattle-shows has been to lower the breed in size, which of course affects the cows injuriously also as beefers."

Of late years high prices have been given for "crack" Ayrshires, both by home breeders and for exportation to the United States, Canada, and other parts of the world. At the Ayr Show, April 1873, £80, £60, and £70 were given respectively for the first, second, and third prize cows in one particular section; while for Mr Stewart's aged white cow, to which reference has been made above, the sum of £150 was offered by one of the judges, but the owner refused to part with her under £200—the calf she was then carrying having been sold for £20.

Professor Primrose M'Connell, F.H.A.S., writing of Ayrshire[2] cows, says: "The characteristics of the breed may be briefly stated as follows: They will cost £15 per head to lay in; will cost £15 per annum to feed; will yield about £20 of produce, which will be over 600 gallons of milk per annum, showing 3.5 to 4 per cent of fats, 12 to 15 per cent of cream, 12½ per cent of solids, and 200 lb. of butter per annum; and will sell when fat at £12 to £15. Her hardiness will enable her to live and to thrive in ex-

[1] Transactions of the Highland and Agricultural Society. No. I. Fourth Series. 1866.

[2] Live-Stock Journal Almanac, 1886.

posed situations and on scanty fare; while when taken south, if she gets plenty of good water to drink, and is not pampered with too much good food, she will do better, and well repay the outlay and trouble. One more point in conclusion: it is a rule with all cows to treat them gently, but especially so with Ayrshires. In their own locality they scarcely ever have any one else than women and girls to attend to them, so that those who bring them south need not expect great things if they leave them to the tender mercies of men with hòrny hands, and who think a cow milks better if she is kicked about and subjected to rough treatment."

The Channel Islands Breeds. — The Jersey breed has attained much popularity in this country for its wonderful dairy properties. Great pains have been taken for a long period by breeders in the Channel Islands to maintain the purity of their cattle; the importation of breeding cattle from any other country being strictly prohibited by an Act of the insular Legislature, which was passed in the year 1789, and is still in force.

The quantity of milk yielded by Jersey cows is not large, but it is very rich in cream, and the butter is of a deep golden colour. A Jersey cow will give from 10 to 14 lb. of butter each week when in full milk. We have known a small Jersey cow to give 10 lb. of butter each week, besides supplying a moderately large family with sufficient cream and milk during the time. The cows are gentle in their disposition, but a Jersey bull is apt to become wicked after he is two years old. The Jerseys possess few of the points which recommend cattle to the grazier, and they also want size—characteristics which have probably tended to prevent their general introduction into ordinary dairies, where it is a matter of importance that the cows used shall be of a description that will fatten easily, and "pull down the scales" when they are no longer fit for the dairyman's purpose.

The Guernsey cattle are larger than those of Jersey, and also remarkable for their yields of butter.

The Royal Jersey Agricultural Society has decided the points of the pure-bred Jersey as follows:—

Bull—pedigree on male and female side: head fine and tapering; forehead broad; cheek small; throat clean; muzzle fine, and encircled with a light colour; nostrils high and open; horns smooth, crumpled, not too thick at the base, and tapering, tipped with black. Ears small and thin, and of a deep orange colour within; eye full and lively; neck arched, powerful, but not too coarse and heavy. Chest broad and deep; barrel hooped, broad and deep, well ribbed home, having but little space between the last rib and the hip. Back straight from the withers to the top of the hip, and straight from the top of the hip to the setting on of the tail; the tail at right angles with the back, fine, and hanging down to the hocks. Hide mellow and movable, but not too loose, covered with fine soft hair, and to be of a good colour. Fore-legs short and straight; fore-arm large and powerful, swelling and full above the knee, and fine below it. Hind-quarters, from the hook to the point of the rib, long and well filled up; hind-legs short and straight (below the hocks), and bones rather fine; the hind-legs must be squarely placed, and not too close together when viewed from behind, nor to cross in walking; hoofs small.

The points of the cow or heifer are similar to the above, but with the following additional properties—namely: Udder full in form, *i.e.*, well in line with the belly, and well up behind; teats large and squarely placed, being wide apart; milk-veins very prominent.

The usual colour of the Channel Islands cattle is a fawn mixed with white; but we sometimes see individual animals cream-coloured, and others a mixture of black with white or dun.

The Kerry Breed.—The Kerry may be regarded as the only existing native breed of cattle which belongs to Ireland. "There are two varieties of it—first, the true Kerry, and next the 'Dexter.' The former is a light, neat, active animal, with fine and rather long limbs, narrow rump, fine small head, lively projecting eye, full of fire and animation, with a fine white cocked horn tipped with black, and in colour either black or red. Cattle of this description weigh when fat about 4 cwt., some even less; they fatten readily, and their beef is fine in the grain and very rich in flavour. The cows yield rich milk, and the quantity they give, combined with the ease with which they are kept, renders them great favourites as 'fancy' cows in the case of families residing in suburban villas and the like. The following are the dimensions of a fat Kerry cow, which was awarded a prize at a show of the Royal Dublin Society: 38 inches in height at the shoulder, 70 inches in girth, and 42 inches in length from the top of the shoulder to the tail-head. These measurements indicate a weight of about 30 imperial stones. The Dexter variety is the result of a cross, introduced about fifty years ago by a Mr Dexter; but it is not exactly known what breed that gentleman resorted to for crossing with the Kerry. It is averred by some that the Dexter variety is the result of selection, and not of a cross of another breed. Be that as it may, the points of the Dexter variety are materially different from those of the true Kerry; for the Dexter has a round plump body, square behind; legs short and thick, with the hoofs inclined to turn in; the head is heavy, and wanting in that fineness and life which the head of the true Kerry possesses: and the horns of the Dexter are inclined to be long and straight. . . . Of late breeders in Kerry have paid more attention to their native cattle than they did; they have certainly every inducement to do so, for pure-bred Kerry cows and heifers command high prices. The breed was long neglected, and many of the animals still hawked through the country by jobbers under the name of Kerries, are but poor specimens of the breed."[1]

Red Polled Norfolk and Suffolk Breed.—The red polled Norfolk and Suffolk breed is useful for the dairy, and considerable improvement has been made in it of late years which renders it also well suited for the grazier. A Herd-book of the breed has recently been published, and a "standard description" of the points of the breed was agreed upon at a meeting held at Norwich, October 18, 1873. The following are the recognised points: Colour, a deep red, with udder of the same colour, but the tip of the tail may be white; nose not dark or cloudy; form, a neat head and throat, a full eye; a tuft or crest of hair should hang over the forehead; the frontal bones should begin to contract a little above the eyes, and should terminate in a comparatively narrow prominence at the summit of the head. There should be no horns, slugs, or abortive horns.

[1] "Review of Irish Agriculture," by R. O. Pringle. Journal of the Royal Agricultural Society of England. Vol. viii. Second Series. 1872.

The Sussex Breed.—The Sussex breed of cattle possesses several of the characteristics of the Devon, but is larger in frame. Oxen have been much used for purposes of husbandry in Sussex, and the breed of cattle belonging to that district is admirably adapted for draught, possessing good action combined with physical strength. Some fine specimens of Sussex oxen are shown annually at the London Christmas Shows, and the breed has been very greatly improved in recent years. They are now thick, heavily fleshed, thoroughly useful cattle, maturing earlier than formerly, and also displaying finer quality and truer symmetry of form.

Shetland.—The Shetland or Zetland breed of cattle belong to the northern group of islands from whence they derive their name. The true Shetland cow is a handsome animal, with fine bone, mellow skin, and silky hair. The cows are noted for the rich milk they yield, on very poor keep; and the Shetland cattle fatten readily when moderately well treated. A piece of well-fed Shetland beef has been fitly called "a dainty for an epicure." Oxen of this breed, when fat, seldom exceed 4 cwt., and cows and heifers about 2 cwt. The Shetland cattle have been much neglected, and any attempt to improve them should be through the medium of selection, and not through the introduction of any other blood. It is true, do doubt, that when Shetland cows are put to shorthorn bulls, a valuable cross is produced, which attains much greater weight than the original Shetland cattle; but crosses with the shorthorn are only suited for a district possessing a better climate than that of the Shetland Islands, and where there are more abundant supplies of food. There is no breed which resembles the Shetland in all respects so much as the Kerry; and if it were considered desirable to introduce other blood as a cross with the Shetland, the Kerry presents itself as the most likely to be useful.

CHAPTER VII.

MANAGEMENT OF CATTLE.

SECT. I.—CALVES.

In entering into details of the management of cattle, and, indeed, of all kinds of farm live-stock, there is one principle which it is well to keep at all times in view—namely, that whatever is worth doing is worth doing well. If it is worth while rearing cattle or sheep, it is evidently much better to adopt a system which is certain to lead to profitable results, rather than follow one which must, from its very nature, prove unsatisfactory. The "manufacture of meat," to be thoroughly profitable, must be conducted from first to last on proper principles. We must begin by breeding our stock in a proper manner; and from the day the calf comes into the world until the day when the matured animal is consigned to the butcher, the rule to be observed should be—*continuous progression, and no retrogression.* This rule is not, however, observed by many persons who rear stock. Their great object appears to be to ascertain the smallest quantity of the least nutritious food upon which an animal can live; and instead of hastening the necessarily tedious process of rearing and feeding, they appear to strive by every means to retard it. With all the much-vaunted advance of agricultural science and practice, there is still much to be learned on the subject of stock management; and as a proof of this, we need look no further than the badly bred and ill-thriven beasts that are to be met with in large numbers at every fair and market in the kingdom.

We have already discussed the question of breeding, and we have now arrived at that stage when the young calf makes its first appearance in the world.

The natural mode of rearing a calf is to suckle it on its mother. This, however, cannot be done in every instance, from the demand for dairy produce; and for this reason the calf is usually removed from the dam soon after birth, and brought up by hand.

It has been much debated whether the new-born calf should be allowed to remain some time with the mother after birth, or immediately removed from her. Many experienced persons are of opinion that the calf should be left until the cow has satisfied the instincts of nature by licking the calf all over. This is useful to both cow and calf—the viscous matter which covers the calf having a salutary medicinal effect on the cow, while the process has evidently a strengthening influence on the calf. Where it is deemed necessary to remove the calf immediately after its birth, it must be carefully rubbed with dry cloths and wisps of straw or hay until it is quite dry and clean. When the calf is removed, it should be to some place out of the mother's hearing.

The calf crib should be 4 feet square, and enclosed with sparred walls 4 feet high, and each crib should be provided with a small manger and hay-rack. In some cases the cribs are so constructed that the calf has access—either at will or when the door of the crib is opened—to a small enclosure, which allows the calf to exercise its limbs. When cribs are made large enough to accommodate more than one calf, it will be necessary to put a muzzle on each calf to prevent them from sucking one another, which they are very apt to do. The crib and adjoining enclosure must be paved with stone, or laid with asphalt or concrete, and due attention paid to the drainage. Good ventilation and plenty of light are also essential requisites; and the walls should be whitewashed once a-year at least. Sprinkling the floor, &c., daily with diluted carbolic acid—five parts of the acid to one hundred parts of water—or with M'Dougall's or some other disinfecting powder, takes away bad smells. The cribs must be regularly cleaned out, and wet litter removed.

The milk of the cow immediately after calving is of a peculiar nature, and differs in its composition from what it afterwards becomes. At this stage it contains an unusually large quantity of caseine or cheesy matter, as will be seen by the following comparison of the composition of the ordinary milk of the cow with that of the *biestings*, as the milk given immediately after calving is termed:—

	Ordinary Milk.	Biestings.
Caseine (cheese)	4.48	15.1
Butter	3.13	2.6
Milk-sugar	4.77	—
Saline matter	0.60	—
Mucus	—	2.0
Water	87.02	80.3
	100.00	100.0

The biestings, or first milk, is the best food which can be given to the young animal. It is that which nature has provided; and if the calf is allowed to drink freely of it, there is little risk of undue costiveness or of scour.

There are various modes of rearing calves. 1. They are "reared on the cow"; that is, they are allowed to run with the mother, or with a nurse-cow, and to suck the cow at pleasure. This mode is generally followed in pure-bred herds, or when the dams, although they give rich milk, do not give it in sufficient quantity, or long enough to render them useful for dairy purposes. Dairy produce being, however, of great value, and an article of much importance to the farmer, this mode of rearing calves, although the most natural, cannot always be carried out. Indeed the extension of dairying, and the better understanding of calf-rearing by other means, have induced many who formerly suckled their calves to abandon the practice.

2. Another mode is to rear at first on new milk, and afterwards to substitute wholly, or in part, skim-milk for the rich new milk. This plan has its disadvantages as well as its advantages. First, cows which are fully milked by hand, and not allowed to suckle their calves, are liable to garget, or inflammation of the udder, which rarely if ever occurs when a cow suckles her calf. Next, the quality of the skim-milk may be so poor that the calves which are fed upon it cannot thrive as they ought to do; and calves fed in this way are very liable to scour, indigestion, and other bowel

complaints. It may be laid down as a first principle in calf-rearing, that it is impossible to have a large quantity of butter for sale, and at the same time have well-reared calves—that is, when the calves depend entirely on milk given them by hand.

3. Many breeders make a compromise between the modes of rearing stated above. They allow the calf to suck the cow, and after getting from her what is considered sufficient for the calf, they remove it to its crib, and relieve the cow of the rest of her milk by hand; the milk so obtained being used in the dairy.

4. In recent years there has been great extension in the system of using artificial food, which is prepared by several eminent firms, who have given much attention to the production of meals and cakes for farm live-stock. It is indeed within the mark to say that the manufacture of calf meals, and meal substitutes, has almost completely revolutionised the system of calf-rearing, much to the advantage of stock-owners. At the outset these foods are given in small quantities, which by degrees are increased as the allowances of milk are lessened, or wholly withdrawn. There is no doubt these substitutes are very useful, and in preparing them, the great end to be kept in view is to endeavour to render them as near in composition to new milk as possible; for, as Professor Johnston has justly remarked, "Milk is a perfect food for a growing animal, containing the curd which is to form the muscles, the butter which is to supply the fat, the phosphates which are to build up the bones, and the sugar which is to feed the respiration. Nothing is wanting in it."

In rearing calves by the pail, the first point to be attended to is, to teach the calf to drink. The natural action of the young animal is to suck; and therefore, instead of thrusting its head into the bucket with the view of compelling it to drink, the dairymaid or calf-feeder should put a finger or two of the right hand into the calf's mouth, and bringing the pail of milk under the head, get it to swallow some of the milk while in the act of sucking the fingers. In a day or two the fingers may be gradually withdrawn during the time the animal is drinking, and in a few days more the calf will drink without this inducement. The calf's head should on no account be thrust down into the pail so as to cover the nostrils. Tucker's patent calf-feeder, which has been lately introduced, appears well adapted for the purpose. It consists of a circular vessel made of zinc, and is furnished with an artificial teat on the top, which the calf soon learns to suck. It prevents waste, indigestion, and scouring and swelling, which are the results of indigestion.

For the first day or two after birth the calf should not get more than about 2 pints of milk four times a-day; but as it increases in strength the quantity of milk is also increased, and the calf fed thrice daily. From the second week the daily allowance should be 6 quarts, divided into three meals. Some breeders increase the quantity given daily from the fourth week to 8 quarts, and continue the allowance until the twelfth week, when the calf is weaned. Mr M'Combie, however, insists on the calf being "allowed to suckle or be fed from the pail for six or eight months. It has then strength to stand weaning, and if properly cared for will not be checked in its growth, and it will retain the good calf-flesh it has put on. The loss of the calf-flesh cannot be remedied, and great care should be taken to avoid this. If the calf-flesh is lost the animal will be reduced in value, and can never be made to yield first-class meat."

Instead of following the mode of rearing calves described above, most people begin at an early period to substitute skim-milk for the new milk. This is done gradually, until the calf is fed wholly on skim-milk. This mode of rearing is apt to cause indigestion, costiveness, and scour, and must therefore be carefully regulated. Even when calves are reared wholly on new milk, they should be accustomed early to eat cake and other suitable kinds of artificial food, which is easily done by putting a few small pieces of cake, &c., into the manger. A piece of rock-salt, and also of chalk, should likewise be left in the manger. When skim-milk is given, it should be first warmed to the temperature of new milk, as cold milk is injurious; and sour skim-milk should not be given, as it has a bad effect on the bowels. When the allowance of new milk is reduced, and skim-milk substituted for it, it is necessary to add linseed gruel, oatmeal gruel, or palm-nut-meal gruel, or some prepared food to the skim-milk. This must be done gradually, beginning with a small quantity at first, until the calves get used to it. The linseed must be pure, and well boiled. It will be advisable to have it crushed before boiling: 5 lb. of linseed will make 7 gallons of gruel, which will be sufficient for five good-sized calves. Bean-meal is also a useful addition, and we have seen calves very fairly reared on 10 to 12 ounces of a mixture of linseed-meal and bean-meal, equal parts, and made into gruel. This represents, of course, the allowance daily for each calf, along with some skim-milk. Another mode of preparing gruel is to put 1 quart of meal made by grinding linseed-cake, to 4 quarts of boiling water, which is poured over the meal, and the gruel is then allowed to stand from eight to twelve hours covered up. A similar mode of preparation answers when palm-nut-meal is used. If the gruel is found to purge the calf, add another quart of water to the quantity mentioned above, and give less of the gruel and more of the skim-milk for a day or two, or mix a little wheat-flour with the gruel. A little sweet hay and finely sliced swedes or carrots should be put into the rack and manger.

Mr Ruck, Cirencester, rears his calves on food prepared as follows: 7 lb. of finely ground linseed-cake is dissolved in 2 gallons of hot water, and to this is added 2 gallons of hay-tea; 7 lb. of mixed meal, consisting of equal parts of wheat, barley, oat, and bean meal is also added, with two gallons of hot water. This mixture is given to the calves as follows: 2 quarts in the morning, further diluted with 2 quarts of warm water, and 2 quarts mixed with 2 quarts of water at night. Upon this gruel, Mr Ruck states, the calves thrive well, and are weaned at twelve weeks old.

Mr D. A. Milward, Tullogher, New Ross, Ireland, describes in the 'Irish Farmers' Gazette' his system of rearing calves, which deserves attention.[1] "In the year 1859 I reared thirty-six calves with twelve cows; in 1860, forty calves with fifteen cows; and in 1861, thirty-two calves with sixteen cows: and although, in the commencement of the year, we gave all the milk in its pure state, yet owing to the smallness of the quantity in proportion to the number to be fed, we were greatly dependent on artificial means. . . . I take the calves from their mothers on the second

[1] Irish Farmers' Gazette, January 11, 1862.

day, and give them 8 quarts of new milk a-day for the first fortnight, after which we begin giving skim-milk with a mixture of thin Indian-meal gruel which has been well boiled; this is continued for say ten weeks, the average quantity of milk being 6 quarts a-day, and of meal 1½ lb. a-day for each calf. At about a month old, or perhaps sooner, we commence giving sliced mangels, hay, and linseed-cake, the quantity at first being, of course, very small, but increasing as they get used to it, until they consume 3 to 5 lb. of mangel, ½ lb. of oilcake, and 1 or 2 lb. of best hay. They will pick the hay of their own accord, but the mangels should be sliced very thin, and put in their mouths; and as soon as they come to eat it from the troughs, a little powdered oilcake may be added. Until three months old they are not let out except to play in a warm yard on a fine day, while their house is being cleaned out; after that time they are put out, if the weather is fine, into a sheltered paddock by day, and brought in at night for some time, until they are well accustomed to the exposure, their dry food being continued as usual, but their drink consisting of weak gruel or hay-water. As soon as the after-grass on the artificial meadows (or sown grasses) begins to get up, they are finally sent out and weaned, the younger ones getting a little oilcake for a short time.

The following are the details of a system of rearing calves which we have seen carried out with very satisfactory results by Mr A. J. Campbell, on his farm near Fermoy, county Cork. The calves get, for the first month, new milk from the cows, about 2 quarts each, three times a-day. They then get sweet skimmed-milk, of one setting, with a little porridge made of Indian meal, bean-meal, and linseed-meal, as will be afterwards described. The quantity of porridge is gradually increased until they are from six to eight weeks old, when they are allowed 1 pint of the mixture for each meal—that is, 1 quart of porridge daily, mixed with about 5 quarts of skimmed milk. The calves are kept in separate pens, but they get a run in a paddock by day, and they also get some cut grass or other green forage. They are weaned from milk from the middle of July to the end of that month, but get each 1½ lb. daily of a mixture of bruised oats, bean-meal, and linseed-cake; and this feeding is kept up during autumn, when they have a run on the young grass after the barley is cut. The porridge, which we have mentioned above, is made and used in the following manner: 5 pints of Indian meal, 4 pints of meal made of crushed linseed, 3 pints of bean-meal. The 12 pints of dry meal are mixed in a pot with 10 quarts of water, and left on the kitchen-range, boiling and simmering from morning to evening, and from evening to morning, for the evening and morning feeds respectively. On the milk being skimmed, it is put into a large tub, and the porridge poured into it, and well incorporated with it. The addition of the porridge makes the milk lukewarm. The oldest calves are first fed, and when that has been done, sufficient milk, partly warmed, is added to the remainder of the mixture, so as to reduce it in strength for the younger calves, who are considered to get at first about half allowance of porridge into their milk.[1]

The following mixture has been recommended as useful for rearing calves, when mixed with skim-milk: 1 bushel (60 lb.) of wheat ground down, with 1 peck (14 lb.) of linseed. This will be sufficient to rear one calf. The miller must be cautioned to grind this mixture carefully, otherwise the linseed will run through.

The practice of calf-rearing throughout the country varies greatly.

"A few allow the calves to suckle their dams till the youngsters can do without milk. This plan should be followed with heifers not intended to be kept on as cows, but, as a rule, it is not economical. Many think it advisable to let the calves suckle their dams for a week or ten days, and then feed them by the hand. Perhaps the majority pursue the hand-feeding system from the very outset. At first the calves get about two quarts of new milk twice a-day, and when about a month or six weeks old, they are turned on to sweet skimmed milk, this change being made gradually by mixing a little skim-milk with the whole milk. Some discontinue the new milk even earlier, others continue it longer than the periods stated.

"It is well to have the skim-milk scalded as soon as the cream has been taken from it, because it will thus longer remain sweet. A simple way of scalding is to insert a vessel

[1] Irish Farmers' Gazette, July 6, 1872.

full of the skim-milk into a larger vessel containing hot water. Some even boil the skim-milk, and are thus able to keep it sweet a whole week.

"One large farmer who sells his milk on the six week-days, keeps at home his Sunday's milk, has it boiled on Monday, and gives a portion of it to his calves every day. The supply of this milk often lasts the whole week. If the Sunday's milk falls short, the calves get two quarts of new milk, with one quart of water added. Some feed three times a-day in the first two or three weeks, others only twice.

"Supplementary foods should be begun soon, but at the outset given in very small quantities. Some give extra food before the calf is a month old, others not till it is in its sixth or seventh week. The commodities most largely used are linseed, linseed-cake, one or other of the prepared foods, malt, pea, bean, and barley meal. All are given in the form of gruel, and the gruel can hardly be too well steeped or boiled. The gruel is given along with the milk, the allowance to start with being very small.

"As the calves grow up, the allowance of milk is reduced, and that of the other food increased.

"A little fresh sweet hay should be put within the reach of the calves as soon as they can eat it with safety. The boxes or stalls in which the calves are kept should be cleaned regularly and carefully; let the youngsters have a dry, comfortable bed, give plenty of exercise and fresh air, but keep them perfectly clear from draughts.

"At six months old, or earlier, the calves are wholly weaned from milk. They are then fed on hay (which should be cut), pollard, linseed-cake, or some kind of meal or prepared food, with, in some cases, a moderate allowance of either turnips or mangels. The roots should be cut up finely. It is well to avoid putting calves too early to grass. When they are put out it is usual, where a liberal system of feeding prevails, to give them a little cake for a few weeks —from 1 or $1\frac{1}{2}$ to 2 lb.—until they take well to the grass, and have a sufficient nourishment in it.

"It is considered unwise to let very young calves out to grass. Calves under six months old, or any that are not thriving well, should, if convenient, be kept in the house, where they will, as a rule, make better progress than if they were out at grass. And if young or weakly calves are put out to grass, they should be taken in for an hour or two in the height of the day, and in some cool plaçe have put before them some rich food, such as cut hay and linseed-cake, with perhaps a little meal or coarse pollard. This allowance need not be large—little will do much good, and will be well repaid by the youngsters—that is, if they are of the right sort. Judicious and liberal treatment will enable a farmer to make the most of good animals, but no sort of treatment ever can make bad animals good." [1]

Mr Edward Bowly, a well-known breeder of shorthorn cattle, has given the details of his mode of rearing calves in a prize essay 'On the Management of Breeding-cattle,' previously referred to. Mr Bowly says: "My early calves —those which drop from December till the end of February —I allow to suck the cows for a fortnight, then take them off and give them as much as they will drink of skim-milk and thick gruel made from boiled linseed, in equal proportions, twice a-day. As soon as they are inclined to eat, I supply them with oilcake, carrots, and hay. When three months old I reduce the milk and linseed to once a-day, and in three weeks afterwards discontinue it altogether, continuing the food till they are turned out to grass. Then I give them 2 lb. of oilcake daily, which I continue in addition to their other food for twelve months—that is, till they go to grass the following year.

"Those calves which drop late in March, and during the summer months, I allow to run with cows, often purchasing nurses for the purpose, it being desirable to remove them from their dams, as cows being sucked by calves will not always take the bull so soon as those milked by hand."

Hay-tea is much used in some parts of the country as a substitute for a portion of the milk given to calves. It is made by putting a quantity of sweet hay into a tub, which is closely covered up after boiling water has been poured over the hay. It is kept in this state for twelve hours before being mixed with the milk and given to the calves. We doubt if hay-tea possesses the nutritive properties which some ascribe to it; and although, of course, it must be

[1] Our Resources in Live-Stock. By James Macdonald. Vinton & Co. (Limited). London.

useful to some extent when made from really good hay, it should be mixed with linseed-gruel, or gruel made from Indian meal, and not relied upon as the principal article in the food of the calf.

The value and use of cocoa as food for calves have been described in the chapter on "Food."

Carrageen, or Irish moss, is used occasionally as an auxiliary food for calves. This plant is a sea-weed, and supplies a considerable amount of nutritious matter. When prepared for use it is first well boiled, at the rate of 1 lb. of moss to 5 or 6 gallons of water. When thoroughly boiled, it is strained and set aside for use, when it forms a jelly, which is given to the calves in the proportion of one-fourth jelly to three-fourths of milk, the jelly being thinned by the addition of a little hot water, so as to warm it to blood-heat previous to its being mixed with the milk.

Some years ago sago was much recommended as food for calves, or as a substitute for milk; but as it contains scarcely anything but starch, it was found unfit for the purpose. A calf fed chiefly on sago would soon become weak and rickety. When mixed with other food, such as bean-meal, ground cake, &c., it is useful to a certain extent.

Rice-meal, when of good quality and well boiled, is used with advantage, in conjunction with other food, in rearing calves.

Bull-calves, which are intended to be kept for use as sires, must be well fed from the first, and get a full allowance of new milk daily for six months. They should also get bean-meal, cake—decorticated cotton-cake being very suitable—and crushed oats, in order to produce a vigorous muscular growth. Daily exercise must not be omitted, and the young bull should be ringed during the first year, and accustomed to be led about. He should not be put to serve cows until he is 18 months old, and the number should be limited to a few, say twelve or fifteen in the first year. The greatest care must be observed to treat young bulls with gentleness. In most cases, bulls which become vicious are rendered so by harsh treatment.

Bull-calves which are not designed to be kept as bulls should be castrated when about a month old.

After calves are weaned and put to grass, they should have vetches or cut clover given to them when brought into the house or yard in the evening. It is advisable also to continue their daily allowance of cake, from ½ lb. to 1 lb. each per day, as it is a great preservative against black-quarter, the most fatal disease to which calves are liable.

In preparing veal-calves for market, they must be afforded plenty of fresh air, with abundance of clean dry litter; but it is better that there should be as little light admitted as possible, unless at feeding times, as the fattening process goes on more rapidly when the animal is perfectly undisturbed. The cribs should not be larger than merely sufficient to allow the animal room to turn. During the first week milk must be given rather sparingly, so as to sharpen the appetite, rather than to induce surfeit. The quantity given should be gradually increased, until the calf gets as much as it will take; and from first to last the milk given must be new, as it comes from the cow. As the calf increases in size, it is probable that it will require a larger allowance of milk than that which is produced by its dam, in which case the want must be made up; and in such a contingency, it is better to give the more advanced calves the "strippings," or last-drawn milk of the other cows. A lump of chalk should be placed in each crib, so that the calves may lick it at pleasure.

In England vealing calves are not pail-fed, but allowed to suck the cow three times a-day, and the calves are bled frequently during the period of fattening, with a view to improve the colour of the flesh. Fresh eggs, given raw, boiled barley-meal, and boiled Indian corn are given by some; but although these—particularly the last two—are useful, and not expensive, yet they must not be resorted to for the purpose of superseding the full allowance of new milk, which is the best possible description of food for producing fine-flavoured and nicely coloured meat. From six to ten weeks is the usual time of fattening, and the utmost attention must be paid to regularity in feeding, cleanliness, and pure air.

It has been stated that calves which are reared by hand are more liable to a disordered state of the bowels than those which are suckled by their mothers or by nurse-cows. One of the most common of these diseases is scour, which frequently proves very fatal. It is caused by great acidity of the stomach, and sometimes occurs as early as the second or third day after birth. The most prominent symptom is the passing of yellowish-white excrement, and there is also a tendency to swelling in the belly. The milk in the stomach is curdled into a hard mass, and this must be dissolved, otherwise the calf will die. Mr Bowly, to whose prize essay on the 'Management of Breeding-cattle' we have already referred, says that he has restored calves suffering from this complaint by giving them magnesia and rhubarb, of each a tea-spoonful, and 20 grains of grey powder—a preparation of mercury and chalk—repeated every six hours. Considering prevention better than cure, Mr Bowly states that he has adopted the plan of giving to each calf as soon as dropped, and before sucking the cow or getting milk, rhubarb, magnesia, and castor-oil, of each a tea-spoonful, repeating it if necessary—giving the cow at the same time a cleansing drench, composed of 1 lb. of Epsom salts, 1 lb. of treacle, and a table-spoonful of powdered ginger; and he says that since he has adopted this mode of treatment he has not lost a calf from this disease. Scour sometimes attacks calves at a more advanced age; but if taken in time, 4 to 6 oz. of Epsom salts, ¼ oz. of nitre, and the same of ginger, given in a little warm gruel, will remove the cause, which is generally some obstruction in the stomach or bowels.

Giving very young calves the milk of old-calved cows is a common cause of that acidity of the stomach which leads to scour.

Black-quarter has been already mentioned, and also the value of oilcake as a preventive. This disease, however, rarely attacks calves until autumn; and in addition to the oilcake, it is also advisable at that season to put a seton in the brisket of each calf. The seton consists of a piece of tape or soft cord passed through a portion of the skin by the seton-needle, the ends being tied together. The tape or cord is smeared with oil of turpentine before it is inserted, and it should be pulled up and down at least once daily; the openings should also be frequently washed with lukewarm water to keep them clean, and the tape renewed every ten days.

When calves are kept in damp, dark places, and not allowed sufficient exercise and nourishing food, they are liable to a disease of the bones at the joints, which is termed from that circumstance "joint evil." The causes mentioned indicate the nature of the preventive treatment that should be followed. There is also a disease of precisely the same nature to which highly bred, pampered calves are liable. This is often difficult to overcome. Air and exercise, and judicious dieting, will be useful: and a liniment, composed of ½ oz. of iodine, 2 oz. of glycerine, 2 oz. of mercurial ointment, and 6 oz. of olive-oil, all mixed together, may be rubbed with considerable friction into the joints.

These are the complaints which chiefly belong to early calfhood, and the scope of this work does not permit us to enter into a description of those which occur at a later period.

SECT. II.—YOUNG CATTLE.

The judicious treatment of young cattle is a point of the greatest importance, and it is by no means unusual to find cattle which had been well reared as calves treated afterwards in such a manner as materially to retard their progress. They are either poorly wintered in the fold-yards, or left to pick up their living on the bare pastures without shelter, and without any help in the shape of extra food, unless it be some hay, wh ch is frequently of poor quality; and even this is only given in stormy or frosty weather, when it is thrown down on th ground and left there, for the cattle to pick at or trample over. When young cattle are wintered in the fold-yard on "an economical system," straw and water, and sometimes, but not always, a few turnips, constitute their keep. It is impossible that young cattle can thrive as they ought to do when wintered according to either of these modes, and the result is a loss of flesh, which requires them to be a considerable time at grass before it is replaced; and a system of management of this kind is tantamount to throwing away money without the slightest equivalent. "Nor are the evils of the starving system limited to the breeder. The grazier who purchases cattle that have been hunger-bitten in their youth, finds to his cost that he can only fatten them by an extra expenditure of time and food; and after all, they are more worthless, weight for weight, than such as have never been lean."[1] Mr M'Combie

[1] Wilson's British Farming.

says on this point: "Where do all the scraggy, bad-fleshed beasts come from that we see daily in our fat markets, and what is the cause of their scragginess? It is because they have been stinted and starved at some period of their growth. If the calf-flesh is once lost, it can never be regained. A great deal of tallow may be got internally by high feeding, but the animal can never again be made one that will be prized by the great retail butcher."

In treating of the management of young cattle, we shall take it for granted, in the first place, that provision is made for the winter keep of cattle by growing roots, &c.

The calves after being weaned, which will be, in general, about the 1st of August, should be turned upon a piece of good fresh grass, and their allowance of oilcake continued. Some allow each calf at this time, and until winter, ½ lb. each daily of oilcake, and others 1 lb. half cake and half bruised grain. Decorticated cotton-cake, mixed with crushed Indian corn, is very suitable food for young cattle. It will be advisable to put the calves into a yard with sheds at night, more especially if the weather is rainy or the nights chilly. Vetches or second crop of clover should be given to them in the yards.

In order to have a supply of food when the pastures begin to fail, it is advisable to have vetches in readiness, or to sow an acre—more or less, according to the number of cattle—of globe or greystone turnips at the commencement of the turnip-sowing in May. These roots will be ready by September, and the calves ought to be gradually accustomed to use them, by a few being fresh drawn each day and scattered on the pasture. The turnips so laid down may be divided into pieces by an instrument constructed for the purpose, having two or three sharp blades united above, and affixed to an upright wooden handle. Silage will most probably come to be used extensively in the rearing of young stock. It is well to bring calves early into their winter quarters, as they lose flesh rapidly when exposed to stormy weather. With regard to the treatment of young cattle at the time to which our remarks refer, Mr Wilson says that "much stress used to be laid upon giving them a run out, even during winter, as a means of preventing black-leg and other diseases. We are convinced this is an error, and that, whether as regards exemption from disease or early and profitable maturity, it is best at all times to afford to young cattle generous diet and comfortable quarters." The truth of these remarks will be recognised by all who have paid attention to the subject.

The yards should be roomy enough to afford accommodation for five or six calves, and have one end covered, so as to form a comfortable shed. Troughs for the reception of turnips and oilcake must be placed along the inside of the wall which divides the yard from the next; and it is a great improvement to have a roof erected on the dividing wall, to cover the cattle when feeding at the troughs. This roof may be of any light material, such as felt, dressed with gas-tar. Corrugated iron forms a cheap and efficient roof, and is now being used very largely. A water-trough must also be erected in each yard, and supplied with pure soft water regularly. These troughs should be provided with pipes to carry off surplus or foul water to an underground drain. The bottom of the yard and adjoining shed must be paved, or laid with asphalt or concrete, and have a gutter running its entire length for the purpose of carrying all rain-water or other liquid to an underground drain, by which it is conveyed to the tank. The opening in the drain must be covered with a grating.

As it is of importance to know how to lay a floor of asphalt, we give the following directions for that purpose: First level the earthen bottom, giving it a sufficient inclination to the point where the water will be carried into the underground drain. On the floor so prepared lay a coating of broken stones, like small road-metal, and after covering this with half an inch of gravel, have it rolled with a garden or lawn roller. The asphalt, having been broken into small pieces, is melted in a boiler; perfectly dry sand or fine gravel is then gradually stirred in until it is of the consistency of thick mortar. It must be kept constantly stirred, and boiled for about three hours; the larger the boiler the better, and two are better than one. It is then ladled out into iron buckets, well greased on the inside, poured on the floor, and smoothed with a greased trowel: before it hardens, fine sifted dry sand is strewed evenly over it, and it is then rubbed with a wooden float, in the same way as plaster is rubbed on a wall. It becomes perfectly hard in half an hour, or less in cold weather. Before commencing to pour on the asphalt, a space should be laid off and enclosed by thin pieces of wood or iron; this space to be of such an extent as the contents of the boiler will cover. If the floor is to be 2 inches thick, 1 gallon will cover 1 square yard; but some allowance must be made for waste. A simple way is to lay off a strip along the wall, 3 feet wide, and have a thin piece of wood, 3 feet long, ready to lay across when the boiler is nearly empty. This piece being measured, the succeeding ones can be prepared accordingly. The pieces of wood should be levelled and greased on the side next the asphalt, and nailed down lightly; when the asphalt is cool, the pieces of wood are knocked away, and the next piece of flooring dovetails under the former one. Finally, the joints are either smoothed down with a hot iron or levelled with a mason's chisel. As the asphalt cools in the carriage, and sets in the buckets, it is desirable to have the boiler near the ground to be floored. It requires a little experience to catch the exact time to strew on the sand and rub the asphalt down with the wooden float. If done too soon, the asphalt sticks to the float; if too late, the asphalt becomes hard and glazed, and the sand and float are inoperative; but a handy man soon learns the knack of it.

A floor impervious to damp may also be made in the following manner: Use screened fine gravel and gas-tar, in the proportion of 2 quarts of tar to each bushel of gravel, mixed on a boarded platform. Apply 1 inch thick on a floor previously prepared by laying it with broken stones, covered with coarse gravel, and roll well. When it is quite hard, put on from 3 to 5 inches more, rolling in the same way repeatedly.

Another mode is as follows: Mix Portland cement with water, and three parts of coarse gravel to one of cement, thoroughly mixed up to the consistency of mortar. A bottoming of 6 inches thick of broken stones, broken tiles, road-metal, or anything of that kind, is first laid down on the ground, beaten hard down, and levelled to 3 inches below the future surface. Three levelling rods—slips of wood with a level upper surface—are laid parallel, at 6 feet apart, and temporarily fixed at the proper level with a little of the mortar. The mortar is then thrown down in hodfuls, in the space between the rods; a board, with a perfectly smooth edge, stretching across from one levelling rod to the other, and resting on both, is then drawn slowly forward over the mortar, which is thus brought to a uniform level, and it may then be made smooth with a plasterer's steel float, and a little unmixed cement wetted to the consistency of cream. No more cement should be wetted than is to be laid immediately, as it sets very quickly; but notwithstanding that, the floor does not become thoroughly hard for about six weeks.[1]

Floors constructed by either of the modes above described will be found useful for cow-houses, cattle-sheds and yards, piggeries, &c.

Returning to the feeding of young cattle, we would remark that the artificial food—that is, the cake, or cake and corn—should be given as the first feed in the morning. This is found to be much better than giving a feed of cold roots on an empty stomach. After the cattle have consumed this feed, let them have a little fresh straw, and at 9 o'clock A.M. a feed of sliced or pulped roots, and the same again at 3 P.M., straw being given in the interval between the feeds, and also when doing them up for the night. Young cattle will consume 4 to 5 stones each of turnips daily, but it will be found economical to give smaller quantities of roots with other foods. The pulping system, fully described in the preceding chapter, assists greatly in the economising of roots. If the cattle scour on the turnips, the quantity must be reduced, and that of artificial food slightly increased. About the beginning of January it will be necessary to increase the allowance of artificial food; and from March until the grass is fully equal to keep them, each animal should get 2 lb. of mixed food daily. Less, however, will suffice in the case of heifers which are intended to be retained on the farm, and not pushed on for grazing purposes; at the same time it is most desirable that heifers for breeding should have good growth, and this will be best secured by generous feeding.

In fitting up the yards, racks for straw or hay are placed inside the covered sheds, and movable racks put in the open yard, when the yard is roomy.

[1] The Field library.

Where there are a number of young cattle to be wintered, care must be taken to assort them properly, so that weak calves may not be placed in the same yard with others which are stronger, as these will often prevent the former from getting their proper share of food. The yards must be kept at all times dry and comfortable, by means of abundance of litter; and the eaves of the sheds should be furnished with spouts to carry off the rain-water to tanks—or elsewhere, if abundance of soft water can otherwise be obtained.

The order in which turnips are consumed is as follows: first, globe and other soft varieties; second, Aberdeens; and third, swedes; but the latter, as well as mangel-wurzel, are usually reserved for the fattening stock. If the stock of turnips is likely to fall short in spring, some of the substitutes mentioned in the chapter on "Food" may be resorted to.

On farms where few and frequently no roots are grown, as is the case on many cattle-farms in Ireland, artificial food and shelter are two main points to be attended to in wintering young cattle. We are aware that attention to these points is the exception, and not the rule, on most of the farms to which we refer. The young cattle are restricted to the grass afforded by the pasture-fields, except during severe frost and snow, when some hay is laid down on the ground for their use. If there are hedges or plantations on the farm, so much the better for the cattle; but if no such means of shelter exist, it is not considered necessary to provide it otherwise. The result is a waste of flesh, and in severe winters the waste is frequently so great as to reduce the animals to mere skeletons. An attempt has been made to form an estimate of the value of the loss of flesh resulting from this mode of wintering cattle. In the article on "Irish Agriculture" from which we have already quoted, [1] the following statement is made:—

"Another test of the 'cheapness' or profitableness of a system of management based upon unassisted nature may be obtained from the following calculation: By the last agricultural returns we learn that there are in Ireland

[1] "Review of Irish Agriculture," by R. O. Pringle. Journal of the Royal Agricultural Society of England. Vol. vii. Second Series. 1872.

842,183 calves or yearlings, 745,863 two-year-old cattle, and 2,385,056 three-year-olds and upwards. Assume that one-third of the number in each class are not allowed to retrograde in condition, and that each head of the remaining two-thirds loses flesh during the winter and spring months in the following proportions: yearlings, 2 stones of 14 lb.; two-year-olds, 4 stones; three-year-olds and upwards, 6 stones;—then we find a total loss of flesh amounting to 12,652,076 stones, or 1,581,509½ cwts., which at 60s. per cwt. represents a money value of £4,744,528, being nearly five millions sterling lost annually owing to the flesh being literally wasted off the bones of the animals."

Now there is nothing more certain than that the judicious use of artificial food, accompanied with shelter, will not only prevent waste of flesh, but keep the animals in a profitably progressive state. Oilcake, rape-cake, decorticated cotton-cake, with or without Indian corn or other kinds of grain, may be profitably consumed in this way by store-cattle, and increase materially their value to the owner. Even 2 lb. of either of these foods per day will tell, but more may be given with profit; and two-year-olds which get 3 lb. of oilcake or 3 lb. of rape-cake daily, with some straw or hay, will be turned out to grass at May more forward in growth as well as condition, than three-year-olds which have been left all winter to unassisted nature. This is not a theoretical statement, but a plain matter of fact. Here, again, the reader may be referred to what has been said as to the pulping system.

As to shelter, it is not necessary that it should be of an expensive nature in its construction. A fold-yard connected with other buildings may be constructed against a wall, with lean-to roofs. The sheds and enclosure may be formed of rough timber, and the roofs covered with felt or prepared canvas, coated with gas-tar, or any other cheap and convenient material. Sheet-iron makes an excellent and cheap roofing for sheds; but in putting it on, it is necessary to observe that each course overlaps that which is under it. The sheds should be roughly paved, and have troughs and racks for hay at the back part under cover. The yard may be paved or bottomed with peat-mould, cut ferns, or any other suitable material.

When sheds are erected in the pasture-fields, the construction may be equally simple. In all cases the sheds should face the south. Sheds in pastures are useful in summer as well as during winter, as they afford shelter to stock during the heat of the day, and from the attacks of insects. Cattle soon learn to use these sheds, when they have at all times free ingress and egress.

The effect of shelter on animals has been explained by Mr Wilson, Edington Mains, in his article on "Cattle" in Morton's Cyclopædia. He says:—

"But another source of far more serious *waste of food* than was imagined has recently been discovered, or at least more satisfactorily explained than heretofore. It is now ascertained that of the food consumed by warm-blooded animals, a considerable portion is expended in maintaining the natural heat of their bodies; which is, in fact, to be regarded as so much fuel which is dissipated by a process strictly analogous to combustion, and the fat, accumulated under certain circumstances, as a store of this fuel laid up for future emergencies. This being understood, it is at once apparent that if fattening-cattle are exposed to a low temperature, either their progress must be retarded, or a great additional expenditure of food incurred. Farmers have long been aware that cattle fatten fastest when kept dry and moderately warm, and they account for this, vaguely, by saying that they are most *comfortable* in such circumstances. But modern science has taught us that it is in this respect with animals as with steam-engine boilers: prevent radiation of heat from the latter by a sheathing of some non-conducting substance, and you get more steam from less fuel; protect the former by suitable clothing or housing—that is to say, keep in their animal heat—and they will eat less, and yet lay on more fat."

Finally, on this point we would remark, that the manure collected in these sheds, which should be regularly cleaned out, will be found useful in top-dressing the grass-lands, much more so than it is when dropped in spots in different parts of the field. The rank coarse grass which springs up from these droppings is lost, and instead of allowing the dung to remain where it fell, it should be spread regularly, which will prevent waste. The plan we have found best adapted for this purpose is to send a boy with a clubbed stick into the fields, perhaps twice in the course of a week, with directions to knock about the half-hardened droppings.

Cattle which have been wintered in yards should not be turned out in spring until the pastures afford a full bite; and if the nights are cold, and the fields not well sheltered by plantations, they should be brought for a time at night into the yards. Sudden changes of temperature, and also of diet, must be carefully avoided as far as possible; and when a change in either case becomes necessary, it should be effected gradually. Exposure to cold easterly or northerly winds is liable to bring on catarrh, or cough; and in some seasons this complaint is so prevalent as to appear epidemic. Rheumatic affections are also common among cattle which are much exposed—the early spring and end of autumn, particularly if there has been much wet, being the seasons when this description of disease is most prevalent.

At one time it was the usual practice, when cattle were about to be put on grass at the 1st of May, to have them all bled, and there are some who still follow this custom. It is, however, quite unnecessary, more especially if the cattle are in good health; and if otherwise, probably bleeding is not the best treatment for them. If they have been reduced by poor keep, bleeding only makes matters worse, by still further weakening their constitutions.

It is of the utmost importance that pasture-fields are well supplied with pure water. In too many instances watering-places are merely stagnant pools filled with mud and filth. Unwholesome drinking-water is most prejudicial to the health of all kinds of live-stock; and among the worst diseases which result from such a state of matters is splenic apoplexy, which almost invariably proves quickly fatal. During the outbreak of rinderpest in 1865-66, various cases which were supposed at first to be cases of cattle-plague were found to be other diseases originating in unwholesome drinking-water; and this, we may remark, was observed in sheep as well as in cattle.

A clear running stream, having a hard bottom, is the best means of watering grass-fields; and where the banks are deep, access should be given to the water by sloping down a portion of the bank in different places. The slope should be paved, or well covered with coarse gravel, to prevent the cattle from trampling the soft earth into mud. Another very good plan for securing pure drinking-water, which we have seen in operation, is as follows: An opening 16 feet in length is made along the course of a main drain, in which there is a constant stream of water. One side of the opening is sloped down, and a perpendicular wall is built on the other, rising a little above the surface of the ground. The sloped part is paved; but instead of allowing the water to flow back over the stones, it is confined into a channel running along the foot of the perpendicular wall. This channel is 16 inches wide, and the water is raised in it to a foot in depth by means of a slate or a small sluice put in at the outlet. The bottom of the channel is paved, and the paving-stones are kept in their place by kerb-stones, which are sunk lower than the paving of the channel. The kerb-stones also rise fully 3 inches above the level of the paving of the slope, so that in paving up to the level of the kerb-stone, a depression is made in the paving of the slope at that part, which has the effect, first, of preventing the cattle from slipping into the channel; and next, urine or other matter is caught in the depressed part, and is let off through an opening in the retaining wall built at the lower end of the watering-place.

If the watering-place in a field is merely a stagnant pool, it is much better to put a fence round it, and sink one or two Abyssinian pumps, according to the extent of the pasture, so that the cattle would get drink out of troughs. It will, of course, require constant attention on the part of the herd to see that the troughs are kept filled.

When a living spring exists at the upper part of a tract of pasture-land, the water may be conducted by pipes to troughs in the field most convenient to the spring, and the overflow from these troughs, being allowed to run into underground pipes, may then be led to troughs in other fields at a lower level. Common draining-pipes will answer for this purpose.

During the summer and autumn, care must be taken to shift the cattle frequently, so that they may have fresh pasture. Keeping cattle long on foul pasture, although the grass may be moderately abundant, is not in their favour.

Another great point to be observed is, to avoid overstocking; the question of profit and loss in summer grazing very often depends on this point.

When the cattle are brought into the yard for the winter, the same course of treatment as that already described will be followed,—with this difference, that as the cattle are now a year older, they will require a larger allowance of food. When cattle are well bred, they are now frequently put up to fatten during the second winter; but in many cases they get another year's grazing, and are put up when two and a half years old, so that they come into the butcher's hand when they are about three years old. When they have been left, in the course of their rearing, chiefly to unassisted nature, they are not fattened until they are between three and a half and four years old; and in many instances, when merely grass-fed, not until they are over four years old. This delay of a year or a year and a half in finishing cattle for the butcher must, therefore, be taken into account when estimating the expense of artificial food given to young cattle for the purpose of keeping them in progressively improving condition during the process of rearing. The cost of rearing a bullock or heifer, according to the mode followed in the cattle-rearing districts of the west of Ireland, until the animal is three and a half years old, when it is ready for sale at Ballinasloe fair on the 1st of October, is given in the 'Review of Irish Agriculture,' from which we have already quoted. It is as follows:—

Value of calf on 1st November	£5	0	0
Keep till next May	1	0	0
Summer keep till 1st November . . .	1	10	0
Second winter's keep	1	10	0
Second summer's keep	2	10	0
Third winter's keep	2	0	0
Keep from 1st May to 1st October . . .	3	0	0
	£16	10	0

This is irrespective of interest on capital, risk, expense of marketing, &c. The above estimate was submitted to several persons interested in the question, and they all agreed that it was a correct and moderate estimate. In fact, from the rise in the value of calves, and other matters, an addition of 30s. to £2 might now be made to it. The average prices at Ballinasloe fair, October 1873, were as follows: First-class oxen, £23, 10s.; do. heifers, £24. Second-class oxen, £18; do. heifers, £19. Third-class oxen, £12; do. heifers, £11, 10s. Taking the second class as representing the bulk of the cattle exposed for sale at the fair, a comparison of the cost of rearing and market value of the cattle at three and a half years old leaves but a narrow margin to cover contingencies not taken into account. All this tends to prove the advantage of generous feeding, when the cattle are of a kind that will profit thereby.

The dentition of cattle is affected partly by the breed to which they belong, and partly by their feeding. A bullock or heifer which possesses early maturity, and has also been well fed, will have dentition much more forward than an inferior or more poorly fed animal. Professor Simonds has given the following tabular view of the dentition of cattle under different circumstances:—

TABLE OF EARLY AVERAGES.

The breed and other causes favouring development.

Yrs.	Mos.	
1	9	Two permanent incisors.
2	3	Four " "
2	9	Six " "
3	3	Eight " "

TABLE OF LATE AVERAGES.

The breed and other causes retarding development.

Yrs.	Mos.	
2	3	Two permanent incisors.
2	9	Four " "
3	3	Six " "
3	9	Eight " "

Highly bred stud bulls are usually kept during summer in well-ventilated boxes, where they are fed on cut grass and other kinds of green forage. When kept in this manner, a bull must get at least two hours' walking exercise daily, and his feet should be well looked after, as the hooves are apt to grow so long as to be inconvenient to the animal. It is a good plan to let the bull have the run of a well-fenced paddock during the day, with a cow or two as companions. Some breeders allow their bulls to run at grass with the cows; and it certainly keeps them in good health to do so, particularly in the case of young bulls; but if the bull is aged, or inclined to be ill-tempered, it is better not to let him go at large.

Bulls which are on service should get artificial food morning and evening; say oilcake or decorticated cotton-cake, crushed oats, and crushed beans or bean-meal, equal parts of each. The daily allowance will run from 3 lb. to 6 or 7 lb., according to circumstances. It is not desirable that the bull should be in high condition, but it is essential that the food given should be of a nature calculated to ensure muscular development.

SECT. III.—FATTENING CATTLE.

In dealing with this branch of our subject, we shall treat, in the first place, of what may be called the natural mode of fattening cattle—namely, by summer grazing; and next, the fattening of cattle during winter on roots and other food.

Pastures may be divided into three classes: (1) First-class pastures, that will fatten heavy bullocks—say such as weigh from 7 cwts. each and upwards—and finish them for the butcher, without any artificial assistance; (2) pastures suitable for fattening light heifers, or cattle of the lighter breeds; and (3) inferior pastures, suitable only for store-cattle.

The extent of land which belongs to the first class is comparatively limited, being confined chiefly to a few counties in England and Ireland. Pastures of the second class are more widely diffused. It is evident that the cattle must be of a suitable description for the particular class of pastures upon which it is intended to graze them for the summer.

It is desirable that the fattening pastures should be cleared of stock during winter and spring, so that there may be a good growth of grass when the cattle are put on at the 1st of May. Some graziers run a few light store-beasts, or wedders, over their grazing lands during winter, and these clear up the rough spots; but the land should be clear for three months at least before the regular stock is put on. Over-stocking must, of course, be avoided. If the pasture becomes bare, the stock must, if possible, be shifted to another field, and a very short time will suffice to restore the first field, so that the cattle may return to it. The droppings should be regularly spread, and any rough spots of grass mowed from time to time, taking care not to cut too much at once, so that the grass so cut may be consumed by the cattle. Sheep should not be run along with fattening beasts, as they eat out all the sweetest parts of the pasture. When the cattle which are put upon the grass at the 1st of May are in forward condition, they will soon be fit to go to market, and the pastures, after a short rest, may then be stocked with a second lot, which may be finished on the grass before the end of autumn, or put up in the stalls to get the finishing touch, or, as Mr M'Combie calls it, "the last dip." All depends upon the feeding nature of the pasture and the system pursued by the grazier. In the event of the pasture not being sufficient to finish a second lot, the fattening process will be materially assisted by giving the cattle from 3 lb. to 4 lb. each, or more, according to circumstances, of oilcake daily, or they may receive a mixture of cake and bruised grain. This is usually done by means of small troughs put down in different parts of the field, and into which the cake is put. In some cases—but this is a bad practice—the broken cake is simply strewed on the pasture, the finer portion being screened out and given to sheep.

In the case of second-class pastures, the use of oilcake and other kinds of artificial food is of great importance. This subject was freely discussed at a meeting of the Central Farmers' Club (London) on 6th of May 1861. The question on the card was—"By what means can the feeding of stock on pasture-land in spring, summer, and autumn be so increased as to supply the demand of an increasing population?" Mr Owen Wallis, of Overstone Grange, Northamptonshire, opened the discussion, and in the course of his remarks he said, when speaking of the use of artificial food, that "one of the main objects gained would be the equalisation of the supplies. Now, at the close of the Norfolk season"—that is, when the supply of winter stall-fed beasts ceases—"there are but few grass-fed beasts ready for market, and beef is very scarce; whereas, in October and November, many more beasts are sent for sale than there is a demand for, and many are sold very badly, and pay little or nothing for grazing. If, however, a portion were got into a forward state during the winter, and were kept improving, in the way I have described, they would be ready for market when wanted. As they are sent away, others that are in the most forward state should take their places; and these, when ready, should go to make room for others. By this arrangement no one lot of beasts would be at expensive food so long as to cause too great an outlay upon them. This part of the feeding process should not exceed six, or at most eight weeks; and that, with beasts sufficiently advanced, would be ample to finish them."

In further describing his system of feeding, Mr Wallis said, that "as to the quantity of cake it is desirable to give, I commence with 4 lb. per day, and finish with 6 lb., giving on the average 5 lb. per day. If this is continued for six weeks, it will amount to 15 stones per head, which, at the average price of cake during the summer, will not exceed 20s. We know from our experience that between a ripe bullock and one that is not well up to the mark there is commonly a difference of more than double that sum in their respective prices, supposing they are equal in size. If, therefore, by an outlay of £1 we receive £2, the investment is profitable. But supposing it to be rather less than this, we must not forget the extra number of beasts that can be so fed on the same quantity of land; and the rent, rates, and taxes being the same in both cases, a further additional profit is thus obtained, to say nothing of the rapid improvement of the soil."

On this last-named point, the improvement of the soil, Mr Wallis gave the following illustration: "Mr Oakley, of Lawrence End, Herts, informs me that he has used the meal of Egyptian beans very successfully. He gives it with straw-chaff cut very fine. By pursuing this plan, and by the improvement of the pasture resulting to it, he now feeds on the same land more than double the number of cattle that he did formerly."

The late Mr Fisher Hobbs, who took part in the discussion, referring to the improvement of grass-land under this system, said that "he concurred in the opinion that the use of oilcake was a very good means of carrying out that object. He had, like many other gentlemen, seen land doubled, and more than doubled in value, in consequence of oilcake to a fair extent having been given to beasts during the summer months. He knew many pastures in this country which would at one time scarcely maintain a fair amount of store-stock; oilcake, however, having been used, it was found that animals fed with grass fattened very well; and within five years, at least ten per cent more animals were fattened upon those very pastures. He was persuaded that oilcake was a simple and comparatively inexpensive mode of improving the grass-lands of this country, and of making lands which were previously store-pastures, with good management fattening-pastures."

Other gentlemen present bore similar testimony as to the results of the system, and Mr Congreve (Rugby) "believed the time would come when farmers would be obliged to use their store-pastures as feeding-pastures. He knew several gentlemen in his own neighbourhood who did so already. They put a bullock upon two acres (statute), gave him 4 lb. of cake upon the store-land, and sent him to market in July; whereas those who were upon the good land did not go until September."

The system of giving cattle artificial food upon grass is therefore one which should become general, although recent experience in bad seasons and low prices for grain has shown that we must not rely so much as formerly for a return through the soil for the outlay on the cake and grain given to the stock. Those who are compelled to sell their beasts in an unfinished state at the end of autumn, would be saved the loss they sustain from their cattle not being sufficiently good to command a paying price. But while this is a matter which affects the interests of the grazier, it also affects the public at large, for it is clear that an irregular supply of meat is not for the advantage of the public; and it is also evident that when the grazier is compelled to sell his beasts before they are fully ready for market, the public are deprived of a considerable proportion of the supply of meat which they are entitled to expect. Their purveyors, the graziers, through mismanagement or neglect of auxiliary means, put the public on short allowance.

We come now to consider the fattening of cattle during the winter half-year; and the first point to which we shall direct attention is a description of the accommodation which must be provided for them. Nor is this a matter of minor importance, because upon it depends in a considerable degree the profitable returns which the feeder is entitled to expect.

There are four distinct modes of housing fattening beasts, which we shall describe in detail :—

First, large courts, with sheds, where several cattle are placed together, but not tied up.

Second, a modification of the court system, or "hammels," as such are designated.

Third, houses in which the cattle are kept constantly tied up ; and,

Fourth, boxes, each box containing one untied animal,— being, in fact, covered pens, in which the cattle can move about at pleasure within a narrow space.

Although large courts with sheds are adapted for the accommodation of young store-beasts, they are not equally well suited for fattening cattle. There is too much room afforded, and all unnecessary exercise causes a waste of the substance of the animal, which must be replaced by an extra expenditure of food. The animals kept in open courts are also exposed to a low temperature, which tends to create a still further demand upon the food, for the purpose of keeping up the natural heat of the body. When the courts are not provided with roofs, as we have seen in some parts of England, the evil is considerable ; and this may be, and frequently is, still further heightened by imperfect drainage, causing wet and uncomfortable standing and lairs, which is scarcely remedied even by a profuse use of litter.

All courts should be provided with sheds 14 feet in width —the length depending on that of the court, or should be entirely covered in or almost so. The roof of those sheds may be supported by stone, brick, or iron pillars in front, or the front may be a wall, with two or three openings, each 6 feet wide, and arched over. The walls surrounding the court should be 5 to 6 feet high, in order to afford as much shelter as possible ; and a gateway 9 feet wide is also necessary, to admit carts when the dung is to be removed. Feeding-troughs, resting on solid mason or brick work, are ranged along the inside of the outer wall, and the turnips are conveyed to these troughs either through a square opening in the wall immediately above the troughs—a close-fitting wooden door shutting up the aperture at other times—or through sloping spouts in the wall. The troughs may be from 6 feet in length to any number of feet required. They are made 2 feet wide and 9 inches deep, and the stone or brick foundation on which they are raised should be 2 feet in height. It is advisable that means should be taken to supply pure water to a trough specially set apart for that purpose in each yard. It is also desirable that a light roof should be put up, of such width as to cover the cattle when feeding at the troughs. A permanent hay-rack should be fixed up against the inside wall of the shed, and movable wooden or iron racks placed outside in the court. A movable wooden straw or hay rack is made 5 feet square and 5 feet high, but the bottom should be at least 1 foot off the ground. The bottom of the court must be paved, or floored with asphalt or concrete, as previously described, and all surplus liquid must be conveyed to the liquid-manure tank. It is essential that the eaves of the sheds be fitted with gutters; and in the event of other water not being easily procured, the rain-water collected by means of the gutters should be preserved in a convenient tank for future use.

The preceding remarks have reference to open courts, or courts partially covered; but a great improvement is effected by putting a roof over the whole area of the court. In constructing covered courts or yards, care must be taken to ensure perfect ventilation, combined with freedom from draught. It is recommended that each bullock should have at least 170 square feet of surface. Cattle in covered courts make equal progress on less food, as compared with cattle in open yards, the saving in food being variously estimated at from $\frac{1}{4}$ to $\frac{1}{8}$—that is, five may be fed instead of four, or nine instead of eight, upon the same amount of provender. As the manure is not washed by the rains, it is estimated that 10 loads made under cover produce an effect equal to that of 15 loads from an exposed yard.

In a paper read before the London Farmers' Club, in November 1885, Mr John Coleman, York, who is well qualified to speak on the subject, pleaded the case of covered courts very strongly. He regarded the manure made in covered courts as worth on an average double that made in open courts, so that in a period of eight months' feeding they had:—

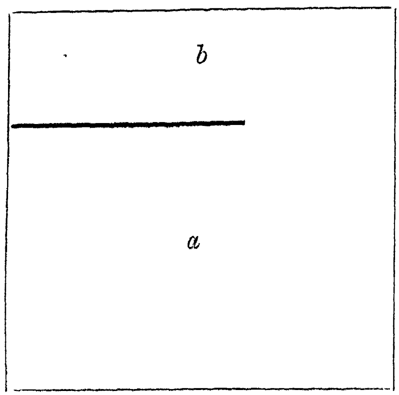
8 tons of covered court dung, at 7s.	£2 16 0
12 tons of open court dung, at 3s. 6d.	2 2 0
Total gain in manure per head	0 14 0
Add savings of carting, heaping, and turning. . .	0 4 0
Savings in manure per head	£0 18 0

Then in litter he estimated that there was a saving equal to £1 per head, and in food a saving of 6d. a head per week over the thirty-two weeks, making a total saving of £2, 14s. per head in the eight months' feeding. As to the cost of the covered courts, he stated that roofs might be constructed at from 2s. 6d. to 6s. 6d. per yard superficial, according to two plans he produced and described, and if they preferred tile, they could make an ordinary framed roof at about 7s. 6d. per yard. Assuming the highest cost, and that 120 square feet were required for each beast, the cost would be £5 per head—13⅓ yards at 7s. 6d. He pointed out that to repay this amount in thirty years, interest and principal, would involve an annual charge, at 6½ per cent, of 6s. 6d. a-year.

Large courts, however, are not, as we have said, so well suited for fattening beasts, and that modification of the system which is known as "hammels" is an improvement. Hammels are simply small yards with covered sheds, and of a size sufficient to contain from two to four head of full-grown beasts. The size of the court, when the dung is taken out by cart and horse, is 30 feet long by 18 feet broad; shed, 14 feet wide by 18 feet long—the breadth of the court. Width of gate, 9 feet to 9½ feet. Hammels of less size may be made with a court 20 feet long by 17 feet broad; shed, 14 feet wide by 17 feet long. The following diagram (p. 150) shows the arrangement—*a* being the court, and *b* the shed.

Each hammel has a turnip-trough in the court, as above described, and a fixed rack for straw or hay in the shed, with a movable rack in the court. Previous remarks as to floors and drainage apply also to hammels. In all cases it is essential that both large courts and hammels should front the south, and as much shelter as possible should be afforded on the other sides, either by the disposition of the farm-buildings, or by means of plantations.

Houses, or byres, in which the animals are kept constantly tied up during the period of fattening, exist in all parts of the United Kingdom; but in many instances the construction of the byres is very faulty.



In the best-arranged cattle-houses there is a passage—3 feet to 3 feet 6 inches wide—at the head of the stalls, for convenience in feeding; and this may be further facilitated by a railway laid in the passage, along which the food is conveyed in a truck, which is shoved by the cattleman from one stall to another until the animals are all fed. In some byres the cattle-stalls are arranged in double rows, head to head, in which case the feeding-passage runs down the centre of the house. In other cases the stalls are arranged in a single line, with the heads of the cattle to the back wall, but separated from the wall by the feeding-passage. In old-fashioned byres the mangers are placed right against the wall; and when such is the case, the food is carried up to the mangers from behind the cattle. Sometimes the cattle are arranged head to head across the house, with the feeding-passage between, each feeding-passage being entered from without by a separate door; and thus there may be two, three, or more sets of cattle, each having a feeding-passage, in one house.

A great defect in many byres is the shortness of the stall or stand, the animals, when such is the case, being often compelled to stand with their hind-feet in the gutter. This is particularly objectionable when the byre is occupied by calving cows. We have no hesitation in saying that many if not most of the cases of "slipping calf" which occur amongst housed dairy cows are caused by the shortness and narrowness of their stalls. The partitions between the stalls are also sometimes too long, and the cattle when lying press against the hind-post, which is very prejudicial to in-calf cows.

The following are the dimensions of the inside fittings and arrangements of a byre for full-grown cattle. Feeding-passage, 3½ feet wide; width of manger, 2 feet; length of stall or stand, 8 feet; length of partition between stalls, 6 feet; height of partition, 3 feet; width of single stall, 5 feet; width of double stall, for two beasts, 9½ feet; width of gutter, 1 foot; depth of gutter, 3 to 4 inches; width of passage behind, 3½ feet; total inside width of house, 18 feet. The width of the passage behind may seem narrow, but practically it is 4½ feet, as it includes width of gutter.

The partitions are sometimes made of flagstone, but wood is warmer. Iron fittings, including posts, mangers, racks, &c., with wooden partitions, are now prepared, and answer the purpose well, besides giving the byre a very finished-like appearance. The stalls and passages are paved or laid in concrete, except in that part of the stall which is immediately in front of the beasts, where their knees rest in the act of rising. In this part the floor ought to be made of clay, well beaten down. Some use mats made of cocoa-nut fibre, which are laid down in front of the cattle, as a protection to the knees whilst rising up.

Sparred floors are occasionally used in byres. These floors are constructed of deals, and for bullocks are 3 inches thick, 4 inches wide, with a space or opening 1⅞ inch wide between the deals. Underneath is a pit varying from 2 to 4 feet deep. This receives the manure, which is allowed to accumulate until the pit is full, when it is taken at once from under the boards to the field. No straw is used as litter, the animal lying on the bare boards. After twenty years' experience of sparred floors, Mr Mechi contends that it is the best system of management. Others who have adopted it also speak well of it, but it has not yet become extensively used; and some, while recommending the sparred floor, consider that cattle manifest evident signs of discomfort until some straw is put under them.

In constructing byres, it is always desirable that they shall be open to the roof, as nothing can be more prejudicial to the health of the cattle than imperfect ventilation, and this is invariably the result when the heated air is prevented from escaping by the roof. Ventilation is sometimes secured by slightly raising a row of slates along the ridge. Another mode of ventilation is to raise one or more structures of wood, roofed with slates, on the ridge of the roof—say 3 feet long, 2 feet broad, and 3 feet high. The sides are occupied by thin boards, placed in a slanting direction downwards, known as louver-boards, and similar to Venetian blinds. A current of air is kept up by small openings in the walls, so placed as not to cause the animals to be exposed to a draught. In some instances we have found a current of air secured by means of an "air-drain"—that is, a small brick dry-drain carried along the entire length of the byre, and through the outside walls into the open air. This drain has a cast-iron cover, perforated with holes, somewhat similar to the gratings placed in churches and other public buildings for the admission of hot air. A drain of this kind may be run along between the rails laid down in the feeding-passage.

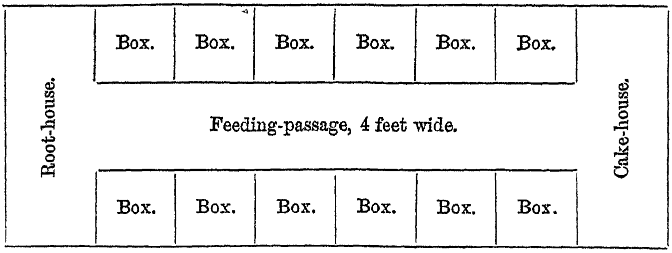
Boxes, as a mode of accommodating fattening cattle, were first brought into public notice, we believe, by Mr Warnes of Norfolk,[1] and the principle has since been steadily gaining ground amongst intelligent agriculturists. A writer in Morton's 'Cyclopædia of Agriculture' thus describes the construction of cattle-boxes:—

"Each box is about 10 feet by 9, or 10 feet square. It is formed either by excavating its area to a depth of 2 or 3 feet below the general level of the floor, or by building a wall to form a pit or well about 3 feet deep, and enclosing this by railed partitions. The litter is allowed to accumulate in the box, the animal treading it into a compact mass. The increase of height is dependent, of course, on the quantity of straw supplied; but with a liberal supply, the rate of increase will not exceed 9 inches a-month. The boxes are arranged in a roofed building, with gangways or

[1] Warnes, On the Cultivation of Flax, &c., 1846.

passages between the rows, for the convenience of access. . . . The feeding-troughs are attached to the posts by wooden pins, which pass through holes bored in the posts at short intervals apart vertically, so that the boxes can be raised as the litter accumulates. The floor of each box is slightly dished, and an eye-stone is placed in the centre to convey the surplus moisture into the manure-drain."

The following diagram shows the arrangement of a number of boxes under one roof:—



There may, of course, be modifications of the plan to suit circumstances. For example, there may be only a single row of boxes, and these may be open in front, above the railed portion. By this plan there is perfect ventilation. We have also seen the principle carried out without any excavation being made, each animal being confined in a strong railed pen, from which the manure was removed daily. In such cases, however, the full idea of the box system was not adhered to, because it goes upon the principle that the manure, when trodden down in the box, and kept for some time in this way under cover, is superior to dung which is removed daily and thrown loosely together in a yard. It is only necessary to empty the boxes twice in the season, but the manure being firmly trodden down does not emit any unpleasant odour. Less straw is required to be used as litter when the box system is followed, compared with feeding in hammels or yards; but it may be remarked that it is considered an improvement to have the straw which is to be used as litter for box-fed cattle cut into lengths of 8 or 9 inches, by a straw-cutting machine constructed for the purpose. When cattle are the subject of experimental comparison with respect to the effects produced by different kinds of food, or the fattening properties of different breeds, the box-feeding system is of the greatest utility; but, even for ordinary purposes, all who have had experience of boxes agree in pronouncing them superior to all other modes of accommodating fattening cattle. Where a breeding herd of shorthorns is kept, boxes may be regarded as indispensable. They afford room to heavy in-calf cows, and avoid risks attending stalls; and when a cow has calved, she and the calf can be more readily taken care of. A bull, also, will always be better in a box than tied up in a stall.

Before concluding this department of our subject, we shall refer to some trials which have been made, in order to ascertain the results of feeding cattle housed in different kinds of buildings.

In the 'Transactions of the Highland and Agricultural Society,' certain experiments are recorded, which were made by the late Mr Boswell of Balmuto and Kingcausie, Scotland, in order to ascertain whether fattening cattle throve better when tied up in byres than when loose in hammels, and the results were most decidedly in favour of the latter. Thus, while eight cattle which were tied up gained during the experiment an additional live-weight of 68 stones 7 lb., the hammel-fed lot, also eight in number, gained 91 stones 8 lb. In Mr Boswell's experiments, four cattle were accommodated in each hammel. The hammel-fed beasts, however, consumed rather more turnips than those fed in the byre; but after deducting the value of the extra quantity of turnips, there was still a balance of nearly 8s. per head in favour of the beasts fed in hammels. Mr Boswell came to the conclusion, from the results of his own experiments, as well as the unanimous opinion of every agriculturist with whom he conversed on the subject, "that there is no point more clearly established than that cattle improve quicker, or in other words, thrive better, in open hammels than in close byres."

Again, in Mr Templeton's report of his experiments, made in 1851, at Clandeboye, county Down, Ireland,[1] it is stated —"That the cattle *in all cases* made the greatest improvement in the hammels. The cost of erecting hammels and byres for stall-feeding will be nearly the same, unless at farm-steadings, where there are walls against which can be

[1] Transactions of the Highland and Agricultural Society.

placed sheds, as has been done here, and which makes the cost of hammels about one-third less than that of houses for stall-feeding. The cattle in hammels use a third more litter than those in stalls, but a third less attendance suffices for the cattle accommodated within them than in stalls. Hence, as far as my experience has gone, it is decidedly in favour of the small hammel, or the box with a small yard, as it may be named, as the best accommodation for feeding cattle. I have accordingly adopted it to a considerable extent, in preference to any other."

The hammels at Clandeboye "were about 12 feet square, and roofed over, having a feeding-trough along the inner back wall." The open courtyards in front of the roofed portion "were also about 12 feet square each, and each had a feeding-trough of 7 feet in length in it, with an entrance-gate in front." Three cattle were accommodated in each of these hammels.

Mr Moscrop, Olliver, Richmond, Yorkshire, has also given the result of his experiments in fattening cattle in stalls, boxes, and hammels.[1] The animals selected for the purpose were twelve shorthorn bullocks 2½ years old, which had been bred on the farm and treated alike in all respects up to the commencement of the experiment. On the 4th of November they were taken from the field, and divided as equally as possible into three lots. Lot 1 were tied up in a well-ventilated byre; lot 2 were placed singly in boxes, each box measuring 10 feet by 10 feet, and the floors sunk 2 feet below the ground-level; lot 3 were placed, two each, in hammels or sheds, having open yards in front. The usual measure was 14 feet by 13 feet, walls 8 feet high, the yards in front being the same size as the sheds; exposure, southern. The temperature was closely noted during the time the experiments were conducted, namely, fourteen weeks, and the mean was as follows:—

Byre	43 and 1.7th°
Boxes	41 and 1.14th°
Sheds	35 and 5.14th°

At first the cattle were all fed alike, with cut turnips and chaff *ad libitum;* each animal having, in addition, 2 lb. of linseed-cake and 2 lb. of Indian corn *per diem.* It was

[1] Transactions of the Highland and Agricultural Society, 1872.

soon ascertained, however, that supplying each lot with food in equal quantities, though possessing the merit of simplicity, showed that the results obtained from such a mode of feeding could not prove otherwise than delusive, as it was found that a supply, ample to satisfy those in the stalls, was barely sufficient for the box-fed animals, and altogether inadequate to satisfy the appetites of those in the sheds. The feeding was therefore varied accordingly.

The following is an abstract of the results:—

Lot 1, fed in byre, gained live-weight, 8 cwt. 3 qrs. 7 lb., at a cost of food and labour of £19, 3s. 10d.; and to produce 100 lb. live-weight cost £1, 18s. 10d.

Lot 2, fed in boxes, gained live-weight, 10 cwt. 21 lb., at a cost of food and labour of £20, 9s. 7d.; and to produce 100 lb. live-weight cost £1, 15s. 10¾d.

Lot 3, fed in hammels, gained live-weight, 10 cwt. 1 qr. 21 lb., at a cost of food and labour of £23, 6s. 11d.; and to produce 100 lb. live-weight cost £1, 19s. 11¼d.

The greatest profit from a given consumption of food was derived, therefore, from cattle fed in boxes; whilst the least profitable mode of consumption was by the cattle fed in hammels.

Mr Moscrop puts the results in another form. "Assuming three-fifths of the live-weight of well-fed bullocks to equal the net weight of beef, we find that beef grown from food of such descriptions, proportions, and values," as those used by him, "costs us in the byre 9s. 0¾d.; in the boxes, 8s. 4½d.; and in the sheds, 9s. 3¾d. per stone of 14 lb.; the difference per stone between the greatest and least cost being 10½d." The dung made in the boxes being superior to that made either in the stalls or hammels, was also an item in favour of the boxes. Another point was the cost of attendance. Mr Moscrop found that with cattle averaging 50 stone dead-weight, and getting full turnips, all cut by manual power, that from 30 to 35 head of stall-fed animals is quite as many as one man can well attend to —the dung being cleaned out twice a-day. In boxes where there is no cleaning out, a man will as easily attend to from 45 to 50 head. In hammels, although there is no cleaning out, yet the space to be travelled over is greater than either to the stalls or boxes; the quantity of litter is also much greater, and more space for it to be spread over, and from 40 to 45 head will be found as many as one man can properly attend to—assuming, of course, that he has all the litter to carry himself. Mr Moscrop estimated the man's labour at 15s. a-week. The quantity of straw required to keep the animals of each lot dry and comfortable was as follows: In byre, 12 lb. per head per day; in boxes, 20 lb.; and in hammels, 40 lb.

Having given the foregoing particulars as to the different modes of housing fattening cattle, we now proceed to the details of management:—

The first point which claims our attention is the character and qualifications of the "cattleman," for on this depends in a great measure the owner's success in preparing cattle for the butcher, and, indeed, in all stages of cattle-rearing. Many persons apparently consider that any man who can carry turnips and fodder to cattle is qualified to be a cattleman. This is a great mistake; and we have reason to believe that many failures in stall-feeding are due to the ignorance and unfitness of the men to whom the feeding of the cattle has been intrusted.

The qualifications of a good cattleman have been well summed up as follows: "A good cattleman makes his business his hobby, takes pleasure in his work, studies the comfort, likes, and dislikes of each animal under his charge, and does for them, of his own accord, what no amount of instruction or supervision could ensure. A man of this stamp is invaluable, and cannot be manufactured by any amount of book-learning given him by a school board. He will detect anything amiss with an animal hours before a mere ordinary observer, and will know when to give and when to withhold, when the food should be increased, and when reduced. And a great difference has often been observed between two lots of cattle having similar treatment, excepting that they were under the care of different men." Mr M'Combie says that a cattleman "must not only know what to give cattle, but the great secret, *what not to give them.*" It is not a business that can be taken up offhand; the man must be thoroughly intelligent and observant, as well as faithful.

Taking up cattle from their pastures to put on turnips should not be delayed until a late period in autumn. Exposure to cold and wet wastes a considerable proportion of the condition acquired during the grazing months, and it will take some time in the stalls to recover the loss. This, of course, causes a greater expenditure in feeding-stuffs. Cattle intended for the Christmas markets should be taken up by the middle of September, or sooner if the nights are cold, and the weather otherwise unfavourable; and all cattle intended for winter fattening should be removed from the pastures before they lose flesh.

It is important that cattle which are intended to be fattened during winter should be in tolerably forward condition previous to being finally put up; and it is a great mistake to purchase cattle which are in low condition for this purpose. A good deal of time is lost, and consequently greater expense incurred, in bringing such cattle forward; and thus the feeder who commences operations with animals in fair condition has the advantage of a start, which, if he conducts his after-operations judicially, will prove of immense advantage to him.

In laying in cattle for winter feeding, it is necessary to form as correct an estimate as possible of the quantity of food which the feeder will have to give them. By using artificial feeding-stuffs and grain, the home-supply of roots and fodder will no doubt be eked out; still it is essential that some idea is formed as to the length of time the home-supply is likely to last. It is a great error to lay in more cattle than the supply of food will be amply sufficient to finish; but it is, nevertheless, a very common error; and for that reason it is by no means unusual to find the fat-stock markets in spring crowded with half-finished cattle, which have just arrived at the point when they would begin to pay for all they had got, but which the owners are compelled to dispose of at a loss, owing to supplies of food running short. It is always safer to under-estimate the number of cattle that can be wintered or fattened on a farm, than to over-estimate the number; and if supplies of food are likely to be plentiful in spring, it is usually easy to lay in half-finished cattle to use up the extra food as the lots of fattened beasts are sent to market, and thus make way for others. It is a very good plan, when there is abundance of food in spring, after the first lots of heavy cattle have gone to market, to lay in a lighter class of animals—say light well-bred heifers—which can be easily fattened before the supply of roots is exhausted, or, if necessary, finished fully by a short run on the pastures.

The supply of turnips intended for cattle should be drawn and stored by the middle of December at furthest. Mangels must be lifted and stored earlier than swedes, as they are more liable to injury from frost. Many persons leave the turnips in the field until spring, merely bringing home at one time sufficient to last the cattle for a few days. This is a slovenly and also a wasteful practice. When turnips are allowed to stand in the field until a fresh growth is begun in the stems, the value of the bulb for feeding purposes is much impaired, from the circumstance that, when the root arrives at that particular stage, certain of its best constituents become changed into indigestible woody fibre. Besides this consideration, it has been proved that cattle thrive better on turnips which have been stored at the proper time, than on turnips drawn from the field day by day as required.

Mr James Porter, Monymusk, Aberdeenshire, has given, in the 'Transactions of the Highland and Agricultural Society,' the details of an experiment which proved the superior feeding value of stored turnips over those drawn fresh from the field. Mr Porter states that he had eight cattle, rising two years old—crosses between the Aberdeen and shorthorn breeds,—which he selected for experiment. They were weighed on the steelyard, and divided into two lots, as nearly equal in weight and quality as circumstances would permit. One lot was put on stored turnips, and the other on the same kind of turnips pulled and drawn from the field, load by load, as the cattle consumed them, all clear of tops and tails. The feeding-byre was roomy and well ventilated, and contained four double stalls, two for each lot; so that the animals were kept perfectly separate. Both lots of cattle received equal quantities of turnips daily —nearly as much as they could eat—with oat-straw *ad libitum*, for a period of 48 days, when it was found they had consumed 28½ tons of turnips, or an average of 95 lb. per day for each beast. The result was a balance of 119 lb.

increased weight on the lot fed on stored turnips, above the increase in the weight of the lot fed on freshly drawn turnips; while the lot fed on stored turnips had a more healthy appearance, and, as Mr Porter states, "presented a striking contrast" to those fed on freshly pulled turnips, which, he says, "were dry in their coats, and lanky in appearance."

There is another important consideration in favour of storing turnips—namely, those who leave out their turnips and draw them only as they are required, not only poach the land by carting on it during wet weather, but also run the risk of finding their supplies falling short should a snowstorm set in, or of being obliged to give frosted turnips to their cattle—than which nothing can be worse for the animals. Mr M'Combie says: "It is a sorrowful sight to see a gang of men with picks taking up turnips in a frosty day, leaving a third of the produce on the land, and the turnips going before your bullocks as hard as iron." When turnips are taken up and stored at the proper time, and during dry weather, very little dirt adheres to them, so that the cattle get them clean as well as fresh. This is not the case when the turnips are drawn day by day from the field; and when this practice is pursued, the cattle are obliged to swallow a considerable quantity of wet earth along with the roots, which is not desirable.

It is a difficult matter to clean a large quantity of dirty turnips, which is, no doubt, the reason why it is so seldom attempted. The following is a quick and efficacious mode of which we have had experience: A small stream which passed the farmyard was dammed at a little distance above the buildings, by means of an ordinary wooden sluice, and the turnips were carted and thrown into the bed of the stream immediately below the sluice. When the sluice was opened, the force of the water carried the turnips along with it, rolling them over the paved bottom of the stream, until they reached a grating close by the door of the root-house, which prevented them from being carried further; and the sluice being shut down, or the water collected having been run off, the roots were left in a perfectly clean state, and were easily thrown out, as the water speedily passed away. Of course, every farmyard is not so situated as to have a stream which could be turned to account in this way.

The quantity of turnips consumed by fattening animals varies according to their size, and the quality of the roots. At the same time, even in a level or equal-sized lot, some animals will be found to consume more than others. As a general rule, cattle which will weigh when fat from 5 cwt. to 6 cwt. will consume from 10 to 12 stones each of turnips per day; and cattle that will weigh from 8 cwt. and upwards will use 14 to 16 stones, or even more, per day—that is, when fed solely on turnips and straw, which is now seldom, and never should be, practised. That the quality of the roots has an effect on the consumption will be seen from the following statement, given by Mr Porter in the 'Transactions of the Highland and Agricultural Society.' The object of Mr Porter's experiment was to ascertain the feeding properties of turnips grown on different kinds of manure—namely, (1) guano; (2) farmyard dung; and (3) a combination of dung and guano. The cattle were selected so as to be as nearly equal as possible; and the result was, that the lot fed on turnips grown on guano consumed on the average daily during three months 157 lb.—11 stone 3 lb. for each beast; those fed on turnips grown on dung consumed daily 125 lb. each—say 9 stones; and those fed on turnips grown on dung and guano consumed 134 lb. each per day, or 9 stone 8 lb. The dead-weight of Mr Porter's cattle, when fat, varied from 7 to 9 cwt.—two in each lot being bullocks, and the third in each lot heifers, all 2½ years old. The quantities named were freely given in former years, but recent experience has shown the advantage of greatly lessening the allowance of roots.

It is of the utmost importance that cattle which are put up to fatten should be gradually accustomed to the change of food. Only a very few turnips should be given at first; and, in general, it is not advisable to give the cattle a full supply of roots until about a fortnight after they have been tied up. Caution with regard to this matter is necessary, because even a moderate quantity of roots may prove too much for the digestive powers of some animals, and thus produce irritation of the bowels and purging. When this effect is produced the allowance of turnips must be lessened, until such time as the digestive organs become accustomed to the food, when the quantity given may be gradually increased.

Fattening cattle are fed three times each day—namely, in the morning, at noon, and at sunset. Regularity in giving the meals is essential, for if this is neglected cattle become restless, and do not fatten well. All unused food found lying before the cattle must be taken away, and the troughs cleaned out, before a fresh meal is given. Unused straw or hay can be given to the younger cattle. The roots are usually given at the morning and evening meals, and other foods at noon. The turnips are sliced before they are given to the cattle; and when they have consumed their allowance, the houses are cleaned out, a fresh supply of straw or hay put before them, the litter freshly made up, and they are then left to rest and ruminate quietly until the next feeding-time. The cattleman should look through the byres every night at eight o'clock, and any bits of turnips left in the mangers should be removed, which will prevent any risk of an animal choking during the night. A moderately warm temperature should be maintained in the houses, but it need not exceed 55 degrees, and at the same time a constant supply of pure air must be kept up. Some writers have gone the length of recommending that the houses in which cattle are fattened should be artificially heated to a much higher temperature than that which we have stated; but we consider that it would be injudicious to do so. When cattle are tied up they ought to be daily dressed with a curry-comb, because they are prevented from cleaning their skins as they would do if left loose. This should not be done, however, whilst the animals are in the act of feeding, as it rather annoys them to be curried when so engaged.

Although cattle are fattened largely on turnips and straw in different parts of the kingdom, particularly in the north, it has been found impossible to pursue a similar system of fattening in other localities, owing to the inferior feeding value of the turnips grown in those districts. As a general rule, however, it has been held that, on an average, one ton weight of turnips will produce 14 lb. of beef and tallow. When different varieties of roots are grown for the use of fattening cattle, the least nutritious should be first used. Aberdeens should therefore precede swedes in the order of consumption. Globe and other soft-fleshed varieties should be reserved for the young stock, unless, perhaps, a few laid down on the grass before the cattle that are intended to be fattened are finally taken up from the pastures. Mangel-wurzel should be retained until the last, as the roots improve by keeping, when stored in time, and lose that acrid quality which they possess when first pulled, and which produces severe purging in cattle when mangel is given fresh from the field.

A few items from Mr William M'Combie's account of his experiences as a feeder of fat cattle will be found interesting and useful.[1]

"I sow annually from twelve to sixteen acres of tares, and about 1st July save a portion of the new grass full of red clover; and from the 1st to the 20th of August both tares and clover are fit for the cattle. I have for many years fed from 300 to 400 cattle; and if I was not to take them up in time I could pay no rent at all. A week's house-feeding in August, September, and October, is as good as three weeks' in the dead of winter. I begin to put the cattle into the yards from the 1st to the middle of August, drafting first the largest cattle intended for the great Christmas market. This drafting gives a great relief to the grass-parks, and leaves abundance to the cattle in the fields. During the months of August, September, and October, cattle do best in the yards, the byres being too hot; but when the cold weather sets in, there is no way, where many cattle are kept, in which they will do so well as at the stall. You cannot get loose-boxes for 80 or 100 cattle on one farm. I generally buy my store-cattle in Morayshire. They have all been kept in the straw-yard, never being tied. When the cattle are tied up on my farms, a rope is thrown over the neck of the bullock, the other end of the rope is thrown over the stake; two men are put upon it, and overhaul the bullock to his place. When tightened up to the stall, the chain is attached to the neck and the beast is fast. We can tie up fifty beasts in five hours in this way. When tied, you must keep a man with a switch to keep up the bullocks. If you did not do this you would soon have every one of them loose again. They require to be carefully watched the first night, and in three days they get quite accustomed to

[1] Cattle and Cattle-Breeders.

their confinement, except in the case of some very wild beast. I never lost a bullock by this method of tying up. This system is like other systems—it requires trained hands to practise it.

"I never give feeding cattle unripe tares; they must be three-parts ripe before being cut. I mix the tares when they are sown with a third of white peas and a third of oats. When three-parts ripe, especially the white peas, they are very good feeding. Fresh clover, given along with tares, peas, &c., forms a capital mixture. I sow a proportion of yellow Aberdeen turnips early to succeed the tares and clover.

"In a week or ten days after the first lot is taken up from grass, a second lot is taken up. This is a further relief to the pastures, and the cattle left in the fields thrive better. This taking up continues every week or ten days to the end of September. At this period all feeding cattle ought to be under cover that are intended to be fattened during the succeeding winter. The stronger cattle are drafted, and the lesser ones are left till the last *cull* is put under cover. From August till November a man may take care of thirty cattle very well, or a few more, if the cattle are tied; but when the day gets short, twenty to twenty-five are as many as one man can feed, to do them justice.

"I change the feeding cattle from tares and clover on to Aberdeen yellow turnips, and afterwards to swedes, if possible by the middle of October. I do not like soft turnips for feeding cattle. The cattle that I intend for the great Christmas market have at first from 2 lb. to 4 lb. of cake a-day by the 1st of November. In a week or two I increase the cake to at least 4 lb. a-day, and give a feed of bruised oats or barley, which I continue up to the 12th or 14th of December, when they leave for the Christmas market. The cake is apportioned to the condition of the different animals, and some of the leanest cattle get the double of others which are riper. The cattle being tied to the stall places this quite in your power, while in the straw-yard it could not be done.

"The method I adopt as to using cake and corn is the following: On the different farms where I feed the cattle I put a fourth part of their number only on cake and corn at one time, and six weeks (which is about my limit of time for cake and corn, &c., paying the feeder) before they are to be sent to the fat market. When the six weeks are expired they are sent away; another fourth part of the original number take their place, and get their six weeks' cake. When they leave, the other cattle in succession get the same treatment. When turnips are plentiful, the system works very well. The cattle draw beautifully, week by week, from the different farms, and come out very ripe. I may mention that all the cattle I graze are generally kept during the previous winter upon as many turnips as they can eat, and are in high condition when put to grass. . . . In Aberdeenshire I consider that a large bullock ought to pay 25s. to 30s. a-month for keep, if he is properly treated. We often get less, and sometimes a little more, owing, in some measure, to the way in which the cattle are bought, the price of beef at the time, the season of the year the cattle are bought, and the time they are sold."

In the preceding remarks we have referred to turnips as the principal article employed in fattening cattle for market. In former years, roots no doubt were the principal article of cattle food in many parts of the country; but now, as already remarked, they are being used in much smaller quantities. Various auxiliaries are used, in order either to hasten the process of fattening, or to eke out the supply of roots. The nature of the different articles used as the food of live-stock has been described in a previous chapter. It is unnecessary, therefore, that we enter afresh into that subject; but there are some other points connected with the fattening of cattle to which we shall briefly direct attention.

Whilst the food of fattening cattle is usually given in a raw state, some feeders have considered it beneficial to give at least a part of it cooked. Others, again, have not discovered any perceptible advantage from the use of cooked food; and it must be acknowledged that the evidence regarding its use is somewhat of a conflicting nature. As our remarks would be defective on this branch of our subject were we to pass over the question of raw *versus* cooked food without special notice, we shall present our readers with a brief summary of certain practical details, which, from time to time, have been laid before the public, believing that in this way we shall be doing the most service to them, by putting them in possession of facts which will enable them to try and judge for themselves as to the suitability of either mode of procedure.

The effects of prepared food in feeding cattle, as distinguished from those produced from the same kinds given in a raw state, formed the subject of a premium offered by the Highland and Agricultural Society many years ago, and in consequence of that premium, various experiments were instituted and reported. In all cases the results were unfavourable to the use of steamed food. Thus, Mr Walker, Ferrygate, East Lothian, selected six heifers, which he divided into two lots of three heifers each. The food in both cases consisted of as many swedes as the cattle felt inclined to use, with 20 lb. of potatoes, 3 lb. bruised beans, and 2 oz. of salt, to each beast. For the lot on cooked food those materials were prepared by steaming, and it was found that this lot consumed fully one-half more turnips than the lot which got the turnips in a raw state, besides the natural loss of weight in turnips which followed steaming. The result showed a loss on each heifer fed on the steamed food, whilst those on raw food returned a profit. Mr Boswell of Kingcausie, in Kincardineshire, and Mr Howden of Lawhead, East Lothian, reported, generally, similar results; but it must be observed that in those cases the lots fed on cooked food received this and nothing else, except straw.

But although those experiments show that the attempt to fatten cattle solely on cooked food is unprofitable, they do not determine the question whether a portion of the food may not be given with advantage in a prepared state. With reference to this point, therefore, we find that the lengthened series of experiments made by Colonel M'Douall of Logan, showed, amongst other things, that one feed of cooked food per day, with two feeds of raw swedes, returned the most profit, more so than three feeds of raw swedes; but when two feeds of cooked food were given, and only one feed of raw swedes, there was a loss. The food consumed daily by each animal when two feeds of turnips and one feed of cooked food were given was as follows: 84 lb. of swedes, and one feed of cooked food at noon, consisting of 3 lb.

cut straw boiled along with 3 lb. of bean-meal—the latter, the bean-meal, being increased towards the conclusion of the experiment to 5 lb. daily. The same kind of cooked food was given to the lot which was allowed two prepared feeds per day, but in this case the daily quantity of turnips consumed by each amounted to only 42 lb.

On referring to the report of a discussion which took place at a monthly meeting of the Highland and Agricultural Society, held in 1850, we find Mr Kennedy, who then occupied the farm of Myremill, Ayrshire, stating that he found "a bullock of 7 cwt. requires from 60 to 70 lb. of cut swedish turnips per day, and along with this, from 16 lb. to 20 lb. of cooked food, consisting of 1 lb. of linseed or 2lb. of oilcake meal, converted into mucilage by boiling, which is then poured over a mixture of 2 lb. bean-meal, 2 lb. bruised barley or oats, 10 lb. to 12 lb. of hay, a stone of chaff, and some salt, well mixed together, and allowed to lie for two or three hours, that the dry ingredients may absorb the mucilage." Under this system of feeding, he stated that his cattle throve better than when a large quantity of turnips was given without the prepared food. Mr Ogden, Berryhill, Northumberland, gave each of his fattening cattle "2 lb. of oilcake, 2 lb. of bean-meal, 4 lb. of cut straw, and 1½ oz. of salt daily. In preparing this mixture, to serve 24 cattle for 24 hours, 48 lb. of oilcake, 48 lb. of bean-meal, 96 lb. of cut straw, and 30 oz. of salt, are, in the first place, well mixed together in a trough; 36 gallons of boiling water are then added, after which the whole mass is well turned and incorporated together and pressed down, and in an hour or two is quite ready for the cattle." The mixture is prepared by the cattleman every forenoon, and keeps quite sweet for 36 hours. He found that when cattle got a daily feed of this mixture they consumed "1 cwt. of turnips less per day than when fed upon turnips alone." Mr Marshall of Holm Lodge, Yorkshire, has described the results produced by a preparation of boiled linseed, ground corn, and cut straw, given in conjunction with raw turnips.

"The crushed linseed is boiled in water—1 lb. of linseed in 1½ gallon of water—for two or three hours. The ground corn and chopped straw are mixed together first, and the boiled linseed is poured over them and mixed with them, on a floor, with a shovel; the heap allowed to stand one or two hours, and given while yet warm; for, if allowed to stand a few hours, the mass ferments and quickly turns sour. Hence the necessity for the strictest cleanliness in all the vessels and implements made use of."

The allowance given daily to heifers weighing 6 cwt. is "2 lb. crushed linseed, 5 lb. of ground corn, 10 lb. of chopped straw, and about 80 or 90 lb. of yellow bullock turnips, with a little straw, not cut, placed in the rack at night." The cattle were fed four times a-day, alternate feeds of raw turnips and prepared food being given.

We have already referred to pure linseed as food for cattle, and its use as such was most enthusiastically advocated by Mr Warnes of Norfolk, whose object was to show that a more profitable description of food was to be found in the produce of our own soil, by the combination of linseed with ground corn, than we obtain by the use of imported oilcake. We shall give a few extracts from Mr Warnes's work, merely to show his mode of preparing cattle-food.

"The seed [linseed] must be first reduced to fine meal—1½ lb. of which, stirred into 12 lb. of water while it is boiling, with 4½ lb. of barley, bean, or pea meal, and given to a bullock of between 40 and 50 stone [5 cwt. to 6¼ cwt.] every day, will, in addition to swedish turnips, be quite sufficient, or perhaps more than he would be inclined to eat. This small quantity of linseed will act well on the stomach, and the bullocks will thrive and fatten in a degree that can scarcely be credited, except by the person who tries the experiment. In no instance has it failed. The quantity of seed may be increased after the animal has been accustomed to it for some time, but, I believe, to no great extent. I have reduced this to a certainty from repeated tests; therefore, as oil is stored so abundantly in linseed, I think I may fairly attribute the failure of those who have so freely condemned the use of both oil and seed to a want of proper inquiry into, and a prudent and systematic employment of, their extraordinary fattening properties."

Again:—

"Either potatoes, carrots, turnips, or mangel-wurzel, boiled and incorporated with linseed-meal, form a compound upon which cattle fatten with great rapidity. To make it, nothing more is required than to fill the copper with washed potatoes, carrots, &c., sliced. Supposing the copper would contain eight or nine pails of water, let only one be added. In a few minutes the water will boil, and the steam will speedily cook the roots; then a convenient portion should be put into a stout-bottomed trough, with a little linseed-meal, and mashed with the rammer, while a boy turns it over. The remainder must be prepared in the same way. As the mass increases in the tub, it should be firmly pressed down, in order that it may retain the heat as long as possible. The length and size of the rammer ought to be adapted to the height and strength of the person employed. It will be found convenient to have two or three at hand, varying from eighteen inches to two feet long, tapering, and from four to six inches square at the bottom. A pin should be passed through the top, for the convenience of being worked with both hands."

Mr Warne's method of making what he called his bullock compound is as follows:—

"Put 150 lb. of water [15 gallons] into an iron boiler, and as soon as it boils, not before, stir in 21 lb. of linseed-meal; continue to stir it for about five minutes, then let 63 lb. of barley-meal be sprinkled by the hand of one person upon the boiling mucilage, while another rapidly stirs and crams it in. After the whole has been carefully incorporated, which will not occupy more than five or ten minutes, cover it down and withdraw the fire. The mass will continue to simmer from the heart of the caldron, until the meal has absorbed the mucilage. On this compound being removed into tubs, it must be rammed down to exclude the air, and prevent it turning rancid. The compound will keep a long time if properly prepared. The consistency ought to be like clay when made into bricks."

Mr Warnes afterwards added pea and barley straw, cut into chaff, to the compound. The merits of this compound, in comparison with oilcake, were tested on different occasions, but particularly in connection with a challenge offered by the North Walsham Farmers' Club; in consequence of which, Mr Postle of Smallburgh determined to try it on twelve bullocks, divided into two lots, one lot being fed on compound, and the other on foreign oilcake. Each lot was also allowed as many turnips as they could consume, which however, were all weighed, in order that accurate accounts might be kept, both of the quantity and cost of food consumed in the experiment. The result was that the compound-fed beasts produced 38 stone 6 lb. more meat, fat, &c., than the oilcake-fed lot; and there was also a considerable difference of expense in favour of the former, as the lot fed on compound consumed less turnips than those fed on oilcake, the compound costing altogether £19, 6s. 1½d., whilst the cost of the oilcake used by the second lot was £21, 14s. 9d.[1]

From this, as well as the other experiments which we have quoted, it will be seen that a portion, but not the whole, of the food given to fattening cattle may be cooked with advantage. Cattle which have been fed solely on cooked food have, no doubt, been found to fatten rather more rapidly than those fed on raw food, or with only a portion of the daily ration cooked; but the increase in weight in the former case has not been sufficiently great to counterbalance the extra expense incurred in cooking.

There is no doubt that since pulping roots has been introduced, cooking food for fattening cattle is less frequently practised. It is useful, however, to know how it may be done, and occasions may frequently arise when the system, perhaps in a modified form, may be followed with advantage. In such cases, we know from experience that the compounds recommended by Mr Warnes will be found useful.

Having already described, in a previous chapter, the preparation of food by pulping, and its results, we need not return to the subject in this place. Nevertheless, before concluding this section, we shall give a general view, in a concise form, of the kinds and quantities of food used by various persons when fattening cattle for the butcher.

Mr Templeton.—84 lb. turnips (Aberdeens or swedes), 14 lb. of hay, and 3 lb. of oilcake per day.

Mr Mechi.—2 cwt. cut swedes, 7 lb. of oilcake, 3 lb. of boiled linseed, 1 lb. of barley-meal, and 12 lb. of chaffed wheat-straw.

[1] On the Cultivation of Flax; The Fattening of Cattle with Native Produce; Box-Feeding; and Summer Grazing. By John Warnes. London: 1846.

Mr M'Laren, Inchture.—Two feeds per day of turnips, whole or pulped—in the latter case mixed with chaff and fermented—and one feed of prepared food, consisting of chaff, mixed with 2 lb. bean-meal, 2 lb. of linseed-meal, and ½ lb. of treacle for each beast. The treacle, bean and linseed meal, were first mixed with as much hot water as served sufficiently to moisten the chaff, the whole being placed in a steam-chest, along with any refuse of cabbage or turnip tops, and strongly steamed the day previous to being used. Straw, as much as the cattle could eat.

Mr Simson, Cloona Castle.—11 stones (154 lb.) turnips given at two feeds, first at 5. 30 A.M., and second at 2 P.M. At 11 A.M., a feed consisting of crushed grain and 2 lb. of oilcake; a little hay, and plenty of oat-straw or wheat-straw.

Mr William Little.—Turnips, 4 or 5 lb. of meal, and 2 or 3 lb. of good oilcake.

Mr George Murray, Elvaston Castle, Derby.—From 1st October to 1st March, 4 lb. of linseed-cake, and 1 bushel of cut roots, with plenty of cut straw, chaff, and a little hay. On 1st of March the cake was increased 6 lb., with the addition of 6 lb. of bean and barley meal.

Mr V. Parsons, Slough Farm, Monmouthshire, second prize farm, R.A.S.E., 1872.—Cattle turned two years, 2 lb. of cotton-cake and 1 lb. of linseed-cake per head daily on grass. When brought in for the winter, cut swedes or mangels in spring three times a-day, 3 lb. each of linseed-cake or cotton-cake, and mixed meal (wheat, barley, and peas) once a-day, given along with chopped clover. One feed daily of the whole clover (hay) is also given.

Mr M. Spencer, West Aberthaw, Cowbridge, highly commended farm, 1872.—Cut roots, hay, and 4 lb. each daily of linseed-cake or cotton-cake.

Mr Rees Thomas, Aberthaw, Cowbridge, highly commended farm, 1872.—pulped roots and chaff, given fresh, and 5 lb. to 6 lb. of cake, mixed occasionally with crushed corn.

Mr James Murray, East Barns, Dunbar.—Whole turnips and hay or oat-straw for about three weeks, when they get a little barley-meal and bran with the roots as a preparation for cake, the allowance of which commences with 2 lb. per head *per diem*, and is gradually increased, as found desirable, to about 6 lb., to feed the beasts off as fast as possible.

Mr George Hope, Fenton Barns.—The steers are put on turnips, with a little meal and salt; and in about six or eight weeks they begin with 3 lb. of cake per day, increasing ultimately to 6 lb. They are frequently given as many small potatoes as they can eat, so that they do not consume a very large quantity of turnips. Mr Hope has in this way consumed nearly 300 tons of potatoes in a season.

Mr Bryce Wright, Dowhill, Girvan, Ayrshire, has adopted a system of soiling, as follows: From thirty to forty two-year-old bullocks, shorthorn crosses, are bought in the beginning of March, and put into boxes and yards. Their food consists of swedes or potatoes, with about 3 lb. per day each of cake or corn, generally the former. They begin with swedes, roughly cut, and continue them as long as they last, afterwards getting washed potatoes. In about two months soiling is commenced, the cattle being kept single as much as possible, and in loose-boxes. At the commencement of soiling, the grass is cut morning and evening as required, and given fresh immediately after each cutting; but in the summer one cutting *per diem* is considered sufficient, if the quantity required for the second meal is protected from the sun. In addition to the grass, the beasts get at least 3 lb. of cake each *per diem*, and plenty of straw; and they are fed thus three times a-day at regular hours, being also well supplied with water. These beasts generally go off during July, or by the 1st of August at the latest, and their places are supplied by drafts of another lot which are bought in April, and are kept in fold-yards until places can be found for them in the boxes. Mr Wright considers that by the soiling system, under his circumstances, and especially in his climate, he can feed three times the number of beasts that he could by pasturing. There is no waste of grass, and the extra expense of cutting and feeding is very trifling. The soiling treatment of the second lot continues until turnips come in, because additional cuttings of "seeds" can always be obtained in a moist climate by judicious top-dressings.

The foregoing illustrations have been derived from various reports in the 'Transactions of the Highland and Agricultural Society,' and in the 'Journal of the Royal Agricultural Society of England.'

SECTION IV.—MILCH COWS.

Whether we consider the produce of the milch cow in its natural state, or when it has been manufactured into butter or cheese, it must be regarded as an object of considerable importance in the domestic economy of every family. It is, in fact, one of the necessaries of life; and this holds good with respect to all classes of society. Hence it is evident that the treatment of the milch cow is a matter of even more than ordinary importance; but although such is the case, this class of cattle is frequently subjected to great hardships, instead of being cared for in the manner which the interests of the owners would certainly dictate.

Before proceeding to describe the best and most profitable mode of treatment for milch cows, we shall briefly direct attention to certain radically defective systems of management which are pursued in some parts of the kingdom.

If we may judge by the manner in which cows are kept in some districts, especially during the winter and spring months, we must conclude that their owners take it for granted that our domestic animals are in no wise different from the wild races which have never been brought into subjection by man. In those districts, therefore, where a primitive system of keeping dairy cows is followed, we find that the cows are seldom housed, or even sheltered in a yard, during the inclement part of the year. They get some hay, but roots are not grown for their use, nor is artificial food of any kind supplied to them. One-half the extent of the dairy farms where the cows are treated in this manner is devoted to their summer grazing, while the other half (old grass) supplies hay for their keep during winter. It requires at least 1½ ton of hay to winter a cow kept in this manner; and each cow must have from 3 acres to 5 acres imperial, according to the nature of the land, for summer and winter keep. This is much in excess of the extent of land required where a portion of the farm—say one-third—is devoted to the production of roots and other crops.

But the primitive system of cow management has other disadvantages. Cows which have been wintered out of doors are found to be greatly reduced in spring, and it takes a long time, therefore, before they recover condition sufficiently to enable them to yield anything like a full flow of milk. There is also great uncertainty about their bulling; and many never prove in calf, and have to be sold off as barren cows, or "strippers," as such cows are called.

In other cases, the dairy cows have nominally the shelter of a yard at night during winter; but the yards are allowed to become overflowed with water, and being but scantily littered, the cows never have a dry lair. It seems astonishing that such practices should be followed, considering the great value of dairy produce, and the certainty that the amount of produce obtained from cows is greatly influenced by the manner in which they are kept throughout the year. It shows how pertinaciously people will cling to old-fashioned ideas, which are totally unfit to meet the requirements of the age. And we may here remark that, in mostly every dairy-farming district, where pasture is the leading feature, there is much room for improvement in the management of the land as well as in that of the stock. The pastures in such districts would be vastly improved by a regular system of manuring; but the land is so frequently saturated with stagnant underwater that it is useless applying manures on the surface. As a rule, thorough draining is little known or practised in purely dairy-farming districts.

Cows go about 280 days in calf, and it is usually arranged that they shall calve during the spring months; and their treatment during the previous winter should be of such a nature as will keep them in good fresh condition, but still not such as will force them into a high state of flesh. Where in-calf cows are fairly wintered, it is generally considered that sweet oat-straw or hay, with 3 or 4 stones of roots per day, is sufficient to keep them in fresh condition. To this a daily ration of 2 or 3 lb. of oilcake or rape-cake may be added, as such food will be found not only to maintain that condition which is necessary to render the animal profitable afterwards, but also to preserve her general health and secure her ultimate safety, by the gentle and regular effect it has upon the bowels. It must also be borne in mind that the food given to the in-calf cow has a double duty to perform; and if the mother is not sufficiently sustained by food of a suitable nature, her offspring as well as her milk-producing powers, will be affected. There is a greater waste going on in the pregnant cow than there is in the barren animal, and this waste must be met by sufficient supplies of suitable food. It is strange that these self-evident facts should be overlooked by those who reduce their in-calf cows almost to starvation-point by exposing them to all the vicissitudes of the weather, combined with a scanty supply of food which is not of a nourishing nature.

Cows are fed three times each day; and in regulating their feeding, it should be observed that roots should never be given as the first feed in the morning, unless they have been pulped and given in a semi-warm state. When this is not the case, the first food given in the morning should consist of straw or hay. Cold roots, when eaten greedily by pregnant cows, are apt to produce injurious effects on the system; and the same may be said of cold, and especially frosty, water, if they are allowed to drink freely of it before being fed. Many cases of "slipping calf," or abortion, have been due to these causes. Cows are at all times, and particularly when in calf, remarkably sensitive; and we often find in their case that, from causes which are frequently regarded as trivial, very baneful consequences will arise. They must therefore be guarded from every species of annoyance, as well as all kinds of rude handling. An ill-tempered "cow-man" is utterly unfit for his office; and driving cows with dogs, whether they are in calf or in milk, should be strictly prohibited. The use of whips or sticks should not be permitted, and cows should never be turned into a field to graze along with young horses.

Many farmers keep their cows closely confined to the house all winter, but moderate exercise is beneficial to in-calf cows, provided they have quiet; and this may be obtained by turning them out for two or three hours daily into a dry sheltered field, when the weather is not inclement.

Some cows evince so great a tendency to run to flesh, that they will get into high condition even on a very moderate description of diet. In such cases, the food given must be carefully regulated; and usually some sweet hay, night and morning, with the run of a sheltered paddock during the day, will be all that is required. A dose of purgative medicine should also be given ten days or so before calving, and cows in very high condition may also be bled, so that any tendency to inflammation, resulting in milk-fever, or "dropping after calving," may be prevented. The best medicine which can be given in such cases is 1 lb. of Epsom salts with an equal weight of treacle, and a table-spoonful of ground ginger, mixed, and given in warm gruel. A similar dose may be given soon after calving, if the cow is in high condition; and, in fact, it is a safe precaution to give purgative medicine after calving, unless the cow is poor and weak.

After the cow has calved, her food must be improved, and its quantity increased. Besides a small daily allowance of roots—which should be pulped, if possible—the cow should get linseed or oil cake, or palm-nut-meal, barley-meal, Indian meal, &c., with some bean-meal or pea-meal. The cost will be amply repaid in the extra yield of milk. A portion of the food is frequently cooked by boiling or steaming roots along with chaffed hay, to which may be added any of the different kinds of meal already mentioned, which ought always to be well cooked, the mess being thoroughly mixed, and allowed to stand a few hours, until it becomes lukewarm, before it is given to the cows. About 2 ounces of salt for each cow may be mixed with the food. Professor Johnston recommends "a mixed hay-tea and pea-soup" as being excellent for making cows give milk. This is "prepared by putting hay (chaffed) into a pot in alternate layers, sprinkling between each a handful of pea-meal, adding water, and bringing to a boil." It may also be prepared by mixing the ingredients in a large tub or box, furnished with a close-fitting lid, which is put on after boiling water has been poured over the materials: cabbage-leaves, fresh turnip-tops, and rape (chopped) may be strewed through a mess of this kind, and steamed along with the other materials. The quantity of food given at a meal must be regulated by the appetite of the several cows. Some will eat more than others; but whatever portion of the food is not eaten within a reasonable time should be removed and given to the store-beasts. The troughs or mangers must be kept perfectly sweet and clean.

When cows are fed largely on raw turnips, the milk and also the butter is found to have what is called a "turnip flavour." This may be prevented by adding a little of the sour milk from the collecting pans to the new milk. This hastens the souring of the latter, and thus prevents the formation of the turnip flavour, as it is caused by allowing the milk to sour slowly. The turnip flavour may also be prevented in a great measure by milking the cows in the morning before they get their feed of turnips, and withholding the evening feed of turnips until after they are milked. The addition of a wine-glassful of dissolved saltpetre to the pail of new milk, and stirred through it, is also a useful preventive; but the first-named remedy is, on the whole, the best.

When the grass has advanced sufficiently to afford a full bite, the cows are turned out during the day to graze, returning to the house in the evening, when they get a feed of cooked food, or of Italian rye-grass, rape, clover, or vetches, according as these crops are ready for use. Where dairy farming is pursued as the main object, the best old pastures are reserved for the milch cows, and care must be taken to shift them frequently, so that they may have fresh, clean pasture. It has been found that cows grazed on fields which are well stocked with rye-grass yield more milk than they do when grazed where other grasses prevail; but that the milk produced by feeding on rye-grass is poorer than the other, and does not yield a corresponding amount of butter.

When the weather is very hot, it is better to keep the cows in the shelter of the house during the warmest part of the day, supplying them with cut grass, &c., and allowing them to go out to the pastures in the afternoon. Some prefer keeping their cows out at night during summer, merely bringing them in to be milked, or they are milked in the field; others keep them in the house all night, supplied with food, and turn them out after being milked in the morning. The quantity of milk yielded by cows is greater in the morning than in the evening. If the cows are kept out all night during summer, they ought to be brought in towards the middle of autumn, when the nights get cold, and especially so if the weather is rainy at the time, as exposure to cold drenching rains will lessen the yield of milk. It is desirable, therefore, to have a supply of autumn vetches, which, with the second cutting of rye-grass and clover, will form a valuable intermixture of food for the cows when brought to the house at night, and when the pastures are failing. Another valuable description of green food is obtained by sowing in spring a mixture of vetches, peas, beans, in equal proportions; and some oats may also be added. This, if cut when three parts ripe, is excellent food, and greatly increases the yield of milk. In some cases, artificial food is now given to milch cows when on grass; and a drink, given daily, composed of equal parts of bean-meal, ground oats, and bran, is found to have a decided effect on the milk and butter. About $3\frac{1}{2}$ lb. of the mixed food is sufficient for an ordinary cow. A feed of Indian corn, which has been previously steeped until the grains have become swollen and soft, is also useful.

Whilst such are the modes of treatment usually adopted where a proper system is followed, and where pasturage forms a principal part of the system, there are many excellent managers of dairy cattle occupying arable farms, who never permit their cows to leave the house at any season, except for an hour or two daily, when they are turned into a paddock merely for exercise. One result of this system is, that a much greater number of cows—double the number it is considered—can be kept on a given number of acres, than could be maintained on the same area if the whole or the most part of it was in pasture.

Under the "soiling" or house-feeding system, the object of the farmer is to arrange his mode of cropping so that he may have a regular succession and constant supply of green food and roots throughout the year. The green crop division will furnish cabbages for use in autumn and the early part of winter, with swedes and other kinds of turnips and mangels for consumption during winter and spring. With the grain crop which succeeds roots there will be sown Italian rye-grass and red clover; and as a varied supply of summer food is requisite, one-half the break or division need only be sown with such "seeds," the remaining half being reserved for winter and spring vetches—the former being sown in September after the wheat stubble, and the latter in successional sowings during the spring months. Rape may also occupy a portion of the ground. The winter vetches, being early ready for use, admit of turnips or rape being sown on their removal. The summer keep of the cows consists, therefore, of the different sowings of vetches and rape, and—according to the richness of the land, or the manurial applications resorted to—of two, three, or four cuttings of Italian ryegrass and clover. And it may be remarked that the quantity of manure, liquid and solid, produced under this system, is such as to enable the farmer to fertilise his land very highly from his home resources. In the fourth year of the course, a grain crop will be grown; and should a scarcity of summer food be anticipated, the limits of the cereal crop may be trenched upon by reserving a portion of the land previously under rye-grass and clover for the production of spring-sown vetches. Diversity of food is at all times essential to the productiveness of dairy cows; and it is especially necessary to remember this when they are confined to the house. The addition of 3 or 4 lb. of crushed oilcake, palm-nut-meal, or cotton-cake, or steeped Indian corn, along with some bean-meal, will be found very useful in the case of house-fed cows; and crushed oats and bean-meal should be mixed with their drink. It may be supposed that house-feeding entails much trouble, but such is not the case when it is systematically carried out. The cows, of course, must be fed and milked at regular hours, and the time set for so doing should be rigidly adhered to, because cows which are fed and milked at regular hours know the proper time as well as their feeders, and if any interruption occurs they soon show that they have become uneasy, which it is not desirable to permit; for whatever causes uneasiness or discomfort to the milch cow will tell more or less on her yield of milk. The houses where cows are kept during summer must, of course, be well ventilated, without exposing the animals to strong draughts of air. The following statement contains particulars of considerable interest in connection with this subject:—

"Accurate trials show that warmth and care in feeding exercise a most important influence in the secretion of milk. A herd of cows to which water is usually supplied by pipes and troughs in the cow-house were, from an obstruction in the pipes, turned out twice a-day to be watered. Their milk instantly decreased, and in three days the falling off became very considerable. The pipes were mended, the cows received water in the cow-house, without being exposed to cold, and the flow of milk returned. In another case, the person who had the principal charge of the herd was obliged to leave home for a couple of days; the cows were placed under the care of a youth, with strict charge as to their feeding. This he neglected; the yield of milk immediately declined, and during the rest of the season it never could be restored to its previous quantity. Where cows are housed, and abundantly fed, they should be milked three times a-day, the milking in the middle of the day being found to increase the secretion of milk very materially."[1]

It is of much importance that the operation of milking is performed in a proper manner. Each milker should have a stool to sit upon; a bucket of clean water and a linen cloth should be at hand, in case it should be necessary to wash the udder or teats before milking; and as an essential preliminary each milker should be compelled to wash her or his hands before beginning to milk. We have seen persons engaged in milking having their hands covered with filth; but it is right to say that this was where the cows belonged to town dairymen. The number of cows assigned to a milker is nine; but where the work must be speedily done, six will be enough. Each cow, should, if possible, be milked at each milking by the same person, as some cows will not let down their milk to strangers. In some parts of the country the milker sits on the left or near side of the cow, and in other parts on the off side; but whatever side is selected, the cow should always be milked on that side. The milking should be done in a quick manner, and continued until the last drop has been taken away. The milk which comes last is much richer than that which is first drawn. It is of consequence, therefore, that no portion of this milk should be left; but apart from its richness, there is also this consideration to be kept in view—namely, that unless the milk is quite drawn off, that which is left will cause inflammation in the udder, which may, and frequently does, end in the partial and even the entire destruction of the vessel.

Attempts have been made to construct machines for milking cows, but there has been nothing invented as yet which can supersede the dairymaid's fingers; and we have known cases where cows have been injured as milkers from the use of machines. Some cows are very fretful on being milked, and we believe that in most cases this is caused by rough treatment. Heifers, after their first calf, require to be very

[1] Caird's English Agriculture.

gently dealt with until they become used to being milked, and if kindly treated will soon stand quietly; whereas they would be irretrievably ruined if their first uneasy movements were met with blows and kicks. The mode of breaking in a young heifer recommended by Mr Stephens is excellent. It is as follows: "The surest plan, instead of hobbling, which only irritates, is for the dairymaid, while standing on her feet, to place her head against the flank of the cow, stretch her hands forward, and get a hold of the teats the best way she can, and let the milk fall to the ground; and while in this position, it is out of the power of the cow to hurt her. Such ebullitions of feeling at the first milking after calving arise either from feeling pain in a tender state of the teat—most probably from inflammation in the lining membrane of the receptacle, or simply from the titillation of the skin of the udder and teat, which become the more sensitive as the heat wears off; or the udder being still hard, gives pain when first touched." These points should be kept in mind, so that the animal may be kindly treated at a stage when kindness is of the utmost importance to her future usefulness.

"A Scottish Tenant Farmer," who writes after fifteen years' experience of the management of a dairy farm, on which the number of cows kept ranged from 60 to over 100, has given some useful information in a pamphlet 'On the Management of Farm-Stock in Health and Disease.'[1] The chief part of the milk produced by his cows goes as sweet-milk, by contract, all the year round to Edinburgh, to a hospital, so that it is necessary always to have three-fourths of the cows in milk, and one-half in full milk, summer and winter. The stock consists of well-bred Ayrshire cows, with 8 or 10 pure Alderneys. During fifteen years the "Scottish Tenant Farmer" only lost 3 cows; one from hoven, another from an injury received in consequence of the cow rushing over a fence, from being excited by the flies; and a third died after calving. This freedom from loss during fifteen years, and out of above 300 cows which had passed through the "Tenant Farmer's" hands during that period, is sufficient proof that his system of management must be good.

[1] Published by William Blackwood & Sons, 1866.

The "Scottish Tenant Farmer" states that "from the end of October until the end of April the cows are all kept entirely in the house. In May, if the weather is fine, and free from easterly winds, they are allowed to go out a few at a time—those that stand together—into a sheltered field near the byres, where there are posts to rub themselves upon, and a running stream where they can drink. They are left out for a few hours daily, to accustom them gradually to the change to the open air—all violent and sudden changes being dangerous. From the 1st of June, if the weather is fine, they are out all day, and after the first few days, all night; and this is the plan until the 1st of October. During midsummer, if the sun is very fierce and flies troublesome, the cows are brought into the byres at mid-day, and kept there quiet, and as cool as possible, till after the afternoon milking, which is over by four o'clock (to suit the train), when they are taken quietly and gently out again to their several pastures till next morning. After the 1st of October, if the weather gets cold at nights, in like manner the cows are kept in after the afternoon milking, getting cut grass in the house, and are put out after the morning milking, the great object at all seasons being to avoid exposure to extremes of temperature, to chills from cold, rains, dews, or hoar-frosts in autumn, or to excitement from hot sun or flies in summer."

The following are the details of the winter feeding of the cows :—

"At half-past 5 in the morning, every cow gets a small foddering of hay, 3 lb. weight. While they are eating this, the byres are cleaned and the cows are milked.

"At half-past 7 A.M., a feed of pulped turnips and cut straw mixed, 6 lb. weight, is given to each cow, with a little salt amongst it.

"At 9 A.M., a full drink of water and small foddering of hay or straw, about 3 lb. While they are eating this, the cows are all thoroughly brushed and combed all over.

"At half-past 10 A.M., all the cows in full milk get a mash composed of 2 lb. hashed [bruised] oats or bean-meal, 2 lb. bran, and 1 lb. oilcake, with a large tablespoonful of salt, the whole put into a half-pail of boiling water till thoroughly softened and mixed. It is then cooled to 70 degrees with a little cold water, and given to each cow in full milk. After the above mixture, and at the same hour, all the cows are offered a drink of fresh spring water; and a foddering of hay or straw, 3 lb. weight, is given, sprinkled with salt and water. Then they are shut up quiet, and allowed to rest undisturbed till 2 P.M. Previous to shutting up the byres, they are all looked over and cleaned out. By shutting up the byres, it is not meant that plenty of fresh air is not admitted; merely that the cows are left undisturbed and to chew their cud.

"At 2 P.M., a feed of pulped turnips and cut straw, 6 lb. weight, with a little salt, and a very small foddering of hay after the above. A drink of cold water is then offered, followed by a small foddering of hay or straw. During the time they are eating this, the byres are cleaned out thoroughly. At 4 P.M. they are milked, after which they are littered down and left to rest till 8 P.M., when they receive a foddering of hay or straw, 3 lb., and are left to rest. All the cows in full milk are offered a drink of water at this hour, when they are left quiet for the night; but the person in charge looks over the byres at 11 P.M., to be sure that all is well, disturbing the cows as little as possible."

The following are the details of the feeding during summer and autumn:—

"While the cows are pastured out, no extra feeding whatever is given during the height of the grass. After the grass declines in September and October, any thin cow, milking heavily, may get a mash of oatmeal and bran or oilcake daily; but these are the exceptions. In October, when they come in at nights, they get a few white turnips, and a little foddering of straw or meadow-hay. Salt is given to the cows all the year round, in one way or another—in drinks, or sprinkled on fodder, or somehow—2 or 3 ounces to each cow daily, and is of the utmost importance to their good health and condition."

The writer then proceeds to say that "it may be considered by some that this feeding, especially the winter feeding, would not be nearly enough for the heavier breeds of cows. In this I agree, but the proportions could easily be augmented upon the same system; and for moderate-sized Ayrshire cows, even in full milk, it has proved quite sufficient to keep them in the most satisfactory condition."

When treating of the attendance on feeding-cattle in the previous section, much stress was laid on the importance of having people in charge of the cattle of an intelligent, observant disposition. The "Scottish Tenant Farmer" is also very decided on this point; and as his remarks are applicable to numerous cases which have come under our observation, we shall give them in full.

Under the head of "Attendance on the cows," he says: "Too much stress cannot be laid upon the importance of this point; for it seems but little understood, and less considered. No doubt, economy in labour is a great matter in all farming, and it is a most difficult point to attain and to carry out. But where the care of valuable stock is concerned, one must see that economy is not begun at the wrong end. If it does not pay to keep dairy cows in health and alive, it certainly will never do so to have them sick and dying; and the prevention of disease, and the preservation of animals in perfect health and condition, depends entirely on the care of the attendants about them. A proprietor may give liberally the best food, have the best byres, and keep the most healthy stock; but whatever good orders and rules he may lay down, it will be of no avail unless he provides proper attendants, and sees that they are not over-tasked. *Half the disease, death, and mismanagement amongst animals, and especially cattle and cows, is traceable to insufficient and incompetent attendance.* How often do we hear it triumphantly stated, after being shown a splendid and improved farm-steading and byres for a large number of cows,—'There now! so much for improved construction and arrangement. Whereas before I used to have two men and three women and boys to feed and clean fifty cattle, now I can keep seventy, and one old man and a boy or girl can fodder, clean, and look after the whole.' I have heard such assertions; and on asking the question, 'And do your cattle thrive much better now than formerly?' the answer will in many instances be, 'No, not a bit better; but it takes less labour and fewer people.' Fewer people, I grant; but less labour, no! The one old man and his girl or boy can possibly do the work, but not with 'less labour.' Even with all the manifestly improved appliances, they have so much, too much, to do, and are worked to such a high-pressure point, that they are mere machines, with legs and arms, and hands and feet, but no heads nor eyes; at least, they have no time to use either—no time to watch the peculiarities of each cow, her temperament, her appetite—no time even to watch sufficiently to detect the first symptoms of disease, too often considered as only dulness—no time to observe anything; too hard-worked to feel an interest in their work or in their charge, the patient, dumb, dependent animals which compose it. How often is any old man, worked out for the other departments, thought 'good enough to look after the cows,' or 'beasts,' especially if, as I said before, he has for his aides-de-camp one or two mischievous, young, inexperienced boys or girls! And yet intelligent farmers, and gentlemen who build ornamental and beautifully designed farm-steadings and byres, and fill them with the finest-bred and most valuable cattle and cows, wonder that, after all, disease and death are not kept at bay by all their improvements. The fault is not in the improved byres, nor yet in the high breeding of the cattle. If it is worth having these two, it is worth having the third essential—namely, superior people as attendants, and enough of them. Select people not above their work, but not below it; men and women thoroughly honest and conscientious in doing their duty, and with intelligence and common-sense to understand it; with good tempers, and quiet kindly manners; and with a liking and an interest in what they have the charge of; and with a power of observation. This latter qualification is not possessed by every one, however honest and willing; and people who do not possess it are unfit to have the charge of animals."

The treatment of cows kept in large towns, or their immediate vicinity, is conducted more with a view to the quantity of milk produced than its quality; hence the succulency of the food is more looked to in such cases than its nutritive properties. On this account the grains and liquid refuse obtained from breweries and distilleries are much sought after by dairymen who supply townspeople with milk. About 24 lb. of grains is the usual daily allowance for each cow, divided into three or four parts; the liquid being either mixed with the grains, along with cut hay, or given simply as a drink. When distillery grains are used in conjunction with turnips, the milk is better flavoured than it is when the cows are fed on turnips alone. Great care, however, is necessary in feeding cows on grains, as they are apt to make the cows "grain-sick"; and a free use of such food is otherwise liable to affect the health of the cows, as well as to lower the quality of the milk. In fact it has been stated, and we believe with considerable truth, that a good deal of the disease that is found in town dairies may be attributed to the stimulating effects of the large quantities of grains used in feeding, assisted, no doubt, by filth and bad ventilation. A large portion of the roots given to dairy cows near towns is usually cooked; and the addition of linseed and bean meal, together with other kinds of artificial food of a similar nature, has been found of great value by keeping cows in full milk—a high system of feeding paying well in such cases.

Thus, the late Mr Henry Garnett, Green Park, Co. Meath, who had for several years a contract for supplying a union workhouse with milk, fed his cows on Indian-meal, which was made into porridge; and after being boiled for at least two hours—for Indian-meal must be well cooked—it was poured over chaffed hay, and mixed up in a long wooden trough. Each cow's daily allowance of Indian-meal was 2 lb., which was put into water when the water was just beginning to boil. No advantage was found from steeping the meal beforehand, provided the porridge was thoroughly boiled afterwards. Besides this, each cow got daily 2 lb. of bean-meal, which was mixed in a dry state with the porridge and cut hay, and a little more than half a "barrel" of brewers' grains per week, the grains being also mixed with cut hay. A thin wash was made up for drink, with ground oats, at the rate of 3 lb. for each cow daily, the wash being well boiled before being used. The daily ration, therefore, of each cow consisted of 2 lb. of Indian-meal, 2 lb. of bean-meal, 3 lb. of ground oats, and about 14 lb. of brewers' grains. Of the cut hay no account was kept, but the cows consumed very little long hay. The cows did not get roots. The only drawback to the use of hot food was the liability to "pick calf" which it seemed to impart, and in order to counteract that tendency, hot food was not given to the cows for some weeks before calving. The cows continued to give milk up to the time of calving; and they fattened while yielding milk, when fattening was considered desirable, so that that they were often milked just before they went to the butcher. Other kinds of feeding were tried by Mr Garnett, but he found the above-mentioned dietary to answer better for milch cows than any other description of artificial food. The cows were kept in the house summer and winter, except in the height of summer, when they were turned out to grass at 8 P.M. until 5 A.M. During summer they got vetches, or rye-grass and clover, besides the cooked food.[1]

There are few owners of dairy cattle who have based their practice so closely on scientific principles as Mr Horsfall of Burley Hall, Yorkshire, has done; and that gentleman's contributions on the subject, which have appeared in the 'Journal of the Royal Agricultural Society of England,' furnish happy illustrations of the Society's motto—"Practice with Science."

Mr Horsfall's system of dairy management has throughout been founded on high feeding; his object being to obtain not only a considerable quantity of milk, but also milk rich in butter. In this respect, therefore, he differs from those dairymen near towns, who aim at obtaining a large quantity of milk without regard to its butyraceous qualities; and as he also fattens his cows, and purchases others to fatten, it was necessary that he should devise such food as would enable his cows to produce as much rich milk as possible, and at the same time lay on flesh; paying regard, however, to the comparative cost "with a view to profit—which," as he remarks, "when farming is followed as a business, is a necessary, and in any circumstances an agreeable, accompaniment."

As an important preliminary step, he considered it requisite that attention should be paid to the average composition of milk in framing his dietary; and taking a full yield, or say 16 quarts per day, it was found such would give 5.20 lb. of dry material, consisting of the following constituents: Caseine, 2 lb.; butter, 1.25 lb.; sugar, 1.75 lb.; phosphate

[1] Irish Farmers' Gazette, vol. xxiv., 1865.

of lime, 0.9 parts; chloride of potassium, &c., 0.11 parts. It was therefore necessary to provide a supply of the elements of food suited to the production of milk as represented in this analysis, and at the same time to maintain the cows in a progressively improving condition. The temperature of the cow-house was kept during winter at nearly 60°, which had the effect of lessening the consumption of the heat-giving substances—starch, sugar, &c.; and as these were not required as *fuel* to keep up the proper degree of animal heat, which they would have been if the animals were exposed to cold, they afforded, therefore, a greater surplus for the accumulation of fat.

The daily ration at first for each cow was, 5 lb. of rape-cake and 2 lb. of bran, mixed with a sufficient quantity of bean-straw, oat-straw, and shells of oats, in equal proportions, to supply them three times a-day with as much as they would eat. The whole of the materials were moistened and blended together, and after being steamed were given to the animals in a warm state. An allowance of bean-meal was also given, the quantity being regulated by the state of the cow in regard to her yield of milk; those in full milk getting each 2 lb. per day, others 1½ lb. or 1 lb., and others even less, according to circumstances. The bean-meal was not steamed along with the other materials, but was mixed dry with the steamed food previous to its being given to each cow, so that the proper quantity for each was duly regulated. Latterly, Mr Horsfall was induced to use malt-combs, and in doing so he substituted 1 lb. of malt-combs for a similar quantity of bran, increasing the allowance of rape-cake to 6 lb.; so that the daily allowance for each cow was—6 lb. of rape-cake, 1 lb. of malt-combs, 1 lb. of bran, 1 to 2 lb. of bean-meal, with 9 lb. of meadow-hay, and 28 lb. of mangels, kohl-rabi, or cabbages. Mr Horsfall occasionally substituted 2 to 3 lb. of Indian-corn-meal for the bean-meal, but the corn-meal was cooked. The green food, or roots, was given after each feed of the steamed mixture, as above, and when this was eaten up, a ration of 3 lb. of hay. The cows were allowed as much water, twice a-day, as they would drink.

As some have objected to rape-cake being used as food for milch cows, it is important to notice that Mr Horsfall distinctly states that its flavour is not in the least perceptible either in the milk or butter. This he attributes to the manner in which it is prepared by cooking or steaming before being given to the cattle; the effect of steaming being to volatilise the essential oils, in which the flavour resides; and his opinion of cooking is, that it renders the food more palatable, and more easy of digestion and assimilation. Rape-cake, we may remark, is well adapted to promote the production of milk, being rich in phosphates and also in oil.

With respect to the remaining features of Mr Horsfall's system, we learn that during May his cows are turned out on a rich pasture near the homestead; towards evening they are again housed for the night, when they are supplied with a mess of the steamed mixture, and a little hay each morning and evening. During June, when the grasses are better grown, mown grass is given to them instead of hay, and they are also allowed two feeds of steamed mixture. This treatment is continued till October, when they are again wholly housed. Mr Horsfall, however, is not quite sure that turning out milch cows during the warm months is advisable; and he rather thinks that this should take place during the night instead of during the day-time—just as Mr Garnett was in the habit of doing; and Mr Horsfall founds this opinion on the marked change which took place in the quality of the milk and cream when his cows were grazed in open pastures during the day and housed at night; for although still supplied with a portion of the steamed food morning and evening, yet there was considerably less butter yielded per quart than there was when the cows were fed altogether in the house.

We shall now glance at some of the results of Mr Horsfall's system; and the first point we shall notice is its effect on the condition of the cows. This was ascertained by weighing the cows once a-month; and it was found that cows in full milk, yielding 12 to 16 quarts each per day, varied but little—some losing, others gaining, slightly—the balance in the month's weighing being rather to gain. It was common for a cow to continue a yield from six to eight months before she gave below 12 quarts per day, at which time she usually, if not invariably, gained weight.

Cows giving less than 12 quarts, and down to 5 quarts, per day, were found, when free from ailment, to gain without exception. This gain with an average yield of nearly 8 quarts per day, was at the rate of 7 lb. to 8 lb. each per week.

Another result of the system was apparent in the increased fertility of the pastures upon which the cows were grazed during summer. It has long been observed that pastures kept solely for dairy cows decrease greatly in fertility; hence we find that the dressings of bone-dust, as practised on such land in Cheshire, are necessary, and exhibit very marked effects; but in Mr Horsfall's case the pastures increased in fertility, owing to the fact that those substances which milch cows carry off from the pastures in their milk, and which therefore become so much lessened by such repeated and continued extraction as ultimately to impoverish the pastures, are supplied in the first instance in the food given by Mr Horsfall to his cows, and then conveyed to the pastures through the droppings.

Other results of the system are seen in the quantity and quality of the milk yielded by Mr Horsfall's cows, and of the butter obtained from their milk; but these are points which we shall have occasion to notice afterwards.

Although we have given in the preceding remarks ample information regarding the feeding of milch cows, yet, in order to render this section as useful as possible, we subjoin some additional formulæ, derived from the practice of various persons.

Mr Alcock of Skipton, gives each cow per day 20 lb. of raw mangels, 3 lb. of carob-beans, 1¾ lb. of bran and malt-combs mixed, 3½ lb. of bean-meal, and 3 lb. of rape-cake, with as much as they can eat of a steamed mixture of wheat-straw, bean-straw, and shells of oats.

On Mr Neilson's farm at Halewood, Lancashire, a large stock of dairy cows are house-fed, summer and winter, receiving in winter a mixture of steamed straw, ground (pulped) turnips, and 1 lb. per head of boiled Egyptian bean-meal poured over the mixture. Besides this, and a plentiful supply of turnips and fodder, they receive 2 lb. of oilcake daily.[1]

The following mixture has been found suitable feeding

[1] Caird's English Agriculture.

for a milch cow during winter and spring: 36 lb. of pulped turnips or pulped mangels, 5 to 6 lb. of chaffed hay or straw, and 2 lb. of oilcake, crushed oats, or palm-nut-meal, or a mixture of the three; to be divided into two feeds, and given morning and evening, with 42 lb. of raw roots at midday.

To those who consider that such modes of feeding as have been set forth in the foregoing remarks must be expensive, and that feeding on hay is a much cheaper mode of wintering a cow, we recommend the consideration of the following statement: "Supposing a cow to be fed at the rate of 56 lb. *per diem* during 120 days, she will consume exactly 3 tons, which at 60s. is £9, and no other calculation is necessary to prove that feeding cows with hay is ruinous. I have fed cows with my own hands that have eaten more than 56 lb. *per diem;* but supposing only 30 lb. *per diem*, four months' food will be above 1½ ton, costing nearly £5, which is much too high, and ought to convince the young farmer how necessary it is for him to provide green winter food. It is found that cows fed on pulped turnips or mangels—1 cwt. apiece—mixed with 15 or 20 lb. of straw-chaff, and 2 or 3 lb. of bean-meal, give butter without any disagreeable taste, and this is much more economical food than hay."[1]

The Park Cow—Villa Dairying.—It is curious and interesting to contemplate the remarkable increase that has taken place in recent times in what may be called Villa Dairying—the keeping of a cow or two for the home production of cream, milk, and butter. Every one who can afford it has a park or lawn attached to his residence, and this is prized all the more if it should be sufficient to enable the occupier to "keep a cow." What a bundle of pleasant associations are recalled by this phrase! How much we owe to the cow we seldom realise. We esteem her fully only when, after a period of city life, where the sweets of country life are unknown, we again experience the comforts our "own cow" can bestow. We can warmly sympathise with the ambition to have as much land as would make it possible to keep a cow, and to assist those who are indulging this wholesome ambition, we append the following notes.

[1] The Farmer's Calendar, by J. C. Morton.

It is desirable that there should be about 2 acres of ground for one cow, but with extensive use of purchased food in winter, and a little "extras" in summer, a smaller extent, even rather less than 1 acre, might suffice. If there were only about 1 acre of land, it should be all kept in grass for summer grazing, and purchased food obtained for winter. In all probability a cow of some of the smaller varieties, such as the Jersey, Guernsey, Ayrshire, or Kerry breeds will be selected, and all these are in demand as Park or Villa cows. The house accommodation for the cow need not be costly or extensive, but dry and cool, and free from draughts.

Assuming that the land available for the cow extends to about 2 imperial acres, we would recommend that one half of it be in pasture, and the other in hay each year, and the portion grazed the one year should be turned to hay the following year. It will be necessary to take measures to maintain the fertility of the land, and in addition to whatever portion of the cow's manure may be spared from the garden, it would be advisable to apply some artificial manure—such as mineral superphosphate—2 to 3 cwt. per acre, with 1 cwt. or so of kainit and nitrate of soda. The manure might be applied during autumn or winter to the division of the land intended for hay next season.

Professor Primrose M'Connell, to whom the editor is indebted for some useful notes on this subject, says that the one acre of pasture will graze a cow during summer if of good quality, but it will be found in any case that great improvement will result from giving the cow some feeding stuff indoors. Cows on grass alone do not usually give very rich milk, especially in continuously wet weather, some 8 per cent of cream being the usual thing. Now, in the case of a family cow, we want the milk to be as rich as possible, so that extra feeding must be given. The usual stuff recommended is cotton-cake, either decorticated or undecorticated, and there can be no question that it has a wonderful influence on both the quality of the milk and the manure made. We have, however, seen so much sickness and death among animals which were clearly traceable to the use of this material—and that not in immoderate quantities—that we would advise it to be used very sparingly, if at all. We can speak from experience as to the benefits, without any such drawbacks, of bean-meal, and recommend its use. The quantity given will be from 2 to 4 lb., according to quality and extent of pasture, and is best given in the form of a lump of dough made with warm water and allowed to set for some time before use.

The acre of hay ought to yield over one ton of provender, sufficient to "winter" a cow of the smaller breeds. If it is good land it will yield more, but if so it is all the better. This will allow a minimum of 12 lb. of hay daily to the animal during, say, 200 days of the winter half-year. So much for the fodder part of the feeding produced on the premises: the bought-in stuffs will depend on circumstances. We have said that it is not necessary to use roots; and, in fact, when quality of milk is desirable, they are better dispensed with, but some succulent substitute must be found in their place. We do not know of anything better than a mash composed of chopped hay or straw, mixed with, say, 4 lb. bean-meal, 2 lb. maize-meal, and 2 lb. bran, made up with scalding water and allowed to infuse; this to be given at twice, and in the bulk of a pailful of chop. If the hay crop is good, and there is considerably over a ton of fodder, then some of it can be used for chaffing up in a hand-machine; but otherwise there is no help for it but to purchase a load of oat, or even wheat straw, more especially as some will be needed for litter anyhow. This will be no trouble where straw and hay is being purchased—at any rate for the use of carriage-horses. Oatmeal is a capital substance to mix with bean-meal in the mash, but unfortunately it has the power of making the butter or other products very pale in colour, and this is a drawback when fashion demands that these shall be a deep yellow. If an animal of the Channel Islands breed be used, it is likely that the produce will be yellow enough naturally.

And now another question arises which it is not easy to answer: How is the supply of milk to be kept up when the cow dries off a month or two before calving? Where more than one animal is kept this can be easily arranged by timing the calving (hiring the use of a bull), so that when one is dry another shall be in full milk; but where there is only the one, there is no help for it but either to sell off when the supply is low and purchase another just newly calved, or else make up one's mind to do without milk for a month or so, or purchase from outsiders. If the extra butter has been salted which was made in the flush of the milk, it will help to tide over the time of scarcity. On the other hand, however, the matter might be arranged by keeping two cows on the two acres, and having no land in hay at all, but purchasing in all the fodder required; the one way is as good as the other, and probably there will be no difference in the total expense.

The cow will, of course, get all the refuse vegetables of the garden, and this may be a considerable item in some cases. Further, if a plot of tares is grown it will greatly help the summer pasture. If the system of soiling indoors is followed—cutting the grass and taking in to the animals, of course less ground will be needed to keep them, but the work will be very much greater. Each of these plans has been successfully carried out.

There may be a difficulty in getting the proper hands to do the work. It is likely that the gardener or coachman or general outdoor man will have to look after the feeding, milking, and tending of the animal, and much of the success of the scheme will depend on having these done regularly and conscientiously. Again, there must be some one to make butter and look after the treatment of the milk; and maid-servants who can do this are not over-plentiful. The whole or a part of the skim and butter milk may be used for cooking purposes; but it will often be found necessary to keep a pig to utilise the residue and the refuse from the house.

Now a few words as to the cost. It is easy enough to say what this would be in the case of an ordinary dairy-farmer, but not so easy with a "villa dairy." With the former, the figures—at market values—would be something like an outlay of from £15 to £18 for keep, and a return of £20 to £25 per annum, but with a family residence of some pretensions the rent of the land will likely be at a "fancy" rate, while everything bought in will be at the dearest. It is not likely that the keep per head will cost less than £20, but as the produce ought to be valued at retail price, it will still leave a balance in favour of the cow, while there is the satisfaction of knowing that one is utilising their land and supplying their own dairy produce; besides, a cow which is petted and fed on dainties will yield better than one of a large herd on a farm. We have taken the case of one cow —the least that can be—but the same remarks will apply to any number, with the difference that the proportion of expense to each where there is a number, say half-a-dozen, will be less than where there is only one. It is almost as much trouble to attend to one cow as five or six. It need hardly be expected that the park or villa cow will yield much profit; but it is not likely to cause loss, bearing in mind that the dairy stuffs produced would have otherwise to be bought at retail (not farm) prices. And further, the healthy pleasure derived from this amateur farming, and the satisfaction arising from making the most of one's little field, should count for a great deal.[1]

Mr Gilbert Murray, Elvaston Castle, Derby, writing of the winter treatment of dairy cows, says that no hay is equal to well-saved green-cut rye-grass, cut before the flowering stage. Over-heated hay is bad for dairy cows; green hay is always preferable, and the best means to prevent over-heating is to place layers of straw at intervals in the stack as the work proceeded. He could scarcely imagine a dairy farm being successful where there was no tillage. Not only could the grain be profitably used, but the straw formed a valuable and cheap substitute for hay. Root-crops, in his opinion, are of secondary importance. They are an expensive and uncertain crop. The first feed of the day should be at 5 A.M., immediately before milking. Many farmers still used roots largely, and gave them whole, and in a raw state—a practice strongly to be condemned. A mixture of wheat, bean, or pea meal, with a small quantity of linseed is the best food both for rearing young stock and producing high-class milk. With the exception of a small amount of hay daily, the whole of the other foods should be cooked and given in a semi-liquid pulpy condition.

In many instances silage has been found suitable food for dairy cows; but the experience with it has varied consider-

[1] Agricultural Gazette, July 6, 1885. Vol. xxii. p. 11.

ably. Some details as to experiments with silage are given in another division of the work.

Milk.—The management of dairy cows being directed with a view to the production of milk, the first point to which we shall attend, in connection with this subject, is the effect of food on the yield and quality of the milk.

Mr Horsfall's experience throws much light on these points. His cows yielded milk which gave from 24 oz. to 27¼ oz. of butter from 16 quarts of milk; and when the cows were constantly house-fed, according to his system of management, 25 oz. of butter per quart of cream—or 16 oz. of butter per quart of cream when the cows were put out to pasture.

We shall now compare the yield and quality of the milk given by Mr Horsfall's cows with other cases. We find, from certain returns published by Mr Thomas Scott, that the average quantity of milk, in England, required to produce 1 quart of cream, is 12.20 quarts; the least quantity being 8 quarts, and the greatest 18 quarts. The average quantity of butter from 1 quart of cream was 15.06 oz.; the least quantity produced being 8 oz., and the highest 22 oz. In the county of Cork, where the cows are grass-fed, from 12 to 14 quarts of milk produce 1 lb. of butter;[1] while, as Mr Scott states, "on the great Ballynahinch estate, Connemara [county Galway],—probably the poorest herbage in the three kingdoms,—70 quarts of cream yielded only 31½ lb. of butter—equal to 7½ oz. per quart of cream." Mr Carrington considers 11 quarts of milk to 1 lb. of butter a good average.[2]

From some experiments quoted by Dr Voelcker,[3] the following conclusions are drawn: (1) That most milk was produced by a daily allowance of 5½ lb. of rape-cake, 36 lb. of mangels, and 25 lb. of oat-straw; (2) that 1 lb. of rape-cake produced on the average 1⅕ lb. of milk; (3) that 1 lb. of brewers' grains produced about ¼ lb. of milk; (4) that 1 lb. of rape-cake was equivalent to 4 lb. of grains in its power

1 "Review of Irish Agriculture," Journal of the Royal Agricultural Society of England, vol. viii., Second Series. Part I.

2 Journal of the Royal Agricultural Society of England, vol. i., Second Series. Part II.

3 Journal of the Royal Agricultural Society of England, vol. xxiv. Part II.

of producing milk; (5) that rape-cake produced milk richer in butter than that obtained from cows fed upon brewers' grains. The butter in the latter case, however, was more delicate in flavour.

There are various causes which affect the quality of the milk, and the butter or cheese made from it. Some of these causes are of a nature not easily recognised by an ordinary observer. Mr X. A. Willard, an American authority, who has written some excellent practical papers, published in the 'Journal of the Royal Agricultural Society of England,' on milk and its products, has given some valuable information on this subject. Mr Willard says:—

"The investigations of Hallier and Pasteur with the microscope have explained the nature of causes in operation which change milk from its normal condition, or which render it filthy and unwholesome. They show that this state is brought about by living organisms, that these pervade the atmosphere, and that the germs absorbed in the milk from this source multiply and increase with wonderful rapidity, and take complete possession of the fluid, changing it into their own nature. The germs from cesspools, from decomposing and putrid animal matter, when introduced into milk, carry their own peculiar taint, and by their growth and multiplication soon convert the milk into a filthy, putrefactive mass, similar to that of the substance from which they emanated.

"'The *Pencillium crustaceum*,' says Professor Caldwell, 'can run through its whole course in forty-eight hours at the most, at a temperature of 50 degrees to 60 degrees Fahrenheit, and produce a new crop of several hundred spores for each old one; and in forty-eight hours more each spore of this crop of several hundred will produce several hundred more, and so on. At such a rate of multiplication it would take but a few days to reach numbers too great fo an adequate conception. And what is more, this is not the only way, nor even the most rapid way, in which the *Pencillium* can propagate itself: a *Pencillium* spore will, in the course of an hour, at a moderately elevated temperature, produce from 20 to 100 *micrococcus* cells; each one of these cells will subdivide into two in another hour, and so on. At this rate of increase we should have, at a low estimate of fifty cells from one spore, to start with, four hundred million *micrococcus* cells from this one spore in twenty-four hours.' Again he says: 'From the moment the milk leaves the cow the work of the fungi commences; they begin to increase, and simultaneously the milk begins to change—both operations going on with a rapidity that varies according to the circumstances of temperature and exposure, and never ceasing entirely till the milk or its products are digested in the stomach, or have putrefied or decayed in the air, producing results that vary according to the product, whether butter or cheese, or simply the milk itself, and, what is very important and more pertinent to my subject, according to the kind of fungus that gets a foothold in the substance. The elements of fungi that are already in pure clean milk to begin with, or that are added in the rennet (when cheese is made), appear to do no harm; but on the contrary, by their legitimate growth and action on the substance in the midst of which they find themselves, to bear, at least, an important part in the elaboration of the very principles which give the final product its savour and its value. But the case is quite different with such fungi as are introduced from without, and which originate in putrid matter of any kind; their whole influence is harmful in a high degree. It is one of the most commonly observed facts of nature that milk is especially susceptible to the influence of emanations from putrid matter—or is liable to become tainted, as it is more generally put—which are but other ways of saying that the germs of fungi that are continually thrown off from putrefying matter find in the milk a place where they can readily grow and multiply; and so insidious are these influences, so readily can these minute germs make their way anywhere and everywhere, that if the air containing them in unusual quantity is *inhaled by the cows, the milk will be infected before it leaves the bag.*'

"This statement is consistent with numerous well-authenticated facts. Milk from cows inhaling bad odours has been found to be tainted, and incapable of being made into good cheese. The fact was first brought to notice by Mr Foster of Oneida, whose herd of cows, inhaling the emanations from the decaying remains of a dead horse, caused their milk to be unfit for making cheese—and not only the milk of the cows which inhaled the odour, but that from a large number of other cows, which had been mingled with the former in the cheese-factory vats. All the facts concerning the case were so carefully noticed and investigated, that it left no doubt as to the cause of the tainting of the milk. Repeated observations of a similar character, by members of the American Dairymen's Association, established the principle beyond doubt. Milk-producers, then, may regard this point as a settled principle—they cannot allow their cows to inhale offensive emanations from putrefying animal matter without injury to their milk; they inoculate the milk with the germs of filthy fungi, which make haste to convert it into filth, similar in character to that of the putrefying substance from which they emanated. To what extent the health of stock, and that of persons partaking of such milk, may be affected by such organisms, is a question of great importance, but concerning which I have not sufficient data to venture an opinion.

"Again, I have seen numerous cases where milk was tainted from the cows having passed through sloughs of decomposing vegetable matter. Particles of dirt adhere to the udder or other part of the animal, and, becoming dry, some of the dust probably falling into the milk-bucket during the operation of milking, thus introduce germs which make rapid work in decomposing and putrefying good healthy milk."

Another important case is given by Mr Willard, which shows the necessity for providing pure water at all times for milch cows. Professor Law, of Cornell University, U.S., formerly of Edinburgh, one day during the hot weather in 1871, "observed a peculiar ropy appearance in the cream which had risen on the milk" supplied to him by a milkman. "He examined it under a powerful microscope, and found it filled with living organisms of a character quite foreign to good milk. He immediately called upon his milkman to inquire concerning his management of stock, and general treatment of milk, with a view of accounting for the trouble. There was no fault discovered at the dairy-house, in the milking, or in the treatment of the milk; but on looking through the pastures, he found that the cows, for lack of clean running water, were compelled to slake their thirst for the most part from a stagnant pool. This water he examined under the microscope, and discovered the same class of organisms as those in the cream. He then took some of the blood from the cows, and examined it under the glass, when the same organisms made their appearance. He next obtained a specimen of good milk—milk which on examination was free from impurities—and into this he put a drop of water from the stagnant pool. In a short space of time the milk developed an infinite number of these living organisms, and became similar in character to the milk obtained from his milkman. He examined the cows, and made the usual thermometer tests for determining health and disease in animals. The cows were found to be hot and feverish, thus evidently showing that these organisms, entering the circulation, had affected the health of the animals."[1]

These facts clearly show the manner in which milk has, at different times, been the vehicle for the transmission of enteric fever and other contagious diseases. It seems strange that so innocent and wholesome an article of food as new milk should be the means of introducing deadly disease into those who partake of it; but that such has occasionally been the case there is no room to doubt. In the summer of 1873 a number of cases of enteric fever occurred in the West End of London, amongst families of the upper-middle class, including those of several medical men. The water-supply, drainage, &c., were at once carefully examined, but without discovering any cause for the outbreak. It was then discovered that the infected households had obtained their milk from the same dairy company. On examination, it was found that the dairy was well managed, and that no one connected with the reception or distribution of the milk had been sick. The milk-supplies were received daily by the dairy company from eight farms in the country, and a number of professional gentlemen were appointed to visit and inspect those farms. Those gentlemen were Dr Corfield, Professor of Hygiene at University College, London; Mr John C. Morton, of the 'Agricultural Gazette'; Mr Nelton Radcliff, of the Medical Department of the Local Board of Health; and Dr Whitmore, medical officer of Marylebone. Seven of the farms were ex-

[1] Journal of the Royal Agricultural Society of England, vol. viii., Second Series. Part I.

amined without finding any insanitary conditions at all likely to injure the milk; but on the eighth, situated in Oxfordshire, the tenant had died, a short time previous, from malignant typhoid fever, and another man was lying ill of the same disease. From these typhoid cases the deadly germs had been given off, and reached the milk, either floating in the air or mingled with the water used for washing the milk-vessels.

In 1871 a similar outbreak of typhoid occurred at Islington, from the milk-vessels having been washed with water contaminated by the leakings of a foul cesspool. At Parkhead, near Glasgow, forty typhoid cases occurred early in 1873, amongst the customers of a small dairy, where one of the inmates had several weeks previously suffered from contagious fever. A case of the same kind occurred at Armley, Leeds: the fever-stricken persons were in a close room adjoining the dairy; their attendants milked the cows and worked among the milk-vessels, and much sickness and mortality presently followed where the contaminated milk was sold. At Penrith, three children were down with fever: the mother nursed them, and milked the cows; the milk was kept in the sick-room until it was sold, and many customers shortly had the same fever.

Other contagious diseases have been propagated through the medium of milk. Professor Bell has shown that at St Andrews twenty-six children took scarlatina from the milk having been contaminated by the specific contagion derived from the hands of the dairy-woman, who was herself recovering from scarlet fever, and was besides nursing children sick with it. At Leeds, Dr Robinson records that twenty-one children, scattered in different localities, were struck down with scarlet fever from the use of milk obtained from a dairy where three children were suffering from scarlatina. Some authorities have also stated that both small-pox and cholera germs have been distributed in the milk. Dr John Dougall of Glasgow, who has investigated this subject, states that milk is "a congenial soil for the propagation of zymotic disease." He adds that "it is a more favourable nidus for the nurture of contagion than even a sickly organism." Not only does it appear to preserve fresh and in all their activity the subtle germs,—its albuminoids may possibly even provide fitting material for their multiplication. Such facts should prove a warning to those engaged in the sale of milk, to prevent it from being exposed in any way to contamination from particles of disease, whether suspended in the air or in water. The use of impure water for the washing of milk-vessels is highly dangerous, and has been sufficient to propagate contagious disease. Boiling the suspected milk affords a fair chance of destroying such poisonous particles; and milk should always be boiled when it is obtained from dairymen during any outbreak of mouth-and-foot disease among cattle, or any contagious or infectious disease affecting the human subject.

Milk as it comes from the cow is of the temperature of the animal's body—namely, from 90 to 100 degrees Fahr. It is necessary to abstract the animal heat from milk, and reduce the temperature to about 58 degrees, otherwise it will rapidly decay. In warm weather, or when milk has to be sent some distance by rail, it is of the utmost importance that the temperature should be reduced as soon as possible after it is drawn from the cow; for if this is not done, milk soon becomes sour and unsaleable in the summer months. The cooling process is also necessary if the milk is intended to be made into butter or cheese, otherwise the butter will become rancid, and the cheese will not keep. The animal odour or "cowy" smell perceptible in new milk is also injurious, but it is removed partly by the cooling down process, and partly by the action of air. A "capillary refrigerator" is made by Lawrence & Co., 14 St Mary Axe, London, for the purpose of speedily cooling down milk; and the Royal Agricultural Society has awarded a medal to the inventors for this implement. A simple mode of reducing the temperature of milk is obtained by placing a tank or reservoir in a shaded place, and through which a constant stream of running water is kept up. The milk-cans are immersed in this, leaving the covers open. This plan is useful when the milk is to be sent in the cans by rail or other conveyance to market. Lowering the temperature of milk during warm weather retards the formation of cream, but it renders the butter firmer than it would otherwise be. On the other hand, the temperature must be kept up to a certaint extent during cold weather; because, if the temperature of the milk is reduced below 55 degrees, as it will be in winter, cream will not readily rise, and when the milk is put into the churn, butter will not be produced.

Mr Horsfall's system of management was devised expressly to meet those important points in the management of milk. He says:—

"My dairy is but 6 feet wide by 15 long, and 12 feet high; at one end (to the north) is a trellis-window, at the other an inner door, which opens into the kitchen. There is another door near to this which opens into the churning-room, having also a northern aspect; both doors are near the south end of the dairy. Along each side, and the north end, two shelves of wood are fixed to the wall, the one 15 inches above the other; two feet higher is another shelf, somewhat narrower, but of like length, which is covered with charcoal, whose properties as a deodoriser are sufficiently established. The lower shelves being 2 feet 3 inches wide, the interval or passage between is only 1 foot 6 inches. On each tier of shelves is a shallow wooden cistern lined with thin sheet-lead, having a rim at the edge 3 inches high. The cisterns incline downwards slightly towards the window, and contain water to the depth of 3 inches. At the end nearest the kitchen, each tier of cisterns is supplied with two taps—one for cold water in summer, the other with hot water for winter use. At the end next the north window is a plug or a hollow tube, with holes perforated at such an elevation as to take the water before it flows over the cistern. During the summer the door towards the kitchen is closed, and an additional door is fixed against it with an interval between, well packed with straw; a curtain of stout calico hangs before the trellis-window, which is dipped in salt water and kept wet during the whole day by cold water spurted over it from a gutta-percha tube. On the milk being brought in it is emptied into bowls. [The bowls are of glazed brown earthenware, standing on a base of 6 to 8 inches, and expanding at the surface to nearly twice that width. Four to five quarts are contained in each bowl, the depth being 4 to 5 inches at the centre.] Some time after these bowls have been placed on the cistern, the cold-water taps are turned till the water rises through the perforated tube, and flows through a waste-pipe into the sewer. The taps are then closed so as to allow a slight trickling of water, which continues through the day. By these means I reduce the temperature, as compared with that outside the window, by 20 degrees. I am thus enabled to allow the milk to stand till the cream has risen, and keep the skimmed milk sweet. Having heard complaints during very hot weather of skimmed milk, which had left my dairy perfectly sweet, being affected so as to curdle in cooking on being carried into the village, I caused covers of thick calico (the best of our fabrics for retaining moisture) to be made; these are dipped in salt water and then drawn over the whole of the tin milk-cans; the contrivance is quite successful, and is in great favour with the consumers. I have not heard a single complaint since I adopted it.

"Finding my butter rather soft in hot weather, I uncovered a draw-well, which I had not used since I introduced water-works for the supply of the village and my own premises. On lowering a thermometer down to the well to the depth of 28 feet, I found it indicated a temperature of 43 degrees—that on the surface being 70 degrees. I first let down the butter, which was somewhat improved, but afterwards the cream; for this purpose I procured a movable windlass, with a rope of the required length; the cream-jar is placed in a basket 2 feet 4 inches deep, suspended on the rope, and let down the evening previous to churning. It is drawn up early next morning, and immediately churned; by this means the churning occupies about the same time as in winter, and the butter is of like consistency. The advantage I derive from this is such that, rather than be without it, I should prefer sinking a well for the purpose of reaching a like temperature.

"When the winter approaches, the open trellis-window to the north is closed, an additional shutter being fixed outside, and the interval between this and an inner shutter closely packed with straw, to prevent the access of air and cold; the door to the kitchen is at the same time unclosed to admit warmth. Before the milk is brought from the cow-house, the dairymaid washes the bowls well with hot water, the effect of which is to take off the chill, but not to warm them; the milk is brought in as milked, and is passed through a 'sile' into the bowls, which are then placed on the cistern. A thermometer, with its bulb immersed in the milk, denotes a temperature of about 90 degrees. The hot water is applied immediately, at a temperature of 100 degrees or upwards, and continues to flow for about five minutes, when the supply is exhausted. The bowls being of thick earthenware—a slow conductor—this does not heighten the temperature of the milk. The cooling, however, is thereby retarded, as I find the milk, after standing four hours, maintains a temperature of 60 degrees. This application of hot water is renewed at each milking to the new milk, but not repeated to the same after it has cooled."

With thoroughly practical people the question as to the depth that milk should be placed in the pans when set for cream has been set at rest long since; still a very great mistake is frequently made by many by setting too much milk in the pans. Experience has proved that most cream will rise from an equal quantity of milk set in one pan, at 2½ inches deep, than at any greater depth, for the simple reason that a certain degree of heat is necessary for the butyraceous globules to rise from the body of the milk to the surface, and that, as the milk cools, the globules are arrested in their ascent, so that the sooner the milk is strained and put in the pans, after being taken from the cow, the sooner will the creamy globules ascend to the surface. This question involves others of equal importance. The temperature of the air within the dairy has a great effect on the quantity of cream thrown up. Experiments have been made which have proved that, with the temperature

At 80	degrees,	all the cream	will rise in	10	hours.
" 77	"	"	"	12	"
" 68	"	"	"	18	"
" 55	"	"	"	24	"
" 50	"	"	"	36	"
" 45	"	"	"	43	"

And Spregnel found that on milk kept in as low a temperature as 37 degrees, but little cream would rise in three weeks. On the other hand, when the temperature of the dairy rises above the proper degree, the milk soon turns acid and coagulates, which also arrests the creamy globules and keeps them in suspension; hence experience has shown the necessity of keeping the milk in a temperature of not less than 50, nor more than 55 degrees; and it is an ascertained fact that, when kept at the proper temperature, the produce in butter will be more from the same milk than when it is not, and that the butter will keep longer. This most probably arises from the butter being separated from the milk while it is yet sound and has not undergone decomposition, which the milk unquestionably does when kept in either too low or too high a temperature; therefore the greatest care and attention are requisite in keeping the dairy to an equal degree of temperature.

In ordinary cases, when it is necessary to raise the temperature of milk during winter, previous to churning, it is usual to put a quantity of hot water amongst the milk or cream. This, however, is not so good a mode of raising the temperature as scalding the churn just before putting in the milk or cream, and setting the churn in a tub or other vessel containing a quantity of hot water. The churn remains standing in the tub whilst the milk is being churned, but no addition of hot water will be necessary.

In recent years the use of the centrifugal separator has extended greatly, and is accompanied with excellent results. In the books on dairying referred to, the working of this ingenious machine is fully described.

Butter-making.—The preceding remarks lead us to consider a little more in detail the process of butter-making. But in the first place, we may reproduce the following, which are some of the conclusions arrived at by Dr Sturtevant of America, who has given much attention to the subject:—

"1st, The production of butter is largely dependent on breed.

"2d, That there is a structural limit to the production of butter to each cow.

"3d, That when the cow is fed to this limit, increased food cannot increase the product.

"4th, That the superior cow has this structural limit at a greater distance from ordinary feed, and more ready to respond to stimuli than the inferior cow.

"5th, That consequently the superior cow is seldom fed to her limit, while the inferior cow may be easily fed beyond her limit; and as a practical conclusion, increased feed with a superior lot of cows will increase the butter product, but if fed to an inferior lot of cows, waste can but be the result.

"6th, That the character of the food has some influence on the character of the butter; but even here, breed influences more than food.

"7th, That there is no constant relation between the butter-product and the cheese-product.

"8th, That the caseine retains a constant percentage, and that this percentage does not appear to respond to increase of food.

"9th, That the caseine appears to remain constant without regard to the season.

"10th, That increase in the quantity of milk is followed by an increase in the total amount of caseine.

"11th, That insufficient feed acts directly to check the proportion of butter, and has a tendency to decrease the caseine of the milk and substitute albumen.

"12th, That the best practice of feeding is to regulate the character of the food by the character of the animals fed; feeding superior cows nearer to the limit of their production than inferior cows; feeding, if for butter, more concentrated and nutritious foods than for cheese; feeding for cheese-product succulent material which will increase the quantity of the milk-yield."

The milk, after it is drawn from the cow, is carefully strained, and put into shallow vessels, so that the depth shall not exceed four or five inches. Some recommend that the depth of milk in the vessels should not be more than an inch, as the cream rises more quickly according as the depth is lessened. The "setting" vessels are made of wood, earthenware, glass, lead, zinc, tinned iron, and slate. The last-named material is considered the best; but the vessels, when constructed of slate, are fixtures, and the milk, and also the water used in washing them, must be drawn off by means of a spigot at the lower end. Wooden vessels require great care in the cleansing; and although earthenware and glass are brittle materials, yet vessels constructed of them are so easily kept clean, that they are very useful. Lead and zinc are not suitable, being more or less poisonous; but tin is less objectionable.

When the milk is "set" it should not be disturbed until it is necessary to remove the cream, which will be at the end of twenty-four hours, followed by one or two more skimmings at intervals. A little sour milk mixed with the new milk just before setting makes the cream rise sooner in winter than it otherwise would. The cream must be stirred occasionally after it is put into the jar, and when fresh cream is added, so that all may be thoroughly blended. The object of stirring the cream is to prevent a tough skin being formed upon the surface. Cream is also poured from one vessel to another for the same purpose.

In large dairies the cream is churned daily; and in no case should the cream be kept more than three days before it is churned. When the cream is sweet, the butter is somewhat longer in coming than it is when the cream is sour. The temperature of the cream when it is put into the churn should be about 55°, and it will rise to fully 60° during the process of churning.

When cream alone is churned, box-churns are used in small dairies, and barrel-churns in large dairies. The churns have vents, which it is necessary to open occasionally during the process of churning, in order to liberate the confined air generated during the process.

In some districts the whole milk is churned, and there is some difference of opinion regarding the merits of this system compared with churning cream only. The advocates of churning whole milk allege that more butter is obtained, and that it is of better quality than it is when cream alone is churned; while the advocates of churning cream doubt the assertion as to the better quality of the butter obtained from the whole milk, and hold that the butter-milk, which is the sole residue when whole milk is churned, is not of such value for feeding calves, &c., as the skim-milk left when cream is churned.

When it is intended to churn the whole milk, the new milk, after being strained, is put into a tub, or other sufficiently large vessel, and allowed to remain until it becomes sour; the produce of each milking, after being cooled, is added to that already in the tub or vat. The milk is fit to be churned in two or three days; but the souring process may be hastened by mixing some sour milk with the new milk when the latter is first put into the vat. When whole milk is churned in summer, the natural temperature will be sufficient; but in cold weather it will be necessary to raise the temperature of the milk when it is put into the churn to 65° or 70°.

The upright plunge-churn is used for whole milk, and as it is a laborious operation, horse or other power must be employed, even when the dairy is of moderate extent.

Makers of churns sometimes endeavour to enhance the merit of the articles which they construct by representing that butter is made in a short time by means of their churns. This, practically, is no recommendation. Rapid churning injures the quality of the butter. When cream alone is churned, about forty minutes will be sufficient, the revolutions of the churn (barrel) being at the rate of 25 per minute, until the cream is about to crack, when the churn may be driven a little quicker; but after the cream cracks, and until the butter comes, the speed should be reduced to 20 revolutions per minute.[1]

In churning whole milk, the process will occupy from two to three hours, the stroke being at the rate of 40 to 45 per minute.

During hot weather, churning should be done early in the morning; and on the previous evening the churn should be filled with cold spring-water, which should be left in it until it is time to put in the cream or milk. If the butter is long in coming, a bit of American ice put into the churn is said to hasten the process; and in Ireland, a glass of whisky or a little vinegar is also employed for the same purpose. When sugar, or alkalies of any kind, are put into the cream, the butter will not gather; and Mr Byrne mentions in his Prize Essay, quoted above, "a case of a small dairy, where for some weeks no butter could be separated, and the cream, after hours of hard labour in churning, had to be thrown away. The cause was in vain sought for, and the superstitious neighbours nodded their heads in a manner which plainly hinted that they were confident that some other party had magically taken away the produce from the cream. However, the spell was at last broken by the discovery of a

[1] Prize Essay on Dairy Management, by James Byrne, Royal Agricultural Society of Ireland. 1869.

woollen cloth, anointed with saponaceous matter, which the servant admitted she used for cosmetic purposes; and as the poor girl was not aware that there were such precious compounds as Rowland's Kalydor or Madame Rachel's Elixir, nor that she was the cause of the mischief, she used to dip this cloth in the new milk, having learned that it would beautify her complexion. The cloth was removed, the witches lost their fees, and the superstitious neighbours were enlightened to the fact, that natural magic is the strongest magic nowadays."

Some cows, although yielding a large quantity of milk, are useless so far as the making of butter is concerned, as their milk produces very little cream. This may be detected by using the lactometer, a simple instrument, which shows the proportion of cream in a sample of milk. Cows which yield milk so poor as to be unproductive of cream should be fattened for the butcher; at the same time, a French agriculturist states, that an effectual remedy consists in giving the cow two ounces of sulphuret of antimony and three ounces of coriander-seed, the whole to be well powdered and mixed. The mixture is to be given as a bolus, followed by a draught of half a pint of vinegar, a pint of water, and a handful of common salt. The bolus and the draught are to be given to the cow three successive mornings, on an empty stomach. The result is, it is said, an improvement in butter—gradual but permanent.

The butter first appears in small grains, and immediately these are noticed churning should be stopped, as further churning would injure the quality of the butter. The butter-milk is drawn off, and some cold water put into the churn, and after a few revolutions the butter is then taken out; the effect of putting in the water and moving the butter being to extract a good deal of the butter-milk from the butter. This, however, is not always done, and the butter is taken out, leaving the butter-milk in the churn for a time. The dairymaid washes her hands and arms in cold water, and rubs a little salt on her hands; she then puts the butter into a shallow wooden vessel, or into one in which some cold water has been put if the butter is to be washed. When it is not washed, the butter-milk is extracted by squeezing the butter between the hands, or by repeatedly kneading it with "the heel of the hand," mopping up the butter-milk with a coarse linen or canvas cloth, continuing the process until the butter-milk is thoroughly extracted from the butter. If any butter-milk is left the butter will be speckled, and will not keep. When the butter is washed, cold soft spring-water must be used, and the butter is kneaded in this until the water comes off clean. The water will require to be changed three or four times before that takes place. Much washing destroys the flavour of butter, and it is to prevent the loss of flavour that the dry mode of treatment is resorted to by many butter-makers. Wooden butter-workers are now largely used, and in many well-managed dairies the butter is never touched by the hand in the process of working.

Salting is the next process, and it should follow immediately after the extraction of the butter-milk. The salt, which should be of the best description, must be thoroughly worked into the butter at the rate of half an ounce to the pound; for the foreign market an ounce of salt to the pound of butter will be required. Some recommend that not more than a quarter of an ounce of salt should be used for each pound of butter, but in that case the butter must be sold for immediate consumption. In the case of butter prepared for the Cork market, three pints of salt are used to the firkin of 70 lb. for mild-cured or London market butter, and five pints for heavy-cured or foreign market.[1] The salt is blended with the butter by kneading both together by hand; but this mode is objected to by some, on the ground that the hands of some dairymaids are apt to communicate a disagreeable flavour to the butter; and those who hold this opinion use a butter-spade or the wooden skimming-dish, by means of which the butter, it is stated, is kneaded better than by hand. Mr Byrne says: After the salt is shaken on in layers, repeated drawings of thin slices made by the spade or cup, now on one side, then on the other, for about a dozen times, generally blends it well."

After the salting has been completed, some pack the butter at once in the firkin, while others allow it to lie for a day, and after again working it over with half the quantity of salt, the other half being mixed at the first working, pack

[1] Byrne's Prize Essay, as above.

it in the vessel in which it is to be kept or sent to market. For home use, jars of glazed earthenware are convenient; but for market, firkins or half-firkins made of wood are used. The firkin must be perfectly tight; and it is desirable to have it well scalded with hot water, and, after exposure to the air, well rinsed with cold water, before putting in the butter, in order to prevent the wood from imparting an odour to it. Some fill the vessel with garden-mould or with lime-shells and water for some days, and scald and rinse it. A little powdering of salt is shaken on the bottom of the vessel, and the butter then properly packed, taking care not to leave any vacancy between the butter and the side of the firkin or jar; a little cold pickle is poured on the top and a thin layer of salt, which is removed when the butter is sent to market, and a piece of white linen substituted, and the head fastened on. Butter should not be kept above a few days before it is sent to market, as there is a probability of the quality being injured, no matter how carefully the butter was made, when it is kept long.

Sugar and saltpetre are sometimes used in curing butter. When this is done, the proportions are—half a pound of yellow Jamaica sugar and a quarter of a pound of saltpetre to each pound of salt used; the saltpetre should be ground quite fine.

Butter made in winter is usually of too pale a colour, and to correct this defect, a little red-carrot juice or a teaspoonful or two of extract of annoto is put into the churn, just before the butter is ready to come. It is worthy of notice that the butter obtained from the milk of cows which are fed on furze or whins during winter, has naturally as rich a colour and flavour as the best grass-butter.

The average produce of butter per cow is about 190 lb. Cows which are uniformly well fed, and are of a good description, will give more—say, from 220 lb. to 250 lb.; while poorly fed cows will fall considerably below the average.

Fine Dorset butter, which commands the highest price in the London market, is made as follows: The milk, when brought from the cows, is passed through the strainer into shallow vessels, to the depth of about 3 inches; it is then suffered to stand, in cold weather, 36 hours; but it is never allowed to stand so long as to make the milk very sour before the cream is skimmed off. Before the cream is put into the churn, it is brought to the temperature of 55° or 60°, and then strained into the churn through a cheese-cloth. When the butter is come, and after the butter-milk is drawn off, it is washed in the churn in spring-water, which is again drawn off and fresh water added till it has no appearance of milkiness. This generally requires to be done three or four times, the churn being only turned a minute or two each time the water is put in. The butter is then taken from the churn and salted for the London market; only about $\frac{1}{4}$ lb. of salt to 12 lb. of butter being used. It is then washed again, and with a cloth wrung out of water till all the moisture is pressed from it; it is then made into rolls of 2 lb. each. The rolls are about 7 inches long, and packed on their ends in baskets the same depth, and sent to market.

It sometimes happens that butter kept for family use through the winter will become "winded," especially if great care is not taken to cover the surface of the butter with a linen cloth which has been wetted with brine each time the firkin is opened to take out a supply. To correct this "winding," we find it sufficient to take the butter out of the firkin, and after washing it well in cold water, to re-pack it it in a glazed earthenware jar, first having worked in a mixture of salt and sugar, equal parts of each, at the rate of about $\frac{1}{4}$ ounce of the mixture to 1 lb. of butter. A correspondent of the 'Agricultural Gazette' recommends as a cure for rancidity to wash and beat the butter in a sufficient quantity of cold water in which has been put 12 to 15 drops of chloride of lime to each pound of butter. After being mixed till all parts of the butter have been in contact with the water, it may be left an hour or two, and then washed anew in fresh water. Another correspondent recommends that the butter should be kneaded with fresh milk, and then with pure water. This, it is said, renders the butter as fresh and pure in its flavour as when first made, in consequence of the butyric acid, which causes the rancid taste, being soluble in fresh milk.

Finally, the whole art of butter-making may be summed up in the following points:—

1st, Securing rich, clean, healthy milk.

2d, Keeping all vessels and utensils scrupulously clean.

3d, Setting the milk in an untainted atmosphere, and keeping it at an even temperature while the cream is rising.

4th, Proper management in churning.

5th, Washing out or otherwise extracting the buttermilk thoroughly, and working so as not to injure the grain.

6th, Thorough and even incorporation of the salt, avoiding over-salting, and packing in oaken vessels, tight, clean, and well made.

Cheese-making.—This is a more difficult process than making butter; hence the great variety of cheese met with in different districts, ranging from the rich Stilton down to the stone-like article manufactured from "three times skimmed sky-blue," which is so hard in its texture that "dogs bark at it and pigs grunt at it, but none dare bite."

The principal varieties of cheese in the market are Cheddar, Gloucester, Cheshire, and Stilton. Besides these varieties, cheese is made in different districts of fair quality for ordinary use.

In preparing milk for the manufacture of cheese, an artificial ferment is necessary, and this is found in rennet, which is prepared from the stomachs—the fourth stomach, not the paunch—of sucking calves. The stomachs, usually called bags or vells, when taken from the animals, are cleansed from all impurities, and then, either with or without the contents, which consist of curdled milk, are salted and packed in jars, with a layer of salt between each layer of bags. The air is carefully excluded, and the jar is set aside for a year before its contents are used. When taken out for use they are put into brine, six bags to every two gallons of brine, and the liquid is allowed to stand for about two months. In other cases, the bags, when taken out of the jar, have the brine drained from them, and are then covered with fine salt on both sides and hung up on a piece of hoop to dry. The day before the rennet is required, "a portion of the dried bag, at the rate of 1 square inch to 10 gallons of milk, is put into a cup containing half a pint of lukewarm water and a teaspoonful of salt; and it is by mixing this infusion with the milk that coagulation is obtained."[1] Care must be taken that the bags are not too much decayed, for if such should be the case, the cheese will be permanently injured. No more rennet must be added to the milk than just sufficient to produce perfect coagulation, as too much rennet destroys the flavour of the cheese, and makes the curd tough and hard.

Mr Joseph Harding, Marksbury, Bristol, who is well known as a successful maker of Cheddar cheese, has given the following succinct account of the process :—

"Cheddar cheese is made only once a-day. The morning and evening milk, unskimmed, is put together at a temperature of about 80° Fahrenheit, when the rennet is added. In about one hour it is fit to break; a portion of the whey is then taken off, and heated sufficiently to raise the whole mass to about 100°; this is called the scalding. The whole of the whey is then drawn off, leaving the curd to dry and harden at the bottom of the tub. It is then passed through a curd-mill (which supersedes the breaking it into small particles by the hand), and sufficiently salted. It is then removed to the press, where each morning it gets a clean cloth, and the third day it is taken to the cheese-room, where it is kept in laced bandages for a few weeks, and in as many months becomes ripe and good, gracing the tables of the aristocracy. The labour and waste of making are much reduced since the invention of Cockey & Sons of Frome, of a cheese-making apparatus, which is rapidly getting into general use. It consists of a copper tub furnished with an additional bottom or chamber, which is connected by pipes to a boiler and a cold-water cistern in an adjoining room. The evening's milk being placed in a tub at night, is cooled by a supply of cold water from the cistern, filling the chamber and escaping through the night from a stopcock. While the morning's milk is being added to the night's, the chamber is filled with hot water from the boiler, which raises the milk to the desired temperature in a few minutes. When the cheese is broken, instead of removing the whey in a vessel to the boiler, the chamber is again filled with hot water, and the process of breaking and scalding is performed under one operation. All the utensils are

[1] Wilson's British Farming.

made of tin except the vats, which are made of oak-staves. The vat is made to open at the side, so as to liberate the cheese easily. The cheeses are made thick, ranging from 50 to 100 lb. and upwards, and by the best makers, at all times of the year successfully; though in the majority of instances makers would benefit themselves, and save the cheese-factors from annoyance and much loss, if they skimmed part of the milk, and reduced the size of the cheese in the spring, and especially in the autumn months. It is a mistake to suppose that new milk causes the cheese to heave during the months of March and April, which the cows are constantly calving in. After the first milking, the milk is put into the cheese-tub, when, in the hands of a skilful maker, the cheese is made thick as at other times.

"Fermentation is the natural consequence of the mingling together of milk and rennet. If there be more fermentable properties or powers in new milk than old, it matters little, as, during the process of making, fermentation *must* be destroyed to ensure a good cheese."

We take the following account of the manufacture of Gloucester cheese from Mr Morton's very useful 'Handbook of Dairy Husbandry:'—

"Under ordinary management, the Gloucester cheese is made twice a-day. The morning's milk is heated or cooled to about 80° in one or more large vessels of from 80 to 100 gallons; a pint and a half or thereabouts of rennet is added to every 100 gallons. In an hour's time or so, when the curd has set, the curd-breaker, a wire sieve fixed on the end of a pole, is slowly and repeatedly drawn hither and thither through the mass, the whey is baled out, the curd is pressed by the hand, crumbled fine, and placed in a cloth and in the cheese-vat under a press for twelve hours; it is then salted and turned, and again put under the press. It is kept there as long as there is press-room for it, and afterwards transferred to the dairy shelves, when it is turned at intervals, and where it gradually ripens."

1 gallon of milk produces, on an average, 1 lb. of cheese.

In Gloucester it is calculated that, in addition to the cheese, 4 cwt. from each cow, and 36 lb. or thereabouts of milk and whey butter made per annum, a pig of 12 stone should be fed for every three cows upon the waste whey of the dairy.

There are numerous details of dairy management which cannot be fully entered into in a work of this kind, and those who desire to become acquainted with such matters will find them fully described in Morton's 'Handbook of Dairy Husbandry,' Sheldon's 'Dairy Farming,' Long's 'British Dairy Farming,' and other works. We shall therefore close our remarks on this department of our subject with the following "summary" from a useful article on "Dairy Farming," by W. T. Carrington, of Hollington, Uttoxeter, which was published in the 'Journal of the Royal Agricultural Society of England.'[1]

"1. It appears that on very first-rate pasture, worth upwards of £3 per acre, 1¼ acre will graze a bullock and a sheep, besides making a second lot moderately fat before Christmas with the aid of oilcake. It will give a gross return of £6 or £7 per acre.

"2. 1¾ acre of such land would, if it suited, keep a milch cow, and give a gross return of £9 per acre, with an extra cost of £1 to £2 for dairy expenses, and some aid in fodder and roots from arable land or by purchase.

"3. On ordinary pasture, worth 30s. to 40s. per acre, 3 to 4 acres will be required to keep a milch cow, so as to yield, on an average, 535 gallons of milk per annum.

"4. If the milk can be sold at 8d. per gallon, that will be the best means of disposing of it. The dairy expenses will then be diminished, but the cost of keep, &c., increased. The gross annual return would be £18 per cow, besides the calf.

"5. If whole-milk cheese be successfully made (4¾ cwt. at 65s.), a return of 7d. to 7½d. per gallon, or £16 to £17 per cow, may be obtained.

"6. From 535 gallons of milk, about 200 lb. of butter may commonly be made, worth, at 13d. per lb., £10, 16s. 8d. By rearing calves, fattening pigs, or making cheese with the skim-milk, a further sum of £4, 4s. per cow may possibly be secured. This makes £15 per cow, or about 6¾d. per gallon. Every extra penny in the price per lb. of the butter adds 16s 8d. to the yearly return.

[1] Vol. i., Second Series. Part II. 1865.

"7. By fattening calves for the butcher, 5d. to 6d. per gallon may be realised with less outlay and trouble.

"8. The profits made by rearing first-class Herefords for the butcher (cow and offspring, after running together, being sold fat) are probably far below those derived from dairying.

"9. The exhaustion of the soil by the sale of cheese or milk is not to be overlooked; but neither are our modern resources for the enrichment of our pastures by artificial means to be forgotten.

"10. Dairy expenses vary between £1 to £2 per cow.

"11. Supplementary food to the value of 40s. must generally be given to the cow, to secure a first-rate return of produce."

Associated Dairies.—For some years a system of associated or joint-stock dairies has been established in the State of New York, and from thence it has spread into other States of the Union. The object of these dairies, in the first instance, was the manufacture of cheese, but it has latterly been extended to the manufacture of butter. The first factory on this system was established by a Mr Jesse Williams, a Welshman, in 1851; and although the system progressed slowly for some years, still in 1866 there were no fewer than 500 cheese-factories at work in the State of New York alone, in which the milk of 200,000 cows was manufactured into cheese.[1] The extension of the system was mainly due to the fact that it is more economical as regards labour and appliances than private dairying, while the cheese made at those factories sells for more than that made in ordinary farm-dairies.

It is found that milk should not be brought to the factory from a greater distance than from 4 to 5 miles. The number of cows supplying milk to a factory ranges from 300 to 2000. Under 300 cows the factory system does not pay; while extremely large dairies are not so profitable, comparatively, as those of a moderate extent—that is, when the number of cows supplying milk does not exceed from 500 to 800. The milk is delivered daily by the farmers at a fixed price. Each factory is under the management of a skilful

[1] "Report on the American Cheese Factory System," by H. M. Jenkins. Journal of the Royal Agricultural Society of England, vol. vi., Second Series.

person, who has the sole charge; and it is calculated that one assistant is required for every 200 cows' milk. These assistants consist of men and women, boys and girls not being suited for factory work. The capital invested in a factory where the milk of from 700 to 1000 cows is manufactured into cheese appears to be about £1200 (6000 dollars). The cost of erecting a butter-factory and supplying it with machinery and dairy appliances is about £800 (4000 dollars). Mr Willard states that at some of the butter-factories having the milk of 400 cows, the gross proceeds from sales gave to the farmers who supplied the milk and were shareholders, about 11d. per gallon for the milk delivered.[1]

The "advantages of butter-factories" are thus set forth by Mr Willard: "The advantages of butter-making on the associated dairy system over that in private families are very great. In the first place, by the association system a uniform product of superior character is secured. Every appliance that science or skill or close attention is able to obtain is brought to bear upon the manufacture, and prime quality necessarily follows as a result. If you could assume that in a neighbourhood of 100 families, each family had the skill and convenience of the factory, and that each would give the subject the same close attention, then, doubtless, there would be no difference as to the quality of product; but such a state of things rarely exists. Again, the factories are able to obtain a larger price, because it costs the dealer no more to purchase the 100 dairies combined than it would to purchase an individual dairy, and the uniformity and reliability of the product does not entail the losses that are constantly occurring in different small lots by reason of inferior quality. The factories, too, relieve the farmer and his family from a great deal of drudgery; and unless the work can be done by members of the family who cannot be employed profitably at other labours, it is a matter of economy to have the butter and cheese made at the factory, since what would take a hundred scattered over the country to do, is performed in the same time by three or four when the milk is worked up together in one place."

[1] Journal of the Royal Agricultural Society of England, vol. vii., Second Series. 1871.

We consider that the associated dairy system for the manufacture of butter is admirably adapted to meet the cirstances of the majority of dairy farmers in Ireland. It would ensure a much superior article, because more equal in quality, and better manufactured, than that which is made at present in the ordinary run of Irish dairies, where there is frequently no suitable convenience for keeping the milk, nor a sufficient number of cows to fill a firkin at one churning, nor, in short, the skill necessary to produce an article of superior quality. All these defects, as well as others we have not named, would be obviated were butter-factories established on the associated system.

Butter-factories have recently been established in Sweden; but it appears that the operations are confined to the purchase and working of cream, not of milk, leaving it to the producer to utilise the skim-milk as he may consider most profitable.

The factory system for the purpose of cheese-making has also been established in Derbyshire, with very satisfactory results, notwithstanding the great opposition it encountered at the outset from proprietors, farmers, and even from cheese-factors. The quality of the factory-made cheese is of a superior kind, and it has realised at least 10s. per cwt. more than cheese made in the usual way on individual dairy farms. The success of the system in Derbyshire should lead to its extension in other cheese-making districts in the kingdom.[1]

Quality of Milk—Adulteration.—When cows are fed largely on sloppy food, such as distillery or brewery refuse, bran-mashes, or on grass from irrigated meadows, &c., the milk becomes thin or watery—so much so that, if sold in its natural state, a suspicion may arise that it has been adulterated by mixing it with water. Again, some cows naturally give very poor milk, and as such animals are of little value in the dairy, more especially where the manufacture of butter is the chief object, it is desirable that the farmer should possess the means of testing the quality of the milk when it is considered necessary to so.

Dr Voelcker, who has devoted much attention to the investigation of milk, states that "milk may be considered

[1] For a detailed account of the system as established in Derbyshire, see a report by Mr Gilbert Murray in the Journal of the Royal Agricultural Society of England, vol. vii., Second Series. Part I. 1871.

rich when it contains from 12 to 12½ per cent of solid matters, and from 3 to 3½ per cent of pure fatty substances. If it contains more than 12½ per cent of dry matter, and 4 per cent or more of pure fat, it is of extra rich quality. Such milk throws up from 11 to 12 per cent of cream in bulk, on standing for 24 hours at 62° Fahr. Good milk of average quality contains from 10½ to 11 per cent of dry matter, and about 2½ per cent of pure fat. It yields from 9 to 10 per cent of cream. Milk adulterated with water, or naturally poor, contains more than 90 per cent of water, and less than 2 per cent of pure fat. Such milk yields only from 6 to 8 per cent of cream, and even less if it be very poor.[1]

The instrument used for ascertaining the percentage of cream in milk is called a "creamometer," or cream-gauge. It is made in the form of a cylindrical glass tube, with glass foot, and is divided into 100 equal degrees. The graduated marks proceed downwards, from a point near the open end marked nought (0) or zero, and each degree indicates 1 per cent of cream. In testing milk for cream, fill up the tube to zero, and after standing 24 hours note the number of degrees occupied by the cream. Dr Voelcker considers it important (1) that the milk should be kept during the experiment as nearly as possible at a temperature of 62° Fahr. In comparative trials, it is essential that the temperature be the same in them all. (2) That in all trials the milk should be left standing for the same length of time, which may be 18 or 24 hours. If left for a longer time, the bulk of milk slightly diminishes. (3) Milk should be agitated as little as possible previous to being tested. Milk which has been carried by rail throws up less cream than that which has been less disturbed. The same occurs when milk has been shaken by conveying it some distance in a cart. Voelcker says that shaking "has the effect of breaking some of the cream-globules, in consequence of which either the fatty matters remain suspended in the milk, or more probably the cream thrown up gets richer in fat."

The lactometer is a simple instrument designed for the purpose of indicating, by the point to which it sinks in different samples of milk, the extent to which they have been mixed with water, or are naturally defective. A low

[1] Journal of the Royal Agricultural Society of England, vol. xxiv. 1863.

specific gravity always indicates a large quantity of water, and this is shown by the extent to which the lactometer sinks in the milk.

The manner in which the quality of milk is tested in the American butter-factories is described by Mr Willard.[1] Two cream-gauges, a per-cent glass, and a lactometer, are employed for the purpose. Mr Willard says: "In testing, one of the cream-gauges is filled to gauge-mark 10 with milk known to be pure, and drawn from several cows. This will be the standard for pure milk for that day. Another gauge is filled to the same number (10) with milk from a can (or cow) which you wish to test. To avoid any mistake, the first jar containing pure milk is marked with the letters P. M. on the side or bottom. The jars are set away side by side, a sufficient length of time for the cream to rise. Now note the quantity of cream in each. If a less quantity is formed on the milk you are testing than on the other, it indicates dilution, or skimmed milk. Now remove the cream from each with a spoon, introduce the hydrometer (or 'lactometer,' as it is usually called,) into the jar marked P. M., and note on the scale-mark when it floats. Then remove it to the other jar, and note also when it floats. If it sinks lower than in the first jar, the evidence is considered almost positive of dilution with water. Replace the lactometer in jar marked P. M.; from per-cent glass, filled with water exactly to 0 or zero, pour into P. M. jar until the lactometer sinks exactly to the same point as in the other jar. Now count a number on per-cent glass from zero down (each mark represents one half of one per cent), and you will have precisely the percentage of water with which the milk you are testing has been diluted."

[1] Journal of the Royal Agricultural Society of England, vol. vii., Second Series. 1871.

CHAPTER VIII.

SHEEP.

CHARACTERISTICS OF DIFFERENT BREEDS.

The Leicester.—Since the time that Bakewell formed the improved breed of Leicester sheep by judicious selection, it has been considered the principal breed of long-woolled sheep in the British Islands. It is essentially a refined breed, as regards form and quality; and for this reason it has been employed with vast success in the improvement of other breeds.

The points of a good Leicester are—Head hornless and well set on, wide across the forehead, but not too short; face white; fine bold eye; neck very muscular and wide at the base, not too short, a short neck being a defect; moderately wide between the top of the shoulders; shoulders oblique; chest wide; fore-flanks widely developed: ribs well sprung; loins wide and well covered; rumps wide, and a little projecting over the tail; thighs wide and well let down, and with what is technically known as a good "twist"; wool long and thickly set, with rather a curly lock; carcass deep and round. In many modern Leicesters there is great width across the shoulders and ribs; but the hind-quarters are lighter than they should be, and taper towards the tail. The fleece averages about 7 lb.

Early maturity and great aptitude to fatten are characteristics of the Leicester breed, and these qualities are imparted to other breeds when the Leicester is used in crossing them. Sheep of this breed lay on much outside fat, and when slaughtered young the flesh is tolerably juicy;

but if kept until they have attained some age—say over two years, when they weigh from 120 to 150 lb. each—and extra high fed, they become too fat to suit consumers. The inside fat is not in proportion to the outside. The ewes are only middling nurses, and the lambs are tender; so that the pure Leicester is not a favourite in all parts of the country.

Border Leicester.—A variety of Leicester sheep is bred in the south of Scotland and in Northumberland, which differs in some respects from the Leicester of the midland districts of England. This class of sheep, which has received the name of "Border Leicester," has been spread throughout Scotland, to the almost total exclusion of Leicesters of the English type. The breed has been introduced into Ireland, where it thrives well when kept pure.

The face of the Border Leicester is a clear white, more so than that of the English type; the head is fine, and the ears thin and pricked. The back is broad, straight, and flat; ribs well sprung; body longer, and the animal more "upstanding," than the English Leicester; quarter also longer, and the thigh fuller. The wool is long and soft. When too finely bred, there is apt to be a want of muscle in the neck, and a tendency to bareness of wool on the belly. At the great annual sales held in the month of September at Edinburgh and Kelso, large numbers of rams are sold at high prices, chiefly for the purpose of putting to Cheviot or blackfaced ewes. At the Kelso ram sales, September 1873, one of Lord Polwarth's lot, a shearling, was sold for £195, and another for £115; and at the sale of the Marvingston flock (Mr John Lee's), same month, a prize shearling ram brought £143, and shearling ewes from five guineas to twenty guineas each. Such prices are sufficient evidence of the estimation in which Border Leicesters are held by an intelligent class of breeders, and supplies a sufficient answer to those who assert that the Border Leicester is what they call "a mongrel variety." Mr John Wilson, Edington Mains, Berwickshire, and the late Mr John Grey of Dilston, both eminent authorities, have, however, most satisfactorily proved the purity of the Border Leicester, in an article published in the 'Transactions of the Highland and Agricultural Society,' 1862. These gentlemen proved the direct descent of the Border Leicester from

Bakewell's flock; and showed that diversity of climate and of general treatment, and diversity of taste in the breeders —all of which have been long at work — are sufficient to account for all the changes that have taken place both in English Midland Leicesters and in Border Leicesters, although both started with like materials, and from the same common source.

Lincolnshire Breed.—This is an important breed, both from its meat-producing properties, and the weight and quality of the fleece. Mr John Algernon Clarke, who is an excellent authority on all matters connected with the Lincolnshire breed, has given the following account of it:[1]—

"The old Lincolnshire long-wools were ungainly animals, with a carcass long and thin, legs thick and rough, bones large, pelts thick; and although attaining to a great weight, they were a very long time in arriving at maturity. In fact, their chief merit was their wool, from 8 to 16 inches long, and weighing from 8 to 14 lb. per fleece; and this wool formerly made the breed profitable to the lowland graziers, although covering a slow-feeding, coarse-grained carcass of mutton. Upwards of fifty years ago, when Young wrote his 'Survey,' the new Leicesters were spreading very rapidly over the country, probably faster than they had done (with one or two exceptions) in any other, driving out the Lincolns from the poorer lands, and improving them by crossing. 'The true Lincoln,' he says, 'is a larger sheep and with a longer wool, and therefore demands better pasturage; where it finds such, there the old breed remains. Upon inferior land the Leicester establishes itself, from the necessity of having smaller size and shorter wool.' At the present time the pure old-fashioned Lincolns are scarcely to be found, except in some few places in the south-eastern lowland and the rich eastern marshes. The improved Lincoln and Leicester sheep universally prevail, varying widely, however, in different districts; and while perusing the following characteristics, the reader must remember that prejudice for one's own is as firmly rooted in this as in many other counties. The larger breeds chiefly occupy the south-eastern quarter of the county, and are known as 'the

[1] Journal of the Royal Agricultural Society of England, vol. xv.

Lincolnshire long-wools,' in contradistinction to the Cotswold and improved Oxfordshire breeds. They partake largely of the peculiarities of both Cotswold and Leicester, having the expansion of frame and nobility of appearance of the one, combined in a great degree with the quality of flesh, compactness of form, beauty of countenance, lightness of offal, and inclination to fatten, of the other; but they far exceed either in the weight of their wool. They are usually kept until 27 to 33 months old, when their weight is from 28 lb. to 72 lb. per quarter; and the two clips of wool weigh together about 20 to 25 lb. Under good management this wool is of a quality which rarely fails of obtaining a price equal to that of the lighter long-wools, or even pure Leicesters; and there is therefore, perhaps, no breed that can equal this in rapidity of growth and propensity to fatten under a fleece so weighty and valuable. The more celebrated breeders of rams of this variety are Messrs Kirkham, Benniworth, Topham, Clarke, &c. In the midland and south-western parts of Lincolnshire the sheep are more closely allied to the true-bred Leicesters (the proportion of 'blood' being estimated at three parts Leicester to one of old Lincoln), and are very compact and well formed, with fine and good countenances, and rather close-set but beautiful wool. They can generally be fed off at the age of 18 to 27 months, and are noted for their large proportion of lean-meat; if kept longer it is for the purpose of taking the fleece—the two fleeces weighing together about 17 lb., and the carcass about 35 lb. per quarter on an average. The more eminent breeders of this kind are Messrs Casswell, Brice, Clarke, Gilliatt, Chaplin, Cooke, Smith, &c. In the northern and north-eastern parts of the county about one-fifth of the sheep are pure Leicesters, of the superior breed sometimes called improved Leicester; Messrs Abraham, Skipworth, Torr, Dudding, &c., are a few of the favourite breeders. The remaining four-fifths are descended from the original large Lincolnshire sheep, crossed latterly with Leicester rams—being thus neither too coarse nor too delicate, uniting size with quality, and having heavier fleeces though of coarser quality than those of the unmixed Leicesters. These sheep are admirably suited to the light-land districts; and the breeders keep up their breed by selecting rams—sometimes for wool, sometimes symmetry, mutton," &c. &c.

It has been, therefore, by the introduction of Leicester blood, that the coarse and ungainly Lincoln breed has been improved; but the variety which prevails, as pointed out by Mr Clarke, from the different proportions of Leicester blood introduced into that of the Lincoln in various districts, prevents that uniformity of type which is so desirable in any improved breed. Rams of the Lincolnshire breed have been exported in considerable numbers to the Continent, and also to the colonies. The results of the ram sales in 1873 showed that 1025 rams sold at home sales and fairs averaged £17, 19s. 7½d. each; the highest average being that obtained at the Biscathorpe sale (Mr Kirkham's), where it amounted to £35, 18s.

The Cotswold Breed.—Gloucestershire is the native locality of this breed, where it has existed for a very long period, mention being made of it in history in the early part of the fifteenth century. It has, however, been much improved of late years by the introduction, it is believed, of Leicester blood, and by selection in breeding and careful treatment. It is a large breed, and possesses a considerable degree of hardiness; but the flesh is coarse—at least it is so when the sheep become aged. When slaughtered young—that is, not exceeding two years old—the meat is of fair quality. At that age well-fed Cotswolds will weigh from 30 lb. to 35 lb. per quarter. The points of the Cotswold sheep are as follow: "They are without horns, and have white faces and legs, with a strong tuft of wool covering the forehead, more prominently in the male than in the female. The neck and fore-quarter are somewhat deficient when compared with the Leicester; the back is straight, the body well ribbed up, with deep flanks, hind-quarters square and full; the legs are clean, of moderate length and bone. . . . The ewes are prolific, good mothers, and the lambs are covered with a thick close fleece. The wool-produce is an important item in a Cotswold flock. The fleece, which is closer upon the body than the Leicester, averages 7 to 8 lb. each. The staple is long, mellow to the hand, though somewhat coarse in quality.[1] Cirencester fair,

[1] Professor Wilson (Edinburgh) in the Journal of the Royal Agricultural Society of England, vol. xvi.

held in August, is a leading fair for the sale of Cotswold rams, &c.

The Roscommon Breed.—This is another large long-woolled breed, reared chiefly in the province of Connaught in Ireland. The original breed was also a large but a most ungainly and ill-formed description of sheep, being, as Culley stated of the Roscommon sheep of his day, "almost in every respect contrary to what a well-formed sheep should be." Since Culley's time the breed has been much improved, more especially within the last twenty-five years, chiefly by the introduction of Leicester blood, and by careful selection. The improved Roscommon sheep of the present day have large meat-producing frames, and heavy fleeces of silky wool. When well fed they arrive soon at maturity; but the breeders of sheep in Connaught rarely grow turnips, trusting altogether to grass-feeding. Sheep of the Roscommon breed do not usually reach the butcher at as early a period as they might otherwise do. When fat they weigh fully as heavy as Cotswolds, and the flesh is of a better description than that of the aged Cotswold. Ballinasloe, Strokestown, and Tuam are the great fairs for the sale of sheep of the Roscommon breed.

Southdowns.—"Small in size, but great in value," are the characteristics of the Southdown breed; and it has acquired those features solely through careful selection and culture, for the original breed had light fore-quarters, narrow chests, and long legs. These defects have all been corrected, and the modern Southdown is a model of compactness and symmetry. They are hornless; have dark-brown faces and legs; a close fleece, which is short in the staple, fine and curling, and weighs from 3 to 4 lb. The Southdown sheep are very hardy, easily kept, readily fattened, and the flesh is of very superior quality. At 12 to 15 months old Southdown wethers will average from 18 to 20 lb. per quarter, and at two years old from 25 to 30 lb. The ewes are very prolific, and are excellent nurses. The Southdown breed, outside of its native district—the chalk-hills of the southern counties in England—is usually considered better adapted for the home farms of noblemen and gentlemen who rear sheep for their own use, than for rent-paying farmers. This view of the matter may, however, be questioned. It is certain that they can be kept more thickly on the ground than sheep of the larger and coarser breeds, and the mutton is also more valuable. The light fleece of the Southdown, now that wool is so cheap, is less of a drawback than formerly. It is, nevertheless, a valuable breed, especially where the soil is dry and light, and covered with a close, short, sweet herbage. Southdown rams have been much used in crossing other breeds. The late Mr Hugh Watson of Keillor, Major Hunter of Thurston, and Mr R. Scot Skirving, have bred Southdowns successfully in Scotland.

The Shropshire Breed.—In recent years this valuable breed has come prominently to the front. In this country it has spread far beyond its native county, having gained a firm footing in Scotland and Ireland as well as in various parts of England; and its fame for size, quality, early maturity, and wool, has travelled to America, where there is now a considerable demand for Shropshires.

Writing on the agriculture of Shropshire in 1803, Plymley says: "There is a breed of sheep on the Longmynd with horns and black faces that seem an indigenous sort. They are nimble, hardy, and weigh near 10 lb. per quarter when fatted. The fleeces on the average may yield 2½ lb." From these "nimble, hardy" sheep the popular Shropshire is directly descended. No variety of stock in the country has displayed greater improvement, and England has much reason to be proud of its grand flocks of improved Shropshires. Mr W. G. Preece of Shrewsbury was mainly instrumental in bringing the breed into public notice. Some thirty years ago he and others succeeded in getting it recognised as a distinct breed at the Royal Show at Gloucester in 1853. At the Royal Show at Shrewsbury in 1884, there were no fewer than 875 entries of Shropshires, the display of the breed having formed one of the most noteworthy features in the entire show. Referring to the breed at that show Mr Alfred Mansell, College Hill, Shrewsbury, whose name is creditably associated with the improvement and extension of Shropshires, says: "Another fact worthy of notice is that the breed seems to thrive and become acclimatised in all places, if properly cared for, as is proved by the success of exhibitors, extending over a wide area—noticeably at the recent Royal Show at Shrewsbury, the exhibitors of this breed numbering no less than 60, and hailing from 15 counties, including Ireland; whereas the best that can be said for any other distinct breed is that the Southdowns come from 11 breeders in six counties—and by the experience of others who have seen the breed flourishing in every county in England, in Scotland, Ireland, the United States, South America, Canada, the Colonies, France, Germany, Greece, and most other Continental countries."[1]

Shropshires are very prolific, and are capital nurses. They have greater size than the Southdown, and in quality they are not much, if any, inferior. They carry a large proportion of lean meat to fat, are light in offal, and with good treatment they come to market at 11 to 14 months old, weighing 20 to 25 lb. per quarter. In some instances even greater weights are obtained. The fleece averages about 7 lb. The breed is still robust in constitution, and of a thoroughly rent-paying character. The judges at the Royal Show at Birmingham state in their report in the Journal of the Society that they selected for prizes "those animals considered best calculated to uphold and perpetuate the most distinctive type of the Shropshire—namely, a well-developed head, with clear and striking expression of countenance, a muscular neck well set on good shoulders, the body symmetrical and deep, placed as squarely as possible on short legs, due regard being paid to grandness of style, a well-covered head, and wool of the best staple and most valuable kind, rejecting as much as possible all animals showing an inclination to produce black wool or dark skins." The skin should be a nice cherry colour; the face and the legs soft black, not sooty or rusty brown; and they should be free from all white specks. The improvement and spread of the breed have been greatly stimulated by the Shropshire Sheep-breeders' Association and Flock-book Society, under whose auspices a Shropshire Flock-book is now issued annually.

Oxfordshire Downs.—This comparatively modern but valuable breed is said to have been produced by crossing the Southdown ewe, and in several instances the Hampshire ewe, with a Cotswold ram. By putting the crosses together, and by constant attention and judicious selection,

[1] Live-Stock Journal Almanac, 1885.

a breed of sheep has been produced which combines uniformity of character and hardiness of constitution with large frames, aptitude to fatten, and mutton of superior quality. Mr John Treadwell, whose flock of Oxford Downs is the most renowned in existence, thus (writing in 1885) describes the origin and character of the breed:—

"About sixty years ago or more, some sheep-breeders in Oxfordshire, probably seeing the great merits of a cross between the Hampshire ewe and the Cotswold ram, determined to establish a new breed of sheep. Messrs Druce of Eynsham, Gillett of Southleigh, and Blake of Stanton Harcourt, were amongst the foremost who undertook this task. Their aim was to combine in one variety the weight of the Cotswold and the quality of the Down, and most probably the finest quality of Hampshire Down ewe was used with the closest-woolled Cotswold ram with a grey face. No doubt for some time a tendency to breed back was found; but by careful selection and judicious blending it was soon apparent that a *breed* distinguished for size, quality, and form, and great grazing capabilities, had been established. The wool being long, of fine texture and good weight, it soon became a favourite article with the manufacturer.

"The new breed having become largely patronised by flockmasters, it was decided, about the year 1850, to give it the name of the 'Oxfordshire Down.' When it first came to be seen in the showyards (there being no separate classes for it), the exhibits competed with Short-woolled and Cross-bred sheep; but at the show of the R.A.S.E. in 1862 at Battersea, separate classes were assigned to 'Oxfordshire Down' sheep, a strong entry of sixty-two pens being the result. This was the first year I exhibited in a 'Royal' showyard, at that time as one of the executors of my late father. In 1868, having the flock in my own hands, I again entered the lists at Leicester 'Royal,' and have, I believe, exhibited at every 'Royal' show since, never having missed taking a prize of some sort."[1]

The hoggets of this breed weigh when shorn from 35 to 40 lb. per quarter; and the fleece of an entire flock will average about 7 lb. Mr Druce, who is well known as an

[1] Live-Stock Journal Almanac, 1886.

eminent breeder of Oxford Downs, says of the cross between the Cotswold ram and Southdown ewe, that "with the ordinary skill of sheep-farming, I find no difficulty to keep the form and size of the animal as it should be, the wool of a valuable quality and not deficient in quantity; and I maintain that the good qualities can be better secured by employing the cross-bred animals on both sides than by using the first cross."

Hampshire Downs.—This breed is sometimes called West-country Downs. They are chiefly bred on the chalk-formations of Berkshire, Hants, Wilts, and Dorset. The present improved Hampshire Down breed of sheep has been produced by crossing ewes of the old breed of Hampshire and Wiltshire with Southdown rams, combined with selection, and a largely increased growth of green crops and forage plants for sheep-feeding. Referring to these points, Mr E. P. Squarey states, in an account of the Hampshire Down breed, which was published in the 'Field,' July 1873, that "the altered system of farming on the chalk-formations of Wilts, Hants, Berks, and Dorset, and the introduction of the improved Hampshire Down sheep, has led to a very considerable increase of mutton and wool during the last fifty years. In the absence of statistics it is difficult to give a reliable estimate of such increase; but inquiries amongst those most competent to form an opinion, lead to the belief that the increased production in weight of mutton and wool exceeds that of the past century by at least 50 per cent."

The old breed was horned, and after the first introduction of Southdown blood the sheep of North and East Hampshire are described by Mr Squarey as being "large, muscular, early matured animals, growing a fair quantity of wool of moderate fineness; the head large and well set on, of dark-brown colour, verging towards black, covered with coarsish hair, with Roman nose; the neck with greatly developed muscles; the ears thick, and of the same colour as the face, and an occasional tendency to recur to the original type, by producing 'snig horns'; the legs with large bones, and in the most strongly marked types the wool growing below the hocks and knees. An occasional white spot was exhibited on the face, ears, or legs; but the efforts of the ram-breeders were uniformly directed to avoid this, and to procure perfect uniformity of colour. The Wiltshire breeders adopted a more largely framed and probably less handsome animal than their Hampshire brethren. They were less careful as to the uniformity of colour; and a ewe with speckled face or ears was not dismissed from their flocks, provided she had size and other good qualities."

Subsequent operations have removed some of the more objectionable points, as above described, and the result is the present highly improved breed. The wool is short, but of fine quality, and the average weight of fleece is 4½ lb.

The principal fairs where the Hampshire Down breed may be seen in perfection, are the Overton and Weyhill fairs in Hampshire, and the Britford and Wilton fairs in Wiltshire; and in order to give some idea of the money value of the breed, we may mention that at Britford and Wilton fairs, in October 1872, lambs which fell in February of that year realised from 55s. to 72s. per head. Mr Morrison's (of Fonthill) pen of shearling wethers, which obtained the silver cup at the Christmas Show of the Smithfield Club in 1872, as the best pen of short-woolled sheep in the yard, were estimated to weigh 280 lb. each. At the Smithfield Fat Stock Show in 1883, Mr William Parsons, West Stratton, Micheldever, won the Champion Plate for the best pen of fat sheep in the show, with a grand pen of Hampshire lambs, ten months old, and averaging 207 lb. live weight. Their dead weight was 136 lb. each.

The Dorset Breed.—The chief peculiarity of this breed consists in the fact that when the ewes are well kept, they will take the ram as early as April, and thus produce lambs which are fit for market by Christmas. As the ewes will also take the ram soon after lambing, it is not unusual for them to produce two crops of lambs in the year. The Dorset is a whitefaced breed, and has a tuft of wool on the forehead; the legs are also white, but the nose and lips are black. They are hardy, quiet, and easily managed; when well fed, the wethers weigh from 20 lb. to 25 lb. per quarter at two years old. The fleece is close and heavy, and the wool is of an intermediate class between long and short. The average weight of the fleece is about 6 lb.

The foregoing breeds are adapted for low-lying pastures and arable lands. We now come to the mountain breeds, by means of which vast tracts of highly elevated grazings have been rendered of great value to the nation.

The Cheviot Breed.—This valuable breed derives its name from the Cheviot range of mountains, situated partly in Scotland and partly in Northumberland. The Cheviot breed now occupies a large extent of the mountain-pastures in the south of Scotland, as well as a portion of the better class of sheep-land in Sutherlandshire. Large flocks are also kept in Caithness and in Ross-shire. Much attention has been paid to the improvement of the Cheviot breed; and Mr Brydon, Dumfriesshire, an eminent breeder, has obtained from 100 to 200 guineas for rams bred by him, and disposed of by public auction.

Cheviots are without horns, although a "snig" appears occasionally in a ram; heads and legs white, but sometimes showing a slight tendency to light-dun markings; eyes bright, ears fine and lively, body long, legs clean and fine; the neck and fore-quarter are rather light, but these points have been improved latterly in the best specimens of the breed. Cheviot sheep are hardy and quiet, fatten readily on turnips, and the wethers weigh at three years old from 70 to 80 lb., or more, if forced with artificial food. The mutton is of superior quality. The ewes are prolific, and excellent nurses. The fleece, taking a flock through, averages from 4½ to 5 lb. Professor Wilson describes it as "a small-haired wool of medium length, suitable for worsted and woollen purposes. It is a soft, rich wool, and is liked by the manufacturers."

The Blackfaced Scotch Breed.—This breed is spread over the midland and West Highland districts in Scotland, and is also bred in great perfection in the south-western counties of that part of Great Britain. In recent years it has been vastly improved, and has encroached largely upon ground formerly occupied by Cheviots and other varieties. The old Blackface had several objectionable qualities, but these have been got rid of by judicious selection. Careful breeders also endeavour to avoid the too common error of overstocking, which, when practised, tells disadvantageously on the character of the sheep. The Scotch Blackface is a horned breed, the horns of the ram being of large size and twisted in a spiral form, measuring, in several instances, from base to tip fully 3 feet; in the ewe the horn should be flat and "open," or standing out well from the head. The colour of the face and legs is black, and occasionally speckled, but a uniform dark colour is preferred; forehead broad, jaw long and broad, eyes bright, not too near the root of the horn, shoulders well laid, back broad and straight, body short but well barrelled, good haunch.

The Blackface is an extremely hardy breed, and thrives where even the Cheviot would succumb to the climate and scanty fare. The wethers bred on the large hill-grazings are usually sold at three years old, and are put on turnips to fatten, which they do readily, and weigh from 16 lb. to 18 lb., and even 20 lb., per quarter. When forced they will reach 30 lb. to 35 lb. per quarter, but these extra weights are attained at some sacrifice of quality in the mutton, which, in ordinary cases, is of the very finest quality. Gentlemen who feed blackfaced wethers for their own use keep them until they are five years old, feeding them on turnips, hay, and grass.

The wool is coarse, and is chiefly used in the manufacture of carpets, rugs, and other coarse woollens. The fleece is loose and shaggy, and weighs when washed about 3 lb. on an average. The improvement which has been made in the form of the animal by judicious selection has also tended to change the character of the fleece, but there is still much room for amendment in this respect. While these remarks apply correctly to the breed as a whole, it is noted with satisfaction that a very high standard of merit has been reached in several of the leading flocks. The premier flock of the breed is owned by Mr Charles Howatson of Glenbuck, who has produced some show animals of rare excellence, and, better still, has raised his "average yield of wool per ewe and hog to about 5½ lb."[1]

The Lonk Breed.—This breed belongs to the mountain-ranges of Yorkshire and Lancashire, and extends down into Derbyshire. It is akin to the Scotch Blackface, being a horned breed, and having the face and legs marked with streaks of black and white. The horn should be strong, and finer than that of the Blackface, but shaped like it in the curl. The fore-quarter is light, and the loin is deficient in

[1] Blackfaced Sheep. By Alexander Macdonald.—Transactions of Highland and Agricultural Society, 1884.

breadth. The Lonk is not so hardy as the Blackface, but having much finer wool and a heavier fleece, a cross with it on the Blackface improves the fleece of the latter. This has been tested in Scotland; and the .produce of crosses of this kind exhibited at the show of the Highland and Agricultural Society held at Stirling in 1864, and at the Inverness show of the same Society in 1865, were much admired, the wool being manifestly better, while the form of the animal was not altered. The wool of the Lonk is manufactured at Rochdale into blankets and other valuable kinds of woollen goods. The fleece averages about 4½ lb. and sometimes 5 lb. When the sheep are kept on low lands they clip from 6 to 7 lb., and even as much as 8 lb. Mr Peel's prize shearling wethers averaged 11 lb. per fleece; but these sheep had been fed from the first for exhibition. When exhibited at the show of the Smithfield Club, 1865, Mr Peel's shearling wethers averaged 215 lb. each. Ordinary three-year-old Lonk wethers, when fairly fed, kill about 18 lb. per quarter. The mutton is close-grained and well mixed.

The Herdwick Breed.—This breed, the chief characteristic of which is its great hardiness, belongs to Cumberland and Westmoreland. The Herdwick is a horned breed, and the face and legs are grey mottled. The forehead has a tuft, ears sharp, breast well forward, and wide between the fore-legs. The haunch should be good. Herdwick wethers at four or five years old will weigh from 10 to 12 lb. per quarter, and the ewes from 8 to 10 lb. The meat is first-rate. The wool is coarse and open, and the fleece averages from 3 to 4 lb. It is only fit for the manufacture of coarse woollens.

Besides the foregoing mountain breeds there are the Welsh, the Exmoor, and the Dartmoor breeds, all of which are adapted for mountain-pastures. They all produce fine-flavoured mutton. The fleece of the Welsh sheep is light, from 1 lb. to 2 lb., and is somewhat coarse in quality. The Exmoor is a long-stapled wool of good quality; the fleece averages from 4 to 5 lb. The Dartmoor breed produces a deep-grown coarse-combing wool.

Crosses of Breeds.—In the course of the preceding remarks we have had occasion to notice the effects of crossing different breeds, resulting in the establishment of new varieties of sheep, which have come to be recognised as distinct breeds.

Crossing, however, is resorted to for other purposes than the establishment of new breeds; and as the practice has been productive of much advantage to the public by increasing the supplies of meat and wool, it is necessary that we give some attention to the subject.

One of the most important crosses is that of the Cheviot ewe with the Leicester tup, which is cultivated extensively in Scotland and the north of England. The lambs of this cross are called "half-breeds"; and when these are again crossed with the Leicester ram, the produce is known as "three-parts bred" sheep. Leicester rams are occasionally used for several generations, until the produce becomes so full of Leicester blood as not to be distinguished from the pure-bred animal. In such cases, however, the sheep are apt to become too fine, and to lose size and weight of fleece.

The first cross is produced by the draft ewes from a Cheviot flock, which are usually five years old when so disposed of, being put to well-bred Leicester tups. The ewes, after rearing their lambs, are fattened; but in some instances they are kept over another year, and again put to Leicester rams. The lambs are either sold as butchers' lambs, or kept over winter on turnips, and sold, after being shorn, to purchasers, who finish them for the butcher. If well fed during the first winter, a considerable proportion will be fit to go to market fat during the following spring. When fifteen to eighteen months old, they weigh from 15 to 16 lb., and up to 18 lb., per quarter. The meat has more lean flesh than that of the Leicester, and possesses much of the juiciness and fine flavour of Cheviot mutton. The wool is also improved, being long and fine, and weighs more than a Cheviot fleece. Being much liked by manufacturers, it always commands a high price. The best crosses of the Cheviot ewe with the Leicester ram are bred in Caithness. They are heavier sheep, and their wool is brighter than that of similar crosses bred in other parts of the country. Large numbers of these crosses are sold annually as shearlings, in July, at the Georgemas market in Caithness, to buyers from the south of Scotland and from England.

It is not unusual in some of the Border counties for breeders to select a lot of first-class Cheviot ewes and put them to a superior Leicester tup. The best ram-lambs of this cross are retained, and put to ewes also of the first cross, by which means the flock is always half-bred, as such breeders keep to the first-cross ewe and the first-cross ram. Cross-bred rams of this kind are annually offered for sale at the Kelso sales in September. When judiciously conducted, this system of breeding answers very well; but any lack of skill or attention on the part of the breeder is fatal to success.

Draft ewes from flocks of the blackfaced breed are also put to Leicester rams in the same manner; and the result is the production of a valuable class of sheep, which give the consumer superior mutton and the manufacturer a much better description of wool than that of the blackfaced breed. The lambs of this cross make excellent butchers' lambs; and when they are kept over winter on turnips and artificial food, they fatten readily, and make as good weights as crosses of the Cheviot and Leicester. When a man has a hill-farm stocked either with Cheviot or blackfaced sheep, and a lowland arable farm, he is enabled by this system of crossing to make the most out of his sheep, and at the same time to keep himself out of the market as a buyer of ewes or of feeding-sheep for his low farm.

In some parts of the Highlands the original stocks of blackfaced sheep have been crossed continuously with Cheviot rams, until the blackfaced blood has been entirely crossed out. The first cross of this nature is greyfaced, and rather ungainly; but the sheep improve both in form and wool with each successive cross. Occasionally the grey tinge will come out in the face and legs, being an illustration of the principle of atavism, or "breeding back," which has been referred to in a previous chapter. It may be remarked that Cheviots are designated by Scotch shepherds "long sheep," and blackfaces, "short sheep," from the comparative length of their bodies; while the cross between the Cheviot ram and blackfaced ewe—at least the first cross—are known as "half-longs." This cross, however, has not been successful in all cases; and wherever it has failed, the lack of success may be ascribed to want of judgment on the part of the breeders. They have put an inferior class of ewes to badly bred or otherwise inferior rams; and under such circumstances, it is impossible to expect satisfactory results.

Ewes of the cross between the Cheviot and blackfaced breeds are good nurses, and when put to Leicester rams, produce good lambs for the butcher.

Southdown and Shropshire rams have both been used for crossing with ewes of the Cheviot and blackfaced breeds. The cross of the Southdown with the Cheviot produces a very fine description of wool; but by many, especially in the north, the Shropshire cross is preferred, as it gives greater weight than the Southdown, while the mutton remains of very superior quality. The lambs of the cross between a Shropshire ram and blackfaced or Cheviot ewes are usually very fat; but they are somewhat deceptive to those who are not acquainted with them, as they weigh more than their appearance would indicate.

Gentlemen who breed sheep for their own use will find a cross between the Southdown ram and blackfaced ewe to be admirably adapted for the purpose, as the mutton is small and of a singularly rich flavour; but for the grazier, the Shropshire cross, as we have said, is more desirable. Admirable crosses for family use are also obtained by putting Southdown rams to the small Shetland ewe or the Welsh mountain ewe. These rarely exceed 6 lb. per quarter, and the cross of the Southdown does not bring it much over 8 lb. The mutton is very fine in the grain. Southdowns and Shropshires, indeed, cross admirably with nearly all the long-wooled varieties.

Wool.—Unfortunately for sheep-farmers the value of wool is not nearly so great as in former times. The fleece, however, still demands careful attention, and its production is affected by various circumstances. Of these, the manner in which the sheep have been kept is one of the most important. Fine pastures produce fine wool; while rich lands, where the pasture is luxuriant, produce a stronger, but at the same time a coarser, article. When sheep are regularly fed, and maintained at all times in a healthy state, the wool is much more valuable than it is when the sheep have been starved or neglected at any period of the year. Climate has also an influence on the quality of wool, and its freedom from an intermixture of hairs or "kemps." The age, and also the sex, of the animal, has likewise an effect upon the fleece. The wool of an old ewe is much less valuable than that of a younger sheep, or of a wether of the same breed. It is, in fact, unfit for the same purposes as other wool of the same breed.

The fleece contains a yellow soapy substance, denominated the "yolk," which appears to be a secretion exuded through the skin, and evidently designed to render the fleece soft and pliable. When, from any cause, the yolk is deficient, the wool becomes dry, harsh, and weak; while, on the other hand, when it is plentiful, the wool is soft, oily, and strong. The practice of salving sheep previous to the setting in of winter, as practised in mountainous districts, tends to make up for a natural deficiency of yolk in the wool grown in cold climates. The quantity of yolk in the wool of sheep fairly fed on arable land is stated to be about half the weight of the fleece; and it is the presence of this yolk or natural soap which renders it so easy to wash sheep in a running stream, and thus free the fleece from all impurities. Bad management, disease, and starvation prevent the secretion of the yolk, or render it unhealthy; and when such is the case it is apt to stain the fleece, and injure it for the manufacturer.

Wool possesses the property of "felting," and it is this which renders it capable of being converted into cloth. Felting has been defined as "a tendency in the fibres to entangle themselves together, and to form a mass more or less difficult to unravel." A consideration of this property belongs more to the business of the manufacturer than that of the breeder, but it occasionally operates much against the interest of the latter. This is the case when the wool becomes felted while on the sheep's back. When such occurs, it is denominated "matting" or "cotting," the wool forming hard knots, which renders it useless to the manufacturer. "Matting" usually begins in winter, and an excessively wet season is highly favourable to its development, especially when the animals have been much exposed and poorly fed.

A wool manufacturer gives the following as the method adopted in determining the quality of wool: "We first examine the shoulder, at the part where the finest and best wool is usually found. This we take as the standard, and compare it with, in turn, the wool from the ribs, the thigh, the rump, and the hinder parts; and the nearer the wool from these various portions of the animal approaches the standard, the better. First, we scrutinise the fineness; and if the result be satisfactory, we pronounce the fleece, in respect of fineness very 'even.' Next, we inquire into the length of the staple; and if we find that the wool on the ribs, thigh, and back approximates reasonably in length to that of our standard, we again declare the sheep, as regards the length of staple, true and even. We next desire to satisfy ourselves of the density of the fleece; and we do this by closing the hand upon a portion of the rump and of the loin wool, the fleece at these points being usually the thinnest and faulty; and if this, again, gives satisfaction, we signify the wool is even as regards density. Now to summarise these separate examinations. If you find the fleece of nearly equal fineness from the shoulder, rib, thigh, and back, and of equal density at the shoulder and across the loins, you may conclude that you have nearly perfect sheep."

CHAPTER IX.

MANAGEMENT OF SHEEP ON ARABLE LANDS AND PERMANENT PASTURES AT A MODERATE ELEVATION.

SHEEP-PASTURES may be divided into three classes: (1) arable lands, where the pastures form part of a regular rotation of crops; (2) permanent pastures situated at a moderate elevation, where arable farming is either limited in extent or not practised, although the nature of the soil and the climate is favourable to the growth of cultivated crops; (3) mountain-pastures, chiefly of a heathy nature. In considering the details of sheep management, the first and second kinds of pasture may be classed together.

The rams are put to the ewes on such pastures about the middle of October. In southern districts the time selected for this purpose is about Michaelmas; while in those parts of the country where the climate is harsher and spring later, the rams are not sent out until the third or fourth week in October. It is not desirable to have lambs dropping so early that there is a risk the ewes may not have sufficient milk, for lambs which are stunted at the first never get over it.

There are some points which must be attended to before the rams are put to the ewes. In the first place, the ewe flock should be carefully examined some time previous—in fact, soon after weaning the previous "crop" of lambs—and all faulty ewes should be rejected from the breeding flock, and fattened for the butcher. Some ewes may be objectionable on account of their natural conformation, and others from being defective on account of having had inflammation of the udder, thereby partly losing the use of it. Of course all ewes, when they attain a certain age, are "cast" or drafted from the flock. These ewes are either fattened or sold to graziers, who use them for one season for breeding butchers' lambs. In the next place, the ewes should, if possible, be put on rape or soft turnips or rich fresh pasture for a fortnight or three weeks before the rams are admitted to them. This "flushes" them, as it is called, and tends to bring them in season, and to have plenty of strong healthy lambs. Cabbages are also excellent for this purpose; and we may state that, in growing cabbages for sheep, it is better to sow the seed in the same way as turnip-seed is sown, and to thin out the plants with the hoe, than to transplant plants which had been previously grown in a seed-bed. When the seed is sown in drills, and the crop cultivated in the same way as swedes, it comes in for use sooner, and produces a heavier crop, than transplanted cabbages. Every flock-owner should endeavour to grow some cabbages, more or less, according to circumstances, as it is a crop which is admirably adapted for sheep of all kinds.

The next point is most important—namely, selecting the ewes which should be put to particular rams. In ordinary management, it too often happens that rams are purchased simply because they are rams, and without any special reference to the class or characteristics of the ewes they are intended to serve. Even when some attempt has been made in selecting the rams to get sheep of a good description, it is not thought necessary to select the ewes, and the rams are turned into the flock to work indiscriminately. When this is done, the lambs will not possess that close similarity of appearance or family likeness which every breeder should endeavour to stamp on his flock.

Mr William Davidson, who read a very practical paper on the management of a breeding-flock at a meeting of the Athy Farmers' Club (Kildare) February 1866, treats of the matching of ewes and rams in the following terms:—

"The first thing to be done is to take the rams, put a different mark on each, then examine their points thoroughly —not by a mere look of the eye, as judging sheep by the eye, except when newly clipped, is like buying a book by the look of the cover. Catch hold of them; stick your fingers into them; stamp on your mind the good and bad points of each, as no breeder need expect to get rams that are perfection, and the judge will always find some faults even in his own favourite. After having gone over each, and thoroughly fixed the good and bad points of each on the mind, then catch each ewe separately, then handle her minutely in every point as to her wool, quality, bone, constitution, &c.; then put her to the tup that is best in the points of which she is deficient, putting the same mark on her as on the ram chosen for her. It must not be done hurriedly, as on the proper selection of the ewe depends the future type of the flock; and no part of the management of a sheep-flock tries the skill and judgment of the flock-master so much as this. A wrong step taken at this point may cast a slur on a flock for years. I often observe, where there is a certain number of ewes and rams to be used, that an equal number of ewes is put to each ram. That I could never do, as I sometimes have to put nearly 100 ewes to one ram, and perhaps could not get 20 ewes to answer another ram; and sometimes I will have some ewes that neither of the rams would cross well, when I would try and procure a suitable ram for them, or use a ram-lamb that answered them. Some will say this is too particular; but the result will be a flock of well-matched lambs.

"After the proper selection has been made, then the skill of the shepherd is required to see that each ram is working. Sometimes a ram will jump on the ewes and not serve them, and continue to do this throughout the season. This is a great disappointment to the breeder if not detected in time; but a shepherd that understands his business will at once detect a ram of this kind, as the ewe will stick to him much longer than if she had been served. For the first fortnight the ram should be marked blue, the second fortnight red, and then black. By this a ewe will be seen if she is running on the ram by the red on the blue, or the black on the red. When any of them comes round again and is served a second time, she should be changed to another ram, as a ewe seldom holds to the same ram if she comes round again after a second service. After the ewes are all gone over, a ram-lamb should be run among them to stint any that may come round after the other rams."

In a paper read before the Central Farmers' Club in 1876, on "Fashion in Breeding," Mr R. H. Masfen thus referred to the views entertained as to the animals best suited for getting rams: "It is a generally received opinion that a male of small or moderate size is best adapted for the purpose. I will not deny that there is force in the argument, at the same time I think it is attended with a certain risk to the general stock. Compact ewes do not always produce symmetrical sires, and if such a course is continually pursued, the size gradually diminishes. The small ram designated a ram-getter, has often to be accredited with an amount of injury to the future of many flocks. My predilection is in favour of a large size, possessing all the attributes of a male, not too coarse, head and neck strong, spine straight, legs of mutton fully developed within and without, not too gaudy either in the rump or fore-flank. You will have in him an animal that will give you a more useful and uniform flock, although you may, by the other course, have a few crack animals that will command attention, leaving a residuum neither desirable nor attractive."

The ewe goes five calendar months or 152 days with lamb.

The treatment of breeding-ewes during winter next claims our attention, and is a point of great importance. Some breeders bestow no particular attention on their sheep at this time. The breeding-ewes are allowed to run over the pastures, and occasionally, when the young sheep are folded on turnips, the ewes are turned in to follow them, and pick what the turniped sheep have left. This is a bad custom, as the ewes thereby take up much dirt with the remains of the turnips, and the dirt acts injuriously on their bowels and kidneys.

It is not desirable that breeding-ewes should be kept in high condition, or that they get much stimulating food; neither is it advantageous to the owner if he allows them to be half starved, and therefore weak. Cabbages or Aberdeen turnips given sparingly are of great service, but swedes or mangels should not be given until after lambing. Mr Davidson gives "a good cartload of cabbage to every 200 sheep daily from 1st November to 1st January; and from that to lambing-time, about a load to every 100"—that is, supposing the grass to be fairly rough. He also gives from the 1st of February, $\frac{1}{2}$ lb. of oats or cake daily to each ewe, and continues to do so for some time after lambing.

Breeding-ewes thrive well on pulped roots mixed with chaffed straw. A daily ration for each ewe of 1 lb. of bran and $\frac{3}{4}$ lb. of crushed oats, mixed with $2\frac{1}{2}$ lb. of straw-chaff, has been found very useful in the case of a large flock of breeding-ewes, when given from the 1st of January. When pulped turnips and chaff are given, the food may be improved, as lambing approaches, by adding ground rape-cake, ground cotton-cake, (decorticated), or linseed-cake to the pulped materials, at the rate of $\frac{3}{4}$ lb. to 1 lb., blending the auxiliary food well with the pulped roots. Some hay given in cribs, which the ewes can eat when inclined, is also useful. Mr E. Riley, a Yorkshire farmer, recommends the following mixture as excellent food for ewes, and as sufficient to serve 200 ewes for the season—namely, $1\frac{1}{2}$ ton of linseed-cake, $1\frac{1}{2}$ ton of oats, 1 ton of beans, 1 ton of locust-bean meal, 1 ton of malt-coombs, 1 quarter (8 bushels) of malt, and $1\frac{1}{2}$ cwt. of common salt. These materials must be thoroughly mixed together. If judiciously used, auxiliary food is undoubtedly both useful and profitable when given to breeding-ewes, although many appear to prefer losing their lambs rather than be at the expense—and it is comparatively a small expense—of purchasing extra food for their ewes. Losses in such cases are usually ascribed to "bad luck," and not to bad management; and we might ask such persons in the words of a bucolical rhymester—

"Now don't you believe, Mr Smithers,
A farmer may oft blame himself,
When finding his produce deficient,
For fearing to lay out his pelf?

Your sheep, you state, turned out badly,
The lambs being 'sickly and small';
But were your ewes '*primed*' through the winter
Enough for a vigorous '*fall*'?

'Tis so, believe me, in breeding
Both neat stock and sheep; if by halves
You nourish the dams, you must look for
Poor luck with your lambs and your calves."

The lambing season is an anxious time for the flock-master, and due preparation should be made for it beforehand. It is very desirable to have a well-sheltered lambing paddock, in which a sufficient number of low-roofed sheds should be fitted up for shelter to the ewes and their young lambs, which ought not to be exposed to cold showers of sleet or rain. These sheds may be permanent or temporary. If permanent, they may be constructed of thin deals nailed to posts set in the ground and roofed with felt. They need not be higher than just sufficient to allow a man to stand upright when inside. One row of shedding facing the south will suffice, the interior being divided into small pens about 4 feet square, which will be sufficient for a ewe and lamb; each pen opening to the outside by a separate door, or into a passage in the interior reaching from one end of the shed to the other. When this plan is adopted, it is well to have more than one entrance from the outside. Temporary pens may be constructed by means of a few poles and hurdles lined with straw, and covered with brushwood over which some straw is laid. Some boxes to hold cake, &c., and cut turnips, should be placed in the paddock; and the shepherd should have a small wooden house with a stove in it put up for his own accommodation in some sheltered spot convenient to the shed. A small rack for hay and feeding-trough should also be placed in each pen.

The most forward ewes are brought in at night into the paddock, to be at hand when they begin to yean. A field of early Italian rye-grass is of great service at this time; and where the climate allows, it should be sown in August after early potatoes, or any crop which admits of this being done at that time. Rape is also useful, and so are early cabbages.

A shepherd who understands his business is invaluable at this time; and one of the great points in a man of that kind is, knowing what he ought not to do, as well as what should be done. Some men are very fussy at the lambing season, and often injure the ewes by rendering assistance when they should be let alone. It is only in really difficult cases that the shepherd should interfere, and even then with great caution. In false presentations, the hand or fingers must be well oiled before they are introduced into the vagina; and once the lamb has been placed in its natural position, the rest may be left to nature. It is useful to have some laudanum mixed with linseed-oil at hand in case of difficult cases of lambing. The dose of laudanum for a sheep is 4 to 6 fluid drachms, and of linseed-oil from 5 to 6 fluid ounces, and the mixture may be made up in these proportions. The object in giving medicine of this kind is to prevent inflammation.

If the lamb is weak it should be placed in a basket lined with wool or soft hay before the fire in the shepherd's hut, and a little warm milk given to it. The addition of a teaspoonful of whisky or brandy in the milk will be found useful in such cases. Mr Fisher Salter, Attleburgh, Norfolk, strongly recommends the use of sweet wort as a substitute for cow-milk for weakly lambs, or when the milk does not come speedily on the ewe. His formula is, 1 bushel of malt to 10 gallons of water. The malt is first damped, and then boiling water is poured upon it in the proportion stated. It is allowed to stand until sufficiently drawn, and then strained through a fine cloth, and bottled for use. It is given milk-warm to the lambs. A small quantity may be made at a time, keeping about a day's consumption in hand. The grains are given to the ewes. The wort has a most beneficial effect on lambs, none to whom it is given being affected with scour. Cow-milk, when given incautiously, is apt to produce either diarrhœa or constipation, according to the condition of the milk.

In the event of a lamb dying, a twin of about the same age should be taken from another ewe, and the skin of the dead lamb put on it. The foster-mother and the substituted lamb must be put for some days into a pen together, when she will soon take to the young lamb; but it may sometimes be necessary to hold the ewe for a few times to let the lamb suck her.

The ewes must be supplied with roots, and also cake and crushed grain. Palm-nut meal has much effect in producing plenty of rich milk, and a mixture of crushed oats and bran is very useful.

When the lambs become sufficiently strong to follow their dams, the ewes are removed from the lambing paddock and put on young grass; or, when there is no young grass on the farm, a fresh piece of pasture, well sheltered, if possible, and artificial food supplied to them. It is important that the lambs are not stinted when young, as they never recover any stoppage in their growth at that period. This must be prevented whether the lambs are to be sold to the butcher from the dam, or weaned and retained as store-lambs.

Breeding lambs for the butcher is extensively practised in many parts, especially when near a suitable market. The ewes for this purpose are usually draft ewes, purchased in September and October, and after rearing their lambs are fattened, and sold before a fresh lot is brought in. It requires good pasture or the use of much extra food to carry out this system properly. It is tried by some who have not sufficiently good land for the purpose, and the result is that the markets are crowded towards the end of the lamb season with a class of animals which bring only inferior prices.

Lambs which are to be kept as stores are castrated when a fortnight or three weeks old. Those which are to be sold early to the butcher need not be castrated; but if these are not sold at the proper time, they are apt to run away to growth at the expense of condition. Care must be taken not to castrate lambs when the weather is either frosty or wet; and rather than do so under such circumstances, it is better to defer the operation until the weather is suitable. Both ewes and lambs must be gently handled previous to and after the latter have been castrated, and no rash driving with dogs should be permitted. It saves trouble at this time if the ram and ewe lambs have had different marks put on them before they are sent out from the lambing paddock.

Fashion dictates that the tails of lambs, at least on lowland farms, should be shortened; and in the case of some breeds, docking is carried to such an extreme as to be unsightly. The tail affords warmth and protection to the udder, it is likewise a defence against the attacks of flies in hot weather; and it was placed where it is by the Creator for a wise purpose. It is alleged, however, that the tail occasionally permits the accumulation of filth; and if the animal suffers from diarrhœa, and the shepherd is neglectful, the tail will cling to the haunches so closely as to form an almost insuperable obstruction to the passage of the fæces. It is also supposed that the removal of the tail improves the appearance of the animal, by the fulness and width which it seems to give to the haunches. This is, we think, more a fanciful than a real argument in favour of docking. The eye has been so educated, that we allow ourselves to be deceived, to a certain extent, by this means; and there is no doubt but that if we were accustomed to sheep in possession of the tails which nature provided for them, we should be able to discern their real merits quite as well as we now do with the tails removed.

Some dock their ram-lambs at the time when the operation of castrating is performed. Others, and we consider judiciously, do not dock their ram-lambs until perhaps three weeks after they have been castrated, at which time the ewe-lambs are also docked. One flock-master with whom we were acquainted did not dock any of his lambs until nearly the end of autumn, believing that the bleeding which followed the operation acted as a preventive against the inflammatory fever, sometimes known as braxy, to which lambs are subject towards the end of the year.

During the summer, until weaning, the ewes and lambs should be kept on good grass, and frequently shifted to fresh pasture, as there is nothing more injurious to sheep than a foul run. As it is well that the lambs should learn to eat artificial food early, some cake and corn should be put into troughs, and they will soon take to it, more especially if the ewes have been accustomed to food of the kind, as they will in that case go to the troughs, and the lambs will follow them. Very little dry food is necessary, the great matter being to train the lambs to eat it early; but the corn must be crushed, and the cake broken very fine. Some breeders, after the lambs have learned to eat the dry food, put hurdles round the troughs that will let the lambs underneath, but keep out the ewes. Others allow the ewes free access to the troughs, especially when they are to be fattened after the lambs are weaned. When the ewes are to be kept over for stock-sheep, artificial feeding is not required in their case, beyond the time necessary to train the lambs. When vetches are grown on the farm, it will be of much advantage to the lambs if they are supplied with some freshly cut vetches daily. These are put into sparred cribs, which are set in different parts of the field and shifted two or three times a-week or daily. A little salt may be strewed through the vetches.

The time for shearing depends on the locality—partly on the weather at the time, and also on the condition of the fleece, as the new wool should be fairly risen from the skin before shearing. Hoggs—that is, lambs of the previous year—and rams and wethers are first shorn, and ewes at a later period. The former are shorn from the first to the middle or end of May, according to locality and weather—for shearing should not be proceeded with when the weather is harsh and cold—and the ewes from the first to the middle of June. Sheep intended for exhibition are generally shorn by the 1st of April.

Before shearing, the sheep must be well washed to free the wool from dirt. This is an important proceeding, as the value of the wool depends much on the manner in which it is done. A pool, sufficiently deep for the purpose, in a clear running stream, having a gravelly bottom, and a bank sloping so as to admit of easy egress from the pool to a piece of clean grass, is the best place for sheep-washing. It is of advantage, rather than otherwise, when the bank on the side of the stream from which the sheep are put into the pool is slightly elevated above the surface of the water, although this is not essential. The sheep are penned on the bank, and put in one by one into the pool; a man who stands in the water near the bank takes hold of the sheep and turns it on its back, keeping the head above water. While the sheep is in this position, the man turns it slowly from side to side for some time, and then passes it on to another man who stands higher up the stream, who repeats the movement, and examines all parts of the fleece and skin to see that no impurities are left, and when satisfied on these points he allows the sheep to swim ashore on the opposite side to that where it came in. Some employ three men in washing, the third man standing higher up than the second.

Suitable pools, however, cannot always be obtained, and other contrivances are resorted to for the purpose of washing sheep. Where this is necessary, it is important to have a place free from mud, and with a stream running from it. Washing sheep in stagnant muddy holes is most injurious to the wool; and driving sheep along a dusty road after they have been washed must also be avoided. Where water was scarce we have seen sheep washed by putting them under a spout from which a broad thin sheet of water fell from a drain; and when the washers were careful, the fleece was tolerably well cleansed in that way, but it was a very slow process.

We have seen a very good contrivance for washing sheep, where there was a scarcity of water, adopted on Mr Bomford's grazing-farm at Drumlargan, county of Meath. The stream is dammed back by a sluice, and when the water rises to the top it runs over a spout into a lower division, the sides of which are lined with brick up to the level of the ground, say about 5 feet in depth, except at the upper end on one side, where an opening is left to allow egress to the sheep which have been washed. A sluice at the lower end raises the water also in this lower basin, which resembles the lock of a canal on a small scale. The sheep are penned on the brink of the lower division, and when put into the water, one man guides them with his crook to a point where two men, one on each side, are stationed in wooden water-tight boxes, which extend downwards to a level with the bottom of the pool. These men turn the sheep over, and roll them about from side to side as described, and then pass each sheep under the spout by which the water is discharged from the upper dam in a broad thin sheet, and this finishes the operation in a satisfactory manner. The object of the water-tight wooden boxes is to keep the men dry, and they do not therefore require to be dosed with whisky to "keep the cold out of their hearts," as they call it.

The system of washing which was practised by the late Mr William Torr, at Aylesby, is somewhat elaborate. A tub is placed in a fold-yard, and about half sunk in manure to get its rim at a convenient height; it is then filled with water at the rate of 3 gallons for every sheep to be washed in it; 4 gallons for every 10 sheep (or nearly half a gallon per sheep), being hot water in which has previously been dissolved about 1 lb. of soft-soap for every score of sheep. Five men are employed at the tub—namely, two on each side and one at the end, two more having their time fully taken up in catching the sheep and boiling the water. If the work is properly done, at least one score of sheep can be washed per hour, and the total cost is 1d. per sheep, including soap. The advantages claimed for this system are —that the ewes are not long from the lambs, and that much wool is saved, especially from broken fleeces; then the water having been rendered nearly tepid, the sheep do not chill, as they are apt to do when washed in a pond. After washing, the sheep are turned into a fold-yard until taken back to the pastures.[1]

We have seen sheep washed in the sea, but this should never be done. The wool is no doubt made clean, but it absorbs salt, which gives it a clammy feeling when handled afterwards; and wool which has been washed in this way is also, we believe, injured for the use of the manufacturer.

After the sheep have been washed, they must be put on clean pasture, where there are no broken banks of earth to rub against. The fleece must be thoroughly dry before it is shorn; and not only so, but time must be given to allow the yolk to appear, otherwise the wool will feel harsh. This will take from a week to ten days.

For shearing sheep a clean piece of grass is selected, closely adjoining the pens in which the sheep are placed for the convenience of catching them. Temporary pens may be constructed of hurdles; but there should be two pens at least, a large and a smaller pen, erected in every large field in which sheep are pastured, for convenience when it is necessary to sort, dress, or handle sheep. In the case of fields under rotation, such pens may be constructed of hurdles, which can be moved when the field is to be broken up; but in permanent pasture the pens should be constructed in a more substantial manner. Where no such pens exist, sheep must be driven into a corner of the field, and the trouble of sorting or dressing is much increased, and the sheep are also knocked about instead of standing quietly in the pen. To clip 25 or 30 sheep of the larger breeds is a good day's work in most cases.

It is usual to mark sheep after being shorn, by stamping a letter or letters, or other mark, on some part of the body. This is frequently carried to an extreme, and the value of

[1] Journal of the Royal Agricultural Society of England, vol. v., Second Series. 1869.

the wool thereby affected. The letter is made of thin iron, and affixed to an upright iron shank, which is fastened into a wooden handle, the entire length being about 2 feet. The brand is made by lightly dipping the letter into tar, which has been boiled along with a little pitch in an iron pot. It is necessary to keep the tar warm during the process, but if too hot, it will be thin, and not mark well.

The rolling of the fleece is an important point, and it should never be done in a slovenly manner. A smooth deal door, resting on low trestles, answers well for rolling fleeces upon; but others prefer a sparred frame of wood, placed about 2 feet from the ground, as a frame of that kind allows any dirt with which the fleece may have come in contact to pass through. The fleece is spread out on the board, and is first freed from burrs, bits of thorn, &c., which may have adhered to it, and particularly from all locks which have lumps of dung attached to them. If these are rolled up in the fleece—which, indeed, is frequently done—it is a fraud on the person who buys the wool, and is in fact illegal. The Wool-Winding Act provides, under heavy penalties, that no detached dirty portions lying on the ground where the sheep were shorn, and nothing but pure wool, are to be rolled up in a fleece.

When the fleece is laid on the board or sparred frame, the outside is uppermost; and the winder, after examining the fleece, and standing at the breech end, folds in first one side and then the other, so that the width is from 2 feet to 30 inches, according to the size of the fleece. The winder then rolls the fleece, beginning at the tail, into a neat but tight bundle; and on coming to the neck, after putting a knee upon the fleece, twists the wool of the neck with both hands into a band, which is brought round the fleece, fastening the end underneath the band. If the wool is meant to be sent direct to market, or consigned to a broker, packing the sheets should be carried on simultaneously with the clipping; and in packing, great care should be taken that the fleeces are properly laid in the pack-sheet. The sheets are either suspended from hooks in the roof of a shed, or from a long and stout pole, supported by two triangles made of three poles, and tied at the upper end. One man weighs the wool in half-cwts. or stones, according to local usage, and keeps a tally account of the weight. Two men get inside the sheet, one at each end, and lay the fleeces across the bottom, and trample them down. The next layer is laid lengthwise in the sheet—that is, contrary to the first layer, except in the corner, where the fleece is laid across; and so the packing proceeds, each layer being laid reverse to that which preceded it, the whole being firmly packed by the men in the sheet. When the sheet is full, the edges are brought together and sewed firmly by means of a packing-needle and twine. Inattention to minute details in the preparation of the wool for market, beginning with the washing of the sheep, and ending with the packing of the wool, often seriously affects its value.

The next point in the management of sheep we have to notice is the weaning of the lambs. The usual period for weaning is from the 1st of July to about the middle of the month, according to locality. In the south of England, lambs are frequently weaned about the first or second week in May.

After the lambs have been separated from the ewes, the latter should be put on rather bare grass, in order to put the milk off them as soon as possible; and if they are uneasy in consequence of the milk accumulating in the udder, it may be drawn from them once or twice. In fact it is better to make it a rule to do so, as it prevents inflammation in the udder, which usually results in the ewe losing the use of part of it, and renders her unfit to be kept for breeding. When mixed with cow's milk, equal parts, ewe-milk makes a very superior description of cheese; and in some parts of the kingdom it was at one time the practice to milk the ewes daily for two or three weeks after the lambs were weaned, solely for the purpose of making cheese, but that custom is now given up. Ewe-milk cheese should be kept a year in order to allow it to ripen.

All that is necessary in the management is to keep the stock-ewes in fresh condition, without allowing them to become too fat, unless such as are to be sold, which may be kept on better pastures than the others.

The lambs must be kept on good clean pasture and frequently shifted to fresh grass, as previously recommended. This must be attended to in order to preserve them in a healthy thriving state; and the practice of keeping lambs after weaning for weeks, and even months, on the same pasture, is most injudicious.

It has become usual on well-managed farms to dip both ewes and lambs at the time of weaning. Some dip soon after the ewes have been shorn. Dipping at this time is of great advantage to the lambs, as it kills insects on them; and it also tends to prevent attacks of fly or maggot, in both ewes and lambs, during the summer and autumn.

Dipping consists in immersing the sheep, all but the head, into a vessel containing a bath prepared with certain materials. There are various sheep-dips offered for sale, each having its advocates. Of these the best known are Bigg's, M'Dougall's, Reid's, Long's, Cooper's, Wilson's, and the Glycerine dip. A dip should be non-poisonous, as some instances have occurred where sheep have been poisoned by feeding on grass over which newly dipped sheep had passed. Some dips are apt to discolour the wool, leaving a permanent stain which no amount of scouring will eradicate. Dips which contain a large proportion of carbolic acid are said to do so, which is to be regretted, as carbolic acid is most effective in destroying all kinds of insects, including the acari, which produce scab.

Apparatus for dipping consists of a bath-box, with drainer for the dipped sheep, and one or two pens for holding about a score of sheep at a time. One man catches the sheep, and gives them in succession to the dippers, of whom there are two. The animal is turned on its back, and one dipper takes hold of the head and the two fore-legs, while the other catches the two hind-legs. The sheep is then immersed in the bath, and kept there for some seconds, taking care that the head is held above the surface. This done, the sheep is then passed to a fourth person, who lays it, still on its back, on a sparred drainer, and squeezes the liquor out of the wool with his hands. The liquid so extracted runs back into the bath. In other cases, the sheep is let out on an inclined plane, where it stands until most part of the liquid has dripped from the wool.

The following description of a dipping-tank in actual use will be useful to persons who may wish to construct places of a similar kind: The dipping-place is an excavation or tank lined with brickwork. The size is 8 feet long, 22 inches wide, and 3 feet deep. A sloping ladder of brickwork, set on edge, enables the sheep to pass into the dripping-place, the dimensions of which are 16 feet by 9 feet. It is paved with flags (clay-slate), and slightly sloped in the bottom, which allows the drippings to run back into the tank, and thus prevents waste of material. This tank costs about £3.

We have said that the lambs, after weaning, should be put on good clean pasture, and we may remark that the second crop of clover and rye-grass is good pasturage for them, provided they are not put upon it for several mornings at first until the dew has risen. They must be gradually accustomed to it, otherwise they will swell and die. It is a very judicious practice to have a piece of vetches or rape to put them on at this time for a few hours daily. These crops are either grown separately or the seed is mixed, and occasionally Italian rye-grass is added, by which means a very useful mixture of food is secured. Sometimes the crop is consumed by mowing part of it daily, and putting that which has been cut into racks or cribs, dividing the mown part from the standing crop by hurdles. In other cases the lambs are allowed to eat the crop through the hurdles, which are moved forward every day. This system of folding is good both for the sheep and for the land. If artificial food is given (and some will be useful), a mixture of crushed cake and bran is to be recommended, say ¼ lb. to ½ lb. of the mixed food for each daily. This tends to prevent inflammatory fever, and also diarrhœa and dysentery.

The period of weaning affords a good opportunity for sorting and drafting those ewe-lambs which it may not be desirable to retain to make up the breeding-flock. The object of this is to make the flock as even in point of quality and appearance as possible, which is a matter of great importance when progressive improvement is the aim of the flock-master. Many persons, no doubt, keep all their ewe-lambs, good and bad; but if weak or defective lambs are retained as stock sheep, the result will be an uneven flock, and a greater proportion of deaths than ought to be; and the flock, as a whole, will not present that uniform or high-class character which every well-bred and properly managed flock ought to have. Improvement will also be a very slow process, if attainable at all, where there are a number of inferior ewes; so that a judicious selection and drafting of the lambs at the proper time is a matter of great importance, and one which requires considerable skill to do it properly, as there may be amongst the ewe-lambs some which would pass in respect to certain of their characteristics, but may at the same time be deficient in other points which it is desirable to promote or perpetuate. Thus a certain ewe-lamb might pass for size, and even general appearance; but if she has a coarse fleece, or is not well covered with wool, she would not be a fit animal to retain where opposite qualities in the wool were considered desirable. Upon a proper selection of the lambs which are to be retained in a standing flock depends therefore the future character of the flock, and it is too important to be either neglected or done in an aimless random manner.

The ewe-lambs which are drafted out may either be sold off at once, or put along with the wether-lambs and fattened on turnips and auxiliary food during the winter for the spring fat-markets. If the lambs, however, are weakly, it is better to sell them at once, even at the comparatively low price they will realise, as there is always considerable risk attending the wintering of small lambs; and a low price in July or August is better than the price of the skin, which may be all the owner will have ere winter is over, when he keeps his weak lambs.

Dipping has been mentioned as a useful preservative against insects and scab, and the process described. If the sheep were not dipped at the time already mentioned, it must be done in September or October, and all newly purchased ewes should be dipped within a week after they come home, as it is possible that they may have been in contact with sheep affected with scab. In such cases a dip specially adapted for the cure of scab should be used. Dips of this kind are prepared by most of the parties whose names have been given, but the following may be prepared by the shepherd:—

Tobacco-juice, ...	5 lb.
Powdered hellebore, . . .	¼ ,,
Black soap, ...	1 ,,

Boil the soap and hellebore together for twenty minutes;

when cool, add the tobacco-juice, and make up with 20 gallons of water. This will suffice for a score of sheep, and each sheep must be kept fully a minute in the bath. Sheep should not be dipped when the wool is wet.

Another mode of dressing sheep is by "pouring." In carrying out this process, a stool of peculiar construction is required for the shepherd to sit on, with the animal extended in front of him. The stool is nearly triangular, the narrow end being about 1 foot broad, and over this is nailed a piece of board which forms the seat. The two sides expand 3 feet from this point until they are about 30 inches apart at the other end; and the centre is filled up with spars 4 inches apart, like the rounds of a ladder. This frame is supported by legs 18 inches high. The shepherd, sitting astride of the narrow part of the stool, gets the sheep before him, with the head towards him. He then divides the wool by using the thumb and forefingers of each hand, opening the fleece from the head to the tail, so that the skin is laid bare. A girl or boy then pours the mixture from a tin vessel, which will hold about a quart, and shaped like an oil-can or coffee-pot, having a handle and long spout. In pouring, the stuff is put in along the whole length of the "shed" or division of the wool. The shepherd then proceeds to make similar sheds on each side of the backbone, along the ribs, and on each side of the belly; and also along the back and both sides of the neck, and along the breech. On turning the sheep, some of the mixture is well rubbed into the bare parts on the inside of the thigh and arm. If there are any hard scabs, the shepherd must open these with his knife, and see that such spots get a full allowance of the mixture.

The mixture recommended above for a dip answers also for pouring; but when used for the latter purpose, only 5 gallons of water must be added to the tobacco-juice, &c., instead of the 20 gallons required for making up the dip. If scab exists, an effectual remedy will be found in using the following "pouring" mixture: Take 6 gallons of soft water and 6 lb. of common washing-soda; warm the water to the boiling-point, and then add 1½ gallon of spirit of tar. For twenty sheep mix 2½ quarts of spirit of tar with about 3¼ gallons of water. One dressing of this kind will usually cure scab, unless it has been of long standing, in which case a second dressing may be required. Many flock-masters do not dip or pour their breeding-ewes until after the ram has been taken from them; but to avoid risk of contagion, all recently purchased sheep ought to be dressed at once. The usual rule is to dip or pour the lambs and wethers first, and the ewes and rams after their season is over. We may remark that in ordinary cases it is highly discreditable to the shepherd to have any sheep in the flock under his charge affected with scab. At the same time, it is sometimes impossible to avoid it, more especially when sheep have been purchased at fairs or been carried in a railway truck; or when the fences are bad, and allow strange sheep to get into the grounds.

We have thus brought the flock round to the starting-point, and we have now to consider the treatment of the lambs and other feeding-sheep during winter.

It is of material consequence that sheep intended to be put on turnips shall be duly prepared for the change. Rape, and also cabbage, makes a good preparation; but in putting lambs on either for the first time, it is advisable to defer doing so until the middle of the day, and to take them off in about an hour after. If put on these crops in the morning, they are apt to be attacked with inflammation, which carries them off rapidly. When accustomed to the green food, they may be hurdled or netted constantly on it; at the same time, an occasional run at grass is desirable as a change. Hay or straw should be put in racks placed in the rape-field, or chaffed straw mixed with cake or grain given to them as a preventive against diarrhœa. If rape or cabbage is not to be had, the sheep should be broken in on soft turnips, such as green-top globe, greystone, &c., similar precautions being used as those above given, and the tops of the turnips should be cut off with a short scythe or hoe a day or two before the sheep are netted on the crop, or the turnips may be drawn from the field and scattered on the grass-field where the lambs are running. Consuming turnips on a grass-field instead of that where the crop was grown, is advisable when the land is wet or heavy; and even in the case of ordinary turnip soils, the sheep should be removed to grass-land if rainy weather sets in, reducing the land to a puddle. It is also well adapted, in connection with the use of artificial food, when a pasture-field has become covered with moss, or is in poor condition; for if a number of sheep are fed on turnips and concentrated food during the course of a winter and spring on land of that kind, the moss will disappear, and the land, being enriched by the droppings of the animals, will be much improved as pasture. At the same time, it is a more expensive mode of consuming turnips than eating them where they grew, as it involves cartage.

It must be observed that when turnips are laid down on grass, the sheep are not confined to any particular part of the field by means of hurdles or nets. They will, of course, gather most where the turnips have been laid down to them; and if these are always scattered on one spot, that part of the field would become much richer than any other part. The turnips should therefore be scattered thinly over one or two ridges, taking fresh ground every day, and thus the entire field will be equally benefited by the droppings of the animals, and by their trampling, which helps to destroy the moss.

As a portion of the crop of turnips will be required for the house and yard fed cattle, it is the practice to draw this previous to the sheep being put on the land when they are to be fed on the crop where it has been grown in the field. If half of the crop is to be consumed by sheep, then two or four drills are stripped, and the next two or four left standing, and so on, over the entire field. If the land is poor, perhaps two-thirds of the crop may be left for the sheep; and in other cases, none of the turnips may be removed.

Before putting sheep on turnips, it is advisable, in any case, to clear a portion of the field at the side where they are to commence to eat the crop. This is specially required when the sheep have not been trained previously to turnips, by having some laid down for them on a grass-field. When this has not been done, some days will pass before they learn to eat the turnips, and they will keep moving about a good deal, so that the turnips would be dirtied if there was not a vacant space for them to fall back upon. Racks for holding hay or good sound straw, which answers the purpose very well, must be placed in the field; and covered boxes, having an open side for holding rock-salt, are also very useful.

The sheep are confined to the portion of the turnip-field allowed them by means of hurdles or nets; and, if possible, these should be set the entire length of the field, unless it is very long, enclosing a sufficient quantity of turnips to last five or six days. As soon as the turnips have been half eaten, the nets or hurdles are shifted further on, giving the sheep a fresh break; and the turnips which are left on the first pasture are raised by a turnip-picker, which is an implement resembling a long hoe, by means of which the remaining part of the bulb is raised, cutting through the root, and leaving it in the ground. The sheep will go back upon the first eaten portion of the field, and consume all the shells or remaining parts of the turnips. Some feeders run their store-sheep over the ground after the fattening sheep, in order to pick up the shells. When there is any appearance of frost or snow, a few hands should be set to pull the turnips over a portion of the field in advance of that upon which the sheep are folded, so as to afford a supply during the unfavourable weather which is approachiug. It is very much against the progress of sheep if they are at any time confined to turnips which have been rendered as hard as stones by frost.

> "If no snow is seen,
> The field with all its juicy store to screen,
> Deep goes the frost, till every root is found
> A rolling mass of ice upon the ground.
> No tender ewe can break her nightly fast,
> Nor heifer strong begin the cold repast,
> Till Giles, with pond'rous beetle, foremost go,
> And scattering splinters fly at every blow;
> When pressing round him eager for the prize,
> From their mixt breath warm exhalations rise."[1]

It would be well that a little more care should be exercised in storing roots and protecting them from severe frosts. In most cases the turnips, when pulled, are piled up in small oblong heaps of a triangular shape, and covered with the tops, or a little earth is thrown over them. Another plan is to put the turnips up in small circular heaps, each turnip being laid with the leaves outermost. The heap is contracted in width as each circular layer of turnips is placed, until it reaches a point, which is closed by putting a large turnip upright. The leaves, being all on the out-

[1] Bloomfield's "Farmer's Boy."

side, protect the bulbs; the inside of the heap is hollow. When the nets or hurdles are shifted to this part of the field, the turnips in the heaps are thinly scattered over the ground. The crop should also be lifted and stored in a similar manner early in spring, when symptoms of a fresh growth are noticed in the tops, as the nutritive qualities of the roots are much impaired when they are allowed to throw out the seed-stems.

We have already stated that sheep should be trained at first to eat turnips by giving them some of the softer varieties, which should be sown in May for this special purpose. When the sheep are folded on the crop, they should begin with globe turnips or Aberdeens, and finally swedes. Mr Woods, who has had much experience in the management of sheep, says that "when hoggets or any fattening sheep are being fed on common turnips, and it is intended to give them swedes, I believe it would save the lives of scores of sheep if graziers made it a rule to cart a few swedes, to be mixed with the common turnips for a week or two before the sheep are put wholly on swedes. The stomach and system of the animal would then get accustomed to the swedes, and would not feel the change so much, nor be so liable to suffer from indigestion and inflammation which so often ensue when hoggets are first put on them.[1]

We have stated in a previous paragraph that the tops of the turnips should be cut off a day or two before the sheep are put on them, and this should be done as each fresh break is given to them. We are aware that this precaution is not taken by many persons, but it is the safer plan, especially if hoar-frosts occur at the time; for if sheep, particularly hoggets, eat greedily of frosted tops, they are liable to scour or to inflammation.

As the season advances, the teeth of young sheep become loose, and they are unable to break the turnips unless with much difficulty, as shown by the blood which is left on the broken bulbs. A portion of the turnips in the break must therefore be put through a turnip-cutter at least twice a-day, and the cut turnips put into long boxes made of two boards, shaped like the letter V, with closed ends, and fixed in two blocks of wood, one at each end, which serve as feet, and

[1] Woods on the Breeding and Management of Sheep. Ridgway, London.

prevent the trough from being upset. It is advisable, indeed, to begin early to cut a few turnips daily, in order to accustom the sheep to eat out of the troughs, which they will then do freely when their teeth become loose. Aged sheep do not require to have the turnips cut for them. Artificial food is given in the troughs, which must first be cleaned out; and such food should consist of a mixture of cake and crushed oats, or of oats and barley, or peas and Indian corn. In all cases it is advisable to use the produce of the farm in preference to purchased food, as the best price will be obtained for home-grown grain when it is converted into meat and wool. The ewe-hoggets which are intended for keeping will also be improved by getting a small proportion of such food, although some flock-masters think it enough to run their store ewe-hoggets on grass, with the addition, perhaps, of being allowed occasionally to pick up the shells of the turnips left by the fatting sheep. We are in favour, however, of liberal treatment in feeding for store hoggets intended for breeding, as well as for those which are being fatted for the butcher. Good feeding flushes the ewe-hoggets, and gives them additional size.

Sheep on turnips, particularly on swedes, are liable to be affected with urinary disorders, which frequently prove extremely fatal. Mangel-wurzel has a similar effect on sheep —in fact, it has been said that mangels aggravate the evil. When sheep on turnips are observed to pass acid high-coloured urine at long intervals, to be careless about their food, and straining as if to stale, the evil has begun. The remedy is to shift the sheep at once to grass which is fresh but not luxuriant, so that they may have to move about a good deal; and all rich food, such as cake or corn, must be withheld or given very sparingly. A dose of castor-oil, and half a drachm of carbonate of potash, given daily, will be useful. In order to prevent these urinary disorders, the shepherd should move the sheep about quietly twice each day, especially such as seem inclined to lie long on the ground, and to be unwilling to move. By attending to this, particularly during frosty weather, the animals will be induced to void their urine properly, and the mischief will be prevented.

Although, in general, sheep which are feeding on turnips in the field have the advantage of shelter from hedges or other kinds of close fences, there are many localities in which such do not exist, and in these cases much benefit will be derived by placing a row of hurdles, lined with straw, to windward. Sheds mounted on low wheels, so as to permit them to be drawn by a horse from one field to another, and sheds which may be put up in detached lengths, have been constructed, but are not as yet much used. Probably, when we understand better certain principles relating to the physiology of animals, artificial means of affording temporary shelter to fattening sheep will be more appreciated than they appear to be at present.

It is not unusual, however, to fatten sheep under permanent sheds. A shed, if erected for this purpose, should be at least 6 feet in height at the back wall, 8 or 9 feet wide —the front part of the roof being supported on pillars 4½ feet high. The outer yards should be enclosed with a stone or brick wall 3½ to 4 feet in height, or the enclosure may be made of boards, room for a gate sufficiently wide to admit carts being left at the most convenient point. The floor of the shed should be constructed of boards 1½ inch thick, 3 to 4 inches broad, and with a space of ¾ of an inch between each board, through which the droppings and urine escape into a pit dug underneath the shed to the depth of 3 feet or more—the sides and bottom of the pit being built and laid with brick. When the flooring of the shed is made in compartments, that can be easily lifted, dry peat-earth, sawdust, or other absorbents, may be strewn upon the manure from time to time, and a layer of material of that kind should be put in the bottom of the pit. Hay-racks are fitted up against the back wall of the shed, and also troughs for cut turnips, &c. The shed and yard may be constructed of any length, according to the number of sheep it is intended to accommodate. Each sheep will require 10 superficial feet, including the space occupied by the feeding-troughs. The floor of the yard must be paved, and the sheep must not be allowed to stand on wet litter at any time, as foot-rot is the great obstacle which has to be contended against in yard-feeding, and wet litter would increase the evil. The yard should be sufficiently below the level of the inside shed to permit the accumulation of manure, and dry straw must be supplied every day. The manure will be trodden by the sheep into a firm compact mass, which must not be stirred until it is removed altogether at the end of the feeding season. The feet of the sheep must be carefully attended to, so as to check any tendency to foot-rot. Spouts must be fitted up along the eaves in order to prevent any drip from the roof of the shed into the yard. A turnip-yard should be constructed at one end of the shed, and a turnip-cutter is, of course, an indispensable appendage. The sheep must be fed at regular hours, and the troughs kept perfectly clean.

Sheds and yards of a temporary nature may, however, be erected on any sheltered piece of grass-land most convenient. The shed in a case of this kind is merely a thatched roof upon posts 6 feet high, the spaces between the posts on the north side and the two ends being filled with wattled hurdles, one on each side of the posts, and rammed with straw. The yard is enclosed by setting up strong hurdles; and a yard, 10 yards by 20 yards, will be sufficient for 50 sheep. The chaff and corn may be prepared at the farm-buildings, and brought twice a-day by a donkey-cart and boy, the roots being prepared on the spot. In constructing a temporary yard of this kind, a grass-field should be selected as convenient as possible to that on which the manure is to be put, so as to save carting.[1]

It has been found that sheep fed in a shed have made greater progress than sheep fed in the field, although consuming less food. A correspondent of the 'Farmers' Gazette' gives an interesting account in that journal of his experience in house-feeding sheep. His house holds 220, and his supply of wethers for the winter is laid in during the fair of Ballinasloe, held in the first week of October. Having filled his house, he gives the sheep turnips, with ½ lb. of oilcake daily, and a similar quantity of pea-meal and ground oats, mixed together, and some chaffed hay. He begins to send out his house-fed wethers to market in December, and a lot goes off, every fortnight, until near the end of April. As each lot goes off, another lot of equal number is brought in from the pasture-fields. These sheep are much sooner ready for market than they would have been if kept merely

[1] See Mr Coleman's paper "On the Management of Sheep on Heavy and Light Land," Journal of the Royal Agricultural Society of England, vol. i., Second Series. 1865.

on pasture through the winter, which is the usual system of management in Meath, the county in which the 'Gazette's' correspondent resides. Each acre, Irish, supplied sufficient turnips for 40 sheep—that is, 24 sheep per imperial acre—leaving a good profit.[1]

When feeding in the field, one man will look after, shift nets, and pick turnips to 20 scores, or cut and carry to 12 scores of hoggs.

Sheep will consume from 18 lb. to 38 lb. per day of turnips, free from roots and tops, according to the age and condition of the animals. Young sheep consume less than those which are older; and sheep in low condition will use a greater quantity than sheep which are more forward, although of the same age and breed. From 24 to 28 lb. weight of turnips per day may be considered a fair average consumption; therefore, 20 tons of turnips, or the produce of one acre, will keep 20 sheep for 93 days, reckoning each to consume 24 lb. per day.

But when sheep are supplied with auxiliary food, such as cake, beans, &c., the consumption of turnips becomes materially lessened. Thus, in a series of experiments reported by Mr James Bruce, Waughton, East Lothian, in the 'Transactions of the Highland and Agricultural Society,' vol. x. (1846), it was found that when linseed-cake was given at the rate of 1 lb. per day to each sheep, the daily consumption of turnips was only 11¼ lb. per head, being a saving of 49¼ per cent in the quantity of turnips used. When 1 lb. of beans was given daily to each sheep, the consumption of turnips per head amounted to 14½ lb., being a saving of 34¼ per cent. A mixture of ground-linseed and beans, at the rate of 3 lb. 8½ oz. of linseed, and 4½ oz. of beans, for each sheep per week, effected a saving of 32½ per cent in the consumption of turnips, the quantity used daily of the latter being 14¾ lb. per head. Furthermore, Mr Bruce ascertained that 1 lb. of mutton was produced by the following quantities of feeding stuffs:—

Linseed,	2 lb. 14½ oz.
Beans and linseed (mixed),	3 " 8½ "
Linseed-cake,	6 " 5 "
Poppy-cake,	6 " 10 "
Beans,	8 " 5¼ "

[1] Irish Farmers' Gazette, Feb. 6, 1858.

Mr Mechi states as a general rule that 7 lb. of rape-cake, linseed-cake, or beans, will make 1 lb. of net mutton. Mr Bruce said that it may be held as a safe calculation that 1 lb. of good linseed-cake per day to sheep of 9 stone weight (126 lb.) will effect a saving in the consumption of turnips equal to 33 per cent, and at the same time so far improve the health of the animals as to diminish the number of deaths by upwards of 50 per cent. These are important considerations; but he also adds that "mutton can be produced *at a lower rate per lb.* upon a liberal use of foreign keep along with turnips, than upon turnips alone—taking, of course, the increased value of the manure into account; and that of the different articles used, linseed is the most valuable, and beans the least so, but that a mixture of both forms a useful and nutritious article of food."

In connection with this part of our subject, we shall refer to some experiments which were conducted by Sir J. B. Lawes, Rothamsted, in order to test the comparative fattening qualities of different breeds of sheep. The results of these experiments were published in the 'Journal of the Royal Agricultural Society of England,' and the breeds experimented upon were the Hampshire, Sussex Downs, Cotswolds, Leicesters, and cross-breds, the latter being the cross between the Leicester ram and the Sussex Down ewe. Unfortunately for some of these results, these experiments were not all conducted at the same time; those with the Hampshire, Sussex Down, and Cotswold having been carried on in a previous year to that in which the experimental trials with the Leicesters and cross-breds were made. Still the general results were sufficiently plain. The sheep in each case were lambs, or rather hoggets, as the experiments did not commence until the middle of November, and in each case the sheep were fed under cover. "Oilcake and clover-chaff were the dry foods employed, and swedish turnips the green food." Forty sheep of each breed were selected for the purpose of experiment, except in the case of the Cotswolds, when the number experimented upon was forty-six.

The following table exhibits the results of Sir J. B. Lawes's experiments:—

Particulars.	Hants. — 26 weeks.	Downs. — 26 weeks.	Cotswolds. — 20 weeks.	Leicesters. — 20 weeks.	Cross-bred Wethers. — 20 weeks.	Cross-bred Ewes. — 20 weeks.
	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Average weight per head when put up	113 7	88 0	119 13	101 5	95 1	91 4
Average weight per head when fat (including wool)	183 1	140 12	183 7	145 14	139 9	133 12
Average total increase per head	69 10	52 12	63 10	44 9	44 8	42 8
Average increase per head weekly	2 10¾	2 0¼	3 2¾	2 3½	2 3½	2 2
Average increase per 100 lb. live weight	1 12¾	1 12½	2 1	1 12¾	1 14¼	1 14

Upon this part of the summary Sir J. B. Lawes remarks :—

"It is seen that of the six lots that have been experimented upon, the Cotswolds give by far the largest average weekly increase per head—indeed, about half as much more than either the Sussex, Leicester, or cross-bred sheep, and nearly one-fourth more than the Hampshires, which are the second in order of *rate of increase per head per week.* The increase *per* 100 *lb. live weight per week* does not show by any means such a variation in the rate of increase among the six lots, when it is thus calculated in relation to their respective weights, instead of per head. Still, even in this respect, the Cotswolds stand the first ; next come the cross-breds, then the Hampshires and Leicesters, and lastly the Sussex Downs. It is here worthy of observation that, excluding the Leicesters, the order in which the different lots give increase in relation to their weight is obviously pretty nearly the inverse of that of the *quality of the mutton ;* that is to say, those which have given the greatest increase in proportion to their weight yield the coarsest mutton, and those which give the least increase in relation to their weight the finest mutton. Consistently with this view, the Leicesters, however, fall somewhat short in the rate of their increase, considering the somewhat inferior quality of their mutton, compared with that of the cross-bred and Hampshire sheep."

In the second division of Sir J. B. Lawes's summary, he gives the various particulars of the consumption of food by the different lots of sheep. These were as follows :—

Particulars.		Hants.	Sussex.	Cotswold.	Leicesters.	Cross-bred Wethers.	Cross-bred Ewes.
		lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Average food consumed per head weekly,	Oilcake,	7 12¾	6 0½	8 1	5 14	5 14	5 9½
	Clover-hay,	7 0	5 12½	6 14¼	5 9½	5 9½	5 5
	Swedes,	106 3¾	77 12½	113 4	83 13	82 14	78 0
Average food consumed weekly per 100 lb. live weight of animal,	Oilcake,	5 4¼	5 4¼	5 3¾	4 12	5 0	4 15½
	Clover-hay,	4 11½	5 0¾	4 7½	4 8½	4 12¼	4 11¼
	Swedes,	71 10¼	68 0¼	73 6½	67 13	70 10	69 5¼
Food consumed to produce 100 lb. increase of live weight of animal	Oilcake,	291 9¼	297 6¼	253 10¼	263 13¾	264 4¼	263 8¼
	Clover-hay,	261 6¾	285 7	216 11¾	251 10¾	251 4¾	250 5½
	Swedes,	3966 12	3835 12	3557 8	3761 0	3725 4	3671 0

Without alluding to other items in the tables, we shall conclude this part of our subject with "a short enumeration of useful and practical facts relating to sheep-feeding," which Sir J. B. Lawes considers have been brought out by his experiments.

Consumption of food.—Sheep of different breeds consume quantities of food in proportion to their respective weights when at an equal age, stage of feeding, &c.; that is to say, three sheep weighing 100 lb. each will consume the same quantity of food as two sheep of 150 lb. each.

Sheep on good fattening food—such as cake or corn, with chaff and roots—will consume weekly about 4¾ lb. of cake, 4¾ lb. hay, and about 70 lb. of roots, for every 100 lb. of their live weight.

When fed as above, they will consume every week about one-seventh of their own weight of the *dry* substance of food; that is, after deducting the moisture which it contains.

Rate of Increase.—Sheep well fed and under cover will increase about two per cent per week upon their weight; that is to say, 100 lb. live weight will increase from 1¾ lb. to 2 lb. per week.

To increase 100 lb. in live weight, sheep will consume about $2\frac{1}{4}$ cwt. of cake or corn, $2\frac{1}{4}$ cwt. of hay-chaff, and $1\frac{1}{2}$ to $1\frac{3}{4}$ ton of roots.

The increase of a fattening sheep is at the rate of about 1 lb. live weight to 8 lb. or 9 lb. of the *dry substance of the food* consumed.

Live and dead weights, &c.—Hoggets or teggs (under twelve months old), and in a lean or store condition, will contain about one-half of their weight carcass, and about one-half offal.

Shorn sheep, sufficiently fat for the market, will contain about 56 lb. of carcass in every 100 lb. of the unfasted live weight.

Sheep in an ordinary state of fatness yield from 7 lb. to 14 lb. of offal or loose fat per head, according to breed and size—the long-wools giving the least, and the Downs the most.

A few cases giving the details of actual practice will serve as illustrations of the foregoing remarks.

In the report by Mr H. M. Jenkins, "On some Features of Scottish Agriculture,"[1] it is stated in that portion of the report which relates to the farm of Fentonbarns, until recently occupied by Mr George Hope that "the ewes [Border Leicesters] run with the ram in October on the best seeds, getting either turnips or cabbage if the bite is not very good; afterwards they go on the two-year-old grass until lambing time, getting turnips as before. If roots are scarce, their place is supplied by meal and wheat-chaff, or by meal and bean-straw. Lambs begin to drop about the middle of February; but the beginning of March is a more favourite time. As the ewes lamb they are put on young seeds until the end of March, shelter sheds being erected in the fields, in which they get turnips and cake, or meal; oats and bran are also esteemed good food at this time. The meal at present given to sheep is the refuse from the manufacture of starch from Indian corn, and the quantity given varies from 1 to $1\frac{1}{2}$ lb. per day, which is given mixed with chopped straw damped with water and a little salt. Lambs are weaned about the first or second week of July, except in the case of those ewes to be drafted, whose lambs are

[1] Journal of the Royal Agricultural Society of England, vol. vii., Second Series. 1871.

taken away three or four weeks earlier. Lambs are dipped soon after weaning, and again about the end of November or beginning of December. Shearing is commenced about the end of May, and is done by the two shepherds, assisted by three or four of the ordinary farm-labourers. . . . The crop of lambs is generally large, but it depends to some extent upon the food given to the ewes for a certain time previous to lambing [tupping?]. If cabbages have been given to them in any quantity, the lambs are most likely to number 175 for every 100 ewes. The hoggets are folded on turnips, the tup-hoggs getting cake, but not the females. . . . About 200 three-quarter-bred lambs are also annually fed on turnips, which are generally given on the seeds; or the lambs are to a certain extent folded on the roots, and get 1 lb. of cake each daily. They are sold to the butcher as shearlings in May and June, generally weighing about 16 or 17 lb. per quarter. The fleeces of these sheep weigh about 6½ lb. each on the average; but those of the Leicester flock will commonly weigh about 8 lb. It is found, however, in the climate of Fentonbarns and its neighbourhood, that extra feeding has a great influence on the weight of the fleece, and as much as 12 to 13 lb. of wool may be grown by a highly fed Leicester hogg."

The following are the details of the management of a flock of Leicesters, as pursued on a farm in Mid-Lothian:—

"We draft out in September the aged, delicate, or those that may be deficient in wool, which we dispose of to the butcher. If good-breeding ewes, we are not particular as to their age, for we have them occasionally as old as eight or nine years. What is intended for stock we put on clean fresh pasture; and if that is not to be had, we give them turnips on the grass. By the end of the month, or 1st of October, we put the tups to them, selected from the best blood we can get, well covered all round with good Leicester wool, with fine bone, &c. We next select the ewes that will suit the different tups that we have got for them, and put them into separate fields. One tup can easily serve 60 ewes if necessary; but he will last all the longer if moderately wrought the first year, or when a shearling. When the tups are removed from the ewes, if the pastures are rough, turnips may be dispensed with for a time; but by the middle or end of December they will require a few laid down to them each day, and these increased as the season goes on, to as many as they can eat in February, with as much good hay as they can eat all the winter, cut into chaff with a chaff-cutter, and put into boxes. I think a part of hay is better for ewes than too many turnips, and if these are not plentiful, a few bruised oats and bran mixed with the cut hay is a good substitute for them. We cut all our turnips for the ewes with a turnip-cutting cart, and lay them down on the grass. The old ewes get their share as well as the young ones. When the lambs are two or three weeks old they are put upon young grass, with a few turnips or oats given to them daily. We generally clip our ewes about the 1st of June; but much depends upon the weather and the condition of the ewes as to the time of clipping. By the end of July we take the lambs from the ewes, and at the same time we dip both ewes and lambs, which is the means of keeping the flies from blowing them in soft weather, that being the only time we dip them. The lambs are then removed to hay-stubble, or second crop, if it can be got; from that to young grass after the grain is removed from the ground, and from that to turnips, always keeping them in fresh meat. Thereafter we separate the tup from the ewe-lambs; and in December we commence giving the tup-lambs a little cake and bruised oats, and continue to increase the quantity as the season goes on. If we have turnips, we do not give the ewe-lambs any artificial feeding. Our hoggs we clip about the 1st of May, and then draw out the best of the tup-hoggs for breeding purposes, and sell them in September at the Edinburgh tup-sales. The others we sell to the butcher. In September we select a sufficient number of the ewe-hoggs to keep up the cast of ewes that we have drawn out, and we either sell the remainder for breeding or to the butcher."[1]

We now turn to Mr Jenkins's report of Mr William Torr's farms, Lincolnshire, in the 'Journal of the Royal Agricultural Society of England,' from which we have already quoted the description of Mr Torr's system of washing sheep. Mr Torr's flock is made up chiefly of pure Leicesters, and "con-

[1] Sheep, by William Reid. Edinburgh: Nimmo.

sists of 1200 breeding-ewes. No lean stock is sent to market, the whole of the lambs being fed on the farms, as well as some lean ones in addition, which are bought in the autumn to make up for losses, &c. The crop of lambs is about 10 per cent in excess of the number of ewes put to the ram. . . . The ewes and lambs are kept on seeds, which are entirely stocked by them—the ewes with couples having an allowance of oats and peas. A system of changing the pasture of the sheep is carried on as far as practicable, and is regarded by Mr Torr as one of the most essential points in good sheep-farming. Early in July the lambs are weaned on May-sown rape and clover-eddishes. The hoggets are put on turnips in September, the Banbury cutter being kept fully employed in cutting the roots outside the nets. The troughs are placed in the fold, which was more or less cleared the previous day, and a small quantity of oilcake is allowed per head. The shearling ewes are put on turnips next, and before the older ones, which get a smaller allowance and begin later. The draft ewes which still remain begin to feed off the July-sown rape early in November, clearing it, and being all sent to market before Christmas-day. From 80 to 90 pure Leicester rams are annually bred at Aylesby, and are annually let by private contract on the first Wednesday in September, with the exception of those required for the farm itself. Until then they are kept on the fat of the land—namely, red clover, May-sown rape, cabbages, mangels, corn, and cake. . . . The sheep are shorn by a company of clippers, consisting of 10 men, who travel from farm to farm. The price of clipping is 3s. per score, no beer or any other allowance being given in addition. . . . Docking lambs is done by the same people at 3d. per score. . . . Wool-winding [rolling up the fleeces] is done at 4d. per score fleeces. . . . The lambs are dipped at the end of June or beginning of July, as soon as they are taken from the ewes, by a travelling dipper, at a contract price of 1s. 6d. per score; and the clipped sheep are washed at 6d. per score. . . . After Christmas the lambs and hoggs are dipped with the same wash as in summer [viz., 1 lb. arsenic and 2 lb. of soft-soap, dissolved in 20 gallons of water], or are dressed with sheep-salve; but the ewes are neither dipped nor dressed at this time of the year."

The Lodge Farm, Castle Acre, Norfolk, which, when Mr Jenkins's report was written, was in the occupation of the late Mr John Hudson, affords another illustration of the principles and practice of high farming as applied to the management of sheep. Mr Jenkins found "400 breeding-ewes kept on the farm. These are from Hampshire-Down ewes by a Cotswold ram, and they are again put to a Cotswold ram. The ewes are bought in every year as ewe-lambs; and the rams are, as a rule, hired. The ewes are put to the ram in the best keep that may be on the farm. The lambs, both male and female, are all fed off at from 10 to 12 months old, and go to the London market. In July and August as many additional lambs are bought as may be required to feed off the grass and turnips. The hoggets are put on the water-meadows by day as soon as there is sufficient keep for them—about the end of March. The ewes and lambs are kept on seeds, the ewes having some locust-beans, and the lambs a little cake and lentils, until they are weaned in July, when they are put on the clover-eddishes. When the tankard turnips are ready to draw—about the latter end of August—some are thrown to the lambs every day, until the turnips are ready to be folded off. After the lambs are weaned, some of the ewes are put on the water-meadows, and sold to the butcher as soon as fat. During the winter, the hoggets are kept on cut turnips and swedes with an allowance of cake, going on rye in the spring as soon as the turnips are finished; they are drawn for shearing, for the London market, early in March; and they are generally all gone by the middle of April, when fresh ones are bought for the irrigated pastures, rye, &c. Those on the irrigated pastures by day are removed to the uplands at night. Fleeces range from 7 to 9 lb. in weight. The lambing-ewes live on anything they can get until a fortnight before lambing, when they begin to receive a few turnips. After lambing, which commences in February, they get better keep, including more turnips or some mangels. The hoggets are washed from 10 to 14 days before they are clipped, by the farm-labourers, in ordinary wash-pits, except those which go off early in the spring, which are washed in tepid water from the steam-engine. Clipping is done by a kind of piece-work, which is practically task day-work. The price paid is 4s. and half a gallon of beer per score; but a man is not allowed to do more than a score in one day. Soon after the lambs are weaned—generally towards the end of July, they are dipped in a solution of 'Allen's [of Lynn] composition.' In February the hoggets are sometimes watered [poured] with a bottle, using 1 lb. of arsenic with soft-soap and tobacco-juice to every score of sheep. As a rule, this is not required if the dipping has been properly done in the summer. Great attention has been paid to the arrangements for folding sheep. Instead of the ordinary hurdle, the sheep-pens are enclosed with iron 'lifts,' which run on two pairs of wheels. They are each 12 feet long, 3 feet 6 inches from the ground to the top-rail, and cost about a sovereign; but their durability is proportionate to their cost, as they last more than 20 years. The great gain in using them is, that there is no need to drive hurdles or anything else into the ground when it is hard and dry in summer, thus effecting a considerable saving in labour. When the sheep are feeding off turnips in winter, 4-inch-square mesh-nets are used before and behind them, the iron lifts being used to divide them into lots of about 300 each. Each of such lots is attended by a strong lad at about 8s. per week, a boy at 5s., and another at 4s., who top, tail, and cut the turnips, feed the sheep, move the nets, hurdles, and cribs, and do anything else that may be required for the 300 sheep. These cost, therefore, for attendance, a little more than 1s. per score per week. Where the ewes and lambs are together, these arrangements are supplemented by a wooden 'lift-hurdle,' or lamb-gate, which enables the lambs to run out of the pens and get the best of the feed on the next day's fold before the ewes are put on it, as well as their rations of cake and lentils. This 'lift-hurdle' is about 7 feet long, and the usual height; it is divided into two portions by a horizontal bar midway between the ground and the top-rail, and the lower half is subdivided by rolling upright bars 10 inches apart, just wide enough to allow the lambs to get through. The upper half has a sufficient number of uprights to give the whole the requisite strength."

Mr James Rawlence, who occupies the farms of Bulbridge and Ugford, near Salisbury, is well known as a successful breeder and exhibitor of Hampshire-Down sheep. Mr Jenkins states that "nearly 900 ewes are annually put to the ram. The number of draft ewes is about 250 annually, and the crop of lambs averages about five per cent more than the ewes put to the ram. . . . Mr Rawlence's ruling principle is simply *frequent change of diet.* As a general system the sheep are provided all the year round with a *day* fold and a *night* retreat, so that the appetite is continually whetted by variety. The ewes are put to the ram in August, either on the aftermath of 'second shear' clover, or on sainfoin, and at night they are folded on the rape and turnips before wheat. The same treatment is pursued until the spring, rape and turnips being fed off in succession, and finally swedes, commencing about the middle of October, and continuing until lambing time. As soon as wet weather or white frosts begin, cut hay and straw (about half of each) are given with the roots, and this addition is continued until lambing time. After lambing, the ewes get mangels with hay-chaff for about ten days in the lambing pens; and in addition to this food, the ewes with tup-lambs, or with couples, get either 1 pint of oats or 1 lb. of cake; but unless roots are scarce, the remaining ewes are denied artificial food. At the expiration of ten days or a fortnight the ewes and lambs go on turnips, those with tups or couples getting the same additional food, and they remain there until 20th March. About 20th March the ewes and lambs go into the water-meadows by day, and are folded at night on swedes for the first fortnight or so, and afterwards on Italian rye-grass, or occasionally on rye and winter oats, which have been sown where rye-grass has failed. This treatment is continued until the middle of May, when the lambs are weaned. The tup and wether lambs get an allowance of corn or cake as soon as they can eat, which they find access to by means of lamb-gates. These lambs are weaned by folding on sainfoin by day and vetches at night; the ewe-lambs clear behind them during the day-time, and run over two-year-old seeds at night, and as a rule they get no corn. About the first week in June the tup and wether lambs begin to get mangels and cabbages cut up and served in troughs; the rams and wethers are separated, the former being followed by ewe-lambs at Ugford, and the latter by draft ewes at Bulbridge. The details of management are briefly as follows: At five o'clock in the morning the ram and wether lambs get about 6 oz. of corn or cake on their night fold, and in half an hour go on to a break of sainfoin; about eleven o'clock they get cabbages and mangels cut up in troughs; and at five in the afternoon they are given another 6 oz. of corn or cake, being sent on vetches for the night half an hour afterwards. About the middle of July, however, rape or cabbages are substituted for vetches. The ewe-lambs follow the ram-lambs until the wethers are sold, after which they run on the aftermath seeds in the day-time, and at night are fed on rape and turnips preceding wheat. They get no corn or cake, and are followed according to the system by the breeding-ewes. The draft ewes, when dry, follow the wether-lambs, and get ½ lb. of corn or cake per diem until they are sold, which is usually in July or August. As a rule, the wether-lambs are sold on 12th August, but occasionally earlier. Their average weight is 16 lb. per quarter, but individual cases of 20 lb. have sometimes been recorded. About 140 ram-lambs and 20 older sheep are sold or let every year, the average price obtained during a series of years [*i.e.*, prior to 1869] being eleven guineas. The ewe-teggs [*i.e.*, hoggs or hoggets] not introduced into the breeding-flock are wintered on the thin hill-land at Bulbridge, on mangels and swedes, getting ½ lb. of cotton or rape cake per day, with hay and straw chaff; this treatment is continued until the middle of April, when they are folded in the water-meadows by day, and on Italian rye-grass behind the couples at night, until 20th May. From this date until 1st August they are kept on a down at a cost of 2d. each per week, being folded on bare fallow at night. Sheep are washed in the river about ten days before shearing, by the ordinary farm-labourers, who are paid their usual wages, but get in addition three meals a-day and an allowance of cider. Shearing is done by a travelling company at 15s. per hundred, wool-winders and helpers being found by Mr Rawlence. No drink is given except 1 quart of strong beer per man at night for supper. The fleeces of teggs [hoggs] weigh about 6 lb. and of the ewes about 5 lb. Sheep are dipped about the end of August or beginning of September, in a solution of arsenic and soft soap, by a travelling company, at a cost of 1s. 8d. per score, including materials, helpers being found as for shearing."

Mr Charles Randell, Evesham, writing in the 'Agricultural Gazette' of September 28, 1885, says: "You ask—referring to the summer's drought—how I expect to keep my stock during the coming winter. As to that I see no difficulty. My trials commenced with the year, and were consequent upon an almost entire failure of seeds upon 94 acres. Of this intended provision for sheep, 27 acres were ploughed and planted with winter oats; 12 with winter beans; 30, a thin plant of rye-grass, were left folded over with ewes and lambs living mainly upon mangolds, chaff, and oil-cake; and 25 acres folded over by yearling sheep fed on mangolds, oil-cake, maize, and chaff; the roots consumed being about 20 tons per acre, cake and corn averaging ½ lb. per sheep.

"After the ewes and lambs—about 270, divided into four lots—had gone over the 30 acres of rye-grass, they were folded on 30 acres of old seeds, the ewes still living mainly upon mangolds with oil-cake and chaff, the lambs grazing before them by the aid of lamb-gates, and having their troughs for cut mangolds, chaff, and Waterloo round-cake, mixed with a little linseed-cake. In this way they lived until the winter vetches, of which 30 acres had been planted after wheat and barley in October and November, were fit to wean the lambs to—the strongest eating them through iron hurdles, the young ones having them mown and put into racks (this because they were upon stiff clay land)—the ewes and yearling ewes also getting vetches—the lambs cake and chaff in addition, the ewes nothing else. When the vetches were finished, the ewes had to go over again the rye-grass and old seeds and a young orchard of 20 acres, which had kept the 160 yearling ewes before they went to the vetches.

"And now comes in the 25 acres of land where the seeds had failed, and where the feeding sheep had eaten the mangolds; part of it was spring vetches, ready for the lambs when the winter vetches were finished—part rape, part thousand-heads—part Sutton's early drumhead cabbage. In addition to this provision for lambs, 14 acres of another field (a wheat stubble manured and ploughed before winter) were drilled half with thousand-heads in April, the other half planted with drumhead cabbage in May. The thousand-heads were later after the spring vetches upon the 25-acre field. Then the rape was ready; it is just finished, and the lambs are upon the second piece of thousand-heads, all eaten through iron hurdles. When these are gone the cabbages will be ready, and then the lambs (372) must go to mangolds—I have 33 acres which will not be less than 35 tons per acre—in November instead of February, as usual. The roots must then be pulped, and mixed with a large portion of wheat-chaff, or pea-straw chaff, because the lambs will do better so, and because economy in the use of them is absolutely necessary, not only from having to begin them earlier, but by the fact that of 83 acres sown with seeds, 58 again have failed. I shall, therefore, have to depend upon mangold next spring, as in the last, for the main support of ewes and lambs. I have only ten acres of turnips, sown the 7th of August. Where other turnips should have grown after peas, I have planted 16 acres thousand-heads, 11 acres rape, for the ewes and lambs to eat off in the spring in time for barley. Of the 58 acres where seeds have failed, 8 are planted with vetches, 20 with mangolds, 30 have been sown with trifolium, which, notwithstanding the favourable weather it has had, has disappeared, as it usually does on heavy land. I must do with this as I did last year—fold the feeding sheep upon the land with mangolds and cake, and get spring vetches, rape, cabbages, and, perhaps, turnips afterwards. If the mangolds are not likely to hold out, I shall reduce the daily allowance to all sheep early enough to make them do so, supplementing by a mixture on which I kept 180 ewe teggs all through the winter of 1879, when the low price of lambs at Michaelmas had tempted me to buy a lot to feed. It may be that I shall yield to the same temptation again before the end of the year. The mixture given to the ewe teggs was as follows, and they got fat upon it: Boil 60 gallons of water, add half a bushel of linseed, and let it continue to boil ten minutes. Pour this into a tub, and add three bushels of kibbled barley or maize, or a mixture of the two, or any kibbled corn, putting the corn to the water, not the water to the corn; cover it up, and let it stand all night; then mix with sufficient chaff for a day's allowance for 180 sheep.

"At present the flock of sheep I have to winter consists of 332 Shropshire ewes, 60 Dorset ewes (for fat lambs, early), 372 lambs, 10 rams. The Shropshire ewes were put to the rams on the 1st of September, in seven lots, folded upon aftermath, where they get about half an acre per day at twice, with half a pound each of decorticated cotton-cake, and as much wheat-chaff and hay-chaff mixed as they will eat up clean. This is done upon the same meadow every year, with this difference, that, when grass is abundant, chaff is not wanted; but it is a question of manuring for the next crop of hay, and, whether the grass be much or little, the sheep have to spend so much time upon the land. Just now the ewes are taken away to eat 14 acres of mustard, sown after vetches, which will serve them three weeks or more, when they will return to the meadow. Meantime, their pens there are occupied by Dorset ewes and ewe-lambs. The meadow is usually finished at the time when the ewes are taken from the rams; from that time until brought home for lambing, they will be folded upon the pastures, which have been grazed by dairy cows, and live mainly upon oat-straw without cake. No roots until after lambing."

Mr Charles Howard, of Biddenham, Bedford, states that in his district rye, winter oats, and tares, are sown for spring keep; and he holds a high opinion of cabbages as a field crop, and as food for stock. "Cabbage," he says, "is one of the easiest and cheapest crops to produce on the farm, and it is a matter of surprise to me that more farmers do not cultivate it. I have generally from 7 to 8 acres; some few are planted out 24 inches apart in November, the others in February and March. I commenced cutting them early in June for my rams, and during this (1885) dry summer (as in 1868) they have afforded abundance of food for cattle, sheep, and pigs; and, as I have before mentioned, my lambs have only just finished them. As a rule I grow my own seed from well selected plants, which is drilled then about 4 or 5 inches apart on a nicely prepared piece of land."

The foregoing statements are interesting as showing the practices which prevail in different parts of the kingdom—each course exemplifying the best system of management in their respective districts. They refer mainly, however, to the management of flocks on land naturally adapted for sheep. On strong, heavy land, the management of a flock is more difficult; but as sheep, when properly attended to, are a profitable class of live-stock, the attention of graziers, more especially in England, has been frequently directed of late years to the consideration of this subject, with a view to ascertain the most economical, and, at the same time, the most profitable mode of management on arable farms of strong land.

Unless heavy land is thoroughly drained, it is useless to think of keeping sheep upon it. Retentive soils which are undrained are productive of rot, which is a fatal barrier to success in sheep-farming. An improvement of the pasture, after the land has been drained, will also be effected by top-dressing with lime, and the best form in which it can be applied is in a compost with earth, followed by dressings of farmyard dung, bone-dust, and other artificials. These manures will foster the growth of a greater variety of grasses than the land would produce in its natural state.

The cultivation of forage-crops must form a principal feature in the cultivation of heavy lands, with a view to the consumption of such crops by the flock; and clover, rape, vetches, mustard, and cabbage, are most suited for the purpose. For a supply of food in spring, mangels, where the climate is favourable, and swedes where mangels cannot be grown with success, must be provided. Kohl-rabi is also a valuable crop. Some of the early varieties of turnips, for use in autumn, are also useful. The root-crops are stored and given sliced in troughs, or pulped, which is better. The forage-crops for summer use are consumed by folding the sheep on them, as this can be done on heavy land in dry weather. If the sheep are prevented from being folded at any time by continued wet weather occurring during the summer or autumn months, the forage-crops should be cut and carted to a grass-field, and laid down thinly in rows for the sheep. Artificial food is also required, and when used should be mixed with chaffed hay or chaffed straw.

When a flock is kept on a heavy land farm, it usually consists of what is called in some parts "a flying stock"; that is, ewes purchased in autumn, and sold within the year after rearing a crop of lambs—the lambs being also sold either to the butcher or as stores. Under this system the land is fresh stocked every year. This plan suits farms where the land is exclusively in grass, as lambs do not succeed when wintered on lands after ewes; they have not that clean fresh run of good pasture which lambs require. On farms of this kind, oilcake and chaffed hay, mixed together, should be given to the ewes a short time before the lambing season, as well as afterwards until the lambs have learned to eat the artificial food. $\frac{1}{2}$ lb. of cake each day is enough for the ewe at lambing, and afterwards for the ewe and lamb; and once the lambs have learned to use it, their portion may be kept apart by itself, by fencing the troughs into a corner of the field with hurdles, having upright revolving bars, 9 inches apart, which allow the lambs to pass through. This extra feeding is well repaid in the improved condition of both ewes and lambs, and also in the increased number of ewes which the land is enabled to maintain when grass-feeding is supplemented by artificial food.

In some grazing districts, where the land is strong, and all in permanent pasture, chiefly devoted to cattle-feeding, the sheep-stock consists of wethers bought towards the end of autumn, and run on the grass throughout the winter without any assistance in the shape of artificial feeding. These wethers are shorn, and run thinly among the cattle during the summer, and go off to the market as they become fat for the butcher. By using artificial food, those wethers would be fat for market much sooner than they are when merely grass-fed. Their clip of wool would also be heavier, and more could be kept on the same extent of land, whilst the land itself would be enriched by the increased value of the manure of the animals. Oilcake alone, or a mixture, equal parts, of crushed peas, crushed barley, and palm-nut meal, with the addition of crushed Indian corn as a fourth part of the mixture, has been found of great service in such cases, the daily allowance for each animal being from $\frac{1}{2}$ to 1 lb.

Yards are requisite in keeping a flock on heavy land, and they may be of a permanent nature or of a temporary kind.

Both kinds are described in a previous page. It has been recommended that the bottom of the yard should be covered a foot thick, and the shedding two feet thick, with burnt earth, which may be obtained from roadsides, hedge and ditch banks, &c. By using burnt earth, straw is economised. "The portion of earth with which the open yard is bottomed will absorb the urine, and improve the quality, while it increases the quantity, of the dung-heap; and that which grows dry, as it should do into the shed, must be turned as often as required, until it becomes so saturated with dung and urine, that turning no longer provides dry bedding for the sheep. It is desirable, then, where practicable, to cover these ashes with fresh ones, but this cannot always be done. If fresh ashes cannot be obtained, straw must be put upon the old ones. When the feeding is over, they are useful, mixed with superphosphate, to apply by the drill to the green crops."[1]

It is difficult to keep a self-supplying breeding-flock on heavy land—that is, a flock managed in the same way as a flock on light land, where the ewe-lambs are reared to take the place, when shearlings, of the old draft ewes. There must be a proportion of the land in cultivation to grow mangels, swedes, kohl-rabi, and cabbage, with vetches and rape for summer and autumn feeding, so as to relieve the pastures. Instead of rearing lambs on such farms, to keep up the breeding-flock, some graziers find it better to sell their lambs every year, and buy in a sufficient number of shearling ewes to supply the place of those which are drafted. The plan followed in such cases must be regulated by circumstances, as a system which would suit one case may not suit another. The judicious flock-master will, however, be always ready to avail himself of any hints he may obtain respecting the practices adopted by others who are placed in somewhat similar circumstances to his own, and apply such information for his own benefit.

As an illustration of a system of management which has been successfully pursued with a flock kept on a stiff retentive soil, we give the following particulars from a paper

[1] See report of discussion on "Sheep *versus* Cattle," at Council Meeting of the Royal Agricultural Society, June 20, 1866; Journal of the Royal Agricultural Society of England, vol. ii., Second Series.

read by Mr Bond of Kentwell, Long Melford, Suffolk, at a meeting of the Central Farmers' Club, on December 5, 1858. Mr Bond's flock consists of 500 ewes, chiefly of the Hampshire-Down breed, but to which Cotswold tups are put.

"In the management of the flock, one main point is to have them upon the arable land as much as possible, because of the manure; but never at a wet or improper time. In October the ewes are placed in different lots upon the maiden layers [young sown grasses] and stubbles generally, whilst the tupping is going on; also upon the mangel-wurzel tops, after the roots have been carted. In November they have the swede tops, perhaps a piece of rape, also the pick of the old grass on the pastures; and as the weather becomes wet and cold, they are taken to two good, roomy, well-drained, well-shedded yards, where they receive cut barley, oat, pea, bean, or wheat straw in troughs, also a supply of any clean, fresh-thrashed straw, placed between hurdles, or in racks, from which they eat the straw most freely. Those yards become their winter quarters. They are littered with straw as necessary; and I have always noticed in coarse, wet weather, upon entering the yards early in the morning, that every sheep is under cover in the sheds, which simply proves that they are as great lovers of comfort and warmth as the human or any other animal. We adhere to the yards in the winter; as ewes folded at night upon a bleak field, exposed to severe frosts, cold cutting winds, rain, sleet, and snow, are in a poor position for progress; and we prefer to cart the manure to the field in a dry season, rather than to deposit it there under such unfavourable circumstances to the animal and to the soil. Each day the ewes have gentle exercise, or a free ramble upon an adjoining pasture, where they receive an allowance of 100 bushels of swedes or mangel-wurzel per diem. This treatment is continued till within a month or five weeks of lambing, when a few bushels of crushed rape-cake are daily added to the straw-chaff, which cake, we consider, may advantageously be passed through the animal, instead of applying it direct for a grain crop to the soil. The rape-cake is always eagerly consumed; and even such inexpensive artificial food is very beneficial in preventing too great a reduction in the condition of the ewes, prior to parturition.

About three acres of cow-cabbage are grown, some of which are given to the ewes ten days previous to lambing; or they have a small bait upon aftermath grass, which assists to ease in parturition, and secures a flow of milk. After lambing, the ewes are placed with the lambs upon a piece of aftermath grass, which has been reserved, where they receive mangel-wurzels and cabbages, and return to the yards at night for rape-cake and cut roots with chaff, till the weather becomes sufficiently warm for the lambs to sleep out, which is not usually till April. The lambs are allowed cabbages, and a small supply of bean-meal and rape or oil cake, apart from the ewes. In May or June the flock of ewes and lambs receive mangel-wurzel upon the rye, or rye-grass, or pasture, the lambs running forward for the best feed; after which, in July, the lambs are weaned, and placed upon good clover or pasture, where they continue to receive a small supply of artificial food, and are sold usually at the commencement of August."

There is a subject in connection with the management of sheep which does not appear to have received the attention it deserves—namely, the importance of allowing them free access to pure water. We have even heard it asserted that sheep do not require water; but that is a mistake. No doubt there are circumstances where they may require less water than at other times; but in general, and more especially when they get artificial food, sheep must have water to drink. Sheep which are fed in this manner may be seen going from the troughs to the water, and after slaking their thirst, returning to the troughs. If the grazings are situated in a district where the rainfall is considerable, as in the western parts of each portion of the United Kingdom, the want of water may not be felt so much as it is in the eastern and drier districts; nevertheless, they must obtain water in some shape or other. Mr Mechi, who is a very acute observer, has said it is a great mistake, and the cause of much suffering and loss, not to supply sheep with water, especially milk-giving ewes. During the drought of 1868, many flocks were ruined by want of water; and he gives a striking instance which came under his observation, where the animals were wasted, and sent to Chelmsford market in evil condition, the owner being ignorant of the cause. The dealer, who bought them "for a song," first examined the whites of their eyes, thinking they must have the rot or jaundice; but seeing all right so far, he found that a supply of water was the only restorative required. Mr Mechi says further, with reference to this matter, that grass in a succulent state contains 76 per cent of moisture, but when dried very much less. The same remark holds good for clovers, &c. When we give cake, corn, malt-coombs, bran, &c., it becomes absolutely necessary to provide water, or the animals will not thrive. Give them the opportunity of judging for themselves by an always available supply, and they will exercise a prudent discretion in the matter. An iron water-cart is on most farms an indispensable requisite. When food is too wet and "sloppy," dry cotton-cake or corn is a good and profitable regulator. Turnips and mangels are disproportionately watery as food for animals; hence the losses occasioned by them, especially with breeding sheep. They contain fully 9 pints of water to 1 pint of dry food: 90 per cent of water is too much; 75 to 76 per cent in pasture-grass is the more natural and proper proportion. The animal or human frame has 75 per cent of water—just as good grass has.

In the preceding remarks no special allusion has been made to the second class of sheep-pastures mentioned at the beginning of this chapter—namely, permanent pastures situated at a moderate elevation, where arable farming is either limited in extent or not practised, although the nature of the soil and the climate are favourable to the growth of cultivated crops. Where there is a certain proportion of the land under crops, the sheep will have the benefit of the roots and forage-crops grown in the rotation, and in other respects the management will be a modification of the mode of feeding which has been already described, including the use of artificial food for milk-giving ewes until the grass is well grown, and also to further the growth of the lambs during their first winter as hoggs. By means of such food the hoggs will have heavier fleeces, and be of more value to the grazier who buys them when shearlings. In saying this, we refer altogether to the wether-lambs, as the best of the ewe-lambs will be retained to keep up the breeding-flock, and these require only to be kept improving, which they will do if they are frequently shifted on good grass. If the grass becomes bare, a little help in the shape of some crushed oats and bran will not be thrown away.

It is very desirable on farms of this kind, and particularly so where the land is all under permanent pasture, that a considerable quantity of good hay shall be saved every year. This is no doubt done, for the most part, to some extent, in all cases of the kind; but it often happens that the hay is coarse and poor in quality, being the produce of wet, swampy parts of the ground. In many instances a piece of the best of the land is shut up each spring, and "meadowed"; and this is done year after year until the producing powers of the soil become so exhausted, that the crop is scarcely worth the expense of cutting and saving it. Where this system of meadowing is followed, the land should be fairly manured with farmyard dung during winter, giving it from 12 to 15 tons of dung to the statute acre. If this cannot be done to the full extent, give 10 tons; or form a compost of farm-dung and dry earth, as opportunity offers; and if the proportion of dung is small to that of earth, the value of the compost will be materially increased by adding crushed bones to the heap when it is turned and mixed, some time before it is put out on the land. The bones may be mixed at the rate of 3 to 4 cwt. for each statute acre the heap is calculated to go over. Top-dressing the meadow with a mixture of guano, or nitrate of soda, superphosphate, and "kainit," or coarse salt, is also useful. The great object should be, to have large crops of grass, and to keep the land at the same time in good heart, which can only be done by applying suitable manures.

There is one mode of growing grass for hay which we are surprised is not more common on sheep-farms of the kind we are now considering; we mean, by irrigation. Small streams of pure water usually abound in pastoral districts; and these, with a piece of land having a gentle fall and a gravelly bottom, and, of course, convenient to a stream, are all that is required to produce almost an unlimited quantity of excellent hay. A retentive subsoil is not desirable, because such land, when irrigated, is not safe to put sheep on; whereas, where there is a gravelly bottom, the water may be let on for a few days after the hay-crop has been removed, and the fresh grass which will spring up after the watering will be found very serviceable, especially to put draft ewes on it, or wether-lambs that are to be sold; and ewes and lambs may have a run over the irrigated land in spring—care being taken to shut off the water some days before the sheep are put on the grass. In short, a piece of irrigated land, if of a proper description, can be turned to account in different ways, besides that of growing for hay, which is, of course, the main object.

It does not lie within the scope of our subject to describe the formation of irrigated meadows, nor the management of them; but we may say, the most simple form, and that which is best adapted for the majority of cases, is the "catch-work" system of flooding. It is also the least expensive, costing only from £1 to £2 per acre in many instances. We know irrigated meadows which were originally thin, gravelly pieces of land, of comparatively little value, which were irrigated at a cost of not much more than £1 an acre; and although it is over 40 years since this was done, a heavy crop of grass has been mown every year, without costing a penny beyond two or three days' work of a man clearing out the water-runs before letting on the water for the season.

We shall give one or two instances of successful irrigation of naturally poor land. The first we shall quote is reported by Mr James Wilson, Eastfield, Penicuik, Mid-Lothian, in the 'Transactions of the Highland and Agricultural Society,' 1845. Mr Wilson reports that 1½ acre, imperial measure, which produced scanty and coarse pasture, was watered by leading a small rill along the upper part of the ground, distributing the water over each ridge—18 feet—by small feeders. The supply of water was so scanty that it was not more than sufficient for one ridge at a time; so the field had to be watered ridge by ridge, each ridge being flooded for two days at a time. The water, however, was improved by the occasional overflowings from the farmyard. Notwithstanding the insufficient supply of water, the field produced a heavy crop of grass, part of which was cut and given green to cattle, and part made into hay. The latter, when weighed, represented nearly 4 tons per imperial acre. The land also produced an excellent second crop towards the end of August, and that portion which was first cut produced "a beautiful third crop." The land became, as Mr Wilson states, "worth as many pounds a-year as it was before worth shillings." Mr Wilson also irrigated another portion of his farm which lay "in a steep acclivity on the banks of a river." It was a dry gravelly soil, and, for the most part, almost useless in summer. This piece of land was flooded by making a small cut as a flooder along the top of the bank, and another across about half-way down—the catch-work system—and the steep acclivity rendered it easy to spread the water over the surface. The water was kept on throughout the whole winter, and during summer until a week or two before commencing to cut the grass. The first year the irrigation had comparatively little effect; but the second year the grasses became finer in quality, and the crop of hay produced upon it weighed 4 tons 6½ cwt. per acre. Mr Wilson says, in closing his report: "Thus another portion of land has been brought from comparative barrenness into a state of great fertility, by means both simple and cheap, as a very small amount of labour and attention have been required, and for which, certainly, we have been most amply repaid."

The next illustration of the advantages of irrigating coarse natural grass, is supplied by a prize report by Mr William Simpson, Glenthyan, Aberdeenshire, which was published in the 'Transactions of the Highland and Agricultural Society,' 1849. The ground operated upon was previously covered with a short kind of grass, and had never been cropped; "cattle were occasionally turned upon it when pasture was scarce on other parts of the farm;" and it was not worth more than 5s. per acre yearly. The ground was levelled where such was necessary, and the water led from an adjoining stream in water-courses along the highest parts, so as to spread it over the whole surface. The fall of the ground was fair, but not too rapid. On bare parts suitable grass-seeds were sown, the surface being raked with rakes having iron teeth, and a top-dressing of earth scattered over to be a kind of bed for the seed. After sowing the grass-seeds, the ground was rolled. The part first done—4½ acres—cost £37, 8s. 3d.; but another portion was subsequently prepared for irrigation, at an expense of only £1, 16s. 9d. per acre. The produce in hay the first year was 3 tons, 16 cwt. per imperial acre; and in the following year, 4 tons, 12 cwt. By flooding after the first crop was cut and saved, valuable aftermath was obtained. The results of Mr Simpson's experience of irrigation deserve to be taken into serious consideration by those who occupy grazing-farms of the kind to which these remarks have reference. Mr Simpson concludes by saying: "The reporter is so convinced of the great benefits to be derived from raising, by irrigation, large quantities of good grass, that he is in the course of turning into that channel every stream of water he can command. The grass thus produced is so abuudant and nourishing, that it not only rears and improves the cattle, but at the same time lays the source of creating so much additional manure, as to be highly beneficial in its application to the production of grain, and also of turnips."

It is, we think, a self-evident fact, that breaking up a portion of land on those grazing-farms of which we are now treating, for the purpose of raising crops suitable for sheep-feeding, would materially increase the production of mutton. There are in Ireland, for instance, immense tracts of pasture employed in rearing sheep which, although of improved breeds, do not reach the consumer until they are at least three years old. By raising suitable forage-crops, sheep reared on such farms would reach the consumer much sooner, and in this way there would practically be a considerable increase of the meat-supplies, while the producer would be amply recompensed for the additional expense incurred in cultivating the crops necessary for hastening the maturity of his sheep. The Down pasture-lands in the south of England present a parallel case to that of the grazings in most parts of Ireland. The extensive areas of the Downs have been broken up, and, by the aid of artificial manures, a large increase has been effected in the growth of crops for sheep-feeding,—such as turnips, rape, vetches, trifolium, rye, and Italian rye-grass. The result is, that Hampshire breeders now sell their sheep within the first year, instead of keeping them until they were three years old, as they had to do before they commenced to raise crops suitable for sheep-feeding. The adoption of a similar system by Irish sheep-breeders would effect an increase of at least

50 per cent in the production of mutton in that portion of the United Kingdom.

It is of the utmost importance that sheep-pasture be dry, and if there are any wet spots, these must be drained. Rot is frequently prevalent in wet land; and the losses caused even in one season by that disease would cover the expense of draining a considerable area.

When wetness arises from underground springs, it is better at once to open these up by deep drains, which may be piped, or filled with small stones, as most convenient; but where wetness is caused by surface-water not finding a ready outlet, open draining, as described in the next chapter, will be sufficient in most cases.

Another point of importance is *shelter;* and this will be most effectually secured by having masses of plantation in different parts of the grounds. Plantations made for the purpose of shelter should have a waving outline, which answers the purpose better than a straight outline. From the large tracts of pasture-lands which may be seen in many parts of the United Kingdom, with scarcely a single tree to break the monotony of the scene, it is very evident that the value of plantations as a shelter for live-stock is either unknown or not sufficiently appreciated.

CHAPTER X.

MANAGEMENT OF SHEEP ON MOUNTAIN-PASTURES.

In various parts of Scotland, in the north of England, and in Wales, and also in Ireland, there are immense tracts of mountain-lands, which are only fit for pasturing those breeds of sheep that are suited for such localities. These mountain-pastures differ, however, very much in quality. Some are situated at a comparatively moderate elevation, and consist of green, grassy pastures; in other cases the green pastures are interspersed with heath: another class consists wholly of heath and other mountain-plants, while those pastures lie at a high elevation, and therefore are more subject to storms than grazings which are more favourably situated. Some mountain-pastures are hard and rocky; others consist of deep bog; and some are covered with short heather mixed with fog, which retains water, and is of no value as food. Cotton-grass, which grows on peaty soils, is one of the most valuable plants on a mountain sheep-farm. It begins to flower in February and March, and at that season sheep thrive as well upon it as if they got turnips. It is therefore a great recommendation of a mountain-farm that it has plenty of good "mossing," as abundance of cotton-grass is designated.

It must be evident that one breed of sheep would not suit all kinds of mountain-pastures, and the general principles of management must also be modified to suit different circumstances. As the details of mountain sheep-farming are better conducted in Scotland than any other part of the kingdom, our remarks on this part of our subject will be founded on those practices which prevail on Scotch sheep-farms.

Before entering into the details of management, we shall, in the first place, devote some attention to the means best adapted for the improvement of mountain-pastures, and some other matters in connection with the subject.

The first point which claims our attention is Draining. Mountain-pastures are usually intersected by numerous streams, ranging from tiny rivulets to large rivers. When these streams are small they should be taken advantage of as main water-courses, and anything which obstructs the flow of water removed from them. It may sometimes be necessary to straighten the course of the stream, and in other places to widen and deepen it. The main drains, and sometimes the ordinary drains, where main drains are not required, discharge into those streams. In laying off the ordinary drains the course usually adopted in draining arable land is not followed; and the drains, instead of being straight up-hill, are made across the face of the declivity, with a moderate fall, so that the current shall not be too rapid: and the drains should also be cut so that the water may run in a contrary direction to that of the stream or main drain into which it is discharged. When the water has too great a fall, as it would have when carried in the direct line of the declivity, it is apt to make eruptions in different parts of the soil through which it passes. Ordinary drains are cut so as to be 20 to 24 inches wide at the top, and 8 or 10 inches at the bottom, and from 16 to 18 inches perpendicular depth. A main may be 30 inches wide at the top, 12 inches wide at the bottom, and 18 or 20 inches deep; but if a rivulet is convenient, a main drain will, in most cases, be unnecessary. In making these drains the sod is laid on the lower side of the drain, about 8 or 10 inches from the edge, and the earth which is taken out in finishing the drain is laid at the back of the sod. It is necessary to look after these drains, and to have them cleaned out occasionally. The distance between the drains will vary from 6 yards to 60 yards, according to the circumstances of the case. Flat, swampy parts will require the drains to be made at narrow intervals; and all springs should be dried by having separate drains run through them. The result of draining mountain-pastures is to improve the quality of the grass, and to prevent rot and other diseases which are fostered by wet land. Many farms in Scotland which are now stocked with the best description of Cheviot or improved Blackfaced sheep, were, previous to being drained, so unsafe as to be quite unfit for sheep of any kind.

The following table, which is taken from the 'Transactions of the Highland and Agricultural Society,' 1859, shows the comparative expense per acre of draining at different distances, &c. The rise in labourers' wages which has taken place since that time must, however, be taken into account.

From 15 to 20 yards may be considered, in most cases, a fair distance apart; and the cost cannot be compared for an instant with the results which follow this operation when properly performed.

[TABLE.

Distance between Drains.	At 1d. per 7 yards.		At 1⅛d. per 7 yards.		At 1¼d. per 7 yards.		At 1⅜d. per 7 yards.		At 1½d. per 7 yards.		At 1⅝d. per 7 yards.		At 1¾d. per 7 yards.		At 1⅞d. per 7 yards.		At 2d. per 7 yards.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
At 6 yards apart	9	7¼	10	9⅝	12	0	13	2⅜	14	4⅞	15	7¼	16	9⅝	18	0	19	2½
7 "	8	2¾	9	3	10	3¼	11	3½	12	4⅛	13	4⅜	14	4⅝	15	4⅞	16	5½
8 "	7	2¼	8	1	8	11¾	9	10½	10	9⅜	11	8⅛	12	6⅞	13	5⅜	14	4½
9 "	6	4¾	7	2¼	7	11⅞	8	9⅜	9	7⅛	10	4⅝	11	2¼	11	11¾	12	9½
10 "	5	9⅛	6	5½	7	2⅜	7	11¾	8	7⅝	9	4	10	0⅞	10	9¼	11	6¼
12 "	4	9⅝	5	4¾	6	0	6	7⅛	7	2⅛	7	9½	8	4¾	8	11⅞	9	7⅛
15 "	3	10	4	3¾	4	10½	5	3¼	5	10	6	2¾	6	8½	7	2¼	7	8⅛
20 "	2	10½	3	2¾	3	7⅛	3	11⅜	4	3¾	4	8	5	0⅝	5	4⅝	5	9
25 "	2	3⅝	2	7	2	9½	3	1⅞	3	5⅜	3	8¾	4	0¼	4	3⅝	4	7¼
30 "	1	11	2	1½	2	4¾	2	7⅝	2	10½	3	1⅝	3	4¼	3	7⅛	3	10
35 "	1	7¾	1	10¼	2	0⅝	2	3	2	5⅝	2	8	2	10½	3	0⅞	3	3½
40 "	1	5¼	1	7⅜	1	9⅜	1	11⅜	2	1⅝	2	3⅝	2	5¾	2	7¾	2	10½
45 "	1	3⅜	1	5¼	1	7⅛	1	9	1	11	2	0⅞	2	2¾	2	4⅝	2	6¾
50 "	1	1¾	1	3⅝	1	5⅛	1	6¾	1	8⅝	1	10¼	2	0	2	1⅝	2	3½
55 "	1	0½	1	2	1	3⅝	1	5¼	1	6¾	1	1⅜	1	9⅞	1	11½	2	1
60 "	0	11½	1	0⅜	1	2¾	1	3¾	1	5¼	1	6⅝	1	8⅛	1	9½	1	11

Serious losses have frequently occurred on mountain sheep-farms, from the flocks being overwhelmed by masses of drifting snow. To provide against this contingency is of the utmost importance; and there is nothing equal to the shelter afforded by masses of plantations, where circumstances admit of such being made. Plantations for shelter should have an undulating outline, and when formed in a crescent-like shape they answer admirably. They are also formed presenting different combinations of the crescent on the exterior, the interior being filled up with Norway spruce, larch, and Scots fir.

Another mode of securing shelter is by erecting what are called "rounds," or "stells." These are constructed in a circular form, the walls being 6 feet high, and built of stones without mortar, or of sods, where stones cannot be easily got. A door 3 feet wide is left on the lower side of the stell, supposing it to be built on a declivity; or, if built on a piece of flat ground, on the side least exposed to storms. The diameter inside may be from 8 to 10 or 12 yards, but more is not advisable. The snow blows round a building of this kind, very little falling inside unless the diameter is unnecessarily great. A stell 10 yards in diameter, inside measurement, will accommodate from 70 to 75 sheep, with space for a hay-rack in the centre. A sufficient number of stells should be erected at different parts of the grounds; and the hay which is necessary for feeding may be obtained most readily by irrigating an acre or more of the grassy level spaces usually found along the course of streams, and enclosing the same by a wire fence, or otherwise. When the hay is saved, a portion of the crop should be conveyed to each stell, and put up in a small rick, or stored in a hut convenient to the stell. When stored in a rick, it must be protected from the sheep by means of hurdles.

Where the nature of the ground does not admit of carrying the hay in a cart, which is usually the case, it may be tied up in large bundles and carried slung over the back of a horse. We have sometimes had a large quantity of hay carried in this way, where there was no road for a cart.

Bridges, to allow sheep to pass from one side of a stream to the other, are very useful, especially when the streams are swollen by heavy rains or melting snow. These bridges are easily constructed: a pier of rough mason-work is built, one on each side of the stream—or two rocky points are selected, the tops of which are above the highest point reached by the water; two rough trees or stout poles are laid across, 2¼ feet apart; pieces of wood are nailed upon these poles, and then two layers of sods are placed on the bridge, the first layer with the grass-side under, and the next with the grass uppermost.

Boundary fences are not common in the case of mountain-pastures, except in those districts where the farms are comparatively limited in extent. It is very desirable, however, to have boundary fences, as the sheep are less disturbed than they are when the grounds are open. The usual fence in Scotland is a stone dike about 5 feet in height, and built without mortar. Wire fences are also employed in some districts as boundary fences.

Some enclosures are requisite for accommodation on mountain sheep-farms. The rams having to be kept separate from the flock until the proper time for letting them to the ewes, a tup-park is required for their accommodation. A lambing-park is indispensable; and a small enclosure is also very useful for keeping any sheep that may be sick, or which require special attention for a time. The lambing-park, and what may be called the infirmary-park, should each have a shed sufficient for the purpose. Those fields must be well enclosed, particularly the tup-park, and each should have the convenience of water. If lime can be procured, much improvement will be effected in the pasture if the ground is top-dressed with it. The coarser grasses and heath disappear under the action of lime, and their place is taken by white clover and fine grasses. Shell-marl produces a similar effect. After the lime has improved the pasture, a top-dressing of crushed bones will be found useful and remunerative.

Some sheep-farms have a portion of arable land attached to them; and it is very desirable that such should be the case, wherever it is practicable. The main object should be to raise turnips and sown grasses for the sheep. Rape is also a useful crop in such cases.

Burning the old heath has been long practised as a mode of improving the pasture. The ground should be divided into eight portions, and one of these burned each spring;

thus going over the farm every eight years. Fire is set to the heather on the lee side, and when it reaches the limit of the extent to be burned, it must be extinguished. After being burned, the heather throws out young shoots, and the grasses which grow among the heather become finer. "Muir-burning," as it is called, has given rise to considerable controversy, sportsmen affirming that it is destructive to game. By the law of Scotland, muir-burning must be completed by the 11th of April, unless in particular cases, when, under certain regulations, heather may be burned until the 25th of April. If long delayed, the eggs of grouse may be destroyed; but the growth of young shoots in the heather is quite as beneficial for grouse as it is for sheep, while old heather, with long bare stems and hard dry tops, is unfit for either sheep or grouse.

Among the numerous stubborn difficulties which sheep-farmers have had to contend against in recent years, is the marked deterioration of the upland and mountain pastures. The county of Sutherland affords a good sample of what has been experienced to a lesser or greater extent all over the country. The editor, in drawing up his report on the agriculture of that county,[1] had his attention specially directed to this important subject. "For about sixty years the green and mixed pastures of Sutherlandshire had been constantly grazed by a heavy, hungry stock of sheep, that have browsed upon it all day, and spent the night on the higher and bleaker land, where they have also left the richest of their droppings. The green lands thus received little or nothing, even of the droppings, of the animals that fed upon them. They received no manure, and no artificial nourishing of any kind. They have had to rely solely on the repairing forces of nature; and ever active as these are, in this case they have been unequal to the consuming power." This, indeed, has been almost the universal experience. Various remedies have been suggested, such as dressing the land with lime, bones, or other artificial manure, and some have even recommended ploughing and sowing with oats and grass seeds, these to be consumed by sheep, which might also receive a little cake.

[1] The Agriculture of Sutherlandshire. By James Macdonald. Transactions of Highland Agricultural Society, 1880.

We have now to consider the details of management pursued on mountain sheep-farms; and in so doing we shall follow the order observed in describing the management on arable farms, beginning at the end of the year, which is the commencement of the breeding season.

As it is not desirable that the lambs should be dropped early on mountain-farms, the rams are not sent to the ewes before the 20th or 25th of November, so that the lambing season does not come on until the end of April. From the extent of ground to be gone over, not more than 50 ewes should be allowed to each tup, and in some cases 30 to 40 ewes will be sufficient. The principle of assorting ewes and rams described in a former page with reference to the management of sheep on low pastures, should also be carried out in mountain-farms; but it is not so easy to do so as it is where there are enclosures which permit the different lots to be kept separate. If ewe-hoggs (lambs) run with the ewes, as is done on some farms, means must be taken to prevent them from being tupped; and the best, indeed the only plan, is to sew a piece of coarse sheeting or packing-cloth, about 9 or 10 inches square, over the breech; this piece of cloth is removed when the tups are taken home from the ewes, in a month or five weeks after they have been let out.

An important operation at this season is the dressing of the sheep for the winter. Formerly, in most cases, with the exception of the wethers, the flock was "smeared" with a composition of tar and grease-butter; and sheep so dressed were called "laid" sheep. Of late years "pouring" was practised in different parts in lieu of smearing; and later still, dipping has taken the place of both smearing and pouring. Another mode of preserving sheep during winter is by "bratting," which, however, is chiefly confined to the hoggs.

On high mountain-grazings "smearing" or "salving" has been found useful as a defence against wet and cold. It also destroys vermin, and prevents and cures scabs. Smearing, however, is not practised so extensively now as formerly. These operations—that is, pouring, dipping, or smearing—are usually finished before the ewes are put to the ram; but wethers may be done later.

American tar is usually employed in preparing the mixture used for smearing, except in the case of blackfaced sheep, when Archangel tar is generally preferred. It contains more turpentine than American tar, and the casks marked No. 2 and 3 are best for the purpose. Some years ago large supplies of grease-butter were obtained from the Orkney Islands; but owing to the improvement which has been made in the manufacture of butter in that part of Scotland, that source of supply no longer exists. The grease-butter now used is inferior Irish and American, and supplies are also obtained from Siberia and Australia.

In describing the proportions of tar and butter used, it is generally stated that 8 to 10 *pints* of tar are mixed with 24 lb. or 30 lb. of butter; but it must be observed that the pint so mentioned is the Scots pint, which is equal to 2 quarts imperial measure. A measured quantity of tar is poured into a tub, which has been constructed by cutting an empty tar-barrel across the middle, and then putting an iron hoop round the outside of the upper edge of the tub. A proportionate quantity of butter is put into an iron pot, and slowly melted on the fire. When quite melted the butter is poured upon the tar, keeping back the salt which lies at the bottom of the pot, and both are thoroughly incorporated by stirring the mixture for a considerable time with a stick. One quart of Gallipoli oil stirred into the mixture improves it. About 10 "pints" of tar and 30 lb. of butter will smear 25 to 30 sheep, according to their size. Several tubfuls of smearing-stuff should be made up at once, to save time afterwards.

In smearing a sheep the shepherd sits on the same stool as that we described in a former page as being used when sheep are "poured," and he makes the "sheds" in the wool in the same manner, but closer—that is, not more than two inches apart. The tub of smearing-stuff is set on his right hand, and he takes up some of it on the forefingers, and commencing at the lower part of the shed applies it to the skin, drawing it upwards towards himself. None of the stuff should be smeared over the wood. The cost of smearing is from 9d. to 10d. per head.

Pouring is, as we have said, not so much practised as it was some years ago, having been superseded by dipping; but where scab exists, dipping is not so effective as pouring.

Olive, Gallipoli, and castor oils are each used in the preparation of mixtures for pouring and dipping; and these, and also other vegetable oils, increase the growth of wool, and improve its quality. One gallon of either of these oils, when applied alone, is sufficient for 16 sheep. Where the sheep are much affected with vermin, it has been recommended to add 1 lb. of arsenic for 100 sheep; but we confess we dislike arsenic as an application to sheep, nor do we believe it is necessary, as sheep dressed properly with Gallipoli, olive, or castor oil, have remained perfectly free from vermin.

Mr Robert Laidlaw gives the following directions for preparing a pouring mixture, which he has found, during a number of years, admirably adapted for sheep on high-lying grounds:[1] 30 lb. of grease-butter; 14 lb. of rough turpentine; 3 lb. of soft-soap; 2 lb. of soda; 6 bottles [1 gallon] of spirit of tar; 45 to 50 bottles of water [say 8 gallons]. This is sufficient for 100 sheep. In preparing this mixture, take 10 bottles, equal to 1⅝ gallon of water, and put it into a pot with the soft-soap, turpentine, and soda, dissolving them well by boiling and stirring; add a similar quantity of water to cool it, and put in the spirits of tar. Dissolve the butter in a separate pot, then mix both together, and strain them through a sieve; after which add the rest of the water, and keep the whole in a milk-warm state, pouring it on with tin cans made for the purpose.

The following mixture is also recommended by Mr Laidlaw as a pouring for scab: Hellebore, 7½ lb.; tobacco-paper, 12½ lb. [or 8 lb. of tobacco-juice]; soda, 3 lb.; corrosive sublimate, 1 ounce; spirit of tar, 1½ gallon. This is sufficient for 100 sheep. Take 4 or 5 gallons of water, and put it into a pot along with the hellebore, tobacco-paper (or juice), soda, and corrosive sublimate, and boil them till all is dissolved; then take the pot off the fire and add the spirits of tar, and 10 or 12 gallons more water, stirring it well, so that it may be properly mixed. When the hellebore, &c., is boiling, keep stirring it till all is dissolved, and have a little cold water at hand to pour in, as the mixture is liable to boil over. Some extensive flock-masters, when using the ordinary dips, such as Bigg's or Girdwood's, add 1¼ gallon

[1] Transactions of the Highland and Agricultural Society, 1870.

of castor-oil for every 20 sheep, and find the weight of the wool much increased thereby, owing to the oil promoting the growth.

Either of the foregoing pouring mixtures will answer for dipping; but the following is Mr Hope Vere's recipe for a mixture sufficient for 120 hoggs:[1] Hellebore, 6 lb.; tobacco-juice, 6 lb.; soft-soap, 3 lb.; whale-oil, 5 gallons; pine-oil, 3 gallons; soda, 3 lb. The boiler used in preparing this mixture should contain at least 60 gallons. Fill it with cold soft water, and bring the water gradually to a boil, putting in the ingredients, with the exception of the oils, and stirring with a long stick so as to mix well. When thoroughly mixed add the oils: have a pail or two of cold water at hand if there is not a cold-water tap over the boiler, as when the oils are added the mixture may boil over, and the application of cold water prevents this. When the mixture becomes of a creamy colour it is then time to use it, and it should be served out into the dipping-tank, adding cold water till it is of the requisite coolness. Each sheep should be immersed with the head out for one minute, to let the oils thoroughly into the wool; then let the sheep walk up the incline to the dripping-tank.

"Bratting" is another mode of preserving sheep from the effects of the weather. This consists in covering the back and ribs of the animal with a jacket or "sheet" made of coarse woollen cloth or sacking, which should be dipped in coal-tar early in the summer previous to being used. For hoggs the pieces are cut 27 inches in length and 24 inches in width; while for old sheep the width is 27 inches, and the length corresponding to the length of the largest sheep in the flock. A strap made of some soft material is sewed to one of the front corners to pass beneath the throat, and sewed to the other corner after it is put on; other straps pass under the sheep immediately behind the elbow, across the middle of the belly, and one at the flank. The hinder part of the brat is sewed to the wool of the breech to keep it tight. Previous to bratting the sheep, they must be dipped to kill vermin. The brats are put on about the beginning of November, and are taken off at the end of March, or later if the weather is unfavourable. With ordinary care, a

[1] Sheep-Farming. By C. E. Hope Vere. 1864.

woollen brat will last five years. Mr M'Turk says of bratting, that "it is alike calculated to preserve the flock in higher condition, and the wool from deterioration; and also to afford the means of bringing some of the more reduced of the eild [barren] ewes through the winter, which could not otherwise have survived in a high and exposed district." [1] It has been found that mortality is much lessened by the use of brats.

At Christmas, the rams are brought home from the ewes, and, if possible, should have turnips and hay given them in an enclosed grass-field, or they may be partially folded upon turnips. In case there are no turnips, the rams should get artificial food, and the most suitable kind is oilcake, with about a third of crushed oats or crushed peas. The cake will keep their bowels in good order, and act as a preventive against inflammatory disease.

The winter management of hoggs is a point of considerable importance. Where circumstances admit, it is an excellent plan to turn the ewe-lambs back to the ewes about a fortnight or three weeks after the lambs have been weaned, and to allow them to run with the ewes through the winter. Although the ewes are dry, the lambs, after being returned to them, soon find their mothers, and keep with them. The ewes train the lambs to seek for food and shelter, and this system evidently conduces to preserve the health of the young stock, as there are fewer deaths than usually take place when the lambs are wintered by themselves, and in a separate "hirsel" or flock. It is necessary, of course, as we have already mentioned, that means be taken to prevent the hoggs from being tupped when the rams are sent to the ewes; and this may be done in the manner already described, or by making a temporary separation of the ewes and ewe-hoggs. The small or "shot" ewe-lambs are frequently sold at weaning; but if there are turnips to give them, it is sometimes advisable to carry them on with the help of some turnips, or, lacking turnips, by means of oilcake and other artificial food, in order to make up for the mortality which may be expected to occur amongst the hoggs during winter, such being usually reckoned at about 10 per cent. When the small lambs are sold, the flock must be kept up by pur-

[1] Transactions of the Highland and Agricultural Society, 1845.

chasing ewe-hoggs at the fairs held for the sale of that class of stock early in summer. Under any circumstances, it is desirable to throw in some fresh blood into the ewe-flock, by occasional purchases of ewe-hoggs, taking care that they have been bred on a suitable description of land. This is irrespective of the change of blood through the medium of fresh rams, of which a certain number are purchased every year.

Wether-hoggs are more difficult to rear than ewe-hoggs, being apparently weaker in the constitution; consequently, the losses in this class may be calculated as amounting to 20 per cent, or even 25 per cent. The mortality from braxy has sometimes been as much as 50 to 60 per cent on Highland farms. After being dipped, poured, or smeared, as the case may be, the wether-hoggs are driven about the 1st of November to the low country, often a long journey, where they are wintered on turnips with an outrun on grass; and in some cases they are wintered on sheltered grazings. They return home about the beginning of April, and are put amongst the wether "hirsel," where they continue until they are three years old. Some farmers draft out the smallest of their shearling or "dinmont" wethers next autumn, and fatten them on turnips in the low country, or on the turnips grown on the arable land, when there is a sufficient extent of land of that description in connection with the hill-farm. Wintering from home is expensive when turnips have to be taken for the purpose; hence many hill-farmers have endeavoured to rent a Lowland arable farm, on which they winter their hoggs, and, in some instances, fatten their old wethers.

During the winter, the flock on the hill-farm requires to be closely looked after, particularly during stormy weather. It is at such times that a skilful and conscientious shepherd is invaluable. But, no matter how attentive a man may be, losses will occur during winter from sheep being drowned or snowed over, and from being blown over rocks; in fact, on extensive hill-pastures which are much exposed, a number of losses occur for which no man can account, as no remains of the dead animals are ever found.

The lambing season on hill-farms begins about the 20th April, and although the same close attention to each case cannot be given as on low-lying farms, yet the shepherd must be constantly among the ewes, provided with a bottleful of new milk, to help weak lambs, and a little whisky for the same purpose. If possible, there should be a sheltered enclosure as a lambing-park for such ewes as require special attention; and it would be as well if a shed divided into small pens is erected, in case of having to put a twin lamb to a ewe which has her own, and also for other purposes. The tup-lambs are castrated about the end of June, or even a fortnight later in the case of blackfaced sheep.

The most low-lying and best-sheltered grounds, especially when facing the sun, are best adapted for ewe "hirsels," the higher grounds being reserved for wethers. Ewes and wethers do not thrive well when pastured together.

Shearing begins about the middle of June, commencing with the hoggs, then the wethers, and last of all the ewes, which are not shorn until about the 12th of July. Previous to being shorn, the sheep are washed, which is usually done by swimming once or twice, or oftener if necessary, through a pool in a river. Blackfaced sheep are frequently shorn without being washed.

After washing, the sheep are kept upon a clean pasture for a few days, and then gathered for clipping, the shepherds on such occasions being assisted by those from neighbouring farms, the system being one of mutual help. When shorn, the sheep are branded with the flock-mark; and some wash the sheep after clipping, by swimming them through the pool, which has been found conducive to their health. Whether this is done or not, it is advisable to dip both ewes and lambs, after the former have been clipped, to kill vermin, which otherwise would pass from the bare sheep to the lambs. The appearance of a shorn sheep being very different from what it was before the fleece was removed, some of the lambs will sometimes fail to recognise their mothers, and the shepherd's attention must be directed to this point, as from carelessness in "mothering" the lambs, we have often known lambs to be weaned at the time their dams were shorn.

The weaning time on mountain-farms is from the 10th to the 20th of August, according to circumstances. The lambs should be removed to some good clean pasture out of hearing of the ewes; and after they are weaned—that is, in about a fortnight—the ewe-lambs may be returned to their mothers, as already described, while the wether-lambs are put on good grassy pasture, until they leave for their winter quarters. Some of the ewes will require to be milked once, at least, after their lambs have been removed.

September is the time for drafting those ewes and wethers which are to be sold. Cheviot ewes are drafted at four, and sometimes at five, years old; and blackfaced ewes at five. Younger ewes will also be drafted at the same time, if there is anything amiss with them. Wethers, both Cheviot and blackfaced, are drafted at three years old. Ewes and wethers having received when lambs a distinctive ear-mark, which varies each year, those which are to be drafted are easily picked out from amongst the others.

The draft ewes and wethers in the North and West Highlands are chiefly sold at the great sheep and wool fairs held at Inverness and Fort William about the middle of July. These fairs are largely attended by purchasers from the south of Scotland and from England; and the great peculiarity of those meetings is, that there is not a single sheep nor a single fleece shown on the ground. The character of each flock is quite well known, so that even strangers find no difficulty in obtaining whatever information they may require. In fact, no flock-master dare sell his stock under a false character, as it would tell against him afterwards. Buyers meet sellers on the streets and in the hotels, and arrange their business solely upon character. It is a point of honour that the buyer who got the draft ewes or draft wethers of a certain flock one year will have the preference next year, and thus regular purchasers often deal with the same men for many years. Although Inverness fair has been established for about sixty years, no lawsuit of any consequence has ever arisen out of the sales conducted on this system. It cannot be said, however, that the system is a commendable one. If a flock-master does not sell at Inverness or Fort William, he consigns his draft sheep to a salesman to be sold at the trysts held at Falkirk in September and October, or at Doune in the early part of November; or he goes to those fairs and conducts the sales himself. The buyer at Inverness sends his confidential man, with a sufficient number of drovers, to the farm, the drafts of which he has bought, early in September, or later in the month, as the case may be, when the "shots" or "culls" are taken out, and the rest of the drafts paid for and delivered. The sheep were formerly travelled to the south, a journey extending from three to five weeks, according to the distance, but now they are only travelled to the nearest railway station, and sent in trucks to their destination. Wool is less sold now at Inverness and Fort William than was formerly the case, being for the most part consigned direct to agents in Glasgow, Edinburgh, and Leith.

Before closing this section, we may remark that much mischief is occasionally done by shepherds using their dogs too freely among sheep. The collie is an invaluable and indispensable companion of the shepherd on mountain-farms; but if the shepherd is lazy, he too often makes his dog do what he ought to do himself. When this occurs in the case of ewes in lamb the consequences are often very serious, as abortion is almost certain to follow over-driving with dogs; and, in any case, the dog should only be used when his services are absolutely necessary, and then as gently as possible. We have seen even blackfaced wethers, which can stand a great deal of rough usage, very much abused in consequence of having been rashly hunted with dogs whilst gathering them.

The author—"A Scottish Tenant Farmer"—of the tract 'On the Management of Farm Stock in Health and Disease,'[1] says, with reference to his experience in the management of sheep, that "whatever has been the season, whether stormy or favourable, the percentage of our deaths has for many years steadily decreased, although the number of sheep kept has increased. We have very few deaths; and the strength and value of the stock have risen annually. This experience extends over upwards of 1600 sheep of different kinds, hill-stock and home-farm in grass parks. The points to be stringent upon are: 1st, Surface-draining of all stagnant bogs; 2d, The application of lime to the soil; 3d, The administration of salt to all weakly animals, and the providing of lambing-houses to shelter sheep; 4th, The teaching of all sheep to eat hay, corn, and turnips in time of storms; 5th, Very careful selection of the best breeding-stock; 6th,

[1] William Blackwood & Sons. 1866.

Careful herds, and quiet gentle handling; 7th, Frequent change of pasture. These seven points, carefully attended to, will secure the farmer from the heavy losses so often deplored in sheep-farming."

Now that we have so great a variety of artificial feeding-stuffs at command, it is desirable, we think, that some of these should be more used for sheep on hill-farms than is usually done. There are occasions when artificial food would be eminently serviceable—as, for instance, in the case of lambing ewes when the season is late, stormy, or otherwise unfavourable. We know it would be impossible to employ artificial food on hill-farms to the same extent that it can be done on low-lying farms; but, as we have said, there are times when such food may be used with advantage, and there is no doubt it will come to be used much more than it has been. We can remember when it was considered absurd, in some sheep-farming districts, to winter hoggs on turnips; but that idea has been given up: and in like manner an extended use of artificial feeding-stuffs will become more favourably looked upon when it is found that it tends to lessen the mortality among certain kinds of sheep, and to increase their value, and the value of their fleeces.

It will have been observed that sheep are described by different names, according to their age. Thus, a lamb retains that name until the first autumn after birth, when it becomes a ewe-hogg, a wether-hogg, or tup-hogg, as the case may be; the term hogget being used in several districts. In England, tegg is frequently used instead of hogg. After the hogg has been shorn it becomes a shearling-ewe, or a gimmer, or, as in some parts of England, a theave; the wether-hogg becomes a shearling-wether, or a shear-hogg, and in Scotland a dinmont; the ram being also a shearling, or one-shear ram, which becomes changed to a two-shear, and next to a three-shear tup, according to age. In some parts of England a ewe with her first lamb is called a four-tooth ewe, next year a six-toothed ewe, and then a full-mouthed ewe.

The manner in which sheep are fed has a considerable influence on the appearance of the teeth. When wintered on turnips which have not been properly sliced, some of the teeth will be broken: good feeding furthers dentition, whilst poor feeding retards it. The teeth of sheep which are pastured upon ground containing much sand will show a worn appearance, especially in aged ewes.

The following is Professor Simond's account of the dentition of sheep as a guide to their age:—

1. Early Dentition.

1 year: Central pair of temporary incissors replaced by permanent.

1 year and 6 months: Second pair of temporary incissors replaced as above.

2 years and 3 months: Third pair, ditto.

3 years: Fourth pair, ditto.

2. Late Dentition.

1 year and 3 months: Two permanent incissors.

2 years: Four ditto.

3 years: Six ditto.

3 years and 9 months: Eight ditto.

CHAPTER XI.

FARM-HORSES.

The breeding, rearing, and general management of farm-horses is a most important part of the business of a farmer—as the working of his farm depends, in a great measure, on the state of his stud, and a considerable part of his capital is necessarily invested in this item alone. If the class of animals kept by him is not of the proper description, or if the system of management is not such as to maintain them in proper working condition, he must suffer loss in a greater or less degree. Then farmers may occasionally increase their receipts by breeding and rearing horses suitable for city work, for which there is always an active demand at good prices. But although these are undeniable facts, there are many persons engaged in the cultivation of the land who apparently do not attach sufficient importance to these points; and this is the case whether we look at the weak, badly-bred, and half-starved animals which are to be seen tugging and wriggling at a plough which barely turns the soil—or, as may be seen in many parts of England, long teams of stately horses marching slowly along and dragging an implement which is seldom allowed to penetrate above a few inches into the soil. In both cases there is a waste of labour and capital, which tends in no small degree to lessen the farmer's profits.

SECTION I.—BREEDS.

There are certain distinct breeds which are classed as agricultural horses; but it is also the case that the farm-horses in several parts of the country are of a mixed character.

The distinct breeds are the Clydesdale, the Shire, and the Suffolk Punch.

The Clydesdale Breed.—This breed belongs chiefly to the south-western parts of Scotland—Lanarkshire, Ayrshire, Dumbartonshire, &c. The breed, or crosses of it, also exists generally throughout all parts of Scotland—that is, wherever arable farming is carried on. Large prices have been obtained of late years for Clydesdale stallions for exportation to California and other parts of North America, and to Australia, &c. Home-breeders have also given prices for Clydesdale stallions which, but a few years ago, would have been considered fabulous. As an example of this, we may mention the Clydesdale stallion Prince of Wales, which was purchased by the late Mr Lawrence Drew for £1500.

The Clydesdales are an active description of horse, which step out freely, and have a long stride peculiar to the breed. They are usually good-tempered, steady pullers, and easily kept in fair working condition. Owing to the demand for a heavy class of horse suited for dray-work, the size of the Clydesdale has been increased of late years, and with this object the late Mr Drew and others systematically infused English blood into the Scotch strains. Horses of this mixed breeding, however, are not admitted into the Clydesdale 'Stud Book,' which is published annually by an influential society. In the eastern and north-eastern parts of Scotland the farm-horses are not so heavy as the Clydesdale of the present day, but they are clean-legged, and very smart horses, and those who are accustomed to them prefer them to the heavier Clydesdale. These horses have, of course, a large share of Clydesdale blood, but they also inherit that of some other strain—probably, at least in some districts, that of the Cleveland. The Clydesdale horse is 16 hands high on an average, and the prevailing colours are bay or brown; at the same time neither grey nor black is unusual.

The Shire Breed.—The improved Shire horse of to-day is the direct descendant of the old English breed of draught horses, which can be traced back for several hundred years.

William Stephanides, a monk of Canterbury, who wrote during the reign of Henry II. (1154), says: "Without one of the London city gates is a certain Smoothfield [Smithfield]. Every Friday there is a brave sight of gallant horses to be sold—nags, trotting horses; . . . also cart horses fit for the dray, or the plough, or the chariot." In the reign of Henry VIII. great attention was given to the breeding of improved draught and chariot horses in England, and in 1541 a law was passed with the view of preventing the use of stallions under 15 hands high. Mr Walter Gilbey states that "this statute no doubt served to build up what has since come to be called the breed of the *Shire* horse. It must be borne in mind," he says, "that much of this original desire to obtain a breed of stout and powerful horses, arose out of the demand for horses for purposes of war, to carry the Cavaliers in heavy armour for tournaments, &c., and for the various pageants which formed part of all grand State solemnities, as well as for cavalry and military purposes generally. . . . A century ago the Shire breed was widely spread throughout England. The animal was indeed at that time found in numbers distributed through the district between the Humber and the Cam, occupying the rich fen-lands of Lincolnshire and Cambridgeshire, and extending westwards through the counties of Huntingdon, Northampton, Leicester, Nottingham, Derby, Warwick, and Stafford, to the Severn. While extensively bred in these districts of rich pastures, the breed was not, however, limited to the counties just named. It was to be found both northward and southward, retaining its typical character, varying only but slightly with the soil and climate and food." In recent years the Shire breed has been greatly improved. They retain their position as the largest existing variety of draught horses, and they have been quickened in movement, improved in legs and pasterns, so that they are now much enhanced in value at home, and keenly sought after in foreign countries.

The Suffolk Punch.—The native country of this breed, like the Clydesdale, is intimated by its name. The prevailing colours are chestnut and sorrel. The breed has been much improved, and the display of Suffolk Punches at some of the shows of the Royal Agricultural Society of England forms one of the most striking features in those exhibitions. For ordinary farm work, especially in tillage operations, the Suffolk horses are much liked, as they are active and hardy, while they are capital feeders. Their legs are devoid of long hair, the bone rather round; and in the hard streets, under heavy loads, they do not wear so well as the improved Shires and Clydesdales, whose clean flat bone and free sloping pasterns are of great value in towns. Using Suffolk stallions with mares of other varieties of farm-horses, has been found to produce a very useful description of animals for ordinary farm purposes.

Hunters, and horses suitable for the army, although not, strictly speaking, farm-horses, are bred by farmers in certain parts of the kingdom. The sires used for this purpose must be thorough-bred, speed and endurance being essential qualifications. Breeding horses of this kind has rather declined of late years, but active efforts are being put forth to revive it. There is no doubt this has arisen from the greater attention which has been given to breeding cattle on the pastures where young horses were formerly reared; and the inferior character of many of the animals which are now bred, and with which horse-fairs in England and Ireland are crowded, has been caused by the unsound and unsuitable class of sires and also of mares used for breeding.

SECTION II.—BREEDING.

The first point to be attended to in breeding any class of horses is, the proper selection of the stallions and mares; but although great care and judgment are absolutely essential in this respect, yet we frequently find that practically little attention is paid to it. Where a distinct breed is adhered to, the stallion which is most convenient, or which can be procured on the lowest terms, is usually preferred—whilst the mare may possess a combination of serious imperfections without being considered unfit for breeding; in fact, the mare is often put to breed because she has become unfit for any other purpose. In other cases, where it is intended to breed a light class of horse for saddle or harness work, mares are sent to some washy weed, the broken-down refuse of some racing stable, but possessing a pedigree that looks well on paper. It is totally impossible, in either case, to breed good sound animals useful for any purpose. Any stallion or mare, no matter how well bred, that has contracted feet-founder, sand-cracks, thrush, ring-bone, side-bone, bone-spavin or bog-spavin, curbs, disease of the eye, broken wind, roaring, and suchlike, is unfit for breeding purposes.

A draught stallion should have a sound constitution, good temper, good action, short legs, good feet, straight back, round rib, strong loins, deep chest, good ends, lengthy quarter, and plenty of bone and muscle. Some horses have good ends, but are deficient in the middle. The shoulder should be well laid, oblique, not upright, as the upright shoulder indicates slow action, and is also usually found in a dull-spirited animal.

The mare, besides being free from hereditary diseases, should neither be worn out nor too young; and in respect to her points, should have short, clean, muscular, and sinewy legs; broad, deep chest; back rather long than too short; a broad and well-rounded loin; long quarters; wide haunches; fine lively head, clear eye, and pleasing countenance; large knees, and a broad, wide hock. "It is on muscular power and nervous energy that the strength of animals depends," and not on mere weight of carcass.

Stallions or mares should not be used for breeding until they are four years old, and better still if they are a year older. A four-year-old stallion may get a few mares, but putting a mare to breed before she is matured is injurious to her. On the other hand, a mare that has been worked hard until she has become old, and fed regularly on hard food, will breed a worthless class of stock. A stallion in full vigour will serve from 60 to 80, and even a hundred mares, in a season; but stallions which travel the country will serve more mares, and get them in foal, than stallions that are kept at home and have mares sent to them—the exercise which the travelling stallions get being in their favour as sure foal-getters.

A mare goes in foal from eleven to eleven and a half months; and as it is desirable that there should be a supply of grass at the time of foaling, May is usually considered the most suitable period. Mares should be in fair condition, but not too fat, at foaling; and although they are the better of moderate work, and will work up to foaling, they should not be employed in carting, as that is apt to shake them too much. Ploughing is preferable. A saddle-mare in foal should have regular work as exercise, but not of a kind to strain her. A writer in a recently published work states that he rode a mare in foal, with hounds, until within a month of foaling, without injuring her. It may have been so, but he ought to have been ashamed to tell it, and should have been hooted out of the field.

In general, the mare does not give much trouble when foaling; but when the time approaches, she should be removed from the stall and placed in a well-littered, airy loose-box, where the foal will be secure from injury if it should happen to be dropped when no one is at hand. Warm drinks, composed of oatmeal, bran, and water, should be given to the mare for a few days after foaling; and cut grass, or boiled food, and a little oats mixed with sliced carrots, when such are available. The usual allowance of oats must be restricted for a time. The new-born foal will sometimes have difficulty in voiding its dung; and if such is the case, grease the passage, and this will give relief. The mare and foal should be turned into a sheltered paddock where there is a good bite of grass; but for some time they should be brought back to the loose-box at night, and supplied with green food, such as vetches, or Italian rye-grass, or a mess of boiled swedes mixed with bran, and a little crushed corn and chaffed hay. The great object should be to produce and keep up as heavy a flow of milk as possible at this period, as the progress of the foal depends upon this being the case. When the foal gains strength, both mare and foal may be left out all night. The mare should not be put to work for at least a month after foaling, and it is better that she and the foal should run constantly at grass for two months before she is put to work. Light steady work should be selected for her, during the performance of which, if she is working among other horses, the foal must be kept at home in the loose-box, and admitted to the mare after the yoking. A mare which is suckling a foal should have only one short yoking in the day, if it is necessary to put her to work. By-and-by the foal may accompany the mare when she is at work. A mare will take the stallion in about ten days after foaling, although sometimes she is not in heat for nearly three weeks after foaling. If served at her first heat, she is more likely to prove in foal than afterwards.

It sometimes happens that the foal has to be brought up by hand; and when such is the case, cow-milk is the best substitute. It is sometimes given warm from the cow, and at other times skimmed milk is given, after being mixed with linseed and bean-meal. The linseed should be boiled at least three hours; the bean-meal is added in a dry state. The following is a formula for preparing the daily food of a foal which is fed by hand: 12 pints of skimmed milk, 1 quart of linseed (boiled), 3 lb. of bean-meal. We understand that bringing up foals by hand, on food similar to the foregoing, is practised in Suffolk by breeders of cart-horses. The foal is removed from the mother at the end of the first fortnight.

SECTION III.—YOUNG HORSES.

Foals are weaned about the 1st of October, or sooner if foaled early; and they should not be allowed to lie out during cold, wet, or frosty nights, but should be put into a small sheltered yard having a shed attached to it. The covered shed affords shelter, whilst the yard in front should be sufficiently large to give space for that exercise which is necessary for the health and vigour of the animals. They may, however, have the run of a paddock during the day. They should be freely handled by the person who attends to them; and it is a good plan to put a plain halter upon each, the short shank of which being sometimes trodden upon, accustoms them to a check on their movements afterwards, without exciting any feeling of alarm, or any idea of resistance. They should also be occasionally tied up to the manger, which, along with a rack, is placed at the inside back wall of the shed. It is also well that they should be accustomed to have their feet lifted, and the sole gently beaten with a wooden mallet, as this will render them more easy to handle when the time comes that they must be shod. Many people never think of training a colt until they wish to put him to work; but training should be commenced at the earliest stage of the animal's existence, and if this is done in a steady, quiet, careful manner, it will prevent a vast amount of serious trouble at a later period. In the treatment of the colt, as well as of the mature animal, kindness should be the ruling principle.

Young horses are too often treated very indifferently during winter, and when kept in yards are frequently left to pick up a living out of the refuse food of other stock. When left altogether in the fields, they have to depend upon the pasture without any assistance. The result is, that the foundation is often laid of serious maladies, particularly diseases of the respiratory organs. Young horses which are poorly fed are also subject to worms, and we have seen numbers die from this cause. Starving young stock of any kind is a most unwise proceeding; and it is especially so in the case of young horses intended for draught. A few pounds of crushed oats, even 3 or 4 lb. per day, is not lost on young horses; and they should get occasionally, say once or twice a-week, a warm mash consisting of boiled roots, boiled linseed or linseed-meal, mixed with bran. Pulped food, mixed with bran, &c., is also very good. The value of linseed for young horses is not sufficiently appreciated; and if it were used more regularly than it is, we should see fewer lots of "ragged" colts about farms or in fairs. Where linseed is not obtainable, 1 lb. of crushed oilcake, mixed with crushed oats and chaffed hay or chaffed straw, should be given daily. They must at all times have free access to pure water; and rock-salt, placed in the manger, is very useful. The straw or hay given should be sweet and sound.

When young horses are put to grass for the summer, they should not be grazed along with cattle. They are apt to injure the cattle by chasing them in play, which the cattle will sometimes resent by pushing the colts with their horns. Some cattle acquire a habit of chewing cloth, hair, &c., and if an animal of this kind is put among young horses, it will speedily destroy the hair of their tails, and so injure their appearance. Those "tail-eaters," as such cattle are termed, acquire the habit from the dairywoman allowing them, when calves, to suck at and chew her apron; at least we have traced the acquirement of the habit to this cause.

Many young horses are irretrievably ruined by being put to work at too early an age, and to this may be ascribed a large proportion of the cases of unsoundness and malformations which are so frequently met with in horses. It is certainly the case, that if there is any hereditary predisposition to unsoundness in the limbs or feet, too early working tends greatly to its development, and great care should therefore be exercised on this point. We know that many do not consider it injurious to put a colt to work, say in the harrows, when the animal is about two years old; but we think it better not to do so until he is a year older, by which time there will be less risk, and he should not be put to regular heavy cart-work until he is five years old. If the colt has been properly handled from the first, it will not be difficult to lead him about and to accustom him to carry the necessary harness; and once he is used to it, he should be yoked to a log in a ploughed field, where he can be taught to draw the log along the furrow. Once he becomes used to this mode of training him to exertion, he should be yoked in the plough along with a steady old horse; and, at first, he should not be worked more than two or three hours at a time, observing that he is not worked above his strength. It is most important, in training a young horse, that the person employed to work him is a steady, quiet-tempered man, as a hot-tempered driver might ruin the animal for life. After the pressure of the spring work is over, the young horse should be turned to grass until his services are required for autumn ploughing.

Colts are sometimes castrated when they are a year old, but they "furnish" better if the operation is postponed for a year, and this is very desirable when the colt is weakly.

As it is important to know the age of the horse as shown by his teeth, we give the following statement on this point from the 'Field': "The colt is born with twelve grinders. When four front teeth have made their appearance, the colt is twelve days old; when the next four come, it is four weeks old. When the corner teeth appear, the colt is eight months, and when the latter have attained the height of the front teeth, it is one year old. In the two-year-old the kernel (the dark substance in the middle of the tooth's crown) is out of all the front teeth. In the third year the middle front teeth are being shifted; and when three years old, these are changed for the horse teeth. The next four teeth are shifted in the fourth year, and the corner teeth in the fifth. At six years old the kernel is worn out of the lower middle front teeth, and the bridle teeth have now attained their full growth. At seven years old a hook has been formed on the corner teeth of the upper jaw, the kernel of the teeth next to the middle fronts is worn out, and the bridle teeth begin to wear off. At eight years old the kernel is worn out of all the lower front teeth, and begun to decrease in the middle upper fronts. At nine years, the kernel has wholly disappeared from the upper middle front teeth, the hook in the corner teeth has increased in size, and the middle teeth lose their points. In the tenth year the kernel is worn out of those next to the middle fronts of the upper jaw; and in the eleventh year the kernel has entirely vanished from the corner teeth of the same jaw. At twelve years the crown of all the front teeth in the middle lower jaw has become triangular, and the middle teeth are much worn down. As the horse advances in age the gums shrink away from the teeth, which consequently acquire a long narrow appearance, and their kernels have become changed into a darkish point; grey hairs increase on the forehead, over the eyes, and the chin assumes the form of an angle."

The following rule for ascertaining the height which a colt will attain when full grown is also taken from the 'Field': "When the colt gets to three weeks old, or as soon as he is perfectly strengthened in his limbs, measure from the edge of the hair on the hoofs to the middle of the first joint, and for every inch it will grow to the height of a hand of 4 inches when its growth is natural. Thus, if the distance be found 16 inches, it will make a horse 16 hands high. This rule may not hold good in every case, but in nine cases out of ten it will give the ultimate height within half an inch."

SECTION IV.—GENERAL MANAGEMENT.

A correct system of management with respect to the feeding of farm-horses is a matter of great importance. There is considerable diversity in actual practice. It is well known that farm-horses are more liable to diseases of the stomach and bowels than any other class of horses, and this liability to certain diseases may be considered as distinctly attributable to their management, chiefly in respect of feeding.

The first point we shall consider is the stable accommodation for horses on a farm.

The stable should be 18 feet wide within, the length being regulated by the number of horses intended to be accommodated in it. Large horses will require that the stalls should be 6 feet wide, although narrower stalls are more frequent. The racks should be placed low down, and both front and bottom should be sparred, the bottom being raised 9 inches above the floor. The manger is placed in the corner at the end of the rack. It is usually made of wood, but we have seen the following plan adopted with very satisfactory results: "The corn-box in each stall is a cast-iron pot-shaped basin, having a wide sloping rim made of cement, which prevents the horses from spilling their corn, as some are very apt to do. Besides being a corn-box, this serves also as a water-trough,—the water being admitted by a cock, and run off by means of a brass plug in the bottom of the trough into a drain underneath. Except when the feed of corn is being eaten, the trough is always kept full of water; and the great advantage of this system is, that the horse, being at liberty to drink when he requires it, will not gorge himself with water in the same manner as those which only receive it at stated times, or irregularly, as is too often the case in farm stables."[1]

Hay-racks are frequently put above the horse's head; but that plan is objectionable, because the eyes are often injured from hay-seeds dropping into them, and also because the horse naturally gathers his food from below and not from above the head. Placing the hay-rack above the head has arisen from having a hay-loft over the stable, from whence the hay was easily put into such racks. But there should be no loft in a stable, and the space overhead should be open to the ceiling.

The floor of the stall and stable is either causewayed with small round stones set in sand, or paved with square blocks

[1] Account of Mr Barton's farm, Straffan, county Kildare, in the Irish Farmers' Gazette, vol. xvi.

of stone or bricks. Smooth flags are objectionable, as horses are apt to slip upon them, and so get strained. Concrete and asphalt are also used in flooring stables. It is essential that the drainage from the stable shall be carried away by means of a properly-built underground drain, having a sufficient fall, to the liquid-manure tank. The floor of each stall should therefore slope from the sides to the centre, where a small channel conveys the urine (when geldings are stalled) to a grating in a gutter behind the horse, the underground drain being beneath this gutter. It is necessary to give a slight fall to the channel in the stall, so that the water may flow readily away.

The "travis," or wooden partition between the stalls, must be 8 feet in length from the back wall to the hind-post of the travis; 2 feet of this length will be taken up by the manger and hay-rack. Hind-posts are made either of wood or of cast-iron. The latter is to be preferred. They are made in a rounded form, with a groove behind into which the travis-boards are set. The head-posts are in two parts, between which the boards are placed, and fastened by screw-bolts and nuts. The upper part of the travis is raised by a sweep sufficiently high to keep the horses from stretching their heads over it.

The system of keeping horses in loose-boxes, instead of tying them up in stalls, has become general in the case of saddle and harness horses; and as it is a good system, we do not see any reason why it should not be adopted in farm stables. More room would, no doubt, be required in the range of stabling, and a little more expense might be incurred in fitting up the stable; but the horses would be more comfortable, and the risk of accident would be rendered much less, were boxes substituted for stalls. Each loose-box should be 14 feet in length and 9 in width. The floor of the loose-box should incline slightly to the centre from all sides, a grating being placed at the lowest point.

In most cases the construction of farm-horse stables is most objectionable. They are generally too narrow within —16 feet, and even less, being a common width; and many appear to imagine that valuable farm-horses are sufficiently accommodated when they are housed in close dark holes, without light or proper ventilation. Both, however, are essential points. Dark stables are injurious to the eyesight of horses; and with respect to ventilation, not only should the means of properly ventilating the stables be provided in the construction of the building, but the stablemen must be carefully watched, otherwise they will find means to plug up every hole, having apparently a perfect horror of pure air. A "nice, warm, comfortable stable" is usually a perfect hotbed of disease. The fresh air should be admitted by means of gratings placed low down on the front wall, and the heated air allowed egress through ventilators placed in the ridge of the roof, and fitted with fixed louver-boards. Open ridge-tiles are useful as ventilators. If it is found that the current of cold air from the low gratings strikes the heels or legs of the horses, which is not desirable, let a board be placed with the lower edge close to the bottom of the wall inside the stable and directly opposite the grating, the board being slightly slanted so that the upper edge shall be about 8 or 9 inches from the wall. Close up each end with a triangular bit of board, and the effect of this will be to direct the current of air upwards, so that it will not strike upon the horses when standing in the stalls.

We have seen the air admitted into stables by means of an air-drain, which ran along the entire length of the stable, communicating with the open air at one or both ends, and having small gratings placed at intervals along its course. The outer openings were defended by zinc gratings to keep out vermin. The air rose upwards from the gratings, and therefore did not strike upon the horses, and after being diffused throughout the stable, became heated, and passed off by means of open ridge-tiles, or other ventilators, placed in the apex of the roof. Ventilation, we repeat, is essential to the health of the horses; and when it is found that a gush of heated air, strongly impregnated with ammonia, meets one on opening the door of a stable in the morning, it may at once be assumed that the ventilation is imperfect, and that cases of swelled legs, grease, mange, bad eyes, coughs, broken wind, and other diseases, are of frequent occurrence amongst the horses. When influenza breaks out in an ill-ventilated stable, it becomes very obstinate, and numerous cases of farcy and glanders are clearly attributable to this cause. We have therefore, in this matter, an illustration of the possibility of preventing disease by simply adopting measures for properly lighting and ventilating the place where animals are housed. Instead of doing so, however, people are content to go on losing valuable horses, or incurring heavy expenses in attempting to cure diseases, which a small outlay, and the exercise of a little common-sense, would have prevented.

The temperature of stables should be about 52° in winter, and 55° to 60° in summer.

Passing on now to the general management of farm-horses, we shall first direct attention to their treatment during the winter half-year—say, from the 1st of October till the end of May. During that period horses are allowed a full supply of oats—say 12 to 16 lb.—or of beans and oats, in the proportion of one-third of the former to two-thirds of the latter. A good mixture consists of oats, Indian corn, beans or peas, all crushed, and given in equal parts. The feed should be mixed with some chaffed hay or chaffed straw. The daily allowance is given sometimes in two feeds—one at 5 A.M., and the second at noon—a warm mash being given at night. In other cases it is divided into three feeds, and sometimes into four feeds—namely, one feed between 5 and 6 A.M.; the second feed at 11 A.M.; the third feed at 4 P.M. or 5 P.M., as the days lengthen; and the fourth at 8 P.M.

When a warm mash is given, it may consist of bran or boiled barley, or cooked swedes mixed with other materials. Some give a mash of this kind every night; others give it three times a-week. Whatever mash is given, some salt—say, three to four ounces for each horse—should be mixed with the food. When a mash is to be prepared of swedes or potatoes, which form excellent food for horses when cooked, the roots must first be well washed. Some mix the swedes and potatoes together in equal proportions; but, if possible, it is better to cook the potatoes separately, so that the water may be run off—and they may then, when cooked, be mixed with the swedes. Diseased potatoes, when firm, may be prepared for feeding horses in this way. When swedes are cooked alone, from 50 to 60 lb. of the raw bulbs will be required to put into the boiler or steaming-vat for each horse. This will give from 35 to

45 lb. of steamed food, which should be prepared in time to allow its being cooled, but not cold, before the horses return from work in the evening. About 1 lb. of chaffed hay should be mixed with the cooked food, and about 1 lb. of oilcake, ground fine, stirred in also through the mass. Linseed may also be boiled along with the roots—say ½ lb. for each horse; but when this is done, the bruised oilcake need not be added. When the horses come in from work in the evening, they may get about half the allowance of cooked food, and the remainder at 8 P.M., when they are done up for the night. Some reserve the entire quantity until the last feed for the night. Indian corn, which has been first bruised and then boiled with linseed, is excellent food, especially for fattening a horse. Of Indian corn, between 5 and 6 lb. may be given, with 1 lb. of ground linseed; the whole to be mixed with chaffed oat-straw. Professor Gamgee has stated[1] that "the mortality from colic is always high when the boiled-meat system is in vogue." It is somewhat curious, therefore, that we have found farm-horses, which were liable to constantly recurring attacks of colic when kept altogether on hard food, rendered quite free from such attacks when they got cooked food perhaps three nights in the week, and again becoming attacked with that complaint when the soft food was not given. The late Professor Dick, and other able veterinarians, have all been favourable to the use of cooked food.

A farm-horse will consume from 14 to 18 lb. of hay in the twenty-four hours; but it has been found that when it is chaffed, a less quantity is sufficient. Large greedy horses will consume much more hay than moderate feeders. In many parts of the kingdom oat-straw is the only fodder given to horses during winter, hay being reserved for spring, when their work becomes heavier. In other parts farm-horses are fed upon hay all winter. When hay is given, it is of the utmost importance that it is sweet, free from mould, and that it has not been over-heated in the stack. Hay of that kind, and also oats which have been heated in a similar manner, is most injurious to horses, as it engenders disease of the kidneys; and if there is any tendency to broken wind, it is much aggravated by heated, moulded,

[1] Veterinary Review, 1858-59.

and musty hay. The following shows the great advantage of bruised corn and cut hay for feeding purposes: "The London Omnibus Company have lately made a report which discloses some interesting information, not only to farmers, but to every owner of a horse. They use no less than 6000 horses; 3000 of this number had for their feed bruised oats, 16 lb.; cut hay, 7½ lb.; straw, 2⅛ lb.; and the other, unbruised oats, 19 lb.; uncut hay, 13 lb. The horse which was fed on the former, and consumed 26 lb. per day, could do the same work as well, and was kept in as good condition, as the one receiving 32 lb., thereby causing a saving of 6 lb. on each horse, amounting to £60 per day, or £22,300 per annum on the Company's 6000 horses."

Swedes and carrots are frequently—the latter invariably—given in a raw state, being first sliced, and form a very good article of food for the horse. Potatoes, on the other hand, are apt to cause flatulency, colic, and sometimes inflammation of the bowels, when given raw. These bad effects are entirely removed by cooking.

Of furze, whins, or gorse, as the plant is termed in different localities, we can scarcely say too much, considering it as winter food for horses. It comes into use about the 1st of November, and can be used until the middle of March at least, and during that time little hay or oats are required in addition to the prepared furze. The late Rev. W. R. Townsend, Aghada, co. Cork, states, in his 'Letters on Furze,' that, having "been for fifty years and more feeding my horses and cows on furze, I can say, from that long experience, that it is the cheapest and the best food for the autumn and winter months. I have had my horses getting neither hay nor oats, in more beautiful condition (sleek as mice) than any of my neighbours, though they had costly grooms, the horses fed with the best hay, oats, and beans, and warmly clad. Mine were perhaps not as fit for the race-course or the hunting-field; but for road, riding, carriage-work, or work of the land, they were most fit, though fed only on chopped furze and steamed swede turnips." In giving furze, it may be reckoned that so much furze given is so much hay saved, and the horses will be in better condition on furze than on the best hay. It is the young shoots that are used for feeding. These are cut with a hook, and then put through a bruising machine, which, if properly constructed, renders it very fine. Some put the furze through a common chaff-cutter, mixed with some hay or straw; but the chaff-cutter does not cut it fine enough, and there is therefore considerable waste, as the horses reject those portions which are not sufficiently cut. The quantity of bruised furze which a horse will consume in the twenty-four hours varies from 20 to 28 lb. Furze should be bruised every second or third day; when kept longer than three days it heats, if kept in quantity, and gets dry if it is kept spread out; but in the latter case it may be improved by gently watering it with a garden watering-pot. When horses are to be kept on furze, the plant should be cultivated specially for the purpose, and the crop cut each season. The cultivation is simple, and the crop may be grown on poor land. We have known land not worth more than 5s. an acre producing a sufficient quantity of furze, per acre, to save £3 or £4 worth of hay.

We have mentioned Indian corn as food for horses. Of late years this description of grain has been used extensively, partly as a substitute for oats, and partly in combination with oats and beans. Mr Church, the general manager and secretary of the London General Omnibus Company, says that oats have been discarded as food for the omnibus-horses belonging to that Company. These animals are fed entirely on Indian corn and chaffed hay, each horse receiving as its daily ration about 17 lb. of the former and 10 lb. of the latter. The maize, or Indian corn, is just broken sufficiently to enable the horses to eat it without difficulty, and they thrive on it better than they ever did upon the oats. The same result has been seen to follow the use of Indian corn when given to farm-horses.

When a horse goes "off his feeding," a light purgative will generally be serviceable, and in many cases the preparation for a purging-ball will be sufficient without medicine; that is, making him fast for 36 to 40 hours, with the exception of bran-mashes made with cold water. A little pale malt mixed with oats and chaff is very useful when a horse is naturally a delicate feeder. In a case of this kind, feed according to the rule, "little and often." The malt, besides being very nutritious in itself, renders other food with which it is given more easily digested. Grooms are much addicted to physicking horses whenever they fancy that something is wrong; but this should not be allowed without good cause, as in most cases one or two cold bran-mashes and a little malt will be all that is required. Ploughmen are not so much addicted to quacking their horses as grooms; and if any complaint is to be made of ploughmen, it is that they are rather careless about the health of their horses, unless in the case of a sharp attack which lays the horse off work.

Watering is an important point in the management of horses. The water should, if possible, be soft and pure. It should not be allowed to stand in pails in the stable overnight, as is frequently done, because water readily absorbs gases from the air, and the impure atmosphere of a close stable soon renders water unfit for drinking. It should be given fresh; but if it is cold from frost being in it, or if the horse is very tired, a little hot water should be mixed with it, in order to raise the temperature. In some places a small pipe from the boiler of the steam-engine is introduced into the water-troughs, and by this means a jet of steam can be let on at pleasure, so as to raise the temperature of the water to a proper pitch. The horse should be watered before he is fed; for if he is first fed and then watered, it will in many cases bring on a fit of colic. Besides this, when the horse is watered after being fed, the water carries off some of the food in an undigested state; hence the frequent appearance of oats growing in fields which have been manured with stable-dung. If a horse is inclined to scour, water should be sparingly given; but in other cases he may be allowed to drink as much as he pleases. It is a common practice for ploughmen, when bringing home their horses in a heated and fatigued state, to ride them through the horse-pond until the water reaches the bellies of the animals. They are then brought into the stable, and a feed of oats thrown before them; and if the men are not sharply looked after, the horses are left in that state for a time, without anything more being done. Instead of such treatment, the horses should not be allowed to wet their legs above the knees; and after the harness has been taken off, they should be carefully rubbed down and dried from the ears to the fetlocks, after which they may be fed. It frequently happens that farm-horses are kept too long at work without being fed, and after a fast of this kind they are gorged with hard dry oats on being brought into the stable. The stomach of the horse is very small compared with the size of the animal, and this shows that the horse should be fed frequently. Hearty feeding after a long fast is extremely apt to bring on indigestion, colic, and inflammation of the bowels.

Straw is the material usually employed in farm-stables as bedding, and it is occasionally used in an extravagant manner. We have known young Highland cattle to be wintered in a court on little more than the refuse bedding thrown in with the dung from the horse-stables. But straw of all kinds is now found to be useful as cattle-food, especially when chaffed and mixed with pulped roots, or as an absorbent of linseed-gruel, and also when mixed with other dry food, such as cake, crushed grain, &c. The quantity of straw allowed in cavalry stables for bedding is 8 lb. a-day; but in farm-stables much more is used, and 14 lb. is not an over-estimate for the daily allowance in such stables. The bedding should be removed in the morning, except such as may have become unfit to be used a second time, and taken to a shed outside the stable, or to a spare stall, and there shaken up and turned over twice in the course of the day. After the rotten litter and dung has been removed to the dung-pit, the stalls, &c., must be thoroughly swept out and left exposed to the air to dry. Bedding should never be stored under the mangers; it is injurious to the animal, as the ammonia rises from it and injures his eyes. It also destroys any hay or other food that may be left in the rack. A small quantity of some disinfecting powder should be scattered daily over the stones after the litter has been removed. Some horses have a habit of eating their bedding; the effect of putting old litter under him may be tried —but if this fails, a substitute must be found for the straw.

There are different articles which may be used as substitutes for straw in bedding horses, when a horse eats the litter, or when straw is scarce. Spent tan makes excellent bedding, when put on about 6 inches thick. The droppings are removed daily, but the tan is left, and will continue fit for the purpose for a month or six weeks. It should be stirred up occasionally with an iron-toothed rake, and gypsum scattered upon it. Sawdust is also very useful as bedding. Put it on about 2 or 3 inches thick, and shake a little straw over it. Rake it daily, removing the dung and all the sawdust which has become wet, putting on a litter of fresh sawdust in place of it; and once a-week clear out the stalls. As the horses' feet are apt to get packed with the sawdust, have them regularly picked out every morning, and also in the evening when the horses have been in the stall all day. Fine dry sea-sand also serves the purpose of bedding. If a little straw is spread over it, the sand will be prevented from getting into the hair. Moss litter—dry peat-earth, specially prepared for the purpose—is now extensively used as litter for horses, and by many extensive horse owners, who have employed it for some time, it is very highly spoken of. Dry bog-mould (peat-earth) is often used in Ireland as bedding in stalls and loose-boxes, and is well adapted for the purpose. The leaves of trees collected and stored in an open shed when dry—and ferns, cut, dried, and stored for the purpose—may likewise be turned to useful account as bedding.

Many farmers and farm-servants appear to imagine that it is unnecessary to groom farm-horses regularly and thoroughly. This, however, is a mistake. We have already pointed out the importance of having the horses well rubbed down and dried after coming into the stable. When they have been sufficiently rested, the curry-comb and brush should be put to use in order to clean the skin thoroughly; as by so doing, particles of perspiration and scurf, which close up the pores of the skin, are removed. Grooming is therefore conducive to the health of the animal, as well as to its mere outward appearance. Attention to this point, with which we include the drying of the horse by hard rubbing on his coming into the stable after work, will tend to prevent certain serious maladies, such as "common cold," bronchitis, and affections of the lungs, to which horses are exceedingly liable when they have been left standing undried after coming in heated and wet with perspiration and rain, or both at one and the same time. The mortality amongst farm-horses would be much reduced by more careful management.

The preceding remarks relative to watering, bedding, grooming, &c., apply to all seasons; but we shall now proceed to consider the management of farm-horses during the summer half-year.

The work of farm-horses is not usually severe during summer, and the daily allowance of oats need not exceed 7 lb., given in two feeds. When a pressure of work occurs, however, the allowance must be increased to 12 or 14 lb. per day. The universal rule in feeding horses, at all seasons, should be to keep their power rather above than below their work. In order to effect this, some horses will require more liberal feeding than others; and the quantities of food which we state are not given as formulæ which must not be altered. Mr Wilson, Edington Mains, has very justly remarked, that in feeding horses, "as in many other things, cheapness and economy are not convertible terms. The true way to economise the horse-labour on a farm is to have only good and well-fed cattle, and to get the greatest possible amount of work out of them;" and he cautions people against "alleged very cheap plans of feeding horses,"—as, when such plans "are inquired into, it is usually found that the amount and quality of the work performed by them is in fitting proportion."

Clover is best suited for horses when the plants are in flower, and vetches when the pods begin to form. Cut grass and vetches should be made up into bunches of a suitable size when cut, as by that means there is less waste than when the fodder is brought from the field to the stable in a loose state, and when the men are permitted to dig out of the load what they please. No unconsumed clover or vetches should be allowed to remain in the racks after the horses have left the stable; because, if fresh fodder is heaped on the top of the old, which is frequently done, the racks will speedily become filled with a mass of stuff which is only fit for the dunghill. Any fodder left in the racks should be removed and given to the cows or to the pigs. Towards the end of the season, when cabbages become well hearted, a cabbage or two, shred down or cut with a spade, will be much relished by a horse, and prove an agreeable change of food. Where a number of horses are kept, it is advisable to have a steady yardman, who, besides other duties, should look after such matters, give out the corn, prepare the food—when preparation is necessary—and keep the stables in a satisfactory state as to ventilation, &c.

It is customary in many parts to turn out farm-horses to grass during summer and autumn, as soon as they return from work. They are kept out all night, irrespective of the weather. When horses are regularly employed during summer—and there are few arable farms where such is not the case—they should never be turned out to gather any part of their food in the field, but kept in the stable, in stalls or in loose-boxes, after their day's work is over, carefully groomed, and fed upon green forage cut and carried to them. All that is necessary to carry out this system is a little forethought in sowing winter vetches in October, when the climate admits of this being done, and a succession of spring vetches sown from February until about the end of May. The produce of these crops, together with a portion of the artificial grasses grown in rotation, will afford a regular and abundant supply of food, and that from an extent of land which would be insufficient to keep the horses if they were pastured. There are, no doubt, cases where the pasturing of horses is admissible, such as in the case of mares with their foals, young horses, and old animals which require rest to recruit their energies; but a horse which is regularly worked is not benefited by having to pick up his food in a pasture-field after his day's work is over. There is also a risk of laying the foundation of pulmonary disease in some shape or other, from the checked perspiration which is the result of turning out horses that have been heated at work into the open field, and also from the sudden changes of temperature to which they are exposed.

When horses are kept constantly on hard food—that is, hay, oats, and beans—a bran-mash, made by pouring cold water on bran, should be given instead of oats every Saturday evening. This is regularly done in the case of cavalry horses, and it should also be practised in farm-stables, and by those who keep horses on hard food for any purpose. It tends to keep the bowels moderately loose, and, by preventing constipation, preserves the health of the animals. Work-horses which are kept idle in the stable on Sundays are liable to swollen legs, or "shot of grease"—or, as it is called, to become "stocked." A cold bran-mash given on Saturday evening will prevent this in a great measure; and as some horses are more liable to swollen legs than others, from 2 to 4 drachms of saltpetre should be dissolved in their mash. We may here remark that when farcy, grease, or cracked heels make their appearance, it is proof of negligence on the part of the attendants, and also of the bad sanitary condition of the stables, especially in farcy and glanders.

We shall now give a few illustrations of the manner in which farm-horses are fed.

The late Mr William Torr[1] was of opinion that all horses ought to be in fold-yards; not exactly in stables, but in yards, with one-third or two-sevenths of the surface covered in, and without a thoroughfare through them. He found that by the use of cut straw and tares he could make famous manure with a lot of young horses. Moreover, they were far better there than galloping about the fields. His cart-horses, in yards, supplied with cut straw and tares, did remarkably well. A good many years ago he kept his cart-horses almost entirely on sprouted barley, and with sprouted barley and oil-cake he found he could do without cut hay. The great object was to get muscle in a horse, and for that purpose sprouted barley was the best thing in the summer months, when they had not too many tares. In the winter, however, it was rather difficult to get the barley to sprout. His practice was for one boy to attend to four horses. Each boy was supplied with 8 lb. of cake per day, dissolved in five or six buckets of water, and every feed of chaff given to the horse was saturated with the mixture. The result was that the animal ate his straw with a keener relish; and colic, as it was termed —which in reality meant obstruction of the bowels—was thereby effectually prevented. In winter a few turnips were very good."

In another part of the discussion from which the foregoing statement is quoted, Mr Torr said that in consequence of his system of management he "had no sick horses—not one per cent. He knew that *one of the big blots of bad farming is the*

[1] Discussion on "Sheep *versus* Cattle," Journal of the Royal Agricultural Society of England, vol. ii., Second Series. 1866.

turning out of cart-horses on grass-lands. Not even steam cultivation or aught else can remedy the harm occasioned by this folly or mismanagement." Others who have adopted Mr Torr's system, since he made it public, have expressed themselves highly satisfied with the results.

Mr John Wilson has described the general treatment of horses in Berwickshire in the following terms: "They are usually turned to pasture so soon as the mildness of the weather and the forwardness of the pasture admit of it. While employed in carrying the crop, their fodder consists largely of tares, from whence until Martinmas (November) they are fed on hay. From this date until the 1st of March, oat and bean straw, with 8 or 10 lb. of raw swedes per horse per diem, is substituted, when, with the recurrence of harder labour, hay is given until the return of the grazing season. During three-fourths of the year they receive about 16 lb. of oats per diem, in three separate feeds. From the close of turnip-sowing until harvest, oats are either withheld or given only when a harder day's work occurs. The practice of bruising the whole of the oats given to horses, and also of chopping their hay, is now very prevalent. By giving a few pounds of chopped hay with each feed of bruised oats, and oat-straw in the racks, during the whole of the winter half-year, horses are kept in better condition, and at no more expense, than by giving them straw alone for half the period, and hay alone the other half. We are persuaded, also, that unless horses are stripped of their shoes and turned adrift altogether for a summer's run, soiling in boxes, or sheds with an open yard, is preferable to grazing. Hay and oats ought undoubtedly to constitute the staple fare of farm-horses."[1]

The following dietary has been recommended, but it is only suitable for horses that are on light work: 10 lb. of chopped straw, 10 lb. of oats, 16 lb. of turnips, per diem. The following is a still more "economical" dietary—at least it has been described as such,—but it proves the truth of what Mr Wilson has said, as mentioned above—namely, that "cheapness and economy are not convertible terms:" turnips, 16 lb.; straw, 16 lb.[2]

[1] Wilson's British Farming.

[2] Physiology at the Farm, by Seller and Stephens. W. Blackwood & Sons.

Professor Low's formula, which is as follows, is scarcely sufficient for a horse on full work. It is—chopped straw, chopped hay, bruised oats, and steamed potatoes, of each $8\frac{1}{2}$ lb. = 34 lb. of food daily. It is poor economy to underfeed farm-horses, seeing that so much depends upon them, not to mention their own high intrinsic value if they are horses of a proper description, and suitable for the work of a farm.

Mr Gilbert Murray says: "For an ordinary agricultural horse at regular work on the farm, the average allowance of food is 13 lb. per diem of crushed oats or Indian corn, 3 lb. of bran, 6 lb. of raw swedes sliced, 14 lb. of cut chaff—two-thirds hay, one-third straw,—and 10 lb. wheat-straw litter; the ground corn, bran, and chaff should be mixed together and macerated with water. It should be prepared twelve hours before being used. We find this system admirably adapted for the winter months, as on it the horses are healthy and stand their work well." [1]

An Ayrshire farmer, writing with the experience of fifty years, says: "Just now each horse gets a pailful of boiled meat consisting of the weaks or dightens of oats, swedish turnips, and a few beans with cut straw (bean or oat-straw mixed), as the first meat in the morning. Before going out to plough, half a feed of oats, about 3 lb. At twelve o'clock a feed of oats, about 6 lb. At night, when they come in from their work, another pailful as in the morning, care being taken as to the state of the horses; if warm and sweating, only half a pailful, and the rest after an interval of two hours, then a few carrots or Swedish turnips. This mode I have practised for many years, from 1st November to 1st June, with oat or bean straw, as may suit, but I prefer hay from 1st April. I have always exercised great caution in changing the food of the horses, doing it gradually. About 1st June I give them rye grass and clover, then gradually withdraw the boiled meat for a little, giving them a few boiled beans and a little bran. After the turnips are all in, I do not allow above a feed of oats per day, with plenty of rye grass and clover. About 1st October I begin to give a little boiled meat, but only once a day. I have had horses that did not agree with boiled meat so often, and

[1] Live Stock Journal Almanac. 1885.

care must be taken by those who feed them as to the state of their bowels. But when commenced with caution, not above one horse out of twenty disagreed with my mode of feeding, and they were always in good order for their work. I do not approve of letting horses go out of condition. By following the above rules, I have been very successful in my treatment of horses. During the last fourteen years I have had only one death, and that from inflammation of the bowels. The doctor's bill during all that time did not average 10s. a-year for both horses and cows."

The following are the quantities allowed for hard-wrought horses in Manchester. Six horses per week, in the stables of the Lancashire and Yorkshire Agricultural Company, are allowed—376 lb. of hay and 84 lb. of straw, cut into chaff; 336 lb. of oats, 252 lb. of Indian corn, 84 lb. of beans, 14 lb. of bran, mixed and crushed: equal to 77 lb. of hay and 114 lb. of grain per horse per week, or 11 lb. of hay and 16 lb. of grain per horse per day.

The Messrs Thomson & Kay, carriers, Manchester, give to six horses in the week the following quantities: 366 lb. of hay and 84 lb. of straw, cut into chaff; 216 lb. of oats, 426 lb. of Indian corn, 72 lb. of beans, 84 lb. of bran, mixed and crushed: equal to 75 lb. of hay and straw, and 133 lb. of grain per horse weekly; or 10 lb. of hay and straw, and 16 lb. of grain per horse daily.

The following are the quantities given out in the stables of the Scavenging Department at Manchester for six horses per week: 588 lb. of hay cut into chaff; 288 lb. of oats, 282 lb. of Indian corn, 96 lb. of beans, 84 lb. of bran, mixed and crushed: equal to 100 lb. of hay and 140 lb. of grain per horse per week; or 14 lb. of hay and 20 lb. of grain per horse daily.

The following formula for feeding horses was drawn up by an authority—a breeder of blood and half-bred stock, and some exceptionally grand cart stock: Fill racks with straw to amuse; 3½ pecks to 1½ bushel of oats, with ½ to 1 gallon beans or peas when muscle is wanting in tone, per week; a liberal supply of chaff—manger feeding, in fact. The lesser quantities apply to young stock and the higher breeds (excepting racing stock). Faint, weak, or washy light-carcased horses require a mash occasionally,—*e.g.*, 5 lb. chopped straw (steamed preferable), 4 to 6 lb. roots, $\frac{1}{2}$ gallon oats, $\frac{1}{2}$ to $\frac{3}{4}$ pint of linseed, as a mash, the whole to be incorporated. Bran mashes, with equal parts (1 oz.) sulphur and nitre, keep the system cool in the spring. A useful change: 10 lb. of carrots sliced, chaff, mix, no corn; 10 to 20 lb. hay, as occasion demands, per diem; plain linseed or bean mashes in like manner, bran ones hot or cold. Serious complications arise—*e.g.*, humour, debility, filled legs, &c., if there is any departure from nature's laws. Corn, hay, peas and beans must have a sufficient age, and be of the very best quality, for damaged stuff thickens the wind and makes the coat stare, whilst burnt hay predisposes to profuse staling and other urinary complaints. No outsides of ricks should be given to horses—it is the highway to disaster and disappointment.

CHAPTER XII.

SWINE.

SECTION I.—BREEDS.

The breeds of swine in the United Kingdom, until fifty years ago, were generally coarse, and slow in arriving at maturity. Since that time a vast improvement has been effected in this valuable class of farm live-stock, so that extremely early maturity may now be regarded as a leading characteristic of most of our breeds of swine. The first step towards improvement was the introduction of the Neapolitan and Chinese breeds of swine, with which the native breeds were crossed. Subsequent crossings and selection, judiciously carried into effect, have produced the breeds of the present day; and, except in some remote districts, the gaunt, ill-favoured, slow-feeding animals, which were formerly universal, have now entirely disappeared.

Pigs are divided into the white and black breeds; and these, again, into large, middle, and small breeds.

The large Yorkshire is the heaviest breed of swine in Great Britain. They weigh, when fat, from 600 lb. to 1000 lb. dead weight. The middle-sized Yorkshire pig is that which is, perhaps, the most useful of the Yorkshire varieties. It is produced by a cross of the small York and Cumberland breeds, and runs from 400 lb. to 500 lb. in weight. These cross so well that they have got quite intermixed, and are known as York-Cumberland or Cumberland-York, according to the mode of crossing adopted. The principle in crossing is to put a large boar to a small sow, and a large coarse sow to a boar of a smaller size.

Mr Fisher, farm manager to Mr Wainman of Carhead, Yorkshire, a well-known exhibitor of medium Yorkshire pigs, says that "in selecting pigs for breeding purposes, we prefer such as possess good size, combined with activity and a general robustness of character, and consider the following to be the most desirable points for them to possess: The forehead should be wide, and the nose moderately short; the ears thin, erect, and pointed forward. When the ears hang down over the eyes, they cannot so readily see objects that may approach, and are therefore more liable to accidents of various kinds. The under jaw should show an inclination to roundness, even when in low condition, as indicating a disposition to thrive well. The back should be slightly arched and not too long, as very long pigs are unwieldy, and have great difficulty in lying down and rising; and as mothers, they are very apt to overlay their young before they are strong enough to take care of themselves. The loins should be strong and muscular, and the hind-quarters only slightly drooping, with the tail placed well up; for if otherwise, and the legs are drawn too much under the body, there will be great difficulty in getting the sows served by the boar. The hams should be wide and well rounded, and well let down to the houghs. The flank should be placed low, and only slightly arched, and the belly deep and thick, that the flitches may cut thick in the thin parts. The legs should be straight and small in the bone, and not sink so much at the fetlocks as to throw the weight on the heels and pasterns; the feet should be fine and small, and the gait light and nimble. A good coat of long, bright, vigorous hair, of not too soft a quality, is very desirable, not only as indicating a large amount of lean meat in proportion to the fat in the carcass, of which it is the truthful index, but also as a protection from the sun in summer and the cold in winter, as well as for preventing the skin from being easily acted upon whenever subjected to a little rough usage, or when sent to market."[1]

The small Cumberland pig is larger than the small Yorkshire. The cross is a useful, medium-sized animal, possessing fair size, good quality, and symmetry.

[1] Paper on "The Breeding and Management of Pigs," read before the Newcastle-on-Tyne Farmers' Club, April 1, 1865.

Of the black breeds, the most important are the Berkshire and the Essex. The improvement of both breeds has been the result of crossing with the Neapolitan breed, or with the black Chinese pig.

The Berkshire breed has been divided into middle and small kinds. Pigs of this breed are very hardy and prolific; and, with much aptitude to fatten, have a large amount of lean flesh to the proportion of fat. The pigs run from 200 lb. to 300 lb. and 400 lb. in weight.

The improved Essex is a small breed, possessing great quality and early maturity. An Essex boar put to a coarse black sow effects great improvement in the produce. The Essex breed, however, is rather deficient in point of constitution. The Berkshire breed has derived advantage from being crossed with the Essex; and it has been remarked that "there is probably no black pig which combines more good qualities as either porker or bacon hog, than the produce of an improved Essex boar and an improved Berkshire sow."

SECTION II.—ACCOMMODATION FOR PIGS.

The usual accommodation for a pig is a small house, 4 to 6 feet square, with a paved yard of similar dimensions in front, where the animal is fed. This answers well enough in most cases; but where pig-breeding is followed as a regular pursuit, the accommodation, at least for breeding and for fattening pigs, should be of a better description.

Mr Wainman's breeding-house "is 10 feet square; the floor is flagged, and falls slightly towards the door, the lowest part being the corner behind the door, where there is a movable iron grate, with a small well below to catch the sediment, and a trapped drain leading to the manure-tank. Thorough ventilation is secured by slits in the top part of the door, and a large loop-hole in the opposite wall, 5 feet from the door, both of which can be closed or opened at pleasure. It has a glazed window, 3 feet by 2 feet, to admit the light, and a wooden sleeping-bench, 6 feet 6 inches wide, extending across the house on the side opposite the door, the object being to secure a dry, comfortable lodging, with quietude and plenty of light and fresh air. The benches are composed of wooden bars, 4 inches broad and 1¼ inch thick, nailed to similar bars placed at right angles, leaving a space of 1 inch between each bar. They are then laid down on loose sleepers, 6½ feet long and 2 inches square, placed crosswise on the floor. It has a horizontal rail 9 inches from the wall, and the same distance above the bench, to prevent the sow from lying up to the wall and crushing her young. The rails can either be fixed into the wall, or by uprights, having one end into the floor and the other end fixed to the spars of the roof, so that they can be removed when not required. A 9-inch board is placed edgewise on the front of the bench to prevent the young from straying off the bench when the sows are left to farrow by themselves. This board allows the sows to step over it when they want to feed, and is removed after the first two nights. The bench is taken up, and the dirt which accumulates underneath is cleared away every time it receives a fresh lodger, and it is lime-washed twice a-year."

The boar requires separate accommodation, and his house should have a yard 10 or 12 feet square in front. This yard should be enclosed with a stout wall, 5 feet high, the door being of the same height, and lined with sheet-iron. If the boar's sty can be so placed that he may be let out to walk about daily, without coming in contact with other pigs, it will be all the better, as he will thus be enabled to get regular exercise, which is conducive to health.

Store-pigs do well and thrive better when allowed the run of a cattle-yard, especially in summer. When confined in sties, they must be kept dry. The yards should face the south, but a covered shed facing the north is not objectionable.

In the case of fattening pigs, covered-in buildings are generally most approved of. The pens, which are constructed of stout posts and rails about 4 feet high, and sometimes of iron rails, are placed on each side of a passage 3½ or 4 feet wide. The house, while kept warm, must also be well ventilated. It is better kept dark; at the same time, it should have a window, which is opened when feeding the animals and clearing the pens. When these operations are over, the light should be excluded.

The piggeries of all kinds must be well drained, for pigs will not thrive, and will be liable to rheumatism and paralysis where the floors are cold and damp. The liquid should be conveyed by an underground drain to a tank, and each sty or pen should have a grating in it, through which the liquid passes into the underground drain. The floor should slope in all directions to the grating, and the grating should be movable, in case it is necessary to clear out the drain at that part. The floor may be made of flags, bricks, or flooring-tiles. Sparred floors, when constructed in pieces to lift, are very useful when laid upon the stone or brick floors. The planks used for this purpose are 1½ inch thick, 3 inches wide, and the space between each plank varies from 1 to 1¼ inch, according to the size of the pigs which are to be kept in the different pens. These sparred floors are also laid down permanently over an open space into which the manure drops, and from which it can be removed at any time. When sparred floors are laid down, straw as litter is unnecessary. Mr Mechi says that he has had 300 to 400 pigs at one time for several years, on open sparred floors, which allow a constant circulation of air under and around the animals, and he has found this arrangement most conducive to their health.

The troughs in ordinary sties should be placed in the front wall of the yard, and firmly secured, access from the outside being afforded by an opening, which is secured by means of a flap-board suspended from above, and of sufficient length to admit of the lower part being hooked to the front part of the trough, when it is necessary to exclude the pigs for the purpose of cleaning or of filling the trough. When this is done, the flap-board is returned to its former position and fastened by a bolt. The trough should be divided into two or more divisions, so as to allow each pig to feed by itself. There is a circular description of trough, which is suitable for standing in the middle of a yard or paddock. This trough is made either with or without a hopper, into which the food is put, and from whence it runs into the different divisions of the trough.

SECTION III.—GENERAL MANAGEMENT.

Breeding Pigs.—If the sow is of an ordinary kind, and not very highly bred, she should not be put to breed until she is twelve months old; but if she shows a disposition to get rapidly fat, she may be put to the boar when eight or nine months old. Pigs of the latter description, if allowed to be a year old before they are put to the boar, are apt to prove barren, as we have sometimes experienced to our great disappointment. When the sow is in a fit state to take the boar, she should be driven into his sty, and left there for a time. This is better than taking the boar out of his sty, as, if that is done, it is sometimes very difficult to get him into it again. The boar is fit for serving when twelve to fifteen months old.

Unless under certain circumstances, the sow should not farrow during winter, as young pigs do not thrive in cold weather. The only exception to this rule is, when pigs are to be sold to the butcher at Christmas as sucking-pigs; and in that case the sow and her young ones must be kept in a warm house. The best time to put sows to the boar is about the beginning of November, and again in May. By so doing the first litter will come in March, and the second in September; the latter having thus time to get strong enough to stand the winter. By this system, pigs littered in March and having much tendency to early maturity will, if well fed during the summer, be ready to put to the boar in November, so that they will have a litter by the time they are twelve months old.

The period of gestation is from a little over fifteen weeks to seventeen or eighteen weeks—young or weak sows farrowing sooner than old sows, or those which have a strong constitution. Some breeders do not take more than two litters from their sows, when they feed them off; others keep them until they are three or four years old, and even older; but it is not advisable to keep them after they are three years old, as their litters will become inferior to earlier litters, and the sow is injured for fattening.

When the sow is in pig she should be fairly fed, but she should not be allowed to become too fat. During summer she may have a run in a grass paddock, and in that case there should be a shed in the paddock, to which the sow may retire as she feels inclined. As the time for farrowing approaches, she may be fed more liberally; and oatmeal gruel mixed with a little bran, given in a moderately warm state, answers very well. If kept in the sty, as she will be at this time, she should be walked out quietly every day for a short time. Straw cut in 3 or 4 inch lengths is better adapted for litter at this time than long straw, and even of such the allowance should be small. The symptom of approaching parturition is when the sow begins to carry the straw in her mouth and collect it in a heap, which she will do, placing the straw in such a manner as to raise part of the body when lying down, which assists parturition. This shows that, as Mr Fisher remarks with respect to this point, "they can mostly manage their own business best without our interference." Unless a sow is very fat, she should be left to herself when she is about to farrow. Much mischief is often done by over-carefulness. The litter may range from six to twelve pigs, sometimes there are more, even above a score; but when such is the case there will be more pigs than there are teats, and the sow will be unable to rear the extra number. An ounce of Epsom salts mixed with the food given to the sow immediately after she has farrowed, will be found useful. If the sow is very fat, give a dose of castor-oil two or three times in the food before she farrows. The strength of the food must be increased by adding barley-meal, boiled barley, boiled Indian corn, pea or bean meal, boiled or steamed potatoes and roots; but the food must be given in a milk-warm state. Cow's milk may also be added to the food, and the young pigs will soon begin to learn to use the food.

We should remark that the cleansing, or after-birth, should not be removed, as is done by many persons. It is a medicine provided by nature, and it should be left for the sow to exercise her instinct upon it.

The young pigs will sometimes be attacked with diarrhœa, but instead of administering physic, change the food of the sow, adding to it a considerable proportion of bean-meal. In the case of a summer litter, looseness in the pigs will generally disappear if the mother is fed on cut vetches or other green food, or if she is turned into the paddock for a short time. Unless a change of food is required for this purpose, it is as well to keep to the same kind of food while the sow is rearing her litter.

Young boar-pigs are castrated when four or five weeks old, and young sows are sometimes spayed at the same time, when not required for breeding; the effect of spaying being to render the sows capable of being rapidly fattened. Pigs are weaned when about eight weeks old, and when the boar-pigs have not been castrated they should be separated from the sow-pigs at that time. The food of the mother should be reduced, in order to lessen the secretion of milk, and a dose of Epsom salts—2 ounces—may be given in the food. Weaning should be a gradual operation, by first removing the young pigs for a few hours each day, gradually increasing the intervals, until they are allowed to suck only once in the twenty-four hours. The young pigs must, however, be fed often, say five or six times a-day, giving a little at a time; their food consisting of milk, oatmeal gruel, boiled potatoes, barley-meal, &c.—and for some time it should be given warm. After a time the number of meals may be gradually decreased, until they are reduced to three in the twenty-four hours, and by that time the food may be given cold.

Store-Pigs.—The young animal next passes into the stage of store-pigs, and in that state they should have the run of a large yard or paddock, in order that they may have plenty of exercise. They must be ringed before they are turned into a paddock, in order to prevent them from rooting up the grass. The usual mode of ringing a pig is, by putting a piece of wire through the nose, the ends of the wire being twisted or joined together. Instead of this operation, "the cartilaginous and ligamentous prolongations by which the supplementary bone is united to the proper nasals" are cut, and as "the divided edges of the cartilage will never unite again, the snout always remains powerless."

Vetches, or cabbages, pulped roots, and in fact any succulent green food, is much relished by store-pigs, and they may be fed liberally on such food. At the same time, it is well to give them one meal a-day of Indian-meal porridge, which after being brought to the boil has been allowed to simmer gently for some hours over a slow fire. Mix this with brewers' grains, or the refuse of the kitchen, and a little pollard. A small quantity of palm-nut meal, say from 2 to 4 ounces, according to the size of the animal, is useful, mixed with other food. An abundant supply of pure water for drinking is essential for store-pigs, and in fact for all pigs which are not otherwise supplied with drink. Foul stagnant water is a certain cause of disease. A cold bath occasionally is also a great preservative of health. We have seen pigs washed by means of a hose attached to a water-pipe, where there was a good pressure, and the application was evidently much liked by the animals to which it was applied. Cottagers in England frequently reserve the soap-suds from their weekly wash for washing down their pigs. If pigs are sickly in any way, let them have access to cinders, ashes, clay, or chalk. Sir J. B. Lawes, Rothamsted, gave his pigs access to the following mixture when they became affected with large swellings in their necks, which affected their breathing: 20 lb. of finely-sifted coal-ashes, 4 lb. of common salt, and 1 lb. of superphosphate of lime. This mixture was placed in a trough; the pigs devoured it with eagerness, and the tumours entirely disappeared after a short time.

Fattening Pigs.—The first stage of the fattening pig is that of the porker; that is, when the pig is killed, it weighs from 48 to 56 lb., after being well fed from the time it was weaned. Pigs intended to be fed as porkers should be kept confined to the sty, their food varied occasionally, and given often, but not in such quantities as to cause any to be left over. Skim-milk or butter-milk mixed with barley-meal, oatmeal, or Indian meal, makes exquisite pork. The oatmeal and Indian meal should be well boiled, and then mixed with the milk; barley-meal may be mixed with the milk or with the porridge without being cooked, and oatmeal is also sometimes given in a raw state; but pigs thrive better on those meals, or on rice, when they are boiled—at least until within ten days or so of the time when the pig is to be killed, when it may be given raw, mixed with some milk: a little pea-meal or bean-meal added will assist in rendering the pork firm. Some well-boiled potatoes may be given occasionally, mixed with milk, as a change of food, or a small quantity of pulped food with which meal has been mixed. Raw, unprepared roots of any kind should not be given to porkers, or to any pig which is fattening. The food of porkers should always be given slightly warm. Porkers should be fully fat at from four to five months old.

Pigs intended for bacon are put up to fatten when from twelve to twenty months old, according to the kind; brood-sows of different ages when put off breeding also come under this class. Fattening pigs, as we have already stated, should be kept in warm, well-ventilated houses, which can be darkened at pleasure. They must also be regularly fed three times each day, and the appetite must be stimulated by varying the food, and a little sound condimental food will also be found useful for this purpose, mixed with other food; indeed the prize pigs at the leading shows have generally had more or less of such food given them.

It is of the utmost consequence in feeding pigs to avoid surfeiting them. Pigs which are purchased from jobbers, for the purpose of being put up to fatten, should be very cautiously dealt with at first. They have probably for some time been very moderately fed, and if an over-supply of food is given to them, they will gorge themselves and sicken, and not take readily to their food afterwards. In a case of this kind, it is better to begin with a sloppy description of food, and it will be no harm to clear out their bowels with a gentle dose of Epsom salts given in their food. If they are then gradually accustomed to rich food, they will go on improving. Cooked potatoes, combined with a mixture of different kinds of meal,—such as one-third barley-meal; one-third pea-meal, oatmeal, or bran; and one-third Indian meal,—makes an excellent combination of food. Cook the Indian meal thoroughly, as formerly described, and just after it has been taken off the fire, stir in the other meals, adding them gradually, so that the whole may be well mixed together. Let the mass then remain until it has cooled down to milk-heat, or it may be slightly thinned with buttermilk, which will help to cool it. There are cheap qualities of rice to be got, which, when cooked, may also be given.

As the animal approaches maturity, gradually lessen the quantity of potatoes and of pea-meal, and proportionably increase the barley-meal, rice, and Indian meal. Mr Mechi strongly advocates a mixture of one-third pea-meal and two-thirds barley-meal, and if thinned with skim-milk so much the better. In the cheese-making districts, whey is much used in feeding pigs, and is admirably adapted for the purpose when mixed with other food. Pulped roots which have been allowed to ferment for thirty-six hours, and then mixed with a third part of meal, have been employed with good effect in fattening pigs. This mode of preparing food certainly saves expense. An experienced feeder, quoted by Mr Sidney in his edition of 'Youatt on the Pig,' says that "if you want to gain weight fast, give plenty of barley-meal and milk; if you want to make most of the food consumed, give boiled vegetables and boiled meal, and finish off with raw meal. On the first plan, time is saved at the expense of food consumed. On the second plan, time is lost and the food saved." Mr Sidney states that sixteen pigs, weighing about 4 stone each, were put up, one half on carrots and bran, and the other half on mangels and bran. A ton of carrots and a cwt. of bran produced in eighteen days an increase of 90 lb.; deducting in each case one-sixth for offal, estimating the remainder at 10s. a score, or 6d. per lb., and deducting 5s. 6d., the value of the bran, one lot paid £1, 12s. a ton for carrots, and the other £1, 6s. 6d. for a ton of mangels.

Sir John Bennet Lawes, who has devoted much attention to the comparative value of the various kinds of food used in feeding pigs, has given the results of his investigations on this subject in the 'Journal of the Royal Agricultural Society of England,' vol. xiv. The food used by Sir John was —(1) equal weights of beans and lentils; (2) Indian corn; (3) bran. These foods were mixed in different proportions for twelve pens; three pigs being in each pen. Sir John ascertained that Indian corn or barley-meal, with a limited supply of bran, is good food; and that when the pigs had unlimited access to three kinds of food—namely, the highly nitrogenous mixture of beans and lentils, the non-nitrogenous Indian corn, and the moderately nitrogenous bran—they gradually discontinued the proportion of their consumption of the first, as they approached maturity, and throughout consumed only five per cent of bran. The pigs were ten months old, and the average consumption of corn by each pig per week was 60 lb., or about 9 lb. per day, which produced 10 lb. to 12 lb. of meat per week, or about 1½ lb. per day. There was a rapid decrease in the rate of consumption of food to a given weight of animal as it approached maturity. "When pigs are fed freely upon highly succulent food, such as cooked roots, the refuse of starch, herbs, and the like, they are frequently found to give a very rapid increase. But pork so fed is found to sink rapidly in the salting process, and to waste considerably when boiled. On the other hand, when pigs are fattened upon the highly nitrogenised leguminous seeds—peas being, however, much less objectionable than some others—the lean is hard, and the fat wastes in cooking. Finally, it is the interest of the farmer to use highly nitrogenous leguminous seeds, and even refuse flesh, if at command, during the earlier and growing stages of his bacon hogs. But if a constant market is to be secured for pork, barley-meal or other cereal grains must supersede everything else as fattening proceeds."

Boars.—When the boar is kept altogether for service, his food should contain a considerable proportion of nitrogenous food, such as beans, peas, and some bran, as it is necessary to keep him in a vigorous muscular state. Along with such food he will also get a proportion of cooked roots, green food, &c., and some meal. When he is no longer to be used, he should be castrated and fattened, and the pork will be found of good quality for curing.

There is considerable uncertainty in deciding the age of a pig from the appearance of its teeth, as pigs are not regular in their dentition. Professor Simonds, however, has given some particulars which assist in arriving at a near approximation of the age of a pig. Those particulars are as follows:—

At birth there are four fœtal incisors and four fœtal tusks.

At one month old, in addition to the above, there are four central temporary incisors.

At three months, eight central and lateral temporary incisors, together with the fœtal incisors and tusk.

At nine months the fœtal incisors and tusks disappear, and there are eight central and lateral temporary incisors, four corner permanent incisors, and four permanent tusks cutting.

At twelve months the middle temporary incisors fall, and their place is supplied by permanent teeth. These are of a whiter colour than those they supplant.

At eighteen months there are twelve permanent incisors and four permanent tusks.

CHAPTER XIII.

POULTRY.

Poultry are generally considered of so little importance as scarcely to be worthy of notice. But, when it is taken into account that we import nearly $2\frac{3}{4}$ millions of eggs daily, at a cost of about 3 millions sterling per annum, over and above our home production, it will at once be seen that poultry-produce forms by no means an insignificant item in the food resources of the community. Nor does this take into account the number of fowl of all kinds consumed as food. Of this, so far as our home production is concerned, we learn from the agricultural returns that in 1885 there were in

	Great Britain.	Ireland.
Turkeys, . . .	474,583	811,161
Geese, ...	885,310	2,133,609
Ducks, ...	2,201,601	2,861,530
Fowls, ...	12,401,533	7,537,433
	15,963,027	13,343,733

The value of poultry imported in 1885 was estimated at £655,238; so that, altogether, poultry and their products are by no means so inconsiderable an item as one might suppose, judging from the carelessness exhibited by many persons in the management of this class of farm live-stock.

SECTION I.—COMMON FOWL.

The term poultry includes common fowl, turkeys, geese, and ducks, and we shall describe each class in separate sections.

Dorking Fowl.—The Dorking breed is either of a grey or speckled colour, or white, and minute shades of difference are laid down by those writers who have described the points of exhibition fowl. It is not necessary that we should enter into details of that nature. We may, however, state that the leading points of a good Dorking are: "Great compactness, with great depth and length of the body; low on the leg; head free from coarseness; comb, whether rose, single, or cupped, to be perfect of its kind, and uniform in the hen; legs white, with a pale pink hue between the scales, the fifth toe being well developed apart from the others."

This breed is the best description of fowl for the table, being plump, white-fleshed birds. They require a good range, and the chickens are difficult to rear, more especially on cold, damp soils. Their eggs are large and well-flavoured, but Dorkings are not such abundant layers as some other breeds. The average weight of the egg is stated to be $2\frac{3}{4}$ ounces. The adult male bird should not weigh less than 8 lb., and the adult female not less than 7 lb.; these weights being much exceeded when the birds are well bred, and have been well fed.

Cochins, Brahmas.—These names denote Asiatic fowls. The colours of the Cochins are buff, lemon, cinnamon—dark and light—partridge, grouse, and white; and of the Brahmas, black and grey. These breeds are very hardy, and thrive well when confined to a limited space; the hens are good sitters and good mothers, and the Brahmas are fairly good layers. The pullets are good birds for the table; but male birds are deficient in flesh on the breast, and the skin and fat of the bird generally are apt to be yellow. The feathers are valuable, being very abundant and of good quality. The eggs are buff-coloured, and average each $2\frac{1}{4}$ ounces. The adult cock should not be under 9 lb. in weight, nor the hen below 7 lb. The Brahma is improved as a table bird by crossing it with the Dorking.

Spanish.—There are four varieties of this breed of fowl—namely, the white-faced Black, the White Minorca, the Black Minorca, and the Blue or Andalusian. The Spanish are tall, white-faced fowl; do well in confined spaces; are abundant layers of very large eggs, but are bad sitters and mothers. The eggs should therefore be put under a Dorking hen, or some other good sitting bird. The chickens are hardy, and the breed generally well suited for table use, the only objection being their dark legs, which do not look well at table. The eggs average in weight $2\frac{1}{2}$ ounces; and the weight of the adult cock should not be under $5\frac{1}{2}$ lb., nor that of the hen under $4\frac{1}{2}$ lb. There are also the Leghorns, which are splendid layers, and are members of the Spanish family.

Game Fowl.—This is an elegant breed, of various colours and markings; hardy, fair layers, good sitters and mothers; require a wide range. Their flavour as table fowls is very superior. The great drawback in game fowl is their pugnacious disposition. The eggs are of a fawn colour, have a delicious flavour, and weigh on an average $2\frac{1}{4}$ ounces. The adult cock weighs about 4 lb. 10 ounces, and the hen 4 lb.

Hamburgs.—Of this breed there are the Gold-pencilled and the Silver-pencilled varieties; also the Golden-spangled, the Silver-spangled, and the Black, which is a larger variety than the others. The Hamburgs are handsome fowl; fair birds for table use; abundant layers, but they seldom sit, and are not good mothers. They do not thrive in confinement, and must have a large run. The chickens are difficult to rear. The eggs are white, and weigh from $1\frac{1}{2}$ to $1\frac{3}{4}$ ounce. A Hamburg cock weighs about $4\frac{1}{2}$ lb., and a hen about $3\frac{1}{2}$ lb.

Polands.—This breed is distinguished by large top-knots. They are fair layers; do not sit. The chickens are very delicate, and fowls of this breed generally are very easily injured by wet or cold. The eggs average 2 ounces to $2\frac{1}{2}$ ounces in weight, and the shell is white in colour. The adult cock weighs 5 lb., and the hen 4 lb.

Malays.—This is a large breed, varying in the colour of the plumage, being red, chestnut, rich brown, and also black or white. The Malay is a leggy, and not a handsome, description of fowl. Their eggs weigh about $2\frac{1}{2}$ ounces, and the shell is of a pale-chocolate colour. The adult cock should weigh at least 8 lb., and the hen 7 lb.

The Houdan.—This is a French breed. The plumage is speckled, being irregularly composed of black and white feathers—sometimes black spotted with white at the extremities, in other cases white spotted with black. The head is adorned with a small tuft, and the beak has a peculiar appearance, which makes it look like a nose. The toes are five in number, three before, and two behind, the latter being one above the other. The Houdan is a very superior fowl for the table, and it fattens rapidly. The hens are abundant layers, but bad sitters. The eggs are beautifully white, and of considerable size. The cock weighs from 6½ to 7 lb., the hen being nearly as bulky as the cock.

The Crêve Cœur.—This is another breed which has also been introduced into Great Britain from France, where it is much esteemed for its great aptitude to fatten, delicacy of flesh, and weight at an early age. The Crêve Cœur is also an excellent layer, and the eggs are large and well flavoured, but the hens are bad sitters. The birds thrive well in a confined space, and are remarkably tame. The head of the Crêve Cœur is unique, as it is decorated with a comb, which forms a pair of horns; and both males and females have dense cravats of feathers, which, with their horned heads, impart a peculiar appearance. An adult cock of this breed should weigh 7 lb., and pullets of six months have been fattened to weigh from 7 to 8½ lb.

The La Flèche.—This is a tall breed of French poultry, which is supposed to have originated in crossing the Spanish breed with the Crêve Cœur. The plumage is entirely black —but having brilliant green and violet reflection—with the exception of some feathers on the head, which are white. The comb is like that of the Crêve Cœur, divided into two short conical horns, and there is a small double prominence just over the base of the bill, in the side of which the nostrils are placed. Fowls of this breed fatten very easily; the skin is white and transparent, the flesh rich and delicate; the eggs remarkably large, good, and abundant, but the hens do not sit.

Amongst the other important varieties of poultry, we may recommend the *Langshan*, a grand black-plumaged bird of Asiatic origin, a good layer, and a splendid table-fowl; and the *Plymouth Rock*, a bird of Asiatic shape, but with speckled plumage and yellow legs, and a very useful all-round fowl.

There are other breeds of fowl, but those we have noticed are the most useful.

SECTION II.—MANAGEMENT OF FOWL.

The Poultry-House.—This should face the sun, and its size must be regulated by the stock kept. Sitting-hens should have a house to themselves. The house should be warm, but well ventilated, and thoroughly dry—want of proper ventilation, and cold damp houses, being fruitful causes of disease among fowls. An earthen floor, rammed hard, is better than a brick, a stone, or a wooden floor, and it should be strewn with fine sand when it has been swept. A perch may be constructed by inserting a rounded piece of wood, 2 inches in diameter, into the wall on each side, about 18 inches from the ground, the perch thus stretching from one side of the house to the other; or it may be made in the form of a broad ladder, the perches or rungs being 1½ inch in diameter, and 1 foot apart. The ladder-roost may be 3 or 4 feet wide, and set in a slightly sloping direction against the wall. High perches are most objectionable. Nests are constructed of wooden boxes open at the top, and partly in front, and are lined with soft hay or cut straw, which should be frequently renewed when merely used for laying. The house should be whitewashed twice a-year; and by putting some carbolic acid among the whitewash, at the rate of 1 gallon of carbolic acid to 10 gallons of whitewash, vermin will be destroyed. The house should be swept daily, and the floor slightly sprinkled with a solution of carbolic acid, say 1 gallon of acid to 50 of water, which will keep the house sweet. A plentiful supply of pure water at all times is essential. The water-troughs should be formed of earthenware or of iron; lead in any shape is most injurious: indeed we have known several apparently mysterious cases of mortality in poultry-yards explained by the circumstance that the water was conveyed to them through leaden pipes. Where the run is limited, a quantity of sand, fine gravel, or coal-ashes and small cinders, must be put down in some convenient spot, or under a shed, for the use of the fowl. The feeding-troughs are made of wood, and something like pigs' troughs, but on a smaller scale; and there should be round rails, a foot high, driven into the ground in front of the trough, which is placed against a wall. These posts should be placed about 3 inches apart, the object being to allow the hens to feed without permitting them to get into the trough and dirtying the food. These troughs should be well scrubbed at least once a-week.

Breeding and Hatching.—It is a great mistake, and a frequent cause of sterile eggs, to have a larger number of hens than is proper running with a single cock. Five to eight hens to one cock is the best proportion, depending upon the season and breed; and the number of hens to a cock should never exceed nine or ten. The cock should be strong and vigorous, and not related in blood to the hens. Breeding in-and-in is fatal to success in poultry keeping.

We have stated that the sitting-hens should have a separate apartment where they will not be disturbed. Mrs Somerville says: "The nests—14 inches wide, 14 inches high, and 16 inches from front to back—may range in two tiers along the lower part of a house—8 or 10 feet by 6—each nest being provided with a loose wooden door, reaching within 3 inches of the top, so as to admit of ventilation at the same time that the hen is secured on the nest. The door, when closed, is fitted into a groove at one end, and fastened with a wooden button at the other; each button fastens two doors, and each door is numbered with paint. Shallow wicker-baskets are used, and answer very well for laying and for setting nests. The nests should be filled with short cut straw, which is better for the purpose than long straw or long hay."[1]

Mrs Somerville gives the following account of her system of managing breeding hens: "I never set less than three hens at one time, and that number may always be had broody in the course of a week or ten days by leaving a few spoilt eggs in the nests where the hens you wish to set are accustomed to lay. The broody hens should be managed thus: During the day, make as many nests as you require in the setting-house with clean, soft, bruised straw, underneath which, during the summer months only, place a green sod. When evening arrives, place the broody hens thereon, and put under each hen three or four trial eggs, which should be kept for the purpose, marked with ink—taking care to handle the hens dexterously, placing one hand underneath the breast, holding the legs in the other hand and carrying

[1] Prize Essay; Journal of the Royal Agricultural Society of England.

them upright; otherwise have a convenient basket for the purpose. Feed the newly-set hens as usual with the others, and in all probability at the end of two days they will have taken to the nests; in which case, when off feeding, on the third morning, place the eggs for sitting under each hen, and label each nest, naming the kind of eggs, and date when set. On the evening of the eighth day after setting, take a lighted candle, and, holding the eggs up to the light, observe if they appear quite clear; if so, they are sterile or addled, for the eggs containing birds will appear opaque. It may happen, should there be many addled eggs, that two of the hens will sit the remaining eggs of the three; and that one can be again set, with fresh eggs as before, and so on during the year. The sterile eggs should be marked as trial or nest eggs, or boiled as food for chickens, so that none need be wasted. As each sitting-hen is now secured upon her nest, as many only at a time as may be most convenient can be let off to feed, which should be done early every morning inside the sitting-house, with closed door, allowing them to remain off the nests fifteen or twenty minutes, and taking care that each hen returns to the proper nest. Give water, with grain in its natural state, but not with soft food. During the summer months, or dry windy March, and about a week previous to hatching, take a little warm water, and when the hens are off the nests, sprinkle the eggs therewith; this will greatly assist nature in the process of hatching, as the eggs are often very dry in hot weather. This, as a rule, applies to all kinds of poultry."

The number of eggs placed under a hen varies according to circumstances. When the hen is set in the early part of spring, nine eggs are sufficient, even for the largest hen, and eleven eggs in summer. It is useless setting a larger number of eggs than the hen can cover properly. The eggs set should not be more than ten days or a fortnight old, as old eggs usually produce weak chickens. Hens sit for twenty-one days, and the best time for setting is March, April, and the early part of May. Chickens hatched late in the year are often fed up in spring, and sold as early spring chickens.

Chickens.—When the chickens come out, leave them to remain quietly with the hen, merely removing the shells, and any addled eggs. Do not attempt to feed them for some hours until they begin to peck, when they should get some soft food. Mr Tegetmeier recommends an egg beaten up with a tablespoonful of milk, and heated in the oven, or by the side of the fire, until it sets into a soft custard. Hard-boiled eggs, broken very small, and bread soaked in new milk, is also given; also lettuces, young cabbage-leaves, onion-tops, or other green food, chopped fine. The hen must from the first be well supplied with water. Chickens should be fed upon the principle of "little and often." No more food should be given at any time than they will eat up, but they should be fed often—every second hour, at least; and the first feed should be given as early in the morning as possible. As they advance, oatmeal moistened with milk, and bread-crumbs, wheat, or rice boiled dry, will give variety to the food. A little hemp-seed may also be mixed with the soft food. Peppercorns are frequently given to chickens by henwives, but this should not be allowed. When visited for the last time in the evening, some wheat or crushed oats may be scattered about, and this they will pick up in the morning.

Mr Tegetmeier, a great authority on poultry, is opposed to the plan of keeping the hens with chickens under coops for some weeks, which is done by many poultry-keepers. He says that, "by so doing, the natural insect-food that the hen acquires by scratching—the worms, grubs, small seeds, and flies, &c.—are denied to the chickens, and no artificial diet will compensate for the loss. Nor can the hen dust to free herself from vermin that feed sumptuously on the young chicks at night. It is said that the hen, if cooped, will draggle the chickens through the wet grass, and tire them out. A half-starved hen may possibly do so; but if she is well fed with corn, there is no danger of her so doing. If preferred, she can be shut up until the dew is off the grass; but the finest and heaviest chickens I have ever bred have been those that have been with hens that were never shut up in houses or coops, but being under open sheds, could go out at all hours." If the hen and chickens are cooped up constantly, they must be provided with meat chopped fine, or with maggots, produced by flesh in a state of putrefaction. This is not required if the hen and chickens are allowed the run recommended by Mr Tegetmeier. The chickens must, of course, be sheltered from rain. When chickens lose the care of the mother, they should be kept for a time by themselves until they become strong enough to hold their own with the older fowl.

Feeding.—Farmyard fowl have the run of the stackyard and farmyard, and usually of some piece of grass adjoining the buildings, and ordinary stock fowl are generally kept in this way in good healthy condition—the food they pick up being assisted by means of boiled potatoes, mixed with barley-meal, oatmeal, or Indian meal, and occasionally whole grain. The following was once recommended in the 'Poultry Chronicle' as a good week's allowance for five hens and a cock, of the large breeds: 5 lb. of barley-meal; 10 lb. of potatoes, boiled and mashed; 7 lb. of whole barley; 3 lb. of rice, boiled; 3 lb. of bran, scalded. They should have their food three times a-day. The barley-meal, potatoes, rice, and bran should be mixed together, and 1½ lb. given to them morning and evening, and 1 lb. of whole barley in the middle of the day. The supply of green food, cabbages, lettuces, &c., may be without limit.

When fattening is the object, a different system must be followed, and the fowl, whether chickens or adult fowl, which are to be prepared for market, should be shut up in coops placed in a warm house, which can be darkened at pleasure. Fowls of different sexes should not be placed in the same apartment, although in separate coops.

Mdlle. Millet Robinet, a French lady, a high authority on poultry management, considers that "cramming" is the most effectual and economical means of fattening. "This involves having sparred coops in which each fowl has its own compartment. The coop is a long narrow box in white wood, set on legs 1½ foot high; the outer walls and partitions are close boarded, and the bottom only is made with rounded spars 1½ inch in diameter, running lengthways of the coop, on which the fowls perch, their dung falling through the bars. The top consists of a sliding door, nearly as wide as the compartment, by which the chickens are taken in or out. The partitions are 8 inches apart, so that the fowl cannot turn itself round. The length of each box may be regulated by circumstances, care being taken that the attendant has room to pass along and to sit down; and furthermore, that cocks, capons, and pullets, or the lean and fat lots, are not mixed up indiscriminately. The floor below the boxes is covered with ashes or dry earth to catch the droppings, which are removed every two days with a scraper. The dung is equal in value to guano, and should be preserved from waste and moisture in old casks.

"The best food for fattening fowls is buckwheat-meal 'bolted' quite fine. This is kneaded up with sweet milk till it gets the consistency of baker's dough; it is then cut up into rations about the size of two eggs, which are made up into 'rolls' about the thickness of a woman's finger, but varying with the size of the fowls; these subdivided by a sloping cut into pellets 2½ inches long. A board is used for mixing the flour with the milk, which in winter should be lukewarm: it is poured into a hole made in the heap of flour, and mixed up, little by little, with a wooden spoon so long as it is taken up; the dough is then kneaded by the hands till it no longer adheres to them." Some say that barley, or even oatmeal, is a good substitute for buckwheat-meal, but Mdlle. Robinet is not of that opinion. Indian corn, the white variety, may do, but it makes "short" paste, unless mixed with buckwheat, when it answers well, if cheap enough.

"The food is thus administered: The attendant puts on an apron which will stand being soiled or torn, and takes the pellets on a board, with a bowl of clear water. She takes the first fowl from its cage gently and carefully—not by the wings or legs, but with both hands under the breast. She then seats herself with the fowl upon her knees, putting its rump under her left arm, by which she supports it: the left hand then opens its mouth, and the right hand takes up a little pellet, soaks it well in the water—*this is essential*—shakes it on its way to the open mouth, puts it straight down, and carefully crams it with the forefinger well into the gullet. When it is so far settled down that the fowl cannot eject it, she presses it down gently with thumb and forefinger into the crop, taking care not to fracture the pellet; for if some scraps of it remained in the gullet they might cause inflammation. Other pellets follow the first, till the feeding is finished, in less time than one would imagine. It sometimes happens, particularly in the early stage of fattening, that the tracheal artery is compressed together with the gullet; this makes the poor creature cough, but is not of any serious consequence, and with a little experience this mishap is easily avoided. The fowl when fed is again held with both hands under its breast, and replaced in its cage without *fluttering* it; and so on with each fowl.

"The chicken should have two meals in twenty-four hours, twelve hours apart, provided with the utmost punctuality; if it has to wait it becomes uneasy, if fed too soon it has an indigestion, and in either case loses weight. On the first day of cramming only two or three pellets are given at each meal; the allowance is daily increased by one at a time till it reaches twelve to fifteen pellets. The stomach may be filled, but at each meal you must make sure that the last is duly digested, which is easily ascertained by gently handling the crop. If there be any dough in it, digestion has not gone on properly; the fowl must miss a meal, and have a rather smaller allowance next time. If too much food be forced upon the animal at first, it will get out of health, and have to be set at liberty. The fattening process ought to be complete in two or three weeks; but for extra fat poultry, twenty-five or twenty-six days are required. With good management you may go on for thirty days; after this the creature becomes choked with accumulated fat, wastes away, and dies. To judge of the fatness of the fowl, handle it at the upper part of the back, between the wings, or just under the wings, or again on either side of the tail, below the rump.

"When a fowl is to be killed, it should first be fasted for twelve or fifteen hours, and then held carefully—not hung up by the heels, which would suffocate it—the mouth opened, and either the under side of the tongue cut with sharp scissors, or the pointed blade of a knife thrust into the palate till it pierces the brain; or, thirdly, a few feathers may be plucked from the left side of the head, just below the ear, and a good incision made at the spot. In any case it must be fastened up by the heels immediately afterwards, that it may bleed freely, for on this the whiteness of the flesh depends; but during the death-struggle let it be held by the head."[1]

The fat of fowl so fed and managed is described as being of a dull white colour; and their flesh is transparent beneath a delicate skin.

In fattening fowl by the ordinary process, they are put into coops 3 feet high, 2 feet wide, and 4 feet long, which will accommodate six or eight birds. The bottom and front should be made of bars 3 inches apart, and the coop should be raised a foot from the ground, so that the droppings may fall through. A board, 6 inches wide, is placed in front of the bars as a stand for the food and water-troughs. The coop should not be left outside, nor even in a covered shed, but placed in a warm, well-ventilated, dark house, or one which may be darkened when each feeding-time is over. The food may consist of oatmeal and barley-meal mixed with milk, given alternately, a little dripping being mixed with the food occasionally. The food may also be varied by mixing some well-boiled potatoes with the meal and milk, giving it in a dry and not in a sloppy state. Indian meal, well boiled, may also be used. Rice, when well boiled, and mixed with barley-meal, is good food for either young or adult birds.

SECTION III.—TURKEYS.

The best and hardiest breeds of turkeys are,—the black Norfolk; the Cambridge—colour black and white, mixed occasionally with copper colour.; and the American, the colour of which is of a bright metallic hue.

It is frequently alleged that turkeys are much more difficult to rear than any other description of poultry, but this is decided by experienced breeders. Young birds alone should be kept for breeding, year-old birds being most preferred; and three hens and one cock will be found a sufficient breeding-stock to be kept in most cases. Fresh blood should be frequently introduced, so as to avoid close-breeding. Turkeys should be kept by themselves, with their nests so placed that the birds may be secured

[1] The Poultry of France, by P. H. Frere. Journal of the Royal Agricultural Society of England, vol. ii., Second Series. 1886.

on them when sitting. The period of incubation lasts from 28 to 31 days, and the hen should be disturbed as little as possible during that period, except to be fed. They may get their food out of doors; but when more than one hen is sitting in the house at one time, it must be observed that each returns to her own nest. Sprinkle the eggs with warm water about a week before hatching. The best period for hatching is during April.

Mr Tegetemier says, with reference to rearing turkeys: "My own method of procedure is to follow nature as far as possible. I make my turkey-nests on the ground, or if in a paved house, in large shallow boxes, half filled with mould that can be damped at intervals. The hens, unless they come off regularly, are lifted off to feed, and then supplied with grain with a liberal hand. When the young ones are hatched, they are left undisturbed under the hen until the next day. No attempt is made to cram them—an absurd practice, which interferes most injuriously with the due digestion of the yolk that is absorbed into the intestines at birth, and constitutes all the food required for 24 to 30 hours after hatching. The first food given them is egg beaten up with an equal bulk of milk, and baked into a soft custard; this is alternated with crumbled bread mixed with milk, to which oatmeal is added in a gradually increasing proportion. Ants' eggs are given, if I can get them; but if not, the custard for a fortnight or three weeks. Quite as important as any other part of the dietary of young turkeys is the supply of green food, and many persons chop up nettles, onions, &c., with the meal; but if young turkeys are watched when grazing, it will be observed that they prefer eating bitter herbs belonging to the natural family Compositæ, or compound flowering-plants, such as the dandelion, &c. The common lettuce belongs to the same tribe, and I have fed largely upon it. The greediness with which young turkeys devour this plant is remarkable. At three weeks old a dozen turkey-chicks will eat four or five large lettuces in a day—and they even seem to prefer them when running to seed, at which time there is abundance of milky juice in the plants. At the age of a month they will begin to peck a few grains of wheat or barley; but bread-and-milk and meal should form the staple of their food for the first two or three months of their lives. Most persons say that young turkeys are particularly delicate when they are 'shooting the red.' This is not to be wondered at, when it is remembered that they are generally put on whole grain, without milk, long before they arrive at that age, and suffer accordingly. Another point of the highest importance in feeding turkeys, or young birds of any kind, is the hour at which they get their first repast. In summer it is daylight at four o'clock in the morning. If the birds have their first meal deferred until six or seven o'clock, they have been hungry for two or three hours, and suffer very much. To be successful in rearing these, and any other young birds, they must either be supplied overnight with their first meal, or the poultry-maid must be up with the lark. There is no better plan than putting the hen and chicks, for the first month or two, in a closely-wired aviary at night, which is open to the early sun; and lettuce and a good supply of soft food can be put under a coop, so that the hen cannot eat it, and there will be found but little left an hour after daybreak."

Turkey-chicks being very liable to injury from wet, should not be let out in rain, and a shed should be placed in their run where they can find shelter from sudden showers.

When turkeys have been well reared from the first there is no difficulty in fattening them for market. By shutting them up for a fortnight and feeding them on meal and milk, they will be put into the finest condition for the table.

Young turkey-cocks will weigh at Christmas from 15 to 20 lb., and even more in some cases; hens weigh from 10 to 12 lb.

SECTION IV.—GEESE.

The principal breeds of geese are the Toulouse and the Embden. The prevailing colour of the Toulouse is a blue grey, marked with brown bars; the balls, the orbit of the eye, and the legs, are of a clear orange red; and the forehead possesses a degree of flatness which is a prominent characteristic of the breed. The Toulouse goose is large, but low on the leg, and well developed in the breast. It is an excellent breed for improving the weight of undersized birds.

The Embden goose is also a large variety; its colour is pure white, and it is alleged that the flesh is whiter than that of the coloured birds.

Geese do not attain full maturity for breeding until they are three or four years old, but they will continue breeding for many years. One gander is put to three or four geese. The period of incubation is thirty days; and as the early part of April is the best time for having young goslings, the goose should be set about the beginning of March. The goose may be set when she has laid thirteen eggs; and she must be carefully fed and watered, and also allowed access to a pond. When the goslings are hatched, leave them undisturbed, as in the case of turkey-chicks; and when fit to go out they will soon pick at the grass. If the weather is at any time unfavourable, put some freshly-cut green grass sods in the place where they are kept. Set shallow vessels with water, in which a little oatmeal may be mixed. Oatmeal porridge is also useful. If the weather is dry about midsummer, and pasture bare, give them some oats, and when the stubbles are ready let the geese have the run of them. They must at all times have access to plenty of water, and it is a mistake to suppose that dirty water is good enough for them. In preparing geese for market, an unlimited supply of oats is essential, and clean straw frequently renewed. Before killing them, let them out to the pond to wash themselves, and on their return have a good bed of straw ready for them; they must fast twenty-four hours before they are killed. We have seen very fat geese which had been prepared for market in the following manner: About a month or five weeks before they were wanted, the geese were shut up in a rather dark house, which was kept clean, and a plentiful supply of pure water always provided for the birds. They were fed on pulped swedes, raw, mixed with oats, or any refuse grain that might be about the farm at the time. A little patience must be exercised with them at first, as they require a week at least to reconcile them to the confinement and the food.

SECTION V.—DUCKS.

The best breed of ducks are the Aylesbury and the Rouen. The plumage of the Aylesbury is pure white, the bill of a pale flesh colour, and the legs orange. The Rouen resembles the wild-duck in plumage and colour of bill, but is much larger in size. Both breeds are good layers. The Pekins are also good layers, but are not so fine in quality of flesh. The eggs are usually hatched under hens, and when the ducklings appear they must be kept warm if the weather is cold, and fed on oatmeal and milk; and after some time on oats given in water. When intended to be sold as ducklings they should not be allowed access to water to swim in, but be fed constantly on oatmeal and milk; also Indian meal or barley-meal and milk, with a few boiled potatoes occasionally, and they will be fat for market in seven or eight weeks. Those which are to be kept for store purposes may be allowed access to water; but the profit in ducks lies in getting them to market when not over eight or ten weeks old.

SECTION VI.—GUINEA-FOWL.

This can scarcely be considered an ordinary description of farmyard poultry, but they are very useful for the table, and much liked on account of the game-like flavour of their flesh. The eggs are also fine-flavoured, and although small, sell as well as those of the common hen. Mrs Somerville says: "It is the best way, in the case of breeding, to set the eggs under the common hen, the *time of incubation* being one month. After hatching, place the hen under a coop, around which fix a guard to prevent the young straying, as they are very wild: they may have the same food as young turkeys. The coop, which should have a boarded bottom, will require to be moved to fresh ground every day at least. After the first week the young birds should be shut up within the coop, to avoid injury whilst being removed: they may have their liberty when three weeks old, but the mother should be kept in the coop a week longer. The young will by degrees become tame, and good foragers, and little difficulty will be experienced in rearing them under this method; but they are troublesome amongst other poultry, being regular attendants, however well fed, at the chickens' coops, besides being very quarrelsome, often driving the most spirited cocks before them, and perhaps injuring them in some way. As many males as females are required, as they always pair; the spotted variety is the hardiest, the white are very delicate birds."

SECTION VII.—PEA-FOWL.

This is also a fancy variety of fowl, and usually kept for ornament, but the young birds are excellent for the table. One cock is allowed to three hens. From four to seven eggs are laid, and the period of incubation is twenty-eight days. The hen should be kept under the coop until the young birds are six weeks old. They are fed in the same way as turkeys.

SECTION VIII.—PIGEONS.

Pigeons, when kept in large numbers, are a nuisance in a district where arable farming prevails. They are useful, however, where they can be kept without injury, as they sell readily at most times, and particularly when game or springs chickens are scarce. They require little attention, beyond giving them some food regularly, as they usually provide for themselves. The cotes should be kept clean, which, however, is not always attended to. A plentiful supply of rock-salt is recommended for their use. The Blue Rocks are considered better than the purely fancy varieties for ordinary use. A pair will hatch ten times in the course of a year.

SECTION IX.—EGGS.

As it is often necessary to preserve eggs for some time for family use, the following plan, as given by Mrs Somerville, will be found useful: "Procure a tub that will contain, say 40 gallons, which place in a cellar or other cool room, and put therein 1 bushel of quicklime, 2 lb. of common salt, and ½ lb. of cream-of-tartar; then add 30 gallons of cold water, and stir round a few times to mix the ingredients; afterwards leave until the following morning, when again stir up all well together. It should then be of such consistency that an egg will float on the surface. Another vessel of convenient size must be provided, in which the eggs are to be preserved, packing them close together, with the narrow end downwards—which should be done daily, after a commencement is made, as the fresher the eggs are the better—adding as much of the prepared liquor as will just cover the eggs. This must be done day by day until the vessel is filled within 3 inches of the top, then fill up the vessel with the liquor, and in a few days a crust of ice-like appearance will be formed over the vessel, so as to keep it perfectly air-tight. Eggs, if fresh, preserved thus will keep as long as required, and for all cooking purposes will answer as well as the freshest, from which they can scarcely be distinguished." Less pickle may, of course, be prepared than the quantity stated, but the proportion of the different ingredients must be observed.

The following is another mode of preserving eggs: Gather the eggs day by day, so that they may be perfectly fresh, and put them into a barrel, with the small ends down, on a layer of oats or bran. When one course of eggs is full, put on another layer of oats or bran, then a layer of eggs, and so on, alternate layers of oats and eggs until the barrel is full, the last layer of all being either oats or bran.

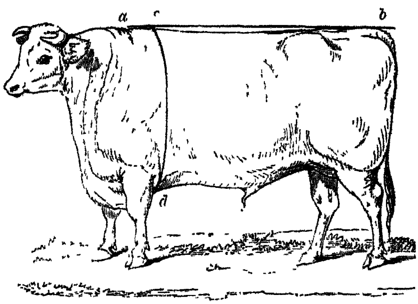
APPENDIX.

WEIGHT OF ANIMALS.

ASCERTAINING THE WEIGHT OF FAT ANIMALS.

We take the following remarks on this subject from Mr Stephens's last edition of the 'Book of the Farm,' a work which has long and justly been regarded as the highest authority on the details of agricultural practice:—

Ascertaining the weight by measuring the body of the ox is a more convenient method than weighing: and when the measurement is correctly taken, and the ox of an ordinary size, the result is pretty accurate. Suppose the following figure represents an ox whose weight is desired to be ascertained by measurement. The



The Measurement of a Ripe Fat Ox, to ascertain its Weight, sinking the Offals.

mode is: Measure with a tape-line from the top of the shoulder *a* to the tail-head *b*, which gives the *length;* then measure round the body at *c* to *d*, immediately behind the shoulder, which gives the *girth;* and on consulting any table calculated for the purpose, at the corresponding figures of the length and girth ascertained, the product will give the net weight. "Upon what principle the rules given in books is founded I cannot say, unless on the assumption that the body of the ox is a hollow cylinder; for a sufficient number of experiments have not yet been instituted to ascertain the exact relation subsisting betwixt the bulk of an ox's body and the weight of the flesh and bones upon it.

Several such rules exist. Suppose an ox is 5 feet in length and 7 feet in girth. One rule is, multiply the square of the girth in inches by the length in inches, and divide the sum by 7344, and the quotient is the weight desired. For example :—

Square the girth in inches	{ 84 / 84
	7056
Multiply by the length in inches	60
Divide by 7344)	423360 (57 st. 8 lb. weight.

Another rule is, square the girth in feet, multiply the sum by the length in feet, and multiply the double sum by the decimal .238, and the entire sum is the weight desired. For example :—

Square the girth in feet	{ 7 / 7
	49
Multiply by the length in feet	5
	245
Multiply by the decimal	.238
And the weight is	58.310 stones.

A third rule is, multiply half the girth by itself in feet, and the sum by the length in feet, and the double sum gives the weight desired. For example :—

Multiply half the girth by itself in feet	{ 3.5 / 3.5
	12.25
Multiply the length in feet	5
Weight	61.25 stones.

Here is an average excess of $3\frac{1}{2}$ stones above the first and second rules.

A fourth rule is, divide the live weight by 8 and multiply the quotient by 5, and the sum gives the net weight. For example :—

The live weight of $57\frac{1}{2}$ st. dead weight is 92 stones.

Divide by	8) 92 ($11\frac{1}{2}$
Multiply by	5
And the net weight is	$57\frac{1}{2}$ st.

A fifth rule is shortly this:—

$$\frac{\text{Girth } 2 \times 5 \text{ lengths}}{21} = \text{Weight}$$

Square the girth	$\begin{cases} 7 \\ 7 \end{cases}$
	49
Multiply by 5 times the length	25
Divide by 21)	1225 (58 st. weight.

Thus many rules exist by which the net weight of cattle may be ascertained by measurement; and books of tables are found in which those weights are calculated to one's hand. A sliding scale conveniently carried in the pocket indicating at a glance the weight, with reference to the length and girth of animals, is sold by the philosophical instrument-makers.

After repeated trials by Mr Robert Stephenson, Whitelaw, East Lothian, on a number of oxen of the same weights and age, of the relative proportions of their live and dead weights, the following conclusions were come to—that every 100 lb. of live weight gave of

Butcher-meat	57.7	per cent.
Tallow	8.0	,,
Hide	5.5	,,
Entrails and offal	28.8	,,
	100.0	

Accurate measuring would easily be acquired, and the result would ever be correct, were the form of the ox always perfect, which it very seldom is, the fore and hind quarters being frequently unequal, and the degrees of condition various. The judgment is called into exercise to make allowance for those differences, and the allowance may be made somewhat in this manner: When the fore quarter seems heavier than the hind, the line should be extended nearer the head than the exact top of the shoulder *a*; and in like manner, when the hind quarter is heavier than the fore, the line should be stretched a little beyond the tail-head *b*. In regard to the girth, it is a very common fault in the carcass of an ox to be contracted behind the shoulder, the actual girth of which gives a result below the truth. It is very rare to find the girth filled out beyond its proper form. The tape-line must therefore be applied with judgment. The line is most conveniently divided into feet and tenths, instead of eighths, because the multiplication by decimals is the easiest. As an illustration of the practical effects of misapplying the tape-line, I may state that one inch only added to the girth and length assumed in the above examples, makes an increase in the above weights of upwards of 2 st. The addition of one inch to the length is a mistake easily made when the ox stands with his head down; and a similar error may as easily be made in the girth, when the ox stands with his back raised. Experience alone can give proficiency in measuring cattle.

To ascertain the dead weight of living sheep: Weigh the sheep alive, to ascertain weight in stones (14 lb.); double the number of stones which the sheep weighs will give pounds weight per quarter, if the sheep is fairly fat. Thus, a sheep weighs alive 9 stones; 9 multiplied by 2 = 18, or 18 lb. per quarter.

Again: reckon the dead weight to be four-sevenths of live weight. Thus, as above, 9 stones = 126 lb.; four-sevenths of which, or 72 lb. = 18 lb. per quarter.

TABLES OF THE MEASUREMENT AND WEIGHT OF CATTLE, &c.

In order to accommodate those of our readers who may wish to form an idea of the weight of their fat cattle, &c., by measurement, we give the following tables, the correctness of which we have fully tested:—

Take the length from *a* to *b* along the back, and circumference round by *c* and *d*, as in the engraving, all in inches: these numbers found together in some of the columns of the table will point out the imperial weight of the four quarters in stones (14 lb.) and pounds. (See Figure, page 369.)

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
32	22	3	0	34	25	3	12	36	28	5	0
"	23	3	2	"	26	4	1	"	29	5	2
"	24	3	5	"	27	4	4	"	30	5	4
"	25	3	7	"	28	4	6	"	31	5	7
"	26	3	9	"	29	4	8	"	32	5	9
"	27	3	11	"	30	4	10	"	33	5	11
"	28	3	13	"	31	4	12	"	34	6	1
"	29	4	2	"	32	5	1	"	35	6	3
"	30	4	4	"	33	5	3	37	27	4	5
"	31	4	6	35	25	4	3	"	28	5	1
33	23	3	7	"	26	4	5	"	29	5	6
"	24	3	8	"	27	4	7	"	30	5	8
"	25	3	10	"	28	4	9	"	31	5	11
"	26	3	12	"	29	4	11	"	32	6	1
"	27	4	0	"	30	5	0	"	33	6	3
"	28	4	3	"	31	5	2	"	34	6	5
"	29	4	4	"	32	5	5	"	35	6	7
"	30	4	6	"	33	5	7	"	36	6	11
"	31	4	8	"	34	5	9	38	28	5	7
"	32	4	10	36	26	4	8	"	29	5	10
34	24	3	11	"	27	4	11	"	30	5	13

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb
38	31	6	2	43	35	8	11	48	37	11	10
"	32	6	5	"	36	9	2	"	38	12	0
"	33	6	7	"	37	9	5	"	39	12	5
"	34	6	10	"	38	9	9	"	40	12	9
"	35	6	13	"	39	9	13	"	41	12	13
"	36	7	2	"	40	10	2	"	42	13	4
"	37	7	5	"	41	10	6	"	43	13	8
39	27	5	7	44	32	8	7	"	44	13	13
"	28	5	12	"	33	8	11	"	45	14	3
"	29	6	1	"	34	9	0	"	46	14	8
"	30	6	3	"	35	9	4	"	47	14	12
"	31	6	6	"	36	9	8	"	48	15	3
"	32	6	9	"	37	9	11	49	34	11	3
"	33	6	11	"	38	10	1	"	35	11	7
"	34	6	13	"	39	10	5	"	36	11	12
"	35	7	2	"	40	10	9	"	37	12	3
"	36	7	7	"	41	10	12	"	38	12	7
40	27	5	13	"	42	11	2	"	39	12	12
"	28	6	2	45	33	9	2	"	40	13	3
"	29	6	5	"	34	9	6	"	41	13	7
"	30	6	8	"	35	9	10	"	42	13	12
"	31	6	11	"	36	10	0	"	43	14	2
"	32	7	0	"	37	10	4	"	44	14	7
"	33	7	3	"	38	10	8	"	45	14	12
"	34	7	6	"	39	10	12	"	46	15	2
"	35	7	9	"	40	11	2	"	47	15	7
"	36	7	12	"	41	11	5	"	48	15	12
"	37	8	2	"	42	11	9	50	34	11	9
41	29	6	9	"	43	11	13	"	35	12	0
"	30	6	13	46	34	9	12	"	36	12	5
"	31	7	2	"	35	10	2	"	37	12	10
"	32	7	5	"	36	10	6	"	38	13	1
"	33	7	8	"	37	10	10	"	39	13	5
"	34	7	12	"	38	11	1	"	40	13	10
"	35	8	1	"	39	11	5	"	41	14	1
"	36	8	3	"	40	11	9	"	42	14	6
"	37	8	7	"	41	11	13	"	43	14	11
"	38	8	11	"	42	12	3	"	44	15	2
"	39	9	0	"	43	12	7	"	45	15	6
42	30	7	4	"	44	12	11	"	46	15	11
"	31	7	7	47	34	10	4	"	47	16	2
"	32	7	10	"	35	10	8	"	48	16	7
"	33	8	0	"	36	10	13	51	34	12	2
"	34	8	3	"	37	11	3	"	35	12	7
"	35	8	6	"	38	11	7	"	36	12	12
"	36	8	10	"	39	11	12	"	37	13	3
"	37	8	13	"	40	12	2	"	38	13	8
"	38	9	3	"	41	12	4	"	39	13	13
"	39	9	5	"	42	12	10	"	40	14	4
"	40	9	9	"	43	13	1	"	41	14	9
43	31	7	12	"	44	13	5	"	42	15	0
"	32	8	2	48	34	10	11	"	43	15	5
"	33	8	5	"	35	11	1	"	44	15	10
"	34	8	9	"	36	11	5	"	45	16	1

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
51	46	16	6	55	42	17	6	58	39	18	1
"	47	16	11	"	43	17	12	"	40	18	7
"	48	17	2	"	44	18	4	"	41	19	0
52	36	13	6	"	45	18	10	"	42	19	6
"	37	13	10	"	46	19	2	"	43	19	12
"	38	14	2	"	47	19	8	"	44	20	4
"	39	14	7	"	48	20	0	"	45	20	10
"	40	14	12	"	49	20	5	"	46	21	4
"	41	15	3	"	50	20	11	"	47	21	10
"	42	15	8	"	51	21	3	"	48	22	3
"	43	16	0	"	52	21	9	"	49	22	9
"	44	16	5	"	53	22	2	"	50	23	2
"	45	16	10	"	54	22	6	"	51	23	8
"	46	17	1	56	38	16	5	"	52	24	1
"	47	17	6	"	39	16	11	"	53	24	7
"	48	17	12	"	40	17	3	"	54	25	0
53	36	13	12	"	41	17	9	"	55	25	6
"	37	14	4	"	42	18	1	"	56	25	12
"	38	14	9	"	43	18	7	"	57	26	3
"	39	15	1	"	44	18	13	"	58	26	12
"	40	15	6	"	45	19	6	59	38	18	3
"	41	15	11	"	46	19	12	"	39	18	9
"	42	16	3	"	47	20	4	"	40	19	2
"	43	16	8	"	48	20	10	"	41	19	9
"	44	17	0	"	49	21	2	"	42	20	1
"	45	17	5	"	50	21	8	"	43	20	8
"	46	17	11	"	51	22	0	"	44	21	1
"	47	18	2	"	52	22	6	"	45	21	7
"	48	18	7	"	53	22	12	"	46	22	0
"	49	18	13	"	54	23	4	"	47	22	7
"	50	19	4	"	55	23	10	"	48	23	0
"	51	19	10	"	56	24	2	"	49	23	6
"	52	20	1	"	57	24	8	"	50	23	13
54	36	13	1	57	38	16	5	"	51	24	6
"	37	14	11	"	39	16	11	"	52	24	12
"	38	15	3	"	40	17	12	"	53	25	5
"	39	15	9	"	41	18	4	"	54	25	12
"	40	16	0	"	42	18	11	"	55	26	5
"	41	16	6	"	43	19	3	"	56	26	11
"	42	16	12	"	44	19	9	"	57	27	4
"	43	17	3	"	45	20	1	"	58	27	11
"	44	17	9	"	46	20	8	"	59	28	4
"	45	18	0	"	47	21	0	60	38	18	11
"	46	18	6	"	48	21	6	"	39	19	4
"	47	18	12	"	49	21	12	"	40	19	11
"	48	19	4	"	50	22	5	"	41	20	4
"	49	19	9	"	51	22	11	"	42	20	11
"	50	20	1	"	52	23	3	"	43	21	4
"	51	20	6	"	53	23	9	"	44	21	11
"	52	20	12	"	54	24	1	"	45	22	4
55	38	15	11	"	55	24	7	"	46	22	11
"	39	16	3	"	56	24	13	"	47	23	4
"	40	16	9	"	57	25	5	"	48	23	11
"	41	17	1	58	38	17	8	"	49	24	4

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
60	50	24	11	62	58	30	9	65	45	26	2
"	51	25	3	"	59	31	2	"	46	26	10
"	52	25	10	"	60	31	9	"	47	27	4
"	53	26	3	63	38	20	10	"	48	27	12
"	54	26	10	"	39	21	4	"	49	28	6
"	55	27	3	"	40	21	12	"	50	28	12
"	56	27	10	"	41	22	5	"	51	29	6
"	57	28	3	"	42	22	12	"	52	29	12
"	58	28	10	"	43	23	5	"	53	30	11
"	59	29	3	"	44	23	12	"	54	31	6
"	60	29	12	"	45	24	8	"	55	31	12
61	38	19	6	"	46	25	1	"	56	32	4
"	39	19	13	"	47	25	9	"	57	33	2
"	40	20	6	"	48	26	3	"	58	33	8
"	41	21	0	"	49	26	10	"	59	34	4
"	42	21	7	"	50	27	4	"	60	34	12
"	43	22	0	"	51	27	12	"	61	35	6
"	44	22	7	"	52	28	5	"	62	36	1
"	45	23	0	"	53	28	12	66	42	25	2
"	46	23	7	"	54	29	5	"	43	25	11
"	47	24	1	"	55	29	12	"	44	26	5
"	48	24	8	"	56	30	5	"	45	27	0
"	49	25	1	"	57	31	2	"	46	27	8
"	50	25	8	"	58	31	9	"	47	28	2
"	51	26	1	"	59	32	3	"	48	28	10
"	52	26	8	"	60	32	10	"	49	29	5
"	53	27	1	64	38	21	6	"	50	30	0
"	54	27	8	"	39	21	13	"	51	30	8
"	55	28	1	"	40	22	7	"	52	31	2
"	56	28	8	"	41	23	1	"	53	31	10
"	57	29	1	"	42	23	9	"	54	32	5
"	58	29	8	"	43	24	3	"	55	32	13
"	59	30	1	"	44	24	11	"	56	33	8
"	60	30	10	"	45	25	5	"	57	34	2
62	38	20	1	"	46	25	13	"	58	34	10
"	39	20	8	"	47	26	7	"	59	35	4
"	40	21	2	"	48	27	1	"	60	35	13
"	41	21	10	"	49	27	9	"	61	36	8
"	42	22	3	"	50	28	2	"	62	37	2
"	43	22	9	"	51	28	10	"	63	37	10
"	44	23	4	"	52	29	4	"	64	38	5
"	45	23	11	"	53	29	12	67	43	26	8
"	46	24	4	"	54	30	6	"	44	27	2
"	47	24	12	"	55	31	0	"	45	27	10
"	48	25	5	"	56	31	8	"	46	28	7
"	49	25	13	"	57	32	2	"	47	29	0
"	50	26	6	"	58	32	10	"	48	29	9
"	51	26	13	"	59	33	6	"	49	30	4
"	52	27	7	"	60	33	11	"	50	30	12
"	53	28	0	65	40	23	4	"	51	31	7
"	54	28	7	"	41	23	11	"	52	32	1
"	55	29	1	"	42	24	6	"	53	32	10
"	56	29	8	"	43	24	12	"	54	33	5
"	57	30	2	"	44	25	8	"	55	34	0

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
67	56	34	8	69	65	42	8	72	51	36	5
"	57	35	3	"	66	43	3	"	52	37	1
"	58	35	11	"	67	43	12	"	53	37	11
"	59	36	6	"	68	44	7	"	54	38	7
"	60	37	1	70	46	31	0	"	55	39	3
"	61	37	9	"	47	31	9	"	56	39	13
"	62	38	4	"	48	32	5	"	57	40	9
"	63	38	13	"	49	33	0	"	58	41	5
"	64	39	7	"	50	33	10	"	59	42	1
"	65	40	2	"	51	34	5	"	60	42	11
68	44	28	0	"	52	35	0	"	61	43	7
"	45	28	7	"	53	35	9	"	62	44	3
"	46	29	4	"	54	36	4	"	63	44	13
"	47	29	12	"	55	36	13	"	64	45	9
"	48	30	7	"	56	37	10	"	65	46	5
"	49	31	2	"	57	38	6	"	66	47	1
"	50	31	11	"	58	39	1	"	67	47	11
"	51	32	6	"	59	39	10	"	68	48	7
"	52	33	1	"	60	40	6	"	69	49	3
"	53	33	10	"	61	41	2	"	70	49	11
"	54	34	5	"	62	41	11	"	71	50	9
"	55	35	0	"	63	42	6	"	72	51	5
"	56	35	9	"	64	43	2	73	50	36	9
"	57	36	4	"	65	43	11	"	51	37	6
"	58	36	12	"	66	44	7	"	52	38	2
"	59	37	7	"	67	45	2	"	53	38	12
"	60	38	2	"	68	45	11	"	54	39	8
"	61	38	11	"	69	46	7	"	55	40	4
"	62	39	6	71	48	33	4	"	56	41	1
"	63	40	1	"	49	34	0	"	57	41	11
"	64	40	11	"	50	34	9	"	58	42	7
"	65	41	5	"	51	35	5	"	59	43	3
"	66	42	0	"	52	36	1	"	60	44	0
"	67	42	9	"	53	36	11	"	61	44	8
69	45	29	6	"	54	37	6	"	62	45	6
"	46	30	2	"	55	38	2	"	63	46	3
"	47	30	11	"	56	38	12	"	64	46	13
"	48	31	6	"	57	39	7	"	65	47	9
"	49	32	1	"	58	40	3	"	66	48	5
"	50	32	10	"	59	40	13	"	67	49	2
"	51	33	5	"	60	41	8	"	68	49	12
"	52	34	0	"	61	42	4	"	69	50	8
"	53	34	10	"	62	43	0	"	70	51	4
"	54	35	5	"	63	43	10	"	71	52	1
"	55	36	0	"	64	44	5	"	72	52	11
"	56	36	9	"	65	45	1	"	73	53	11
"	57	37	4	"	66	45	11	74	51	38	6
"	58	37	13	"	67	46	6	"	52	39	2
"	59	38	8	"	68	47	2	"	53	39	12
"	60	39	5	"	69	47	12	"	54	40	9
"	61	39	13	"	70	48	8	"	55	41	6
"	62	40	8	"	71	49	4	"	56	42	3
"	63	41	3	72	49	34	5	"	57	42	13
"	64	41	12	"	50	35	9	"	58	43	8

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
74	59	44	6	76	66	52	6	78	70	58	8
"	60	45	3	"	67	53	4	"	71	59	6
"	61	45	13	"	68	54	1	"	72	60	4
"	62	46	10	"	69	54	12	"	73	61	2
"	63	47	7	"	70	55	9	"	74	61	12
"	64	48	6	"	71	56	6	"	75	62	11
"	65	49	0	"	72	57	5	"	76	63	9
"	66	49	10	"	73	58	1	"	77	64	6
"	67	50	7	"	74	58	13	"	78	65	4
"	68	51	3	"	75	59	10	79	53	45	7
"	69	52	0	"	76	60	6	"	54	46	6
"	70	52	10	77	52	42	6	"	55	47	7
"	71	53	7	"	53	43	3	"	56	48	1
"	72	54	4	"	54	44	1	"	57	48	12
"	73	55	0	"	55	44	12	"	58	49	9
"	74	55	11	"	56	45	9	"	59	50	6
75	52	40	3	"	57	46	7	"	60	51	7
"	53	41	0	"	58	47	3	"	61	52	4
"	54	41	11	"	59	48	2	"	62	53	3
"	55	42	8	"	60	48	13	"	63	54	2
"	56	43	5	"	61	49	11	"	64	54	13
"	57	44	2	"	62	50	8	"	65	55	11
"	58	44	12	"	63	51	5	"	66	56	9
"	59	45	10	"	64	52	3	"	67	57	7
"	60	46	7	"	65	53	0	"	68	58	6
"	61	47	5	"	66	53	12	"	69	59	4
"	62	48	3	"	67	54	9	"	70	60	2
"	63	48	13	"	68	55	7	"	71	61	0
"	64	49	11	"	69	56	4	"	72	61	12
"	65	50	5	"	70	57	2	"	73	62	10
"	66	51	4	"	71	57	13	"	74	63	8
"	67	52	0	"	72	58	10	"	75	64	6
"	68	52	11	"	73	59	7	"	76	65	4
"	69	53	10	"	74	60	5	"	77	66	2
"	70	54	6	"	75	61	2	"	78	67	0
"	71	55	2	"	76	62	0	80	53	46	9
"	72	55	12	"	77	62	11	"	54	47	8
"	73	56	9	78	53	44	5	"	55	48	6
"	74	57	7	"	54	45	2	"	56	49	4
"	75	58	0	"	55	46	1	"	57	50	3
76	52	41	4	"	56	46	12	"	58	51	1
"	53	42	0	"	57	47	9	"	59	51	13
"	54	42	13	"	58	48	6	"	60	52	12
"	55	43	6	"	59	49	3	"	61	53	10
"	56	44	7	"	60	50	0	"	62	54	8
"	57	45	4	"	61	51	1	"	63	55	7
"	58	46	1	"	62	51	11	"	64	56	5
"	59	46	12	"	63	52	10	"	65	57	3
"	60	47	9	"	64	53	9	"	66	58	2
"	61	48	7	"	65	54	6	"	67	59	0
"	62	49	4	"	66	55	3	"	68	59	12
"	63	50	1	"	67	56	1	"	69	60	10
"	64	50	12	"	68	56	13	"	70	61	9
"	65	51	9	"	69	57	10	"	71	62	7

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
80	72	63	5	82	74	68	7	84	78	75	10
"	73	64	3	"	75	69	6	85	55	54	9
"	74	65	1	"	76	70	5	"	56	55	9
"	75	65	13	"	77	71	4	"	57	56	9
"	76	66	11	"	78	72	2	"	58	57	9
"	77	67	11	83	54	51	3	"	59	58	9
"	78	68	9	"	55	52	2	"	60	59	9
81	53	47	12	"	56	53	1	"	61	60	9
"	54	48	10	"	57	54	0	"	62	61	9
"	55	49	8	"	58	54	13	"	63	62	9
"	56	50	8	"	59	55	12	"	64	63	9
"	57	51	7	"	60	56	12	"	65	64	9
"	58	52	5	"	61	57	11	"	66	65	9
"	59	53	3	"	62	58	10	"	67	66	9
"	60	54	2	"	63	59	9	"	68	67	9
"	61	55	1	"	64	60	8	"	69	68	9
"	62	55	13	"	65	61	7	"	70	69	9
"	63	56	12	"	66	62	6	"	71	70	8
"	64	57	11	"	67	63	5	"	72	71	8
"	65	58	9	"	68	64	4	"	73	72	8
"	66	59	7	"	69	65	3	"	74	73	8
"	67	60	5	"	70	66	5	"	75	74	8
"	68	61	5	"	71	67	4	"	76	75	8
"	69	62	3	"	72	68	3	"	77	76	8
"	70	63	3	"	73	69	3	"	78	77	8
"	71	64	1	"	74	70	2	"	79	78	8
"	72	64	13	"	75	71	1	"	80	79	8
"	73	65	13	"	76	72	1	86	56	57	0
"	74	66	11	"	77	73	0	"	57	58	0
"	75	67	10	"	78	76	1	"	58	59	0
"	76	68	9	"	79	77	1	"	59	60	1
"	77	69	7	84	55	53	6	"	60	61	1
"	78	70	6	"	56	54	5	"	61	62	1
82	53	49	1	"	57	55	5	"	62	63	1
"	54	49	13	"	58	56	4	"	63	64	2
"	55	50	12	"	59	57	4	"	64	64	13
"	56	51	11	"	60	58	3	"	65	65	13
"	57	52	10	"	61	59	3	"	66	67	2
"	58	53	9	"	62	60	3	"	67	68	3
"	59	54	6	"	63	61	2	"	68	69	3
"	60	55	7	"	64	62	2	"	69	70	3
"	61	56	6	"	65	63	2	"	70	71	4
"	62	57	5	"	66	64	1	"	71	72	4
"	63	58	4	"	67	65	1	"	72	73	4
"	64	59	3	"	68	66	0	"	73	74	4
"	65	60	2	"	69	67	0	"	74	75	5
"	66	61	1	"	70	68	0	"	75	76	5
"	67	62	0	"	71	68	13	"	76	77	5
"	68	62	13	"	72	69	13	"	77	78	5
"	69	63	12	"	73	70	12	"	78	79	5
"	70	64	11	"	74	71	12	"	79	80	6
"	71	65	10	"	75	72	12	"	80	81	6
"	72	66	9	"	76	73	11	"	81	82	6
"	73	67	8	"	77	74	11	87	56	58	4

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st	lb.
87	57	59	5	89	61	66	7	91	68	77	7
"	58	60	6	"	62	67	8	"	69	78	9
"	59	61	6	"	63	68	9	"	70	79	11
"	60	62	7	"	64	69	11	"	71	80	13
"	61	63	9	"	65	70	12	"	72	82	1
"	62	64	8	"	66	71	13	"	73	83	3
"	63	65	9	"	67	73	0	"	74	84	5
"	64	66	9	"	68	74	2	"	75	85	7
"	65	67	10	"	69	75	3	"	76	86	9
"	66	68	10	"	70	76	4	"	77	87	10
"	67	69	11	"	71	77	5	"	78	88	12
"	68	70	12	"	72	78	6	"	79	90	1
"	69	71	12	"	73	79	7	"	80	91	2
"	70	72	13	"	74	80	9	"	81	92	4
"	71	73	13	"	75	81	10	"	82	93	6
"	72	75	0	"	76	82	12	92	60	69	12
"	73	76	2	"	77	83	13	"	61	71	1
"	74	77	1	"	78	85	0	"	62	72	3
"	75	78	1	"	79	86	2	"	63	73	5
"	76	79	2	"	80	87	3	"	64	74	7
"	77	80	3	"	81	88	4	"	65	75	9
"	78	81	4	90	58	64	9	"	66	76	11
"	79	82	4	"	59	65	1	"	67	78	1
"	80	83	5	"	60	66	12	"	68	79	2
"	81	84	5	"	61	68	0	"	69	80	4
88	57	60	10	"	62	69	1	"	70	81	1
"	58	61	11	"	63	70	3	"	71	82	10
"	59	62	3	"	64	71	5	"	72	83	12
"	60	63	13	"	65	72	7	"	73	85	0
"	61	65	0	"	66	73	8	"	74	86	3
"	62	66	1	"	67	74	10	"	75	87	5
"	63	67	2	"	68	75	11	"	76	88	7
"	64	68	3	"	69	76	13	"	77	89	9
"	65	69	4	"	70	78	0	"	78	90	12
"	66	70	5	"	71	79	0	"	79	92	0
"	67	71	6	"	72	80	4	"	80	93	3
"	68	72	7	"	73	81	5	"	81	94	5
"	69	73	8	"	74	82	7	"	82	95	7
"	70	74	9	"	75	83	8	"	83	96	10
"	71	75	9	"	76	84	10	93	60	71	6
"	72	76	10	"	77	85	10	"	61	72	8
"	73	77	11	"	78	86	13	"	62	73	11
"	74	78	12	"	79	88	1	"	63	74	11
"	75	79	13	"	80	89	2	"	64	76	2
"	76	81	0	"	81	90	4	"	65	77	5
"	77	82	1	91	59	67	3	"	66	78	8
"	78	83	2	"	60	68	5	"	67	79	10
"	79	84	3	"	61	69	7	"	68	80	13
"	80	85	4	"	62	70	9	"	69	82	2
"	81	86	4	"	63	71	11	"	70	83	5
"	82	87	5	"	64	72	13	"	71	84	7
89	58	63	3	"	65	74	1	"	72	85	10
"	59	64	5	"	66	75	3	"	73	86	12
"	60	65	5	"	67	76	5	"	74	88	1

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
93	75	89	4	95	81	100	8	97	87	112	9
"	76	90	6	"	82	101	12	"	88	113	13
"	77	91	9	"	83	103	1	"	89	115	4
"	78	92	12	"	84	104	7	98	66	87	3
"	79	94	0	"	85	105	8	"	67	88	8
"	80	95	3	"	86	106	11	"	68	89	12
"	81	96	6	96	63	79	13	"	69	91	3
"	82	97	8	"	64	81	2	"	70	92	7
"	83	98	11	"	65	82	6	"	71	93	12
"	84	100	0	"	66	83	10	"	72	95	2
94	61	74	3	"	67	85	0	"	73	96	9
"	62	75	5	"	68	86	4	"	74	97	11
"	63	76	9	"	69	87	7	"	75	99	2
"	64	77	12	"	70	88	11	"	76	100	6
"	65	79	1	"	71	90	1	"	77	101	11
"	66	80	7	"	72	91	5	"	78	103	1
"	67	81	7	"	73	92	8	"	79	104	6
"	68	82	13	"	74	93	12	"	80	105	10
"	69	83	13	"	75	95	2	"	81	107	1
"	70	85	2	"	76	96	6	"	82	108	5
"	71	86	5	"	77	97	9	"	83	109	10
"	72	87	8	"	78	98	13	"	84	111	1
"	73	88	11	"	79	100	3	"	85	112	5
"	74	90	0	"	80	101	6	"	86	113	9
"	75	91	3	"	81	102	10	"	87	115	0
"	76	92	6	"	82	104	0	"	88	116	4
"	77	93	9	"	83	105	4	"	89	117	9
"	78	95	2	"	84	106	9	"	90	119	0
"	79	96	1	"	85	107	11	"	91	120	4
"	80	97	4	"	86	109	1	99	66	89	2
"	81	98	7	"	87	110	12	"	67	90	5
"	82	99	10	97	64	82	12	"	68	91	10
"	83	100	13	"	65	84	2	"	69	93	2
"	84	102	2	"	66	85	7	"	70	94	6
"	85	103	5	"	67	86	10	"	71	95	11
95	62	77	0	"	68	88	1	"	72	97	2
"	63	78	4	"	69	89	5	"	73	98	7
"	64	79	7	"	70	90	9	"	74	99	12
"	65	80	10	"	71	91	13	"	75	101	2
"	66	82	0	"	72	93	3	"	76	102	7
"	67	83	3	"	73	94	7	"	77	103	12
"	68	84	6	"	74	95	11	"	78	105	3
"	69	85	10	"	75	97	2	"	79	106	8
"	70	86	13	"	76	98	6	"	80	107	13
"	71	88	3	"	77	99	10	"	81	109	4
"	72	89	6	"	78	101	0	"	82	110	8
"	73	90	9	"	79	102	4	"	83	111	13
"	74	91	3	"	80	103	8	"	84	113	4
"	75	93	2	"	81	105	0	"	85	114	9
"	76	94	5	"	82	106	3	"	86	116	0
"	77	95	9	"	83	107	7	"	87	117	5
"	78	96	12	"	84	108	11	"	88	118	10
"	79	98	2	"	85	110	1	"	89	120	1
"	80	99	5	"	86	111	5	"	90	121	6

Girth	Length	Weight		Girth	Length	Weight		Girth	Length	Weight	
In.	In.	st.	lb.	In.	In.	st.	lb.	In.	In.	st.	lb.
99	91	122	10	100	84	115	9	101	77	108	1
100	67	92	3	"	85	117	0	"	78	109	7
"	68	93	8	"	86	118	5	"	79	110	13
"	69	95	0	"	87	119	11	"	80	112	6
"	70	96	5	"	88	121	2	"	81	113	10
"	71	97	10	"	89	122	7	"	82	115	2
"	72	99	1	"	90	123	12	"	83	116	7
"	73	100	6	"	91	125	5	"	84	117	13
"	74	101	12	"	92	126	9	"	85	119	5
"	75	103	3	101	68	95	7	"	86	120	10
"	76	104	8	"	69	96	12	"	87	122	2
"	77	106	0	"	70	98	4	"	88	123	8
"	78	107	5	"	71	99	10	"	89	124	13
"	79	108	10	"	72	101	1	"	90	125	0
"	80	110	0	"	73	102	7	"	91	127	11
"	81	111	0	"	74	103	13	"	92	129	3
"	82	113	0	"	75	105	4	"	93	130	8
"	83	114	3	"	76	106	11				

NOTE.—In using these tables, observe that an allowance must be made if the animal is exceedingly fat or lean: in the former case, add 1-20th; in the latter, deduct the same proportion.

PRODUCE TABLES.

COW.

When Served.	Will Produce on	When Served.	Will Produce on	When Served.	Will Produce on	When Served.	Will Produce on
Jan. 1	Oct. 10	Apr. 1	Jan. 9	July 1	Apr. 10	Oct. 1	July 11
" 7	" 16	" 7	" 15	" 7	" 16	" 7	" 17
" 14	" 23	" 14	" 22	" 14	" 23	" 14	" 24
" 21	" 30	" 21	" 29	" 21	" 30	" 21	" 31
" 28	Nov. 6	" 28	Feb. 5	" 28	May 7	" 28	Aug. 7
" 31	" 9	" 30	" 7	" 31	" 10	" 31	" 10
Feb. 1	" 10	May 1	" 8	Aug. 1	" 11	Nov. 1	" 11
" 7	" 16	" 7	" 15	" 7	" 17	" 7	" 17
" 14	" 23	" 14	" 21	" 14	" 24	" 14	" 24
" 21	" 30	" 21	" 28	" 21	" 31	" 21	" 31
" 28	Dec. 7	" 28	Mar. 6	" 28	June 7	" 28	Sept. 7
Mar. 1	" 9	" 31	" 9	" 31	" 10	" 30	" 9
" 7	" 15	June 1	" 11	Sept. 1	" 11	Dec. 1	" 10
" 14	" 22	" 7	" 17	" 7	" 17	" 7	" 16
" 21	" 29	" 14	" 24	" 14	" 24	" 14	" 23
" 28	Jan. 5	" 21	" 31	" 21	July 1	" 21	" 30
" 31	" 8	" 28	Apr. 7	" 28	" 8	" 28	Oct. 7
		" 30	" 9	" 30	" 10	" 31	" 10

EWE.

When Served.	Will Produce on	When Served.	Will Produce on	When Served.	Will Produce on	When Served.	Will Produce on
Jan. 1	May 29	Apr. 1	Aug. 28	July 1	Nov. 27	Oct. 1	Feb. 27
″ 14	June 11	″ 14	Sept. 10	″ 14	Dec. 10	″ 14	Mar. 1
Feb. 1	″ 29	May 1	″ 27	Aug. 1	″ 28	Nov. 1	″ 30
″ 14	July 12	″ 14	Oct. 10	″ 14	Jan. 10	″ 14	Apr. 12
Mar. 1	″ 28	June 1	″ 28	Sept. 1	″ 28	Dec. 1	″ 29
″ 14	Aug. 10	″ 14	Nov. 10	″ 14	Feb. 10	″ 14	May 12

SOW.

Jan. 1	Apr. 21	Apr. 1	July 21	July 1	Oct. 20	Oct. 1	Jan. 20
″ 14	May 4	″ 14	Aug. 3	″ 14	Nov. 2	″ 14	Feb. 2
Feb. 1	″ 22	May 1	″ 20	Aug. 1	″ 20	Nov. 1	″ 20
″ 14	June 4	″ 14	Sept. 2	″ 14	Dec. 3	″ 14	Mar. 5
Mar. 1	″ 20	June 1	″ 20	Sept. 1	″ 21	Dec. 1	″ 22
″ 14	July 3	″ 14	Oct. 3	″ 14	Jan. 3	″ 14	Apr. 4

MARE.

Jan. 1	Dec. 1	Apr. 1	Mar. 2	July 1	June 1	Oct. 1	Sept. 2
″ 7	″ 7	″ 7	″ 8	″ 7	″ 7	″ 7	″ 7
″ 14	″ 14	″ 14	″ 15	″ 14	″ 14	″ 14	″ 14
″ 21	″ 21	″ 21	″ 22	″ 21	″ 21	″ 21	″ 21
″ 28	″ 28	″ 28	″ 29	″ 28	″ 28	″ 28	″ 28
″ 31	″ 31	″ 30	″ 31	″ 31	July 1	″ 31	Oct. 1
Feb. 1	Jan. 1	May 1	Apr. 1	Aug. 1	″ 2	Nov. 1	″ 2
″ 7	″ 7	″ 7	″ 7	″ 7	″ 8	″ 7	″ 8
″ 14	″ 14	″ 14	″ 14	″ 14	″ 15	″ 14	″ 15
″ 21	″ 21	″ 21	″ 21	″ 21	″ 22	″ 21	″ 22
″ 28	″ 28	″ 28	″ 28	″ 28	″ 29	″ 28	″ 29
Mar. 1	″ 30	″ 31	May 1	″ 31	Aug. 1	″ 30	″ 31
″ 7	Feb. 5	June 1	″ 2	Sept. 1	″ 2	Dec. 1	Nov. 1
″ 14	″ 12	″ 7	″ 8	″ 7	″ 8	″ 7	″ 7
″ 21	″ 19	″ 14	″ 15	″ 14	″ 15	″ 14	″ 14
″ 28	″ 26	″ 21	″ 22	″ 21	″ 22	″ 21	″ 21
″ 31	Mar. 1	″ 28	″ 29	″ 28	″ 29	″ 28	″ 28
		″ 30	″ 31	″ 30	″ 31	″ 31	Dec. 1

The table shows that the cow served on the 1st of January will produce on the 10th of October, the mare on the 1st of December; the ewe on the 29th of May; the sow on the 21st of April,—and so on.

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THE END.

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