U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY.

SPECIAL REPORT

ON

DISEASES OF CATTLE

AND ON

CATTLE FEEDING.

PREPARED UNDER THE DIRECTION OF

Dr. D. E. SALMON,

CHIEF OF THE BUREAU OF ANIMAL INDUSTRY,

BY

Drs. MURRAY, ATKINSON, HARBAUGH, LOWE, LAW, DICKSON, TRUMBOWER, SMITH, AND Prof. HENRY.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., May 14, 1892.

SIR: I have the honor to submit herewith a report upon the diseases of cattle, to which has been added a section upon cattle-feeding, the whole forming the second volume of the series of reports upon the diseases of the domesticated animals. The large demand for and the great popularity of the report on the diseases of the horse has been an additional reason for adhering as closely as possible to the plan adopted in the preparation of that volume. In preparing the illustrations for the report on diseases of cattle an effort has been made to supplement, as far as possible, the illustrations which appeared in the report on the diseases of the horse, so that the two series would together cover the field of veterinary surgery, which it is important to present to the reader in a graphic manner. On account of the importance of the alimentation as a factor in the maintenance of health and cure of disease, as well as in the profitable management of cattle, a section has been added on cattle-feeding, which has been written both from a practical and scientific point of view. This may justly be regarded as the clearest and most succinct presentation of this subject which has ever been published, while it is probably the only article of the kind in which the results of the latest scientific researches have been incorporated.

The writer has seen no reason to change his views, presented in the letter of transmittal accompanying the report on the diseases of the horse, as to the value of such publications to the farmers of the country. On the contrary, many letters have been received testifying that the writers had saved valuable animals by following the advice given in that report. In most of these cases it has been stated that no veterinarian was accessible, and that except for the report the animals would have been without intelligent treatment. In so large a country as ours there must for years to come be many sections in which no skilled veterinarian is located, and, consequently, there must continue to be many demands from stock-owners for information of this kind.

It is well, however, to remind the reader who has not made a special study of this subject that it would be absurd for him to conclude that even with the best of books he can treat his animals as well as they could be treated by a properly educated veterinarian. Careful study of the allied sciences and practical experience are as necessary to make a man successful in the treatment of diseased animals as in the case of sick people. The employment of a veterinarian is, therefore, advisable in all cases where a competent one can be obtained. In the many cases, however, where professional examination of the affected animal is out of the question, the reader may feel assured that the treatment here recommended is safe and the best that can be advised for his use.

It is hoped that this volume may have an important influence in bringing about more intelligent and more humane care and treatment of animals in health and disease. To this end the writers of the several sections have been requested to give a brief description of the various organs of the animal body, and a statement of their normal functions. This information is essential to a proper understanding of the nature of disease or the principles of treatment. When carefully studied it should do much to prevent the unnecessarily cruel and injurious practices which are still too common in the treatment of sick animals even in our enlightened country.

It is plain from what has just been said that this report has been prepared for the farmer and stock-owner rather than for the student or veterinarian. As much practical information as possible has been brought together on the subjects treated, but it has been stated in brief and plain language. Readers desiring a more detailed account of any subject are referred to the various special treatises. Notwithstanding the popular character of this work there is no doubt that it will be found useful to the veterinarian as well as to the farmer. The preceding volume of the series is found on the shelves of many practitioners who regard it as the most valuable work in their library, and it is believed that the accompanying report will be equally serviceable.

Very respectfully,

D. E. SALMON,
Chief of the Bureau of Animal Industry.

Hon. J. M. RUSK,
Secretary of Agriculture.

SPECIAL REPORT

ON

DISEASES OF CATTLE AND ON CATTLE FEEDING.

ADMINISTRATION OF MEDICINES.

By A. J. MURRAY, M. R. C. V. S., Detroit, Mich.

As medicines may be given in different ways, we will consider in detail the most common methods of administering them to bovine animals.

BY THE MOUTH.

Medicines may be given by the mouth in the form of draughts or drenches, powders, electuaries, and balls or pills.

Draughts or drenches.—This is the form in which medicine is usually given to cattle. The medicine should be dissolved in water, beer, or any other suitable liquid. Medicines which are soluble should be well shaken up with the liquid in which they are given, so as to insure their complete solution. For example, if we are giving an ounce of sweet spirits of niter the medicine should be shaken up with at least half a pint of water before giving it. If instead of doing this we give the medicine without diluting it, a sore and inflamed condition of the mouth and throat is produced. The materials which enter into the composition of some drenches are not soluble, that is, no amount of shaking will dissolve them in the liquid in which they are given. As examples of such medicines we may mention powdered ginger, powdered gentian, and carbonate of iron, but by shaking they may be temporarily suspended in the liquid in which they are given, so that by agitating such medicines while in the act of giving them they are temporarily mixed with the liquid and may consequently be given in a draught, though not quite so easily as medicines that are soluble. In giving drenches we must always ascertain to what degree the medicine or medicines composing the drench should be diluted. Carelessness in this matter may be attended with dangerous and even fatal consequences, and it is well to make it a rule not to give medicines unless they are prescribed by some one who is competent to give directions in such matters. Of course this rule will not apply to those who possess a sufficient knowledge of medicine to prevent a mistake being made. In giving a drench to an ox the hand should be passed in front of the horns and the fingers take hold of the *septum nasi* (partition between the nostrils); the nose should be raised in a slightly upward direction, and the neck of the bottle should then be introduced at the side of the mouth so as to allow the medicine to flow gradually out of the bottle. In doing this the animal's neck should not be twisted to the side on which the person administering the medicine stands, nor should the nose be raised higher than is necessary to allow the draught to flow easily down the throat. The neck and head ought to form a straight line of which the nose is the highest point. When an animal is inclined to resist it is necessary for an assistant to take hold of the horns so as to steady the head, and in this way to assist the person giving the medicine. If the animal tries to cough the head should be released for two or three minutes.

Powders.—The medicines which are to be given in the form of powder should be pulverized or finely divided, and also should be well mixed together if there are several ingredients in the powder. Materials should not be used in making up powders which will exercise a caustic or irritating action on the mouth, or which are possessed of a nauseating and disagreeable taste. As powders are usually mixed with food it is obvious that substances possessing a disagreeable taste will be refused by the animals to which they are given.

Electuaries are frequently used in treating sore throat, or when an animal is troubled with a cough. Electuaries are usually composed of a powder, such as chlorate of potash or alum, which is rubbed into a thick paste with sirup or molasses and is then smeared on the animal's tongue with a flat wooden spoon. Any powder, however, may be given in the form of an electuary as long as it is not possessed of caustic and irritating properties, or is not chemically unsuitable for giving in this way.

Balls or pills, though frequently used in treating the diseases of the horse, are not well adapted for the treatment of diseases of cattle. As cattle have four stomachs, solids pass rather slowly through these capacious digestive organs, so that very few veterinary practitioners resort to this form of administering medicine, which is found to be much less effectual than when it is dissolved or mixed with liquid.

BY THE BOWEL.

Injections of medicinal agents.—When the mouth is swollen or affected in such a manner that administration of medicine by that way is not practicable, the agent to be used may, after proper dilution, be given by the rectum, but it is usual to give a double dose when it is administered by this channel, as the action of medicine is less prompt and powerful than when given by the mouth. Before giving medicine in this way the rectum should first be emptied by a warm water injection.

Enemata or injections of hot water are also used in cases of constipation. It is unnecessary to mention what the temperature of water should be for giving an injection, as no one ever uses a thermometer to ascertain the temperature of water which is to be used for this purpose. When the hand is placed in the water to be used the water should feel pleasantly warm, and an injection should never be given without first testing the temperature of the water with the hand. Two quarts is a sufficient quantity to use as an injection, and if it is desired to render the injection stimulating a little soap may be added, though it should be borne in mind that the injection will be retained longer if no soap is added to it. If it is therefore desired that the injection should be retained as long as possible it is best not to add soap. We may mention that injections are not so much used, nor do they prove as serviceable in treating the diseases of the ox as they do in those of the horse.

Suppositories.—A suppository is usually composed of agents which exercise a soothing and anodyne effect on the part to which it is applied, and this effect is in time diffused to the adjoining parts. It is deposited in the rectum in the solid form and is usually cone-shaped. The rectum should be evacuated before introducing the suppository. They are not frequently used in veterinary practice.

BY THE VAGINA.

Inflammation is sometimes set up in the walls of the vagina, which may be occasioned by the bull during service, or while the calf is being extracted during difficult labor. In such cases the antiseptic and healing agent should be dissolved in tepid water and applied once or twice a day to the affected parts with a syringe. When the cleaning (placenta) has been retained in the womb instead of coming away shortly after calving, a purulent (mattery) discharge is set up, which is commonly known as the whites (leucorrhea). In such cases the womb should be washed out daily by connecting a long flexible tube with a syringe, which is passed by the hand into the mouth of the womb so as to wash out, cleanse, and set up a healing action in the surface of that organ.

BY THE NOSTRILS.

Inhalation.—Medicinal agents which are volatile—that is, capable of being diffused in the air—are sometimes administered in this way. The object may be to diffuse a certain quantity of gas, such as chlorine or sulphurous acid gas in the air of a stable, which the animals subjected to such treatment must breathe for a certain length of time. This system of treatment is frequently resorted to when the bronchial tubes of young cattle are infested with worms. Volatile agents, such as chloroform and sulphuric ether, are frequently administered in this way. If a cloth is saturated with chloroform or sulphuric ether and applied to one of the animal's nostrils while the other nostril breathes air, the vapor of either of the before-mentioned agents will pass through the nostrils into the lungs, but the wet cloth applied to the nostril should be covered with a dry one, folded several times on itself, so as to prevent the vapor escaping into the air. This medicinal treatment may also be applied in verminous bronchitis above mentioned, and it is also employed by surgeons to prevent an animal feeling the pain which attends an operation, though in the latter case the administration of the vapor must be carried to the extent of producing insensibility, and should only be applied for this purpose by a veterinarian.

Insufflation.—The agent to be employed in insufflation must be in the form of a fine powder, which is blown up the animal's nostrils. This mode of treatment is seldom employed in cattle diseases.

BY THE WINDPIPE.

The method of injecting medicines into the windpipe should only be applied by veterinarians.

BY THE VEINS.

What is termed intravenous injection, or the injection of medicinal agents into the veins, is not much practiced, and should only be resorted to by veterinarians.

BY THE SKIN.

Rubbing the agent on the skin.—This method of applying medicine is practiced chiefly in parasitic diseases, and the end aimed at is to destroy the parasite whether it be of an animal or a vegetable nature. In making such applications that form of ointment which will enable the operator by rubbing to work the medicinal agent thoroughly into the skin should be preferred. In applying an ointment to the skin of cattle it is desirable to avoid the use of poisonous materials, such as mercury and arsenic. Instances have frequently happened in which, when poisonous ingredients have been used in making an ointment, that the animals have licked themselves after it has been applied, and have consequently been poisoned. Another source of danger when poisonous ointments or solutions are employed is that animals affected with a skin disease frequently present raw patches of skin on different parts of their bodies, and it has frequently been found that when the solution or ointment is applied on such raw surfaces absorption takes place, and dangerous and even fatal results are rapidly produced. The treatment of skin diseases not unfrequently is unsuccessful owing to the failure to wash the skin well with soap and water so as to remove scabs and thus to allow the ointment to be applied thoroughly to the affected parts. When animals are affected with neuralgic or irritating forms of skin disease, local applications are of great service in allaying irritation or pains.

Subcutaneous injection.—Medicines are sometimes injected beneath the skin so that they may be absorbed and pass into the blood. This method of administering medicine is becoming more extensively used, and in various forms of disease proves of great service; but the practice of it is limited to veterinarians, as it requires special instruments and a special knowledge of the medicines and also of the modes of preparing them, to administer medicine in this way.

DISEASES OF THE DIGESTIVE ORGANS.

By A. J. MURRAY, M. R. C. V. S., Detroit, Mich.

It is not proposed to enter into any elaborate consideration of the nature and chemical composition of food under this title, but rather to touch on such general aspects of this subject as are within the experience of farmers, with the view of indicating what may be done to prevent the occurrence of disease. It is a matter of general experience that disorder of the digestive organs is frequently occasioned by defects in the quality of the food supplied to cattle. Hay which is coarse and fibrous overtasks the digestive powers, irritates the mucous surface of the stomachs and bowels, and may lead to a torpid and inactive condition of the stomachs, or when it acts on the bowels may lead to the development of dysentery. Timothy hay may be of good quality for feeding to horses, but when fed to cows, especially those which do not get exercise, it will produce a constipated condition of the bowels. Hay fed to cattle should always contain a considerable proportion of clover, which, from its laxative effect, keeps their bowels in a natural condition.

Food which is finely divided, such as corn meal and fine middlings, fed alone, is not adapted for the digestive organs of cattle. It does not pass readily through the stomachs, and frequently gives rise to severe attacks of indigestion. When fine middlings and corn meal are used they should be mixed up with chopped hay, or what is commonly known as cut feed, as this tends to prevent those finely divided foods clogging together and giving rise to fermentation in the stomach, and they should even then be used in moderate quantity. The chemical composition of a food is not always a safe criterion for estimating its value. Its digestibility must always be taken into consideration, as the physical characters may render it liable to disorder digestion. Hay which has been much exposed to the rain while drying is innutritious and is likely to produce inflammatory affections of the stomach and bowels, and the same remark will apply to musty oats. Ergot not only diminishes the nutritive value of hay, but has a special effect in producing gangrene of the extremities, which is best counteracted by feeding roots to cattle when it is absolutely necessary to feed them on hay made from ergoted grass. (See Plate v.) Rusty straw is also a dangerous article of food, and will produce disease if fed to cattle. Smut on corn impairs its nutritive qualities, and animals which are fed on such corn lose weight, so it appears also to interfere with assimilation. In some instances the indigestion which smutty corn produces terminates in inflammation of the fourth stomach and portions of the intestinal canal. In what is termed "cornstalk disease," indigestion followed by delirium and coma is produced in cattle by feeding them on corn which is supposed by some writers to be infested by a minute parasitic fungus. These living organisms are found on the lower leaves of the corn, which, when invaded by those parasites, has a dwarfed appearance. The diseased leaves become yellowish-green, then yellow, and then wither away. Upon closer examination it will usually be seen that there are certain spots, more especially about the base of the leaf, which is closely wrapped around the stalk, having a different discoloration. These are brown, watery-looking objects at first; then darker, and finally dead. Occasionally there are livid red spots and patches in the same situation. These specially affected spots vary in size from mere points to those of several inches across, often longer, in the direction of the veins of the leaf or leaf sheath (Burrill). Whenever this disease appears in a cornfield it is advised that every stalk and leaf in the field should be burned, and that the field be seeded down to grass. The writer has observed during some years, and usually after a spell of dry, warm weather, that cattle grazing on pastures usually considered as sound and healthy have become affected with indigestion, followed by delirium and coma, but he has been unable to satisfy himself as to the causation of such outbreaks of disease. The explanation of such facts remains a matter of future investigation. Grass growing on wet, marshy land is favorable to the production of dysentery, and we have sometimes seen animals die suddenly while grazing on such pastures, and have traced such deaths to a form of anthrax introduced through the digestive system. Frozen turnips and potatoes produce very dangerous attacks of indigestion when eaten by cattle, and grass which is wet by dew or rain, or covered with hoarfrost, should also be regarded as dangerous. The sudden chilling of the stomachs when a quantity of such food is eaten arrests digestion and will also occasion cramp of the stomach and bowels.

Causes.—In tracing out the causation of disease we find in not a few instances that *excess* is the disturbing element, instead of *quality*. For example, when cattle are turned into a new and rather luxuriant pasture severe attacks of indigestion may result from their eating too greedily, and it is well, under such circumstances, to allow them in such pastures for only a comparatively short time each day, until they become accustomed to their richer and more tempting herbage. The same idea may be applied to different kinds of food which, though wholesome when partaken of moderately, become dangerous when used to excess.

The *manner* of eating may also produce indigestion, as food hastily eaten and consequently imperfectly masticated is not properly prepared for the action of the stomachs. Circumstances, of course, must suggest what ought to be done to prevent the injurious action of this cause.

Water should always be supplied to cattle in sufficient quantity. *Excess* here may prove very injurious, and may occasion cramp in the fourth stomach. If animals have access to water at all times, or at least frequently, there is no danger of their suffering from drinking to excess. In this connection we may state that it is better for cattle to have rock salt placed within their reach, so that they may lick as much as they feel inclined to do, rather than to mix salt in their food, as in the latter case there is a danger of their getting too much, thus engendering excessive thirst. It has been customary lately to recommend hot water as the usual drink for cattle during cold weather, and it is claimed that they are kept in better condition by supplying them with hot water instead of cold water. The argument is put forward that a large quantity of heat is lost in raising the cold water drank to the temperature of the animal's body, and that this large consumption of heat must increase the waste of the tissues. This is an exclusively chemical way of looking at the matter, and we think it should rather be regarded from the standpoint of what effect such a practice would have on the future health, endurance, and vitality of cattle. While we are aware from experience that cramp of the stomach is sometimes produced by cattle drinking ice-cold water, we think that the other extreme of supplying them with hot water is not to be recommended, as it must render them extremely sensitive to any occasional or accidental change which might take place in this sort of regimen. The question has also to be decided as to what would be the ultimate effect of such a practice on the digestive systems. A short experience of this method of watering cattle can not be held to settle the question of its advantages and disadvantages.

Hard water or water containing a large proportion of inorganic constituents is not to be regarded as good drinking water. We have seen water which had been rendered hard artificially, by adding a little lime to it, produce colic to such an extent when it was used for drinking water that its use had to be abandoned.

A large proportion of organic matter is also a source of danger, and should be guarded against. It usually is contaminated by a well or stream being so situated as to receive the drainage of some accumulation of filth, though water in marshy localities frequently contains a high proportion of organic constituents, and is consequently objectionable. We need hardly say that water contaminated by the dead bodies of animals is to be regarded as dangerous, as here we have the further danger that it may become the vehicle of communicating specific diseases.

DISEASES OF THE MOUTH.

WOUNDS AND CONTUSIONS OF THE LIPS.

The lips may become inflamed from contusions, which are sometimes produced by a blow from the horns of another animal, or in the case of working oxen it may be produced by a blow from the driver. While cattle are grazing they are sometimes bitten in the lips by serpents, more especially when they are pastured in woods.

Symptoms.—As a result of a contusion the lips become thick and swollen, and if treatment is neglected the swelling becomes hard and indurated. This condition renders it difficult for the animal to get food into its mouth, on account of the lips having lost their natural flexibility. In such cases an ox will protrude his tongue and endeavor to bring the food into his mouth with that organ. In cases of snake-bite the limits of the swelling are not well defined; it is soft and comparatively painless.

Treatment.—When we have to deal with a bruise, which is easily distinguished from a snake-bite by the different train of symptoms which are produced, the affected part should be bathed steadily for three or four hours with the following solution: Muriate of ammonia, 1 ounce; water, 2 pints. In recent cases no other treatment will be required, but if the swelling is not recent and has become hard or indurated, then the swollen part should be gently rubbed every second day with oil of turpentine until the swelling has subsided. In snake-bite a straight incision penetrating into the flesh or muscle should be made across the center of the wound, and then a similar incision, but passing crosswise of the first, should be made. This is what surgeons term a "crucial" incision. After this has been done a small wad of cotton batting should be pressed against the wounds until the bleeding has almost stopped. Afterwards the following lotion may be applied to the wounds several times a day: Permanganate of potash, half a dram; distilled water, 1 pint. As snake-bites are usually attended with considerable depression, which may terminate in stupor, it is advisable to give doses of whisky at intervals. Half a pint of whisky mixed with a pint of water should be given, and the dose should be repeated in half an hour if the animal is sinking into a stupefied and unconscious condition. The repetition of the dose must depend on the symptoms which the animal shows. It must be borne in mind that the object of treatment is to ward off the stupor, which is one of the results of snake-bite, and that in administering whisky the object is to produce a stimulating and not an intoxicating or stupefying effect.

SALIVATION.

Salivation is a symptom of some general or local disorder. It may, therefore, be a symptom of a general disease, such as rabies or the foot-and-mouth disease (epizoötic aphtha), or it may be a purely local trouble, as when copious secretion of the salivary glands is produced by animals eating irritating plants, such as wild mustard. In cases where saliva is observed to dribble from the mouth that part must be carefully examined by introducing an instrument like a balling-iron into the mouth, or if such an instrument is not at hand, by grasping the tongue and partially withdrawing it from the mouth while all parts of the mouth are exposed to a good light, so that the presence of any foreign substance may be detected. The cause will sometimes be found to depend on a short piece of wood becoming fixed on the palate, its two ends resting on the upper molar teeth of each side; or it may depend on a needle, thorn, or splinter of wood becoming imbedded in the tongue. Sometimes a sharp piece of tin or other metal may become partially imbedded in the inner surface of the cheek. Hay occasionally possesses some quality which produces salivation, though only in some animals. Another cause of salivation is cattle which have been rubbed with mercurial ointment (see Mercurial Poisons, p. 69), licking themselves. Such cases, of course, arise from the constitutional action of mercury, and indicate the danger of using such a preparation externally, on account of the common habit which the animals have of licking themselves.

Treatment.—If salivation depends on the irritation and inflammation set up by the ingestion of acid plants, or forage possessing some peculiar stimulating property, a lotion composed of an ounce of powdered alum dissolved in a quart of water should be syringed into the mouth twice a day, using half a pint of the solution each time. If, however, the salivation depends on the presence of a thorn, splinter of wood, or any other foreign substance imbedded in the cheek or tongue, remove the offending object and wash the mouth occasionally with a weak solution of carbolic acid and tepid water. When salivation is produced by mercurial poisoning or by the foot-and-mouth disease (epizoötic aphtha), the treatment appropriate to those general conditions of the system, as well as the local treatment, must be applied.

IRREGULARITIES OF THE TEETH.

Irregularities of the teeth may be occasioned by the unequal wearing of some of the teeth or by some of the incisors being broken, which may happen when cattle are pastured on sandy or gravelly soil. The molar teeth may also show irregular wear from similar causes. Their edges may become sharp, or it may happen that a molar tooth has been accidentally fractured. It may also occur that a supernumerary tooth has developed in an unusual position, and that it interferes with the natural and regular mastication of the food.

Treatment.—The mouth may be examined by grasping the animal's tongue with one hand and partially withdrawing it from the mouth, so as to expose the incisor and molar teeth to inspection. When it is desired, however, to examine the molar teeth with the fingers, so as to obtain a more precise idea of their condition, an instrument like the balling-iron which is used for the horse should be introduced into the mouth, so as to separate the jaws and keep them apart while the examination is being made. Any sharp edges of the molars must be removed by the tooth-rasp. Any supernumerary tooth which interferes with mastication or any tooth which is fractured or loose should be extracted. In performing such operations it is desirable to throw or cast the ox, and to have its head held securely, so as to enable the operator to do what is necessary without difficulty.

CARIES OF THE TEETH.

The presence of caries may be suspected if the mouth exhales a bad odor, and if the animal occasionally stops during mastication as if it were in pain. The existence of caries in a molar tooth may be ascertained by examining the mouth in the manner already described. If one of the molars is found to be carious it should be extracted, if the caries is so extensive as to render other means of treatment impracticable. When the crown of the tooth has been destroyed and only the stump or root is left, extraction will be impracticable. In such cases it is best to sell the animal to the butcher.

ACTINOMYCOSIS OF THE JAWBONES—BIG-JAW—LUMP-JAW.

[Plates XXXIX, XLI.]

The disease which we have now to consider is generally known among farmers and cattle dealers under the two latter designations. Attention is first directed to the animal by a swelling or enlargement of the jawbone, and the opinion generally expressed when such a swelling is observed is that the animal has received some severe contusion which has been the starting point of the swelling. It is found, however, that when a blow or contusion is the starting point of such a swelling it rarely if ever ulcerates, and that the continuous application of cold water checks the growth of a swelling which is merely the result of mechanical injury. In the disease we are now considering, however, the application of cold water does not exercise the least influence in checking its progress. The swelling described may affect either the upper or lower jaw, or it may affect both at the same time, and produce considerable swelling of the soft tissues as well as enlargement of the bony structure. As a result of the swelling described the molar teeth of the upper and lower jaws may be pushed out of their natural position so that they are no longer in apposition, and they consequently can not serve the purpose of masticating the food. It may also happen that from degeneration of the tooth-sockets the teeth drop out. This result may be suspected when the animal becomes unable to masticate its food. As a result of ulceration it frequently happens that an opening forms on the external part of the tumor, and frequently a similar destructive process forms an opening into the mouth itself.

In a recent work, in treating of this subject, I have remarked that in some cases it will be observed that these swellings, after growing for a short time, remain in a stationary condition—the growth appears to be arrested. Such cases will not require treatment, as the arrest of the growth of the swelling is no doubt caused by the death of the parasite, which ceases to reproduce itself and thenceforth becomes harmless. The living parasite, by rapidly reproducing itself, extends through the bony tissue, and by setting up inflammation causes a rapid increase of the swelling. The aim of treatment then is to destroy the parasite, thereby arresting the growth of the swelling; and this is all that can be done, where the utmost success practicable is attained. The importance of early treatment will, however, be understood when it is remembered that there is a continued and rapid multiplication of the parasite, and that this multiplication is attended with increasing damage to the tissues of the animal in which it is lodged.

Treatment.—When there is an external opening on the surface of the swelling it should be injected with tincture of iodine. When there is no external opening several incisions should be made through the skin covering the swelling, and portions of the outer plate of the jaw-bone should be removed with a trephine, and tincture of iodine injected into the orifices thus made. This treatment should be applied daily, and may be continued until it is apparent that the growth of the swelling has been checked. The iodine checks the growth of the swelling by destroying the parasite whose continuous development is the means of setting up diseased action in the bone. Other methods have been applied in treating this disease, such as burning the diseased bone with the hot iron, which is said to have proved effectual in checking the progress of the disease. But remedies whose action is diffused extensively through the diseased tissues are to be preferred in treating a disease of this nature.

INFLAMMATION OF MUCOUS MEMBRANE OF MOUTH—STOMATITIS.

The membrane of the mouth may become inflamed by cattle eating some irritating substance, by eating acid plants, or little vesicles may form in the mouths of calves when they are affected with indigestion, constituting what is termed aphtha.

Symptoms.—The saliva dribbles from the mouth, and when it is examined the surface of the tongue and other parts of the mouth will appear red and inflamed. When young animals are affected with the form of disease termed aphtha small red elevations will be observed on the tongue and other parts of the mouth, having little white points on their centers, which consist of the epithelium of the mucous membrane raised into vesicles. These white patches are succeeded by ulcerated surfaces, which are exposed by the shedding of the white patches of epithelium.

Treatment.—When there is merely a reddened and inflamed condition of the mucous membrane of the mouth, it will suffice to syringe it out several times a day with 4 ounces of the following solution: Alum, 1 ounce; water, 2 pints. When the edges of the tongue and other parts of the mouth are studded with ulcers these should be painted over once a day with the following solution until the affected surface is healed: Iodoform, 60 grains; ether, 1 ounce. When indigestion is associated with an ulcerated condition of the mouth that disorder requires separate treatment.

GANGRENOUS STOMATITIS—GANGRENE OF THE MOUTH IN YOUNG CALVES.

This affection usually appears in young calves about the time when they are cutting their molar teeth.

Causes.—Insufficient nourishment, the debility resulting from diarrhea and from inflammation of the umbilicus (navel) predispose animals to this disease, and, as already mentioned, its development is associated with disorder of the digestive system resulting from the cutting of the molar teeth. I may mention, however, that I have seen this disease affect cows quite severely, though they afterwards made a complete recovery. This malady then may affect mature animals and may arise from conditions which at present are unknown. It is asserted by Hill, in his work on diseases of the ox, that this is a tuberculous disease, but the fact that animals may recover completely in three or four weeks renders it surprising that he should have made such a statement. That the calf of a tuberculous cow may become affected with gangrenous stomatitis, or that in a few instances traces of tuberculous disease have been found in the bodies of animals that have died from it, are mere coincidences, and lend no weight to the opinion that this malady is of a tuberculous nature. The same writer says this disease may assume a diphtheritic type, but diphtheria is contagious and is characterized by the production of false membrane, while the most prominent feature of this disease is the extent to which death of the affected tissues takes place, which differentiates it from both tuberculosis and diphtheria.

Symptoms.—In the early stage there is redness of the mouth, from which the saliva dribbles, but in two or three days a whitish point appears on some part of the mucous membrane of the mouth. It gradually extends in size and depth, and a red, inflamed zone surrounds the affected part, which begins to present a yellowish, cheesy appearance, and then, as it begins to break up and decompose, exhales a fetid, disagreeable odor. Sometimes the entire thickness of a portion of the tissues composing the cheek becomes gangrenous. If the decayed part is not removed by the knife it is gradually separated from the surrounding living tissues by the process of ulceration. In this way an aperture will sometimes be formed in the animal's cheek through which the saliva is ejected when it is masticating its food. This disease may be complicated by diarrhea setting in, which has an exhausting effect on the animal, as is shown by its frequently lying down. This malady often terminates in death, and it runs its course in from seven to ten days. In treating this disease in cows, however, I have observed that complete recovery does not take place under three or four weeks. Its duration will vary according to the extent to which the animal is affected.

Treatment.—Sulphate of quinine should be given to calves three times a day in doses varying from 5 to 10 grains, according to the size and age of the animal, and should be repeated about four times a day. Half-ounce doses of lime-water mixed with milk should be given if diarrhea is present. When the calf shows signs of debility, or diarrhea is present, whisky or brandy should be administered several times a day. The stimulant should be mixed with two or three parts of water, and should be repeated three or four times a day. In the case of cows, quinine should be given in dram doses. When the animal's appetite is poor or when it is weak, whisky or brandy should be given in half-pint doses two or three times a day, mixed with 2 parts of water. To cleanse the mouth and remove the fetor it should be syringed out several times a day with the following solution: Chlorinated soda, 4 ounces; water, 2 pints. When the gangrenous parts have sloughed, then a lotion composed of sulphate of copper, 2 drams; water, 2 pints, should be applied every day to the raw surfaces to promote healing. The diet should be nutritious, and for calves the cow's milk is to be preferred. The gangrenous tissue assumes a yellow, cheesy appearance, and the animal's recovery will be hastened by removing dead tissue with the knife and not waiting until the process of ulceration separates it from the living parts. During the convalescent stage it is advisable to give carbonate of iron in combination with quinine. It may be given to calves in 10-grain doses, and to cows in 2-dram doses. In concluding we may mention that Longlen, of Arras, was the first veterinarian to publish an accurate and clear account of this disease.

INDURATION OF THE TONGUE—ACTINOMYCOSIS.

This disease commences with small patches of a yellow color, which may appear on the upper or under surface, on the tip, or on the sides of the tongue. The mucous membrane covering these patches is thickened, and it soon breaks up into a number of pimple-like excrescences which run together, and it then ulcerates and is cast off, leaving a red and excavated surface. These patches are found to cover a number of nodular bodies, most of which are as large as a hemp-seed, though some are as large as a cherry or a walnut. These nodules, when cut into, are seen to be composed of a yellow, cheesy-looking substance, which, when removed, leaves a sharply-defined cavity or ulcer. The nodules may be deep seated, so that they can not be discovered by examining the surface of the tongue, but in this situation, instead of producing ulceration and destruction of the mucous membrane, they set up inflammation in the muscular structure of the tongue, which terminates in a marked enlargement and wood-like induration of that organ, which has led to this disease being commonly called "wooden tongue" in Germany. The enlarged and indurated condition of the tongue is a great impediment to the animal masticating its food, so that if the tongue is extensively affected the animal soon becomes emaciated. Similar nodules may form on the inner surface of the cheeks, of the lips, on the surface of the palate, and even in some instances on the mucous membrane lining the nose.

Treatment.—When the nodules are large they may be dissected out or scraped out, so as to leave nothing but healthy tissue, and afterwards dressed with tincture of iodine. When this procedure is not practicable an incision should be made into the nodule, which should then be injected with tincture of iodine. This treatment destroys the microscopic fungus contained in the nodules, and will consequently prevent its spreading and bring about its ultimate separation from the healthy tissues. It is obvious that to treat this disease successfully its nature must be recognized at an early stage. After the muscular portion of the tongue has become enlarged and indurated it will not be possible to restore it to its healthy condition.

[Quite recently actinomycosis of the tongue has been treated with great success in Europe by the administration of iodide of potassium. According to Nocard, this drug given once or twice a day, in doses of 1½ drams dissolved in a pint of water, acts as a specific and is followed by rapid improvement and the permanent cure of the affected animal. The results reported are so extraordinary that they justify the trial of this remedy in all cases of actinomycosis in the tongue or other organs. D. E. S.]

DISEASES OF THE PHARYNX AND GULLET.

PHARYNGITIS—SORE THROAT.

This is an inflammation of the mucous membrane lining the pharynx. It is frequently associated with laryngitis and bronchitis, and sometimes with pleurisy.

Symptoms.—The muzzle is dry, the saliva dribbles from the corner of the mouth; the animal either does not swallow or swallows with difficulty; occasionally the liquids which it attempts to take come back in part through the nostrils, and the animal holds its neck in a stiff, straight position, moving it as little as possible. The eyelids are half closed, the white of the eye is bloodshot, and the animal occasionally grinds its teeth. When it attempts to eat hay or grass, after masticating the food the animal drops it out of its mouth as if to avoid the pain of swallowing, and also evinces pain when pressure is applied on the pharynx externally, and tries to prevent such pressure being applied.

Causes.—Pharyngitis is produced by a sudden cooling of the surface of the body, as when cattle are exposed to a cold wind or a cold rain.

Treatment.—The throat should be syringed three times a day with an ounce of the following solution: Nitrate of silver, 1½ drams; distilled water, 1 pint. Bland and soothing drinks, such as linseed tea, oatmeal and water, should occasionally be offered. Diet should consist of soft food, such as bran mashes with a little linseed meal mixed in them. The upper part of the throat and the space between the jaws should be well rubbed once a day with the following liniment: Liquor ammonia fortior, 4 ounces; oil of turpentine, 4 ounces; olive oil, 4 ounces. Mix. Under the above treatment the inflammation of the throat will gradually subside and the animal will be able to swallow as usual in five or six days. We need hardly say that during its treatment the sick animal should be kept in a comfortable stable.

PAROTITIS.

Inflammation of the parotid gland may arise from the inflammation extending to it when an ox is affected with pharyngitis or laryngitis, or the inflammation may commence in the salivary ducts and may depend on some influence the nature of which is unknown. Parotitis sometimes arises from a blow or contusion which is severe enough to set up inflammation in the structure of the gland.

Symptoms.—There is an elongated painful swelling, beginning at the base of the ear and passing downward along the posterior margin of the lower jaw. The swelling is sometimes limited to one side, and when both sides are swollen it is generally larger on one side than on the other. The secretion of saliva is increased, the appetite is poor, the neck is stiff so that it is painful to raise the head, and food is swallowed with difficulty. In many cases the swelling of those glands, when submitted to proper treatment, disappears in a comparatively short time. In other cases, however, the gland remains enlarged, even after the animal recovers its appetite.

Treatment.—A warm bran poultice should be applied on the swollen gland, and whenever the poultice has cooled it should be replaced by a new one. This treatment should be continued until an abscess forms, which may be ascertained by examining the surface of the gland with the fingers, and when on pressing any part of the surface it is found to fluctuate or "give," then we may conclude that an abscess has formed. It is well not to open the abscess until the fluctuation is well marked, as at this this stage the pus or matter is near the surface and there is less trouble in healing the wound than if the pus is deep seated. The poulticing should be continued for two or three days after the abscess has been opened. By that time the discharge of pus has ceased or become very slight, and the poulticing may be discontinued. The wound should be sponged with tepid water once a day and a little of the following lotion afterwards applied: Carbolic acid, 1 dram; water, 8 ounces. In some cases, after poulticing for four or five days, there will be no indication of softening at any point, and that treatment may therefore be discontinued, and then the swollen gland should be gently rubbed once a day with camphorated oil. If this fails to promote absorption or bring about a gradual dispersion of the swelling, then to attain this object the swelling may be painted with tincture of iodine twice a day or rubbed once a day with compound iodine ointment. When the swollen gland is not being poulticed it should be covered with a piece of flannel. The diet of the animal should consist of soft food while it is under treatment.

PHARYNGEAL POLYPI.

Tumors form not infrequently in the pharynx, and when they increase in size may give rise to a train of symptoms varying according to the situation which they occupy in that part. The tumor may be so situated that by shifting its position a little it may partially obstruct the posterior nares (nostrils), when, of course, it will render nasal breathing very noisy and labored. In another situation its partial displacement may impede the entrance of air into the larynx. In almost any part of the pharynx, but especially near the entrance of the gullet, they will interfere with the act of swallowing, and this fact is so generally recognized in some parts of Germany that whenever an animal begins to lose condition it is said to have a "growth" in its throat. As these tumors are frequently attached to the wall of the pharynx by a pedicel or stalk, it will be seen that they may readily be displaced in different directions so as to produce the symptoms before described.

Treatment.—The method of treatment followed in such cases is to separate the animal's jaws with an instrument termed a gag, and then after drawing the tongue partially forward to pass the hand into the pharynx and to wrench or twist the tumor from its attachment. One veterinarian who has had considerable practice in treating this form of disease scrapes through the attachment of the tumor gradually with his thumb nail. In cases where the attachment is too strong to be severed in this way an instrument like a thimble, but possessing a sharp edge at the end, might be used to effect the same purpose. As it is impossible to use a knife in the pharynx the suggestion here made might in the future be carried out with advantage.

CHOKING.

This accident usually happens from attempting to swallow too large an object, such as a turnip, potato, beet, or an apple or pear, though in rare cases choking may occur from bran, chaff, or some other finely divided food lodging in and filling up a portion of the gullet. This latter form of the accident is most likely to occur in animals which are greedy feeders.

Symptoms.—The symptoms will vary somewhat according to the part of the gullet or throat in which the obstruction is located. In most cases there is a discharge of saliva from the mouth; the animal coughs frequently, and when it drinks the water is soon ejected. These symptoms, however, are not always present, as I have seen a case in which a potato was lodged in the upper part of the gullet, but where there was a small space between the wall of the gullet and the obstruction, so that water given by the mouth passed into the stomach, and in this case there was neither coughing nor any other symptom of distress. The potato was so large, however, that there was not space enough to pass the tip of the finger behind it so as to slide it into the pharynx, though repeated efforts were made to withdraw it in this way while it was simultaneously pushed from the outside in an upward direction. After the lapse of several hours it passed into the stomach of itself.

Treatment.—It is always advisable to put a gag in the animal's mouth, and while the head is held in a horizontal direction by two assistants to pass the hand into the pharynx, and when any foreign body is found in the pharynx to withdraw it gradually and steadily. When the substance is lodged in the upper part of the gullet pressure should be made by an assistant in an upward direction while the operator passes his hand into the pharynx, and if the assistant can not by pressure dislodge the substance from the gullet the operator may by passing his middle finger above and partly behind the substance gradually slide the object into the pharynx and then withdraw it by the mouth. It is usually stated that irregular shaped objects are more difficult to manipulate. This statement, however, is of doubtful accuracy, as a root with a smooth surface, which nearly fits the upper part of the gullet, will be found extremely difficult to move from its position. The presence of an obstructing substance in the cervical portion of the gullet may be ascertained by passing the hand along the left side of the neck, when a hard and painless swelling will be found to indicate the presence of the foreign body. In such cases we must endeavor by gentle and persevering pressure with the thumb and two next fingers to slide the obstructing substance gradually upward to the pharynx. To facilitate this it is well to give the animal a wineglassful of olive oil before the manipulations described are commenced. When the substance has been brought into or nearly into the pharynx, then the mouth gag should be used, the tongue drawn partially forward with the left hand, and the right should be passed forward into the pharynx, so as to withdraw the obstruction. When bran or chaff causes the trouble it is best to give a small quantity of oil to lubricate the walls of the gullet and then by gentle and persevering pressure to endeavor to separate and divide the mass and then to work it downward toward the stomach. This will be assisted by pouring small quantities of oil and water down the animal's throat. It is not advisable to use the probang to push down any soft material such as oats or chaff, as this generally condenses and renders firmer the obstructing substance by pressing its particles or elements together, so that it forms a solid, resisting mass which can not be moved.

In some cases the foreign body can not be dislodged from the neck by pressing and manipulating that part externally. In such an event we must resort to the use of the probang, or if the foreign body is lodged in that part of the gullet which passes through the thorax or chest, there is no way of removing an obstruction so situated except by using the probang. (Plate III, Figs. 2, 3.) The instrument usually employed for this purpose is called the probang of Munro, after its inventor. Before passing the probang a gag is introduced into the animal's mouth, and the gag should have an aperture at each end from which a strap passes and is buckled at the back of the head below the horns. (Plate III, Fig. 4.) The probang should then be oiled, and the head and neck being held in a straight line by two assistants, the tongue must be partly drawn out of the mouth, the probang cautiously passed along the roof of the mouth into the pharynx and thence into the gullet, through which it is passed down. If resistance is met, gentle and continuous pressure must be employed, under the influence of which the agent will generally in a short time pass into the stomach. A probang is a flexible instrument, and adapts itself to the natural curvature of the gullet, so that if it is used cautiously there is not much risk of injury.

Some writers have advised that when the obstruction is lodged in the cervical (neck) portion of the gullet it should be struck with a mallet, so as to crush it and thus alter its shape so that it may easily slip down into the stomach. If the obstructing substance is hard, this will be a dangerous operation, but if soft, as in case of a ripe pear for example, this proceeding might be safely adopted.

In all cases where pressure applied on the neck fails to move the obstruction and the probang also fails to move it, the gullet must be opened and the obstructing substance removed through the wound. In such cases the assistance of a veterinarian or a surgeon must be obtained.

WOUNDS AND INJURIES OF THE GULLET.

Sometimes from the rash and too forcible use of the probang the walls of the gullet may be more or less lacerated or abraded, and the animal consequently swallows with pain and difficulty. In such cases dry feed must be withheld for five or six days, so as to allow the injured parts to heal, and the diet must be limited to linseed tea, hay tea, and thin oatmeal gruel. The same kind of diet must be fed after the operation of cutting into the gullet has been performed.

Sometimes the gullet is ruptured and lacerated to such an extent that treatment of any kind is hopeless. I have known this to occur when the handle of a pitchfork has been pushed down a cow's throat to remove an obstruction. Where such treatment has been applied it is best to slaughter the animal without delay, as the flesh may be utilized, and remedial treatment would be hopeless. In this connection it may be mentioned that whatever substitute may be used for a probang, which sometimes is not at hand, it should be flexible and should possess a smooth surface. The handle of a whip, when it is flexible, may be used in emergencies.

DISEASES OF THE STOMACH.

TYMPANITES, HOVEN, OR BLOATING.

This disease is characterized by swelling of the left flank, and is caused by the formation of gas in the rumen or paunch. (See Plates I and II.)

Causes.—Tympanites may be caused by any kind of food which produces indigestion. When cattle are first turned into young clover they eat so greedily of it that tympanites frequently results; turnips, potatoes, and cabbage may also cause it; middlings and cornmeal also frequently give rise to it. In this connection it may be stated that an excessive quantity of any of the before-mentioned foods may bring on this disorder, or it may not be due to excess but to eating too hastily. Sometimes the quality of the food is at fault. Grass or clover when wet by dew or rain frequently disorders digestion and brings on tympanites; frozen roots or pastures covered with hoar-frost should also be regarded as dangerous. When food has been eaten too hastily, or when it is cold and wet, the digestive process is imperfectly performed and the food contained in the paunch ferments, during which process large quantities of gas are formed. The same result may follow when a cow is choked, as the obstruction in the gullet prevents the eructation or passing up of gas from the stomach, so that the gas continues to accumulate until tympanitis results.

Symptoms.—The swelling of the left flank is very characteristic, as in well-marked cases the flank at its upper part rises above the level of the backbone and when struck with the tips of the fingers emits a drumlike sound. The animal has an anxious expression, moves uneasily, and is evidently distressed. If relief is not obtained in time it breathes with difficulty, reels in walking or in standing, and in a short time falls down and dies from suffocation. The distention of the stomach may become so great as to prevent the animal from breathing, and in some instances the case may be complicated by rupture of the stomach.

Treatment.—In urgent cases the trocar should be used immediately, for when the distension of the stomach has become extreme there is no trying the remedial effect of medicine. The trocar is a sharp-pointed instrument encased in a sheath, which leaves the sharp point of the trocar free. (See Plate III, Figs. 5*a* and 5*b*.) In selecting the point for using the trocar, a spot equally distant from the last rib, the hip bone and the transverse processes of the lumbar vertebræ must be chosen. Here an incision about three-quarters of an inch long should be made through the skin, and then the sharp point of the trocar being directed downward, inward and slightly forward, is thrust into the paunch. (Plate I.) The sheath of the trocar should be left in the paunch as long as any gas continues to issue from it. If the canula or sheath of the trocar is removed while gas is still forming in the paunch and the left flank becomes considerably swollen it may be necessary to insert it again. It is well accordingly to observe the canula closely and if gas is found to be issuing from it, it should not be removed. In order to be certain on this point I have been in the habit of placing the palm of my hand about 2 inches above the mouth of the canula, when if gas is issuing the sensation produced by the current of gas coming against the skin will enable one to form an accurate opinion. When gas issues from the canula in considerable quantity the sound accompanying its escape renders the exact condition obvious. It is occasionally necessary to keep the canula in the stomach for several hours. When this is necessary a piece of stout cord should be passed round the neck of the canula immediately below the projecting rim, and then be passed round the animal's body and tied in a secure knot. The rim surrounding the mouth of the canula should be in contact with the skin. When the canula is secured as described it may remain in the stomach over night. I have even found it necessary to keep it in that position for two days. But whenever the person in charge of the cow is satisfied that gas has ceased to issue from the canula it should be removed.

The canula is only to be employed in extreme or urgent cases, though everyone who has had experience in treating indigestion in cattle will realize that he has saved the lives of many animals by its prompt application. When the tympanic animal is not distressed, and the swelling of the flank is not great, it is best to resort to the administration of internal medicine. Two ounces of aromatic spirits of ammonia should be given every half hour in a quart of cold water, or half an ounce of chloride of lime may be dissolved in a pint of tepid water, and the dose repeated every half hour until the bloating has subsided. It is generally necessary to give a dose of purgative medicine after bloating has subsided, as animals frequently show symptoms of constipation after attacks of indigestion. When the bloating is not too great gentle walking exercise will facilitate the removal of the gas.

CHRONIC TYMPANITES.

Cattle, especially those which have been kept in the stable all winter, are liable to suffer from chronic tympanites. In this form the animal bloats up after feeding, but seldom swells so much as to cause any alarm. The chronic form of indigestion may also follow an acute attack like that previously described.

Treatment should be preceded by a moderate dose of purgative medicine: one pound of sulphate of magnesia, half an ounce of powdered Barbadoes aloes, 1 ounce of powdered ginger, 1 pint of molasses. The powder should be stirred up for a few minutes with two quarts of lukewarm water, then the molasses should be added, and after all the ingredients have been stirred together for about ten minutes, the dose should be administered. It will generally be necessary after the operation of the purgative to give some tonic and antacid preparation to promote digestion, which is imperfectly performed in such cases. We recommend the following for this purpose: Powdered gentian, 3 ounces; powdered bicarbonate of potash, 3 ounces; powdered ginger, 3 ounces; powdered capsicum, 1 ounce. Mix and divide into twelve powders, one of which should be given three times a day before feeding, shaken up with half a pint of whisky and a pint of water. It is also advantageous in such cases to give two heaped teaspoonfuls of wood charcoal, mixed with the animal's feed three times a day. The animal should also go out during the day, as want of exercise favors the continuance of this form of indigestion.

Cases occasionally occur which resist medical treatment. Chronic indigestion has sometimes been found to arise from enlarged lymphatic glands pressing on the gullet and preventing the eructation or belching up of gas which occurs during digestion. Cruzel expresses the opinion that this form of tympanitis occurs in animals affected with tuberculosis, and remarks that the swelling of the flank disappears when the animal stands, but reappears when it lies down.

DISTENSION OF RUMEN OR PAUNCH WITH FOOD.

This form of indigestion is caused by the animal gorging itself with food, and arises more from the animal's voracious appetite than from any defect in the quality of the food supplied to it. In cases of this kind there is comparatively no great formation of gas, and the gas which is formed is diffused through the stomach instead of accumulating in a layer in its upper part. On pressing the flank with the closed fist the indent of the hand remains for a short time in the flank, as if the rumen were filled with a soft doughy mass. This form of indigestion should be treated by stimulants, such as have been described in speaking of the two preceding diseases. But if the treatment applied fails and the impacted or overloaded condition of the rumen continues, an incision should be made with a sharp, long-bladed knife in the left flank, commencing at the point where it is usual to puncture an ox, and prolonging the incision in a downward direction until it is long enough to admit the hand. When the point of the knife is thrust into the flank and the blade of the knife cuts downward, the wall of the stomach, the muscle and the skin should all be cut through at the same time. Two assistants should hold the edges of the wound together so as to prevent any food slipping between the flank and the wall of the stomach, and then the operator should remove two-thirds of the contents of the rumen. This having been done the edges of the wound should be sponged with a little carbolized warm water, and the lips of the wound in the rumen being turned inward they should be brought together with catgut stitches. The wound penetrating the muscle and the skin may then be brought together by silk stitchesl which should pass through the entire thickness of the muscle and should be about 1 inch apart. The wound should afterwards be dressed once a day with lotion and the animal covered with a tight linen sheet to protect the wound from insects and dirt. The lotion to be used in such a case is made up as follows: Sulphate of zinc, 1 dram; carbolic acid, 2 drams; glycerin, 2 ounces; water, 14 ounces; mix.

LOSS OF CUD.

It is very common among farmers, when a cow or ox is ailing, to say that the sick animal has lost its cud. If it is meant that the animal, does not ruminate or chew the cud, and that it consequently must be sick, no fault can be found with the expression. In most cases, however, the remark is not intended to convey the idea that the animal does not ruminate, but that the loss of cud is a disease in itself. We may here observe that loss of cud is a symptom of suspended rumination (Plate II) and shows that the animal's digestive functions are not performed as regularly as usual. It is a symptom of a great many diseases, and when its existence is detected it should lead the observer to try and discover other symptoms, so that on those he may base a correct opinion as to the nature of the disease from which the animal suffers.

VOMITING.

This is not to be confounded with rumination, though some writers have advanced the opinion that vomiting is merely a disordered and irregular rumination. It is not of common occurrence in cattle, though as it sometimes occurs it is well that a description of it should be given.

Symptoms.—Animals which vomit are frequently in poor condition. After having eaten tranquilly for some time the animal suddenly becomes uneasy, arches the back, stretches the neck and head and then suddenly ejects 10 or 12 pounds of the contents of the rumen. After having done this, uneasiness subsides and in a short time the animal resumes eating as if nothing had happened.

Causes.—The causes of this disordered state of the digestive system in cattle are rather obscure. It is evident that the vomited matter proceeds from the rumen, and it appears to show some temporary nervous disorder of that part. It has been found to occur when there was cancerous disease of the fourth stomach, and experimentally it has been shown that a suspension of digestion or great derangement of the fourth stomach produces considerable nervous disorder of the rumen and sometimes vomiting or attempt to vomit.

Treatment.—Easily digested food and plenty of water should be given. Fear and excitement, chasing or hurrying animals after eating heartily, are apt to bring on this result. In order to remove the conditions which produce vomiting the following draft should be given: Hydrate of chloral, half an ounce; whisky, 8 ounces; water, 1 pint. The dose to be repeated when the condition of the animal seems to require it.

DEPRAVED APPETITE—PICA.

Cattle suffering from this disease have a capricious and variable appetite as regards their ordinary food, but evince a strong desire to lick and eat substances for which healthy cattle show no inclination. Alkaline and saline tasting substances are especially attractive to cattle having a depraved appetite, and they frequently lick lime, earth, coal, gravel, and even the dung of other cattle. Cows in calf and young cattle are especially liable to develop those symptoms. Animals affected in this way lose condition, their coat is staring, gait slow, and small vesicles containing yellow liquid form under the tongue; the milk given by cows is thin and watery. Such animals become restless and uneasy, as is indicated by frequent bellowing. The disease may last for months, the animal ultimately dying, worn out by fever. Depraved appetite frequently precedes the condition in which the bones of cattle become brittle and fracture easily, and which is known by the name of osteomalacia.

Causes.—Bad food, especially food which has undergone changes which lessen its digestibility and impair its nutritive value, is the common cause. It has been stated that the food of which animals partake previous to becoming affected with this disease must be deficient in some of the constituents required to supply the wear and growth of the body, and especially that there is a deficiency of lime salts. Cattle pastured on low, swampy land become predisposed to it. It occasionally happens, however, that one individual in a herd suffers though all are fed alike; in such cases the disease must arise from the affected animal not assimilating properly the nutritive elements of the food which is supplied to it.

Treatment.—The aim in such cases must be to improve the process of digestion and to supply the animal with a sufficiency of sound and wholesome food. The following should be given to the cow three times a day, a heaped tablespoonful constituting a dose: Carbonate of iron, 4 ounces; powdered gentian, 4 ounces; common salt, 4 ounces; powdered fenugreek, 4 ounces; mix. In addition to this three tablespoonfuls of powdered charcoal should be mixed with the animal's food at least three times a day, and a piece of rock salt should be placed where the animal can lick it at will.

HAIR CONCRETIONS.

These concretions or hair-balls are produced by animals licking themselves, or by their licking other animals. As a result of this habit the hairs which are swallowed are carried round by the contractions of the stomach and gradually assume the form of a small pellet or ball. These increase in size as fresh quantities of hair are introduced into the stomach, which become adherent to the surface of the hair-ball. These hair-balls are found most frequently in the reticulum or second stomach (Plate II), though sometimes in the rumen. In calves hair-balls are generally found in the fourth stomach. There are no certain symptoms by which we can determine the presence of hair-balls in the stomach, and therefore no treatment can be recommended for such cases. In making post-mortem examinations of cattle we have sometimes found the walls of the reticulum transfixed with nails or pieces of wire, and yet the animal during life had not shown any symptoms of indigestion, but had died from maladies not involving the second stomach.

INDIGESTION OF THE THIRD STOMACH—GRASS STAGGERS—DRY MURRAIN—WOOD-EVIL.

The various names which have been applied to this disease indicate that those who have written concerning it are by no means agreed as to its nature and cause. Among systematic writers, however, there seems to be a general agreement that the seat of the disease is in the third stomach, as they have followed one another faithfully in describing that part as the sole seat of trouble. We think it more correct to regard this as a general disorder of the digestive organs, and that the third stomach merely participates in the disordered functions of the other stomachs.

Causes.—Want of exercise predisposes to this disease, or food which is coarse and indigestible may after a time produce this condition. Food which possesses astringent properties and tends to check secretion may also act as an exciting cause. Food in excessive quantity may also lead to disorder of digestion and to this disease. It is very likely to appear towards the end of protracted seasons of drought, therefore a deficiency of water must be regarded as one of the conditions which favor its development. However, we think it best to state that the causation of this disease is not at present completely understood, and that cases may sometimes occur in which the explanations offered as to their cause are mere conjecture.

Symptoms.—Diminished appetite, rumination irregular, tongue coated, mouth slimy, dung passed apparently not well digested and smelling badly, dullness and fullness of the flanks. It is also frequently stated that on pressing the fist below the short ribs on the right side the third stomach will be found as a hard sort of mass in that situation.

The disease may in some cases assume a chronic character, and in addition to the foregoing symptoms slight bloating or tympanitis of the left flank may be observed; the animal breathes with effort and each respiration may be accompanied by a grunt, the ears and horns are alternately hot and cold, rumination ceases, the usual rumbling sound in the stomach is not audible, the passage of dung is almost entirely suspended, and the animal passes only a little mucus occasionally. The patient falls away in flesh and becomes weaker, as is shown by one frequently finding it lying down. When the animal falls into this weak and exhausted condition the disease frequently terminates fatally.

On examining animals which have died of this disease a dry and somewhat hardened condition of the contents of the third stomach is found. In other cases the stomachs and their contents present a natural appearance, and we may remark in this connection that in the latter class of cases the causation of the disease has yet to be explained.

In some cases the brain becomes disordered, no doubt from the deranged condition of the stomach reaching the brain through what is termed reflex action. There is weakness and an unsteady gait, the animal does not appear to take notice of and will consequently run against obstacles; after a time it falls down and gives up to violent and disordered movements. This delirious condition is succeeded by coma or stupor, and death ensues.

Treatment.—Aromatic and demulcent draughts should be given to produce a soothing effect on the mucous lining of the stomachs and to promote digestion. Two ounces of chamomile flowers should be boiled for twenty minutes in a quart of water and the infusion on cooling should be given to the affected animal. This should be repeated about three times a day. When constipation is present the following purgative may be administered: Sulphate of magnesia, 1 pound; Barbadoes aloes, half an ounce; powdered ginger, 1 ounce; powdered nux vomica, 1 dram; fluid extract of belladonna, half an ounce. The different powders contained in this prescription should be stirred up in 2 quarts of lukewarm water, then the fluid extract of belladonna added and the dose administered. After this purgative has acted, if there is a lack of appetite and the animal does not ruminate regularly, the powder mentioned in remarks on the treatment of chronic tympanitis should be given according to directions. The diet must be rather laxative and of a digestible character after an attack of this form of indigestion. Food should be given in moderate quantities, as any excess by overtasking the digestive functions may bring on a relapse.

INDIGESTION FROM DRINKING COLD WATER—COLIC.

This disorder is produced by drinking copiously of cold water, which arrests digestion and produces cramp of the fourth stomach, probably of the other stomachs, and also of the bowels. Cruzel states that it is frequently observed in working oxen during hot weather.

Causes.—It is not customary for the ox to drink much water at once. In fact he usually drinks slowly, and as if he were merely tasting the water, letting some fall out at the corners of his mouth at every mouthful. He drinks much less in proportion to his size than the horse, and when fed on green food or at pasture he may pass several days without drinking. It would, therefore, seem to be contrary to the habits of the ox to drink largely. But we find that during hot weather, when he has been working and is consequently very thirsty, if he drinks a large quantity of cold water he is immediately taken with a very severe colic. Though Cruzel, a French writer on the diseases of the ox, is of opinion that these are the only conditions under which this form of colic arises, I have known it to affect milch cows quite severely in winter, when they are let out of a warm stable to be watered. Cows which are fed largely on dry hay drink copiously, like the working ox, and become affected in precisely the same manner. But the secretion of milk in the cow is usually much diminished after such attacks. In such cases I have also observed that they are seized with a chill or fit of trembling before the cramps come on.

Symptoms.—There is some distension of the abdomen, but no accumulation of gas. As the distension and pain occur immediately after the animal has drunk the water there can not be any doubt as to the exciting cause. Cruzel, in speaking of the treatment of this disease, says it is customary among French farmers to walk or even trot the ox up and down, and that as a result of this treatment the water passes from the fourth stomach into the bowel, from which it is soon passed off not much changed, except that it is slightly colored by the substances with which it has come in contact in passing through the bowel. Diarrhea then appears to be a favorable termination of this affection.

Treatment.—The treatment above described should be adopted in a modified form. It is obviously dangerous to trot an animal whose stomach and bowels are largely distended with water, but it appears rational to walk the animal about for ten minutes before administering medicine, as this allows time for a portion of the contents of the stomach to pass into the bowel, and renders it safer to give medicine. In many cases the walking exercise and the diarrhea bring about a spontaneous cure of this disorder, but as in some instances the cramps and pains of the stomachs persist, I have been accustomed to give 1 ounce of sulphuric ether and 1 ounce of tincture of opium, shaken up with a pint of warm water, and to repeat the dose in half an hour if the animal is not relieved. In an emergency when medicine is not to be had, half a pint of whisky may be substituted for medicine, and should be given mixed with a pint of warm water; or a tablespoonful of powdered ginger may be administered in the same way as the remedies already mentioned. I have never seen a case of this kind terminate fatally, but Cruzel mentions that he has witnessed two fatal cases. In both the fourth stomach was congested, and in one case there was a rupture of a part of the small intestine. In both of those cases the animals were compelled to trot forward and back, and it seems reasonable to infer that this treatment was the cause of their death.

INDIGESTION IN CALVES—GASTRIC CATARRH—DIARRHEA—WHITE SCOUR.

Sucking calves are subject to a form of diarrhea to which the above designations have been applied.

Causes.—Calves which suck their dams are not frequently affected with this disease, though it may be occasioned by their sucking at long intervals and thus overloading the stomach and bringing on indigestion. Calves which are separated from their dams and which receive considerable quantities of cold milk at long intervals are liable to contract this form of indigestion. Calves fed on artificial food, which is sometimes used as a substitute for milk, also frequently contract it.

Symptoms.—The milk which passes into the fourth stomach becomes curdled and acts as an irritant on the surface of the stomach and bowels, so that a catarrhal condition of their mucous surface is set up. The passages have a thin, yellowish-white appearance and become very frequent. The calf becomes dull, whisks its tail as if in pain whenever there is a passage from the bowels, loses its appetite, becomes weak, and unless the disease is checked dies in a few days from exhaustion.

Treatment.—The calf should have from 1 to 2 ounces of castor oil and a tablespoonful of laudanum. A mild dose of purgative medicine is given to remove the curdled milk from the stomach and bowels. The object of the subsequent treatment is to allay the irritation of the stomach and bowels and to restore the digestive functions. We recommend the following to be compounded and divided into twelve powders: Powdered rhubarb, $1\frac{1}{2}$ ounces; carbonate of magnesia, 3 ounces. One of these powders should be given four times a day; each powder to be shaken up with two wineglassfuls of new milk, to which two teaspoonfuls of whisky should be added. A little fresh milk should be given five or six times a day, or the calf allowed to suck about six times a day, but the quantity should be limited. In applying treatment the mother should always be examined as to the condition of her health, diet, etc., as the disorder may sometimes be traced to some disease or mismanagement affecting the mother.

GASTRO-ENTERITIS.

This consists of an inflammation of the mucous surface of the fourth stomach and of the bowel. The inflammation is seldom limited to the mucous surface of the fourth stomach, but almost always involves the mucous surface of the bowel to a greater or less extent.

Causes.—Long intervals between times of feeding; sudden checking of perspiration; putting working oxen to severe work immediately after feeding, so that they do not have time to ruminate; sudden changes of diet. In enumerating the causes of this disease we think it well at the same time to indicate how the operation of those causes may be prevented. In working oxen, for example, they may be allowed to rest after feeding so that rumination is not interfered with. Grass which has lain so long after cutting that it is wilted, musty hay, and any kind of forage which contains a large amount of hard, fibrous material, so that it resists the macerating and solvent action of the stomachs may set up inflammation of the digestive mucous membrane. Exposure of the body to the action of damp and cold winds is also dangerous.

Symptoms.—Dullness; drooping of the ears; dryness of the muzzle; dry skin; staring coat; loins morbidly sensitive to pressure; fullness of the left flank, which is owing to the distension of the fourth stomach by gas. The pulse is small, the gait is feeble and staggering, each step the animal makes is accompanied by a grunt, and this symptom is especially marked if the animal happens to walk in a downward direction; there is loss of appetite, and rumination is suspended. On the second day of sickness the passages are few in number, hard, and are sometimes coated with mucus. If treatment does not bring relief the symptoms become aggravated, the pulse weaker, complications may set in, such as inflammation of the lungs, or there may be symptoms of brain disorder. The bowels may act very irregularly, sometimes being constipated, and at other times the passages are soft, tarry looking, and streaked with blood. The passages at the last stage of the disease exhale a putrid odor which may even occasion sickness in other animals, and this suggests the idea that in treating this disease it is advisable to keep sick animals apart from healthy ones. When the sick animal assumes a recumbent position there is a continual grunt or moan which appears to accompany each expiration; the animal usually dies in convulsions, and in some cases at this time a bloody liquid issues from the mouth and anus.

Post-mortem appearances.—The contents of the rumen are dry, those of the manyplies or third stomach have a similar appearance and are also dark in color, and on removing some portions of the mucous membrane of the third stomach the subjacent tissue is reddened. The mucous membrane of the fourth stomach has a well-marked red color and sometimes presents ulcerations. The inflammation generally extends to the mucous surface of the small intestine, which shows large brownish spots on its surface and also ulcerated surfaces.

Treatment.—Owing to the fact that this malady frequently is caused by some imperfectly digested food setting up inflammation of the mucous surface of the stomach and bowels, it is advisable when disease is supposed to originate from such cause to give a pint of castor oil, and then to give three or four times a day a quart of linseed tea in which an ounce of carbonate of magnesia has been dissolved, and along with each dose ten drops of tincture of aconite should be combined. The food should be soft and easily digested, such as small quantities of bran mash and oatmeal gruel. It is also advisable as early as the second day of the animal's sickness to give small quantities of hay or grass, so as to encourage the animal to ruminate, which it will not do if kept entirely on very soft and liquid food. Care must be exercised not to give too much of such food as grass and hay, but to gradually increase the proportion of such diet as the animal's digestive organs seem to be returning to their natural function. Purgative medicine must be administered only when absolutely necessary, as a restoration of the digestive organs to their natural functions is desired, rather than to produce purgation.

DISEASES OF THE BOWELS.

DIARRHEA.

Diarrhea results either from increased action of the muscular coat of the intestines, an unusually liquid state of their contents, or, generally, from both of those conditions combined.

Causes.—The exciting causes of diarrhea may be thus arranged: Irritation of the intestines by food taken in excess, or of improper quality, and this especially applies to soft, watery, green food; excessive secretions, especially bile; impure water and water drunk in excess; mechanical congestion of the intestinal vessels; acute or chronic inflammation of the bowels. It may be a symptom of other diseases which depend on the presence of an animal poison in the blood, as may be observed in Texas fever and contagious pleuro-pneumonia. Causes of a more general character, viz., exposure to changes of temperature, either excessive cold or heat may produce it.

Symptoms.—The animal is dull, places its feet well under the body, arches its back, and shows thirst. Passages from the bowels are frequent, at first consisting of thin dung, but as the disease continues they become watery and offensive smelling, and may even be streaked with blood. Frequently this malady is accompanied by fever, great depression, loss of strength, rapid loss of flesh, and it may terminate in death.

Treatment.—When the disease depends on irritating properties of the food which has been supplied to the animal it is advisable to give a mild purgative, such as a pint of castor or linseed oil. When the secretions of the bowels are irritating an ounce of carbonate of magnesia and half an ounce of tincture of opium should be shaken up in a quart of linseed tea and given to the animal three times a day until the passages present a natural appearance. When there is debility, want of appetite, no fever, but a continuance of the watery discharges from the bowels, then an astringent may be given. For such cases we have found the following serviceable: Powdered galls, 6 ounces; powdered gentian, 2 ounces. Mix and divide into twelve powders. One powder to be given three times a day until the passages present a natural appearance. Each powder should be mixed with a half pint of whisky and a pint of water. When diarrhea is a symptom of a malady characterized by the presence of a blood poison, the treatment appropriate to such disease must be applied.

DYSENTERY.

Dysentery begins with inflammation of the mucous membrane of the colon, though the disease may extend to the cæcum and sometimes to the rectum. It is also popularly known in this country by the names of bloody flux and red murrain.

Causes.—Feeding cattle on hay which has been made during a wet season, musty oats, or any forage which is largely infested with parasitic growths. Hay or coarse grass containing a large proportion of woody fiber, pastures which have been inundated, and the vegetation growing on low, marshy localities may set up irritation of the mucous membrane which terminates in dysentery. Water containing a large proportion of organic matter may also occasion this disease. The passages or excreta of animals suffering from the disease are to be regarded as containing an infective element, and should be disinfected, burned or buried.

Symptoms.—The animal eats slowly, ruminates less frequently than when in good health, and walks slowly. Sometimes there are indications of colicky pains. As the disease advances the animal ceases to eat and ruminate, the muzzle is dry, the eyes sunken, the coat rough, the skin dry and adherent or hidebound. The bowels act irregularly, and the passages are thin, black colored or grayish; the passages then become frequent, fetid, and are streaked with blood. This disease does not run a rapid course, and when it proves fatal the mucous membrane of the bowels will be found thickened and reddened at some parts, showing ulceration at some other points, and on some portions of its surface covered with a layer of mucus.

Treatment.—When symptoms of dysentery are first observed, a pound of sulphate of magnesia should be mixed with 4 quarts of tepid water, and then 2 drams of sulphuric acid should be gradually added to this mixture. This should be given at one dose, and it is important that it should be administered at an early stage of the disease, as it not only serves to remove irritating materials from the bowels, but it has an astringent and sedative effect on the mucous surfaces and lessens the congestion. The food should be soft and easy of digestion, and may consist of grass, boiled or pulped roots, and nutritive drinks, such as linseed tea, hay tea, etc. When the purgative before mentioned has unloaded the bowels and stomachs to some extent, the following powder should be given three times a day, mixed in a quart of linseed tea: Powdered ipecacuanha, one ounce and a half; powdered opium, half an ounce; mix and divide into twelve powders. When the foregoing preparation is not found effectual, oil of turpentine may be given in half-ounce doses three times a day in a quart of new sweet milk, and among other remedies which may be employed we may mention sulphate of copper, which should be given in dram doses, combined with 20 grains of opium and mixed with at least a quart of linseed tea. Nitrate of silver may also be given in 10-grain doses mixed or dissolved in a pint of distilled water. These latter remedies are especially efficacious in their effect on the ulcerations on the surface of the intestine, but it is not advisable to use them in an early stage. Whatever remedy is employed in treating dysentery, it should be given mixed in a considerable quantity of liquid, as in this way it brings the medicinal agent in contact with a large portion of the mucous surface of the diseased bowel. In addition to the treatment recommended, the diseased animal must be kept warm and comfortable, and great attention must be paid to its general comfort.

SIMPLE ENTERITIS.

Inflammation of the bowels must be held to signify in a general way inflammation of all parts of the mucous membrane of the bowels, though in some forms of what may properly be termed enteritis we find that the mucous, muscular, and serous coats of the bowels are involved, while in other cases only a limited portion of the mucous membrane of the bowel is affected. The different forms of this malady will all be described under the heading of enteritis.

Causes.—This disease occurs at all seasons of the year, but most frequently at times when there are great variations of temperature. Hard and long-continued work may operate as a cause in the case of oxen. Eating such food as musty hay and oats, forage containing acid plants, the leaves of trees infested with caterpillars, grass which has commenced to ferment after cutting, dusty hay, and grass covered with hoar frost may also give rise to enteritis. Drinking copiously of ice-cold water may also produce it. Exposure to a cold, damp wind or any influence which suddenly chills the surface of the body may operate as a cause.

Symptoms.—Dryness of the muzzle, diminished appetite, partial or total cessation of rumination (see Loss of Cud, p. 32), symptoms of colic which are indicated by restlessness. The animal lies down and gets up frequently, looks round at its flank, raises its tail, paws with its front feet, and strikes with its feet at the abdomen. After a time the symptoms of acute pain subside, and the animal lies down, but does not appear to be free from pain, turns its nose round on the flank and does not eat or ruminate. When injections are given they are soon ejected from the bowel, the passages are dry, glistening, and coated with mucus. Gas is frequently passed, frequent attempts to urinate are made, but only a small quantity of urine is passed at a time. Enteritis comes on suddenly and usually runs a rapid course, death taking place in four or five hours in fatal cases. When the animal has not been long exposed to those conditions which produce the disease, recovery may take place in a comparatively short time; in exceptional cases, however, when the acute stage of the disease has subsided it may assume a chronic and lingering form.

Treatment.—When the animal is seen at an early stage of the disease it should be bled to the extent of from 2 to 4 quarts. The age and condition of the animal must of course be taken into consideration in estimating the quantity of blood which should be abstracted. Half-ounce doses of laudanum should be given several times a day, mixed in a quart of linseed tea.

HEMORRHAGIC ENTERITIS.

This disease is not of frequent occurrence, but comes on suddenly, and is characterized by a hemorrhage or exudation of blood between the mucous and muscular coats of the bowels. The symptoms resemble those of the form of enteritis already described, only that they come on more suddenly and are of a more violent character. This form of enteritis chiefly occurs among working oxen during very hot weather. It is a more dangerous form of enteritis than that already described. When the acute symptoms subside the animal may show great weakness, which is owing to the great extent to which submucous hemorrhage has taken place. At this stage of the disease bleeding is contra-indicated; the passages may be streaked with blood and may even contain blood-clots. The treatment will be similar to that recommended in the first form of enteritis, bearing in mind of course that bleeding should only be practiced at an early stage. After death the affected portion of the bowel is much thickened and increased in weight, owing to the quantity of blood which has been effused between the mucous and muscular coats.

MERCURIAL ENTERITIS.

This is an inflammation of the bowels which may be produced by cattle licking off the mercurial ointment which is sometimes rubbed on them when they are suffering from skin disease. (See Mercurial Poisons, p. 69.)

Symptoms.—The symptoms are similar to those of the forms of enteritis already described. In this form of the disease we also observe grinding of the teeth and dribbling of saliva from the corners of the mouth. Two or three days after the attack gas is frequently passed from the bowels; the belly is tucked up and the flanks become hollow; the passages are very thin and coated with mucus. About the fifth or sixth day there is swelling of the tongue and mucous membrane of the mouth, quivering of the muscles of the limbs, staggering gait, great emaciation, and the animal dies about the twelfth day. Cruzel states that he has several times observed these symptoms in oxen which, in licking off the mercurial ointment with which they had been rubbed, had not swallowed more than 3 ounces.

Post-mortem appearances.—There are traces of intense inflammation of the bowels and also of ulceration of their mucous surface. There are dropsical effusions in the chest and abdomen.

Treatment.—Give drafts composed of the white of eggs and sweet milk, purgatives, followed by the administration of chlorate of potash. The eggs and sweet milk should be given immediately after it is known that the animal has swallowed the mercurial ointment, each quart of milk mixed with the whites of two eggs. A quart of this mixture is given three or four times at short intervals, say half an hour, and then a pint of castor oil should be given so as to produce purgation. After the castor oil has produced the desired effect, give half an ounce of chlorate of potash dissolved in a quart of warm water three times a day. For debility and want of appetite resulting from such illness, half-dram doses of nux vomica combined with 2 drams of powdered gentian should be given three times a day. We need hardly say that from the foregoing statement the conclusion may be drawn that mercurial ointment can not be safely applied on cattle.

ENTERITIS RESULTING FROM INVAGINATION OR INTUSSUSCEPTION, TWISTING, AND KNOTTING OF THE BOWELS.

Inflammation may arise from a knot forming on some part of the small intestine, from the portion of the bowel becoming twisted on itself, or from one part of the bowel slipping into another, which is termed invagination. This form of enteritis occurs occasionally in animals of the bovine species.

Causes.—The small intestine, which in the ox rests on the right sac or division of the rumen, is from the position which it occupies predisposed to this accident. It has been ascertained that animals which have shown symptoms of this malady have trotted, galloped, or made other violent exertions in coming from drinking, or that they have been chased by dogs or by animals of their own species while at pasture. The danger of jumping or running seems to be very slight to the ox if he is fasting, as the rumen in that case not being distended with food allows the small intestine to fall to the lower part of the abdomen, but when the rumen is distended the bowel does not slip so easily to this position.

Symptoms.—This form of enteritis is manifested by severe colicky pains, the ox scrapes and strikes the ground with his front and hind feet alternately; keeps lying down and getting up again; he keeps his tail constantly raised and turns his nose frequently to his right flank; he is frequently bloated or tympanitic on that side. He refuses food, and does not ruminate, and for some hours suffers severe pains. At first he frequently passes thin dung, and also urinates frequently, but passes only a little urine at a time. On the second day the pains have become less acute; the animal remains lying down; moans occasionally; his pulse is small and quick; he refuses food and does not ruminate. At this stage he does not pass any dung, though sometimes a small quantity of bloody mucus may be passed. On pressing forcibly the abdomen a gurgling sound is produced as if there was a quantity of liquid in the stomachs. There must be slight absorption of liquid from the digestive system, as the animal passes very little urine. This condition may continue for a considerable time, as cattle so affected may live for fifteen or even twenty days.

Post-mortem appearance.—At death the bowels are found to be inflamed, the inflammation always originating at the point where the intestine has been invaginated, twisted, or knotted. Sometimes the part is gangrenous, the compression of the blood-vessels preventing circulation and thus causing the death of the tissues.

Treatment.—Purgatives, anodynes, and other remedies are of no service in such cases, and bleeding also fails to produce any benefit. Indeed, it may be said truly that in such cases treatment is useless. Some cases are recorded in which an incision has been made in the flank so as to enable the operator to remove the lesion causing the enteritis by surgical means. Success has attended such efforts so rarely that we can not recommend them.

CONSTIPATION.

Constipation is rather to be regarded as a symptom of disease than a disease in itself. We frequently observe it in parturition fever, in that form of indigestion which is termed impaction of the third stomach, and as a result of gut-tie, invagination, twisting and knotting of the bowels. In order to remove the constipation the treatment must be applied to remove the causes which give rise to it. Calves sometimes suffer from constipation immediately after birth, and the meconium feces that accumulate in the bowels before birth is not passed, as is usually the case in calves. The cause of the disorder is supposed to be that the dams of such calves have been fed too exclusively on dry food before the calf's birth In such cases give an ounce of castor oil shaken up with an ounce of new milk. The mother's milk is the best food to prevent a recurrence of the constipation, as it contains a large amount of fatty matter which renders it laxative in its effects.

INTESTINAL WORMS.

We may state that cattle are less infested with intestinal parasites than any other species of domestic animal, and that it is rarely necessary to apply treatment for the removal of those parasites. Two different kinds of tapeworm and four species of roundworms have, however, been found in the intestines of the bovine species. An examination of the passages is the only certain method of determining the existence of worms in the bowels.

Treatment.—To remove tapeworms give an ounce of oil of male fern three times a day in a pint of milk for three days in succession, and then on the fourth day give a pint of castor oil. For roundworms give 2 drams of sulphate of iron three times a day, mixed in a little oats and middlings, and after continuing treatment for three days give a pint of castor oil as before described. Oil of turpentine may be given in doses of 1 ounce with milk, or santonine in dram doses in feed, to be followed by an oily purgative as described. In treating calves, which are more apt to be infested with worms than full-grown cattle, reduce the doses to one-fourth or a third.

RUPTURES—VENTRAL HERNIA.

Ventral hernia or rupture is an escape of some one of the abdominal organs through a rupture in the abdominal muscles, the skin remaining intact. The rumen, the small intestine, or part of the large intestine, and the fourth stomach are the parts which usually form a ventral hernia in bovine animals.

Causes.—Hernia is frequently produced by blows of the horns, kicks, and falls. In old cows hernia may sometimes occur without any direct injury. The occurrence of this form of hernia is explained by the increase in the size of the abdomen, which takes place in an advanced stage of pregnancy, causing a thinning and stretching of the muscular fibers, which at last may rupture or give way.

HERNIA OF THE RUMEN.

Hernia of the rumen is generally situated on the left side of the abdomen, on account of the situation of the rumen. In exceptional cases it may take place on the right side, and in such cases it also generally happens that some folds of the intestine pass into the hernial sac. Hernias have been classified into simple or complicated, recent or old, traumatic (from mechanical injury) or spontaneous.

In recent traumatic hernia there is swelling on the left side of the lower part of the abdomen. The swelling is greatest in the cases of hernia which are situated on the lower part of the abdomen. The skin covering the hernia will frequently present marks from which one may infer the direction from which the injury has proceeded. Unless an examination is made immediately after the injury has been inflicted it is difficult and sometimes impossible to ascertain the exact extent of the rupture, owing to the amount of swelling which takes place. Frequently there is no loss of appetite, fever, or other general symptons attending the injury. From the twelfth to the fifteenth day the swelling has generally subsided to such an extent that it is possible by an examination to determine the extent of the rupture. It is of importance to ascertain whether the size of the hernia increases after feeding.

In old cows what is termed spontaneous hernia may sometimes take place without any direct injury. The occurrence of this form of hernia is explained by the increase in the size of the abdomen, which takes place in an advanced stage of pregnancy, causing a thinning and stretching of the muscular fibres, which at last may rupture or give way. Such hernia frequently occurs about the end of the period of gestation, and in some instances have contained the right sac of the rumen, the omentum, the small and large intestines, a portion of the liver, and the pregnant uterus.

In old hernia the swelling is soft and elastic, and if they have not contracted adhesions to the sides of the laceration they can be made to disappear on pressure being carefully applied. Sometimes this accident is complicated by a rupture of the rumen, constituting a complicated hernia. If a portion of the contents of the rumen escape into the abdomen the case will be aggravated by the occurrence of peritonitis. The occurrence of such a complication is best ascertained by examining the animal immediately after the accident, when nothing intervenes between the surface of the rumen and the hand but the skin.

HERNIA OF THE BOWEL. (See Plate III, Fig. 6.)

When the intestines form the contents of the hernia it will be situated at the right side of the abdomen. In an intestinal hernia the swelling is usually not painful, of a doughy consistence or elastic, according as the intestine does or does not contain alimentary matter. This swelling can generally be made to disappear by pressure, and when it has been reduced one can easily recognize the direction and extent of the hernial opening. Herniæ of the bowel which are situated at the upper and right side of the abdomen are usually formed by the small intestine. They are less easily reduced than hernia in a lower situation, but when reduction has been effected they are less readily reproduced than those occurring lower. In hernia of the small intestine adhesion of the protruding parts to the walls of the opening, or strangulation, are complications which sometimes take place. If adhesion has taken place the hernia can not be reduced by pressure, and when strangulation has occurred the animal shows symptoms of pain. In such a case the edges of the opening through which the bowel has passed press on the bowel so as at first to excite pain, then inflammation, which if unrelieved usually terminates in gangrene. The animal is restless, turns its nose to the painful part, and shows those symptoms which are usually collectively designated under the term colic. When the swelling or hernia contains a portion of peritoneum the swelling is soft and doughy, and does not produce the sensation on handling it that it does when it contains gas or alimentary matter.

HERNIA OF THE RENNET OR FOURTH STOMACH.

This disease occasionally occurs in calves and is usually caused by a blow from a cow's horn on the right flank of the calf, and this may happen when the calf is trying to suck a strange cow. After such an accident a swelling forms on the right flank near the last rib. This swelling may be neither hot nor painful, even at first, and is soft to the touch. It can be made to disappear by careful pressure when the sides of the aperture through which it has passed can be felt. The application of pressure so as to cause the disappearance of the hernia is best made immediately after the occurrence of the accident, or when the œdema which accompanies the swelling has disappeared.

Treatment.—When a hernia is reducible—that is, can be pushed back into the abdomen—then it is advisable to maintain it in its natural situation, and to allow the walls of the laceration to grow or adhere together. In treating of this subject in a previous work I translated the directions given by the late Henry Bouley, in an article on this subject contained in the "Nouveau Dictionnaire de Médecine et de Chirurgie Vétérinaire," and as his directions are both concise and practical, I here reproduce them:

First prepare a bandage (must be of strong material) about 10 yards long and between 3 and 4 inches broad, and a flexible and solid piece of pasteboard adapted in size to the surface of the hernia. The protruding organ must then be replaced in the abdomen, and maintained in that position during the application of the bandage. This being done, a layer of melted pitch and turpentine is quickly spread on the skin covering the seat of the hernia, so as to extend somewhat beyond that space. This adhesive layer is then covered with a layer of fine tow, then a new layer of pitch and turpentine is spread on the tow, and the piece of pasteboard is applied on the layer of pitch, its outer surface being covered with the same preparation. Lastly, the bandage adhering to the piece of pasteboard, to the skin, and to the different turns which it makes around the body, is carefully applied so as to form an immovable, rigid, and solid bandage, which will retain the hernia long enough for the wound in the abdominal walls to heal permanently.

In considering the point whether it is advisable to operate on a rupture or not, we may here notice some of those conditions which will have an unfavorable effect on the success of the operation. When the opening through which the protruding organs have passed is very large, the edges irregularly torn, and when the hernia has existed for a long time, the size of the abdomen will be found to have diminished, and the replacing and retention of the protruded parts will be attended with difficulty. The stitches which bring the edges of the rupture together in such cases are apt to tear out, so such an operation is not advisable. Small ruptures with smooth, regular edges heal with less difficulty. Herniæ situated on the under surface of the abdomen are more apt to recur when they have been returned, and the wounds made in operating on them are more difficult to heal than when the hernia is situated on the side.

When the symptoms indicate that a hernia is strangulated, it is advisable to incise the sac and return the hernia, enlarging the opening in the abdominal muscles to the size necessary to return the protruding organs, after which the wound in the abdominal muscles should be brought together by metallic or catgut stitches, and the wound in the skin afterwards brought together by stitches of silk thread. Then a compress composed of ten or twelve folds of cloth must be placed smoothly over the seat of injury and a bandage applied round the body, the two ends being fastened at the back. In the smaller kinds of hernia nitric acid may sometimes be applied with success. This treatment should not be applied until the swelling and inflammation attending the appearance of the hernia have subsided, then the contents of the hernia having been returned, the surface of skin corresponding to it is sponged over with a solution composed of one part of nitric acid to two parts of water. This treatment acts by exciting considerable inflammation, which has the effect of causing swelling and thus frequently closing the hernial opening and preventing the contents of the sac from returning. A second application should not be made until the inflammation excited by the first has subsided. In what is termed spontaneous hernia it is useless to apply any kind of treatment.

UMBILICAL HERNIA.

The umbilicus, or navel, is the aperture through which the blood-vessels pass from the mother to the fetus, and naturally the sides of this aperture ought to adhere or unite after birth. In very young animals, and sometimes in new-born calves, this aperture in the abdominal muscles remains open and a part of the bowel or a portion of the mesentery may slip through the opening, constituting what is called umbilical hernia. The wall of the sac is formed by the skin which is covered on the inner surface by a layer of cellular tissue, and within this there is sometimes, but not always, a layer of peritoneum. The contents of the hernia may be formed by a part of the bowel, by a portion of the peritoneum, or may contain portions of both peritoneum and bowel. When the sac contains only peritoneum it has a doughy feel, but when it is formed by a portion of the bowel it will be more elastic on applying pressure.

Causes.—In the new-born animal the opening of the navel is generally too large, and this opening may sometimes give way to the pressure of the bowel on account of the weak and relaxed condition of the abdominal muscles. This defective and abnormal condition of the umbilicus is frequently hereditary. It may be occasioned by roughly pulling away the umbilical cord; through kicks or blows on the belly; through any severe straining by which the sides of the navel are stretched apart. We may mention in this connection that it is best in new-born calves to tie the umbilical cord tightly about two inches from the navel, and then to leave it alone, when it will drop off in a few days in most cases, leaving the navel in a closed condition.

Treatment.—It is well to bear in mind that many, and especially the smaller, umbilical herniæ will heal spontaneously, that is, nature effects a cure. As the animal gets older the abdominal muscles get stronger and possess more power of resistance to pressure, the bowels become larger and do not pass so readily through a small opening, so that from a combination of causes there is a gradual growing together or adhesion of the sides of the navel. In cases of umbilical hernia where there are no indications that a spontaneous cure will take place, the calf should be laid on its back, and immediately on this being done the hernia will often disappear into the abdomen. If it does not its reduction may be brought about by gentle handling, endeavoring, if need be, to empty the organs forming the hernia before returning them into the abdomen. After the hernia has been returned the hair should be clipped from the skin covering it and a compress composed of ten or twelve folds of linen or cotton should be applied, first smearing the skin with pitch and then a bandage of about 3 inches wide should be passed round the body so as to retain the compress in position. The lower part of the compress should be smeared with pitch, and also those portions of the bandage which pass over it, so as to keep it solid and prevent it from shifting. In some cases it will be found that the contents of the sac can not be returned into the abdomen, and this generally arises from the fact that some part of the contents of the sac has grown to or become adherent to the edges of the umbilical opening. In such a case the skin must be carefully laid open in the long direction, the adhesions of the protruding organs carefully separated from the umbilicus, and after the protruding parts have been returned into the abdomen the sides of the umbilicus must be freshened if necessary by paring, and then the edges of the opening brought together by catgut stitches; the wound in the skin must then also be brought together by stitches. The woun l must be carefully dressed every day and a bandage passed round the body so as to cover and protect the part operated on.

In small hernia nitric acid has been used successfully in the same manner as has been described in speaking of the treatment of ventral hernia. Sulphuric acid has also been used for a similar purpose, diluting it to the extent of one part of acid to three or five of water. In thin-skinned animals the weaker preparations ought to be preferred, and caution must be exercised in using such preparations so as not to destroy the tissues on which they are applied.

Another method of treatment is, after the contents of the sac have been returned into the abdomen, to tie a piece of strong waxed cord round the pendulous portion which formed the outer covering of the hernia. The string is apt to slacken after two or three days, when a new piece of cord should be applied above the first one. The constriction of the skin sets up inflammation, which generally extends to the umbilicus and causes the edges to adhere together, and by the time the portion of skin below the ligature has lost its vitality and dropped off, the umbilicus is closed and there is no danger of the abdominal organs protruding through it. This is what takes place when this method has a favorable result, though if the umbilicus does not become adherent and the skin sloughs, the bowels will protrude through the opening.

GUT-TIE—PERITONEAL HERNIA.

In peritoneal hernia of the ox a loop or knuckle of intestine enters from the abdomen into a rent in that part of the peritoneum which is situated at the margin of the hip bone and passes under the remains of the spermatic cord. After the tearing of the peritoneum the spermatic cord is partially separated from its former points of attachment, so as to form a loose band. The portion of intestine is pressed through the peritoneal opening into the pelvis, and frequently curves or winds behind the spermatic cord and is pressed forward in a direction opposite to that it followed when entering the peritoneal rent. The onward pressure of the bowel, as well as the occasional turning of the latter round the spermatic cord, is the cause of the cord exercising considerable pressure on the bowel, which occasions irritation, obstructs the passage of excrement, and excites inflammation, which terminates in gangrene and death.

The tearing of this fold of peritoneum generally occurs on the right side, not on the left, as incorrectly stated by Youatt, and the reason of its occurring generally on the right side is that the bowels are mostly situated on that side of the abdomen, while the paunch occupies the left side and extends to the entrance of the pelvis. (Plate I.) The rent in the peritoneum is situated at the upper and front part of the pelvis, nearer to the sacrum than the pubis. Besides the form of peritoneal hernia already described there is a second form, which occurs as follows: After castration the spermatic cord retracts into the abdomen on account of its elasticity, and its freshly-cut end becomes adherent to the peritoneum, leaving a free space between it and the peritoneum, however through which a part of the intestine may enter, but can not slip out again, on account of its subsequent increase in size. It also happens that the free end of the spermatic cord may become adherent in such a way that it forms a cord or band around the bowel, causing strangulation. This last form seems to have led to the appellation of gut-tie being applied to this accident. It may be mentioned that peritoneal hernia may occur on the left side, though this rarely happens.

Causes.—Among the causes of peritoneal hernia considerable importance is attached to a method of castration which is practiced in certain districts, viz., the tearing or rupturing of the spermatic cord by main force, instead of dividing it at a proper distance above the testicle in a surgical manner. After this violent and rough method of operating, the cord retracts into the abdomen and its stump becomes adherent to some part of the peritoneum, or it may wind around the bowel and then the stump becomes adherent so that strangulation of the bowel results. The rough dragging on the cord may also cause a tear in the peritoneum, the result of which need not be described. The severe exertion of ascending hills and mountains, drawing heavy loads, or the straining which oxen undergo while fighting each other, may also give rise to peritoneal hernia.

Symptoms.—The ox suddenly becomes very restless, stamps with his feet, moves back and forward, hurriedly lies down, rises, moves his tail uneasily, and kicks at his belly with the foot of the affected side. The pain evinced may diminish, but soon returns again. In the early stage there are frequent passages of dung, but after the lapse of eighteen to twenty-four hours this ceases, the bowel apparently being emptied up to the point of strangulation, and the passages now consist only of a little mucus mixed with blood. When injections are given at this time the water passes out of the bowel without even being colored. The animal always lies down on the side where the hernia exists and stretches out his hind feet in a backward direction. These two particular symptoms serve to distinguish this affection from enteritis and invagination of the bowel. As time passes, the animal becomes quieter, but this cessation of pain may indicate that gangrene of the bowel has set in, and may, therefore, under certain circumstances, be considered a precursor of death. Gangrene may take place in from four to six days, when perforation of the bowel may occur and death result in a short time.

Treatment.—The ox should in the first place be examined by oiling the hand and arm and passing it into the rectum; the hand should be passed along the margin of the pelvis, beginning at the sacrum and continuing downward towards the inguinal ring, when a soft painful swelling will be felt, which may vary from the size of an apple to that of two fists. This swelling will be felt to be tightly compressed by the spermatic cord. It very rarely happens that there is any similar swelling on the left side, though it is best in such cases to make a thorough examination. The bowel has sometimes been released from its position by driving the ox down a hill, by causing him to jump from a height of 2 feet to the ground, and the expedient of trotting him has been resorted to with the hope that the jolting movement might bring about a release of the bowel. If the simple expedients mentioned have been tried and failed, then the hand being passed into the rectum should be pressed gently on the swelling in an upward and forward direction so as to endeavor to push the imprisoned portion of the bowel back into the abdomen. While this is being done the ox's hind feet should stand on higher ground than the front, so as to favor the slipping out of the bowel by its own weight, and at the same time an assistant should squeeze the animal's loins so as to cause it to bend downward and so relax the band formed by the spermatic cord. If the imprisoned portion of gut is freed, which may be ascertained by the disappearance of the swelling, the usual sounds produced by the bowels moving in the abdomen will be heard, and in a few hours the feces and urine will be passed as usual. If the means mentioned fail in releasing the imprisoned portion of the gut, then an incision about 4 inches long must be made in the right flank in a downward direction, the hand introduced into the abdomen, the situation and condition of swelling exactly ascertained, and then a probe-pointed knife inserted between the imprisoned bowel and band compressing it, and turned outward against the band, the latter being then cautiously divided and the imprisoned gut allowed to escape, or, if necessary, the bowel should be drawn gently from its position into the abdomen. The wound in the flank must be brought together in the same way as in the case of the wound made in operating for impaction of the rumen.

WOUNDS OF THE ABDOMEN.

A wound of the abdomen may merely penetrate the skin, but as such cases are not attended with much danger, nor their treatment with much difficulty, we propose to consider here merely those wounds which penetrate the entire thickness of the abdominal walls and expose to a greater or less extent the organs contained in that cavity.

Causes.—Such accidents may be occasioned by animals falling on fragments of broken glass or other sharp objects. A blow from the horn of another animal may produce a wound which penetrates the abdomen. Exposure and protrusion of some of the abdominal organs may also be occasioned by the incautious use of caustics in the treatment of umbilical or ventral hernia. The parts which generally escape through an abdominal wound are the small intestine and floating colon.

Symptoms.—When the abdominal wound is small, the bowel exposed presents the appearance of a small round tumor, but in a few moments a loop of intestine may emerge from the opening. The animal then shows symptoms of severe pain by pawing with his feet, which has the effect of accelerating the passage of new loops of intestine through the wound, so that the mass which they form may even touch the ground. The pain becomes so great that the ox now not only paws but lies down and rolls, thus tearing and crushing his bowels. In such cases it is best to slaughter the animal at once; but in the case of a valuable animal in which tearing and crushing of the bowels has not taken place, the bowels should be returned and the wounds in the muscle and skin brought together in a manner somewhat similar to that which was described in speaking of ventral hernia.

DISEASES OF THE LIVER AND SPLEEN.

JAUNDICE—THE YELLOWS—CONGESTION OF THE LIVER.

[Plate IV.]

When jaundice exists there is a yellow appearance of the white of the eyes, and of the mucous membrane of the mouth. A similar aspect of the skin may also be observed in animals which are either partly or altogether covered with white hair. Jaundice is then merely a symptom of disease and ought to direct attention to ascertaining if possible the cause or causes which have given rise to it. A swollen condition of the mucous membrane of that part of the bowel called the duodenum may produce jaundice, as that mechanically closes the orifice of the biliary duct. In constipation there is an inactive or torpid condition of the bowel, and the bile which passes into the intestine may be absorbed and cause the yellow staining of jaundice. Jaundice is one of the symptoms of Texas fever and depends on the congested condition of the liver existing in that disease. It may also arise from the presence of parasites or gallstones in the ducts, forming a mechanical obstruction to the onward flow of bile. It may also arise from injury to the nervous system impeding the functions of the nerves supplied to the liver and checking or diminishing the secretion of bile. This form of jaundice is, so far as we know, unknown in cattle. The conditions under which jaundice most commonly calls for treatment are when cattle have been highly fed and kept in a state of inactivity. At such a time there is an excess of nutritive elements carried into the blood, which is associated with increased fullness of the portal vein and hepatic artery. When continued high feeding has produced this congested state of the liver the functions of that organ become disordered, so that a considerable portion of the bile instead of being excreted and passing into the intestine is absorbed by the hepatic veins.

Symptoms.—This disease occurs most frequently among stall-fed cattle. Pressure along the margin of the short ribs on the right side produces pain; the appetite is poor and the animal shows hardly any inclination to drink; the mucous membranes of the eye and mouth are yellow, the urine has a yellow or brown appearance, the animal lies down much and moves with reluctance, moans occasionally and has a tottering gait. The ears and horns are alternately hot and cold; in cows the secretion of milk is much diminished, and that which is secreted has a bitter taste; sometimes the animal has a dry, painful cough and presents a dull, stupefied appearance.

Treatment.—In such cases it is advisable to produce a free action of the bowels, so as to remove the usually congested condition of the portal vein and liver. For this purpose we recommend the administration of the following dose: Sulphate of soda, 16 ounces; fluid extract of taraxacum half an ounce. The sulphate of soda is dissolved by stirring it up in 2 quarts of tepid water. The extract of taraxacum is mixed in with it, and the mixture should be administered at one dose. When a purgative effect has been produced, a dram of sulphate of cinchonidia, half an ounce of fluid extract of taraxacum and an ounce of spirits of nitrous ether may be shaken up in a pint of water, and given night and morning for several days in succession. This treatment may be assisted by giving occasional injections of warm water and soap. The diet should be laxative and moderate in quantity, and may consist of coarse bran mash, pulped roots, grass in the season and hay in moderate quantity.

HEPATITIS—INFLAMMATION OF THE LIVER.

This is a more advanced stage of the disease already described. Hepatitis is frequently restricted to a special part of the liver, and the rest of the organ outside the area of inflammation may continue comparatively healthy.

The gland cells are the seat of inflammation, and the formation of an abscess or abscesses is a usual result.

Symptoms.—The symptoms are sometimes obscure, and their real significance is frequently overlooked. This may be accounted for by the fact that only a part of the liver is affected and that by the continuance of congestion in that organ the affected parts gradually undergo those changes which are characteristic of inflammation. The most prominent symptoms are yellowness of the white of the eye, and of the membrane lining the mouth; the appetite is poor; the body presents an emaciated appearance, but there is frequently fullness at the lower part of the abdomen. The gait is weak, and the animal lies down more than usual, and while doing so frequently has its head turned round resting on the side of its chest.

Post-mortem appearances.—There is frequently a quantity of serum in the abdomen. The liver is usually enlarged. Instead of having the dark-red appearance of congestion it has a brownish or grayish red tint in some parts, with yellowish red or pale yellow in others. Its tissue is loosened and easily torn, which is owing to its having lost its natural cohesion. Abscesses or deposits of purulent matter are found in its substance. The liver sometimes becomes adherent to the diaphragm or other adjacent parts through inflammation of its capsule. As a result of another form of inflammation a considerable part of the tissue of the liver becomes hardened or indurated, when its surface presents a nodulated appearance, and sometimes in cows that have died after calving the liver has been found smaller than usual, so soft that it is easily torn, and of a uniform yellow color.

Treatment.—Half a pound of sulphate of soda and half an ounce of fluid extract of taraxacum should be mixed with 2 quarts of tepid water, and this should be given night and morning until a relaxed condition of the bowels is produced, as the object is not to cause a strong purgation, but a laxative effect which should be continued for some days. The diet should be similar to that which has been recommended in speaking of congestion of the liver. After the treatment with laxatives has been continued for several days a dram of sulphate of cinchonidia and a dram of nitro-muriatic acid should be shaken up in a quart of cold water, and this dose should be given three times a day until the animal has regained its strength. Oil of turpentine should be rubbed in well once a day over the region of the liver. The skin on which it should be applied extends from the false ribs on the right side to 6 inches in front of the last one, and from the backbone to 12 inches on the right side of it. Extreme heat and pasturing animals on low lying ground are conditions favorable to the production of this disease.

THE FLUKE DISEASE.

The fluke, or *Fasciola hepatica*, is a parasite which infests the biliary ducts of the liver. It varies in size from an inch to a little over an inch in length and has a brownish flattened body. It belongs to the group of *trematoda*, or sucking worms. The fluke passes through several different stages of development before it reaches the livers of the animals which it infests, and it is not only found in cattle, but in sheep and several species of wild animals. Parasites which have attained their full development usually after a time pass out of the animals which harbor them and die, when they have attained the limit of their existence. It has been estimated that after the death and decomposition of a full-grown fluke upwards of 40,000 eggs will be liberated from its uterus. The agency of winds, rains, insects, the feet of cattle and other animals, disperse and carry these ova to considerable distances, so that a large proportion of them find their way to pools, ditches, and streams, where the conditions exist necessary to their future development. After a time they reach that stage in which they are transferred with the fodder or drink to the digestive organs of their host. From the foregoing statement it will readily be understood that this disease prevails on low swampy land, and especially on land which is subject to inundation. During a wet, rainy season the area over which it extends becomes much wider, and the losses which the disease occasions are consequently greater.

Symptoms.—The presence of these parasites in the biliary ducts does not at first appear to impair the animal's health; indeed, it has been stated that for a short time the animals appear to thrive better. This is accounted for by the statement that the presence of the flukes in the biliary ducts stimulates the secretion of bile, that this occasions a more complete digestion of the fatty elements of the food, and a consequent improvement in the animal's condition in the early stage of the disease. When the flukes attain their full size, however, and are present in large numbers, they set up inflammation in the walls of the biliary ducts. As a result of the presence of those parasites the liver becomes indurated and its secreting structure becomes atrophied or wasted. The affected animals become dull and weak; swellings of a dropsical nature form between the jaws and along the throat. There are fever, great emaciation, and dropsical accumulations in the chest and belly, which are soon followed by death.

Treatment is of no avail. Affected animals should be killed at an early stage of the disease.

SPLENITIS—INFLAMMATION OF THE SPLEEN.

With few exceptions veterinarians agree that the recognition of disease affecting the spleen is rarely made during life, unless in the case of certain febrile and contagious diseases, in which the spleen is known to be involved to a greater or less extent. The writer agrees with the general opinion on this point, as in those cases in which he has seen the spleen show traces of disease, and in which the disease was of a primary and not of a secondary character, the symptoms have been so obscure as to render it impossible to draw any certain conclusion as to their significance. Cruzel, a French writer on the diseases of cattle, stated, however, that he had frequently met with cases of inflammation of the spleen in cattle, and that he had no difficulty in recognizing them. We give here the substance of Cruzel's account of inflammation of the spleen, though we think that to judge from his description of the post-mortem appearances it might more properly be termed congestion of the spleen and liver than inflammation of the spleen. Splenitis may occur as an acute affection, as very acute or intense, or as a chronic form of disorder.

Causes.—Oxen of a sanguine temperament which are worked hard, and which, owing to the nature of their work, are frequently interrupted while ruminating, are from these conditions exposed to sudden attacks of congestion of the spleen. Cold and wet, the long-continued use of very nutritive forage, and severe exertion, by increasing the circulation and bringing on disorder of the digestive functions, may ultimately give rise to this malady. The custom of working oxen immediately after they have been fed, their stomachs filled with food, and therefore incapable of severe exertion, is regarded as a frequent cause of this malady.

Symptoms of a general character may be observed, such as dryness of the muzzle, loss of appetite, absence of rumination, gait slow and stiff, and sensibility when pressure is applied on the loins. But the symptoms which are specially characteristic of splenitis are as follows: Shivering, tension of the left flank, and difficult breathing; the ox walks with difficulty, as if the bending of the left fore and hind legs caused pain. Fullness of the left flank, but differing from the fullness of tympanitis or hoven, as it is produced by displacement of the spleen in a backward direction, so that when the flank is percussed or lightly struck with the tips of the fingers a dull sound is produced like that occasioned by the resistance offered by a soft body. The congested condition of the spleen brings about its displacement. The following case illustrates how the disease arises: An 8-year-old ox had been fed heavily on dry lucern, and was immediately afterwards put to work drawing gravel; he continued working for two hours without showing sickness, but did not ruminate. All at once, however, his flank swelled up and he showed considerable pain when pressed strongly on the left flank. This case is referred to in order to show the practical importance of the symptom last described.

Congestion of the spleen occurs suddenly as the consequence of interrupted rumination and hard work. Its duration is short if treatment is applied without delay, but longer if the action of the cause is intermittent. In the first case there is a rapid recovery owing to the speedy subsidence of the congestion. When the congestion is of long duration the malady becomes chronic, and the result may be fatal if the cause continues to act violently and without cessation. The account of the following case illustrates the foregoing statement:

A 6-year-old ox was fed a large quantity of green corn about midnight; he was afterwards driven so fast that he could not ruminate, and then compelled to draw a heavy load. At 10 o'clock in the morning he fell down, when it was noticed that his abdomen was swollen; he was forced up and had hardly been unyoked when he fell dead.

Lesions.—On opening this ox a large quantity of green corn was found in the rumen which had only been masticated once. There were several quarts of blood in the abdomen, the spleen was much enlarged, and had several ruptures at different points along its posterior border.

Treatment.—Bleeding is the first means to be employed in treating congestion of the spleen. The bleeding should be copious, and the first abstraction of blood should not be less than five quarts. In making this estimate the author is supposed to take as the type a working ox which was in good condition at the time of his becoming affected with congestion of the spleen. If there is not a marked improvement in the animal's state two hours after he is bled he should be bled again. In cases of this kind, which are not of a very acute character, bathing of the left flank with cold water is recommended.

In addition to the above measures mild, soothing, acidulated drafts should be given, low diet, rest, and occasional injections of a small quantity of lukewarm water.

DISEASES OF THE PERITONEUM.

PERITONITIS.

Peritonitis may be divided into certain varieties, according to its mode of causation; (1) *Traumatic*, when the disease arises from wounds penetrating the abdomen; (2) *Idiopathic*, when the disease arises from exposure to cold and wet. The second variety of peritonitis occurs chiefly among working oxen, and it may here be mentioned that in those animals the membrane which lines the abdomen and covers the outer surface of the bowels is apt to become congested by sudden chilling of the skin, which empties its rich network of small blood-vessels to a large extent, so that the blood must accumulate in some part of the interior of the body.

Causes.—When a working ox has been warmed up and is sweating during hard work he may have to stand for some time exposed to cold wind or to a cold rain, which soon chills the surface of his body. When cattle are driven through rivers or into ponds, so that their bodies become wet, and they afterward lie on the ground when the air is cold, such exposure may produce peritonitis. Wounds penetrating the abdomen may also cause it.

Symptoms.—A continuous or occasional shivering; the animal lies down, but appears uneasy; it frequently turns its head towards its belly and lows plaintively; pressure on the flanks produces pain; has no appetite; muzzle is dry and no rumination; while standing its legs are placed well under its body; pulse small and hard. The evacuations from the bowels are dry and hard. If this disease is complicated by the presence of inflammation of the bowels the pain is more severe and the animal is more restless. The skin is cold and dry in the early stage of this disease, but in a more advanced stage this condition may be succeeded by heat of the skin and quick breathing. The fits of trembling, uneasiness, small and hard pulse and tension of the left flank are symptoms the presence of which should enable one to reach the conclusion that peritonitis exists.

Post-mortem appearance.—The membrane lining the abdomen and covering the surface of the bowels is reddened to a greater or less extent, and there is usually considerable serous or watery fluid collected in the abdomen.

Treatment.—When we have to do with the traumatic form of peritonitis, as when the horn of another animal has been thrust through the abdominal walls, this lesion must be treated in accordance with directions before given, but the general treatment must be similar to that which follows: Peritonitis resulting from castration or from parturition fever must also be treated in connection with the special conditions which give rise to it, as the general treatment of this disease must be modified to some extent by the exciting cause.

The body should be warmly clothed, and it is advisable, when practicable, to have a blanket which has been wrung out of hot water placed over the abdomen, then covered by several dry blankets, which are maintained in position by straps or ropes passing round the body. The wet blanket must be changed as it cools—the object of treatment being to warm the surface of the body and to determine as much blood to the skin as possible. When the matter of clothing the body has been attended to the aim of treatment must be: (1) To obtain rest for the affected parts; (2) to subdue inflammation and fever; (3) to sustain the animal's strength. The first indication is to give a dose of laudanum or powdered opium. An ounce and a half of the first or a dram of the second may be given in a pint of tepid water, and if the pain is not perceptibly allayed the dose should be repeated in two hours. It is dangerous to give purgatives in peritonitis, as they stimulate the movements of the bowels, increase the suffering, and aggravate the disease. Tincture of aconite should be given in ten-drop doses every two hours for the purpose of reducing fever and inflammation. Cruzel strongly recommends bleeding for this purpose, but it should only be applied when the pulse is strong and when the animal is in good condition, and it should be borne in mind that it can not have any beneficial effect, but the reverse, if inflammation has existed for two days. The diet should consist of laxative food and drinks, such as linseed tea. If peritonitis assumes chronic form the diet should be nutritious, such as hay, cornstalks, linseed cake, grass, etc., and iodide of potassium should be given in dram doses dissolved in a pint of water three times a day.

DROPSY OF THE ABDOMEN—ASCITES.

In this disease there is a serous or watery effusion in the cavity of the abdomen.

Causes.—When old animals are worked and fed on innutritious food they become what is termed anæmic; or, in other words, their blood becomes impoverished and dropsy is a common result of such treatment. An innutritious and insufficient diet will produce the same effect in young animals. The exposure of cattle to sudden changes of temperature and the chilling effect of cold and wet acting on the skin may develop this disease. It is one of the results of peritonitis, and may also arise from acute or chronic inflammation of the liver, such as is of common occurrence when flukes are present in the liver in large numbers. When dropsy depends on disease of the liver it develops very gradually, and this may also be said in regard to it when its occurrence is associated with an insufficient amount of nutriment having been supplied to the animal.

Symptoms.—A gradual increase in the size of the abdomen at its lower part, while the flanks become hollow; pallor of the mucous membrane of the mouth and eye; weak and sluggish gait; want of appetite, and irregularity in ruminating. On percussion or tapping the surface of the abdomen with the fingers a dull sound is produced. If the hand and arm are oiled and passed into the rectum as far as possible, on moving the hand from one side to the other, the fluctuation caused by the presence of fluid in the abdomen may be felt.

Treatment.—The diet should be nutritious, and in those cases where we have merely to deal with anæmia (the bloodless state) arising from insufficient diet the use of tonics and diuretics, at the same time keeping the skin warm, will bring about a gradual absorption of the fluid contained in the abdomen. One of the following powders should be mixed with the animal's food three times a day; or, if there is any uncertainty as to its being taken in that way, it should be mixed with sirup, so as to form a paste, and smeared well back on the animal's tongue with a flat wooden spoon: Carbonate of iron, 3 ounces; powdered gentian, 3 ounces; powdered nitrate of potash, 3 ounces. Mix and divide into twelve powders. The administration of purgatives which promote a watery discharge from the mucous surface of the bowels, also tends, by diminishing the serum of the blood, to bring about absorption and a gradual removal of the fluid contained in the abdomen. Large doses should not be given, but moderate doses should be administered morning and night, so as to produce a laxative effect on the bowels for some days. To attain this end the following may be used: Sulphate of soda, 8 ounces; powdered ginger, half an ounce; mix in 2 quarts of tepid water, and then give at one dose.

DISEASES OF THE DIGESTIVE ORGANS.

DESCRIPTION OF PLATES.

PLATE I:

Position of the first stomach (paunch, rumen) on the left side: *a*, the situation of the rumen; *b*, the spleen or milt resting on it; *c*, the skin and muscles removed from the ribs to show position of the lungs and their relation to the paunch.

PLATE II:

Fig. 1. Stomach of a full-grown sheep $\frac{1}{6}$ natural size. After Thanhoffer, from R. Meade Smith's Physiology of Domestic Animals: *a*, rumen or first stomach; *b*, reticulum or second stomach; *c*, omasum or third stomach; *d*, abomasum or fourth stomach; *e*, œsophagus or gullet opening into first and second stomachs; *f*, opening of fourth stomach into small intestine; *g*, opening of second stomach into third; *h*, opening of third stomach into fourth.

The lines indicate the course of the food in the stomachs. The incompletely masticated food passes down the œsophagus or gullet into the first and second stomachs, in which a churning motion is kept up, carrying the food from side to side and from stomach to stomach. From the first stomach regurgitation takes place—that is, the food is returned through the gullet to the mouth to be more thoroughly masticated or chewed, and this constitutes what is known as "chewing the cud." From the second stomach the food passes into the third, and from the third into the fourth or true stomach, and from there into the intestines.

Fig. 2. Stomach of ox. After Colin, from R. Meade Smith's Physiology of Domestic Animals: *a*, rumen; *b*, reticulum; *c*, omasum; *d*, abomasum; *e*, œsophagus; *f*, opening of fourth stomach into small intestine.

Fürstenberg calculated that in an ox of 1,400 pounds weight the capacity of the stomachs is as follows:

	Per cent.
Rumen 149.25 quarts, liquid measure	62.4
Reticulum 23.77 quarts	10
Omasum 36.98 quarts	15
Abomasum 29.05 quarts	12.6

According to Colin—

	Quarts.
The capacity of a beef's stomach is	266.81
Small intestine	69.74
Cæcum	9.51
Colon and rectum	25.58

PLATE III:

Fig. 1. Clinical thermometer, $\frac{4}{5}$ natural size. This is used to determine the temperature of the animal body. The thermometer is passed into the rectum after having been moistened with a little saliva from the mouth, or after having had a little oil or lard rubbed upon it to facilitate its passage. There it is allowed to remain two or three minutes, then withdrawn, and the tem-

PLATE III—Continued.

perature read as in any ordinary thermometer. The clinical thermometer is made self-registering—that is, the mercury in the stem remains at the height to which it was forced by the heat of the body until it is shaken back into the bulb by taking hold of the upper portion of the instrument and giving it a short, sharp swing. The normal temperature of cattle varies from 100° to 103° F. In young animals it is somewhat higher than in old. The thermometer is a very useful instrument and frequently is the means by which disease is detected before the appearance of any external sign.

Fig. 2. Simple probang, used to dislodge foreign bodies like apples, potatoes, eggs, etc., which have become fastened or stuck in the œsophagus or gullet.

Fig. 3. Grasping or forceps probang. This instrument, also intended to remove obstructions from the gullet, has a spring forceps at one end in the place of the cup-like arrangement at the end of the simple probang. The forceps are closed while the probang is being introduced; their blades are regulated by a screw in the handle of the instrument. This probang is used to grasp and withdraw an article which may have lodged in the gullet and can not be forced into the stomach by use of the simple probang.

Fig. 4. Wooden gag, used when the probang is to be passed. The gag is a piece of wood which fits in the animal's mouth; a cord passes over the head to hold it in place. The central opening in the wood is intended for the passage of the probang.

Figs. 5*a* and 5*b*. Trocar and canula; 5*a* shows the trocar covered by the canula; 5*b*, the canula from which the trocar has been withdrawn. This instrument is used when the rumen or first stomach becomes distended with gas. The trocar covered by the canula is forced into the rumen, the trocar withdrawn, and the canula allowed to remain until the gas has escaped.

Fig. 6. Section at right angles through the abdominal wall, showing a hernia or rupture. Taken from D'Aborval, *Dict. de Med., de Chir. et de Hyg.*: *a a*, The abdominal muscles cut across; *v*, opening in the abdominal wall permitting *i i*, the intestines, to pass through and outward between the abdominal wall and the skin; *p p*, peritoneum or membrane lining the abdominal cavity carried through the opening *o*, by the loop of intestine and forming the sac S, the outer walls of which are marked *b f b*.

PLATE IV:

The liver is composed of innumerable small lobules from $\frac{1}{20}$ to $\frac{1}{10}$ inch in diameter. The lobules are held together by a small amount of fibrous tissue in which the bile ducts and larger blood vessels are lodged. Fig. 1 of the diagram illustrates the structure of a lobule: *v, v,* interlobular veins, or the veins between the lobules. There are branches of the portal vein which carries blood from the stomach and intestines to the liver; *c, c,* capillaries, or very fine blood vessels, extending as a very fine network between the groups of liver cells from the interlobular vein to the center of the lobule and emptying there into the intralobular vein to the center of the lobule; *v, c,* intralobular vein, or the vein within the lobule. This vessel passes out of the lobule and there becomes the sublobular vein; *v, s,* sublobular vein. This joins other similar veins and helps to form the hepatic vein through which the blood leaves the liver; *d, d,* the position of the liver cells between the meshes of the capillaries; *A, A,* branches of the hepatic artery to the interlobular connective tissue and the walls of the large veins and large bile ducts. These branches are seen at *r, r,* and form the vena vascularis; *v, v,* vena vascularis; *i,i,* branches of the hepatic artery entering the substance of the lobule and connecting with capillaries from the interlobular vein. The use of the hepatic artery is to nourish the liver while the other vessels carry blood to be modified by the liver cells in certain important directions; *g,* branches of the bile ducts

PLATE IV—Continued.

carrying bile from the various lobules into the gall bladder and into the intestines; *x, x,* intralobular bile capillaries between the liver cells. These form a network of very minute tubes surrounding each ultimate cell which receives the bile as it is formed by the liver cells and carried outward as described.

Fig. II. Isolated liver cells: *c,* blood capillary; *a,* fine bile capillary channel.

PLATE V:

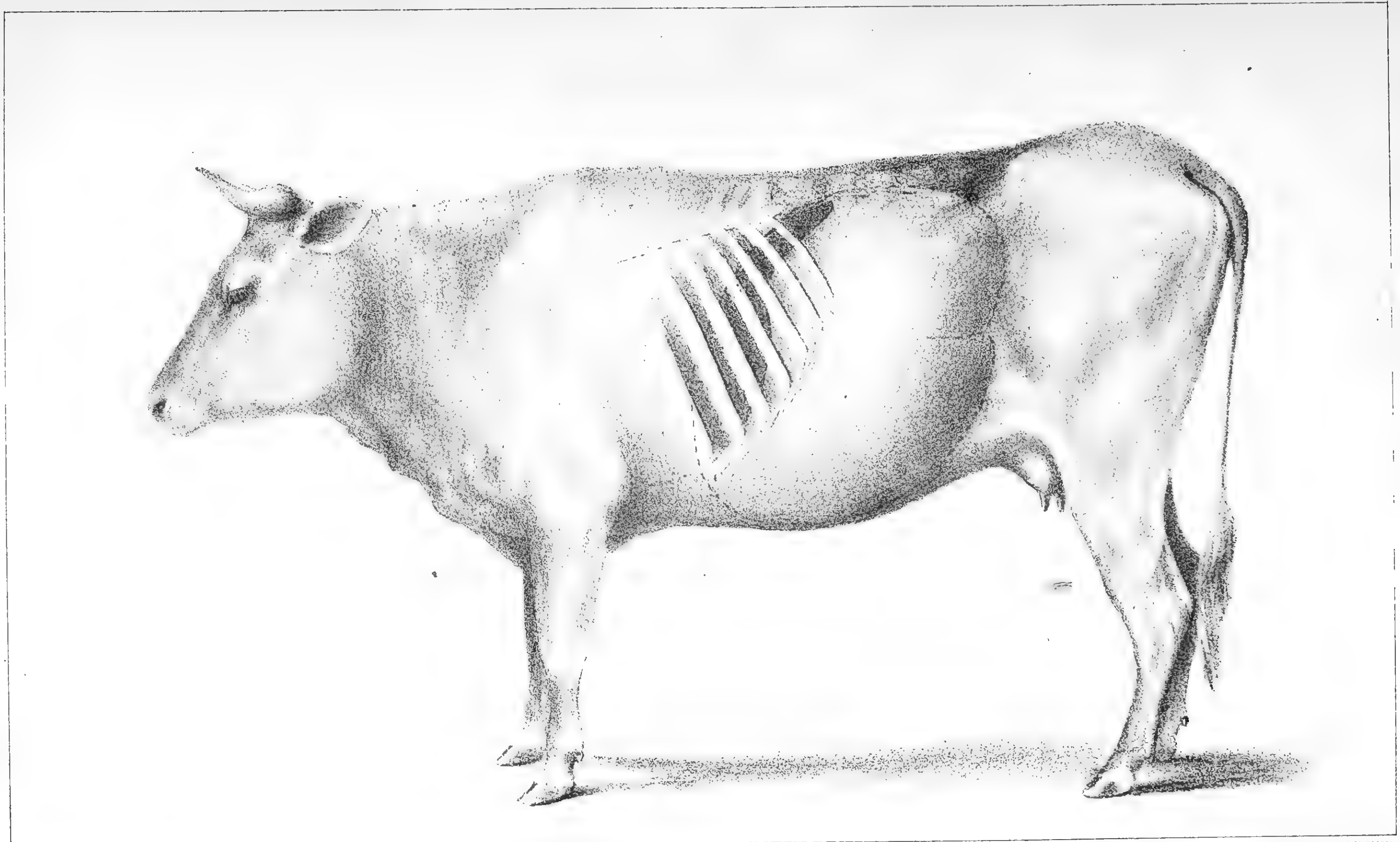
Appearance of ergot in hay: 1, blue grass; 2, timothy; 3, wild rye; 4, red-top.

Ergot is a fungus which may affect any member of the grass family. The spore of the fungus, by some means brought in contact with the undeveloped seed of the grass, grows, obliterates the seed and practically takes its place. When hay affected with ergot is fed to animals it is productive of a characteristic and serious affection or poisoning known as ergotism.

PLATE VI:

Illustrates the effects of ergot. The lower part of the limb of a cow showing the loss of skin and flesh in a narrow ring around the pastern bone, and the exposure of the bone itself.

PLATE I



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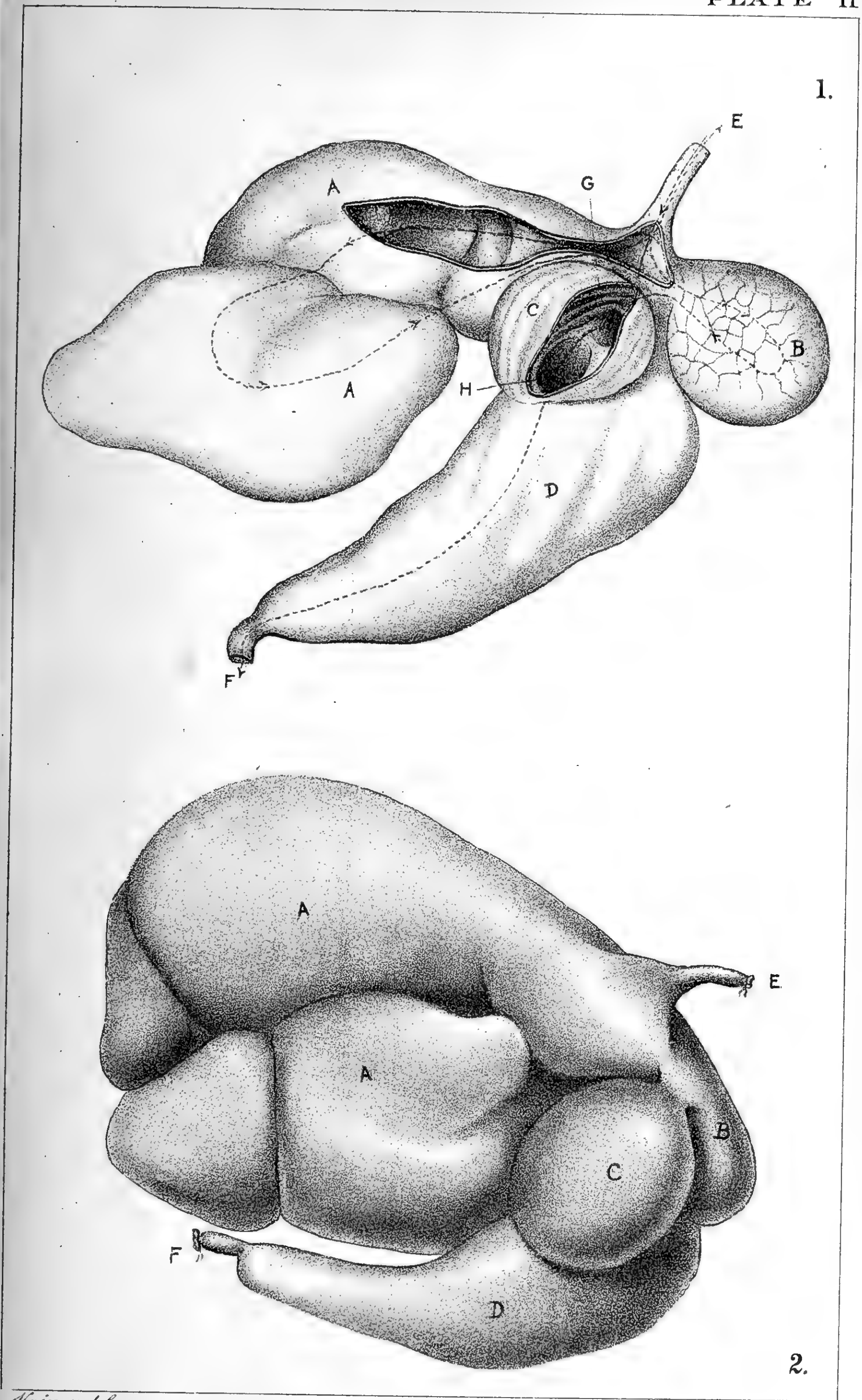
SHOWING THE POSITION OF THE RUMEN.

PLATE II



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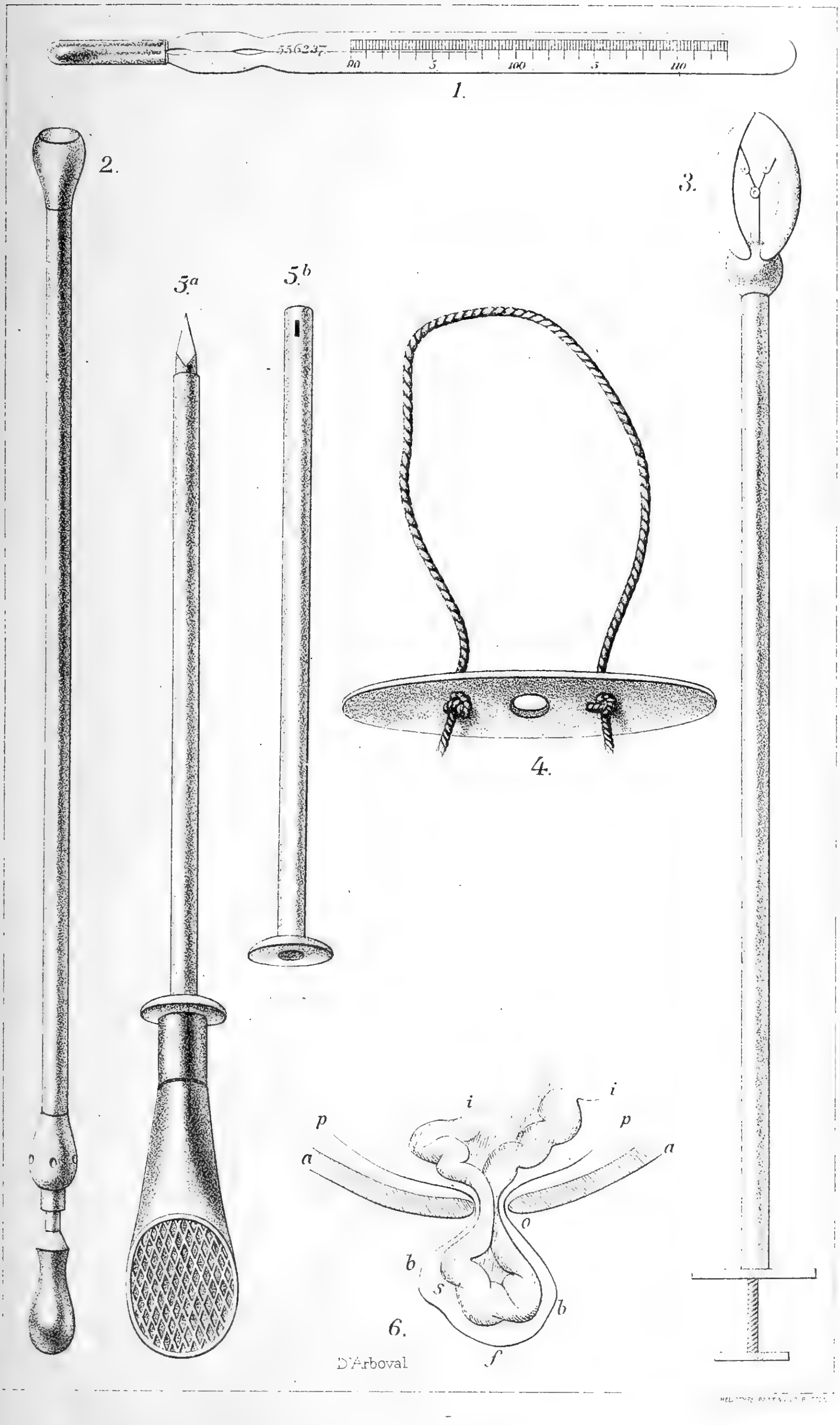
STOMACH OF RUMINANT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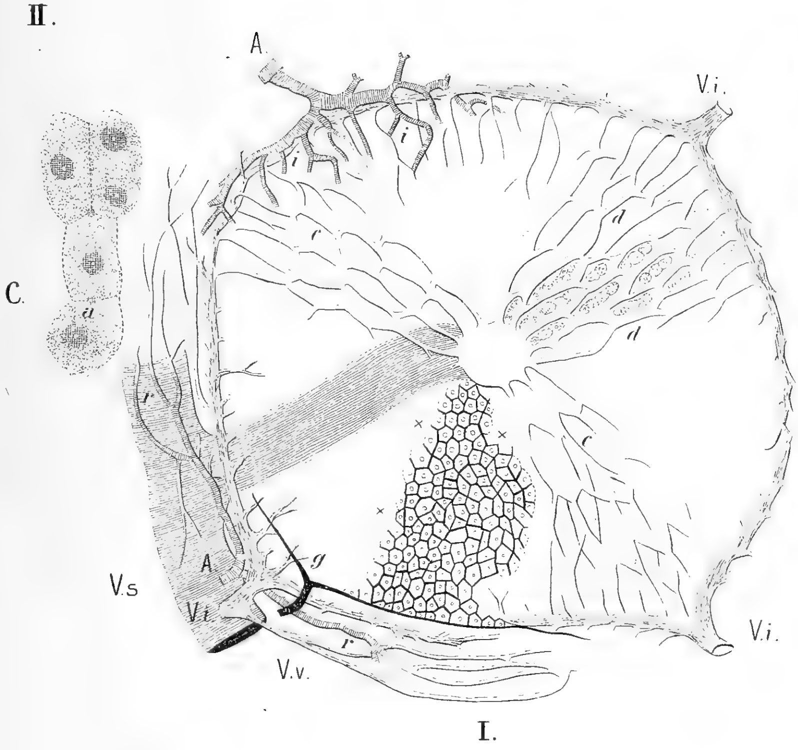
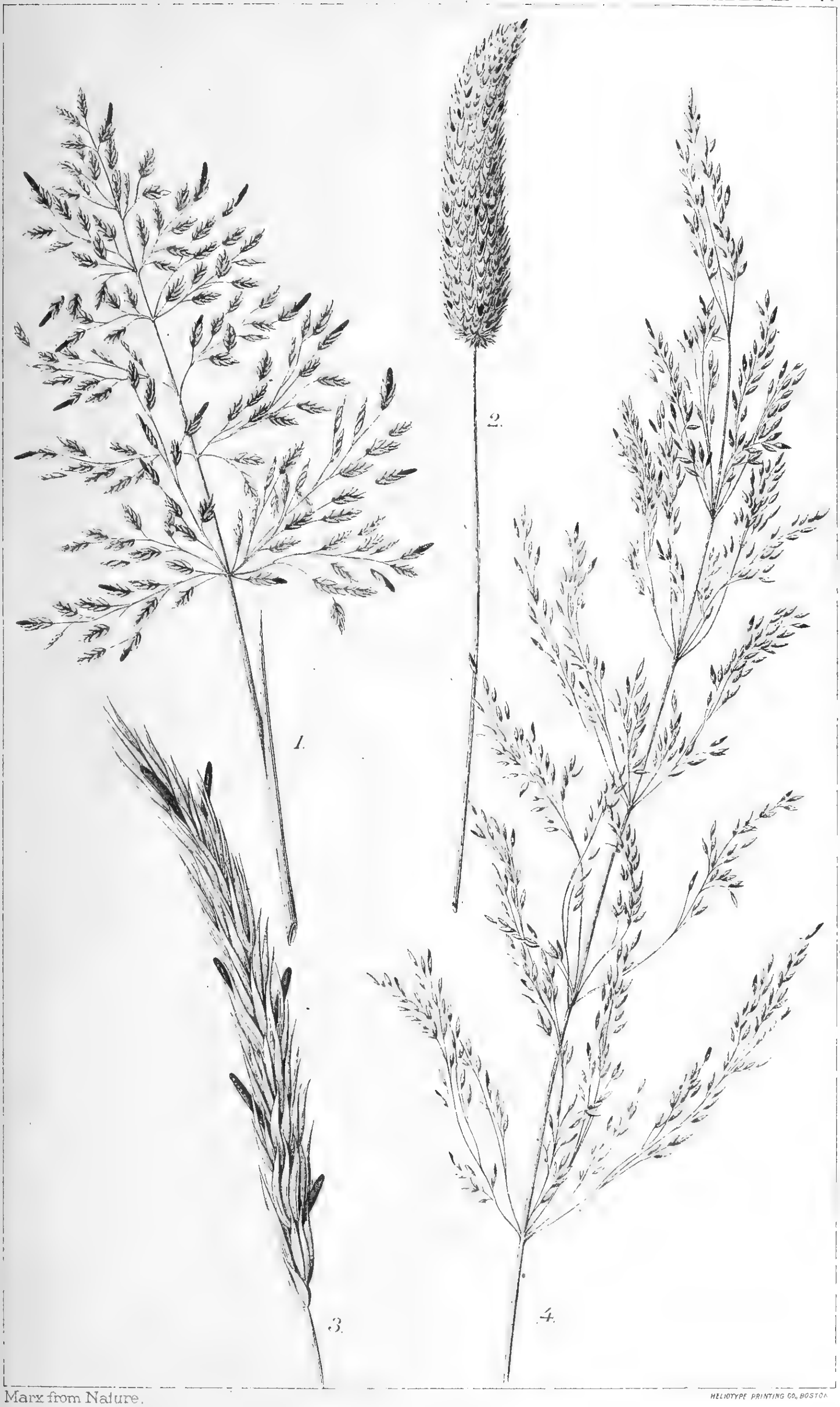


Haines, after Landois, Vol. 1-1886. Page 369.

MICROSCOPIC ANATOMY OF THE LIVER.



Marx from Nature.

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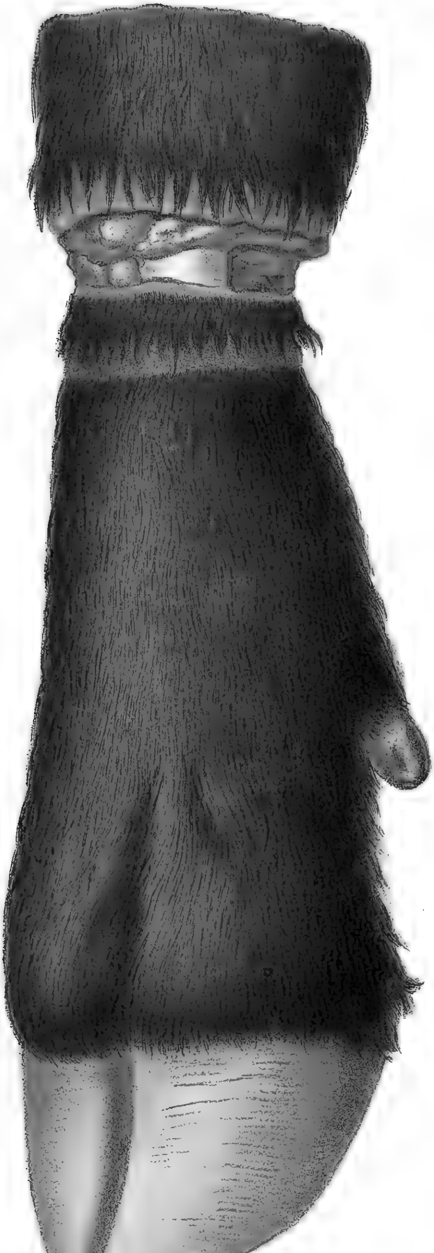
ERGOT IN HAY.



Marx, from nature.

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ERGOTISM.

POISONS AND POISONING.

By the late V. T. ATKINSON, V. S.,

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To clearly define the meaning of the word poison would be somewhat difficult. Even in law the word has never been defined, and when a definition is attempted we are apt to include either too much or too little. The following is perhaps as clear a definition as it is possible to give: "A poison is a substance having an inherent deleterious property rendering it capable of destroying life by whatever avenue it finds access to the system, or it is a substance which, when introduced into the system or applied externally, injures health or destroys life irrespective of mechanical means or thermal changes." The common conception of a poison is any substance which will destroy life, in small quantity, excepting such as act by purely mechanical means, as, for example, powdered glass.

THE ACTION OF POISONS.

This may be either local, and exerted directly on the tissues with which they come in contact, or remote, acting through the circulation or nervous system; or both local and remote action may be exerted by the same drug. Poisons which act locally generally either destroy by corrosion the tissues with which they come in contact, or by inhalation set up acute inflammation. When any corrosive agent is taken into the stomach in poisonous quantities a group of symptoms is developed which is common to all. The tissues with which the agent comes in contact are destroyed, sloughing and acute inflammation of the surrounding structures take place; intense pain in the abdomen and death ensue. In a like manner, but with less rapidity, the same result is reached if the agent used be not of a sufficiently corrosive nature to destroy the tissues, but sufficiently irritating to set up acute inflammation of the mucous membrane of the digestive tract. Of the poisons exerting a remote influence, the action is quite different, little or no local effect being produced upon the digestive organs. The poisons, when absorbed and transmitted through the agency of the circulation, exert their baneful influence, and though some of them act with extreme rapidity no effect can be produced until the agent has been absorbed. The poisonous effect of any substance is modified by the quantity used; by its chemical combinations; by the part of the animal structure with which it comes in contact; and also by the physical condition of the subject. As an illustration, opium may be given with safety in much larger doses to an animal suffering from acute pain than to one free from pain, and to an adult animal with greater safety than to a young one. The rapidity with which the poison is absorbed, owing to the part of the body with which it is brought in contact, is also an important factor. So marked is this quality that some agents which have the power of destroying life with almost absolute certainty when introduced beneath the skin, may be taken into the stomach without causing even noticeable inconvenience, as curara, the arrow poison, or the venomous secretion of the snake fang. Other agents in chemical combination may tend to intensify, lessen, or wholly neutralize the poisonous effect. For example, arsenic in itself has well-marked poisonous properties, but when brought in contact with dialyzed iron it forms an insoluble compound and becomes innocuous. Idiosyncracies are not so noticeable in cattle practice as in practice among human beings, but the uncertainty with which some drugs exert their influence would lead us to believe that well-marked differences in susceptibility exist. Even in some cases a tolerance for poison is engendered so that in a herd of animals equally exposed injurious or fatal effects do not appear with uniformity. For example, among cattle that are compelled to drink water holding in solution a salt of lead, the effects of the poisoning will be found varying all the way from fatality to imperceptibility.

GENERAL SYMPTOMS OF POISONING.

So widely varied are the symptoms produced by different poisonous agents that it is almost impossible to lay down even a general rule of symptoms which may be applied to all cases. Ordinarily, poisoning is not suspected until after the death of the affected animal. To establish the presence or absence of poison in the system becomes necessary only with a view to arresting its effect on other animals that may have been similarly exposed, or to promote the ends of justice in criminal jurisprudence. The symptoms shown before death are likely to give reason to suspect either intestinal irritation, with manifestation similar to those of colic; or disordered brain function with the characteristic indications of vertigo, coma, paralysis, dilatation, or contraction of the pupil, etc. The animal secretions and excretions may be perverted, augmented, or suppressed. Chemical analysis and philosophical experiments only can determine with absolute certainty the presence of many of the poisons. On the other hand, diagnosis may be reached with reasonable certainty where the previous history of the case is known, as well as the surroundings and the poisonous agents to which the animal would be likely to have access.

GENERAL TREATMENT.

The treatment of animals suffering from poison must vary according to the nature of the toxic agent. There are a few general plans of action, however, which should be followed as far as possible. If a stomach-pump can be procured no time should be lost in emptying the stomach of its contents and carefully washing that organ by either injecting pure water or a solution of the proper antidote. If the stomach can not be emptied, the antidote should be administered which will counteract or neutralize the particular poison from which the animal is suffering, such as powdered chalk to neutralize acid poison. If the poison has been taken in solid form and there is a probability that part of it is still undissolved its further destructive action may be arrested by the administration of mucilaginous drinks, as infusions of flaxseed, white of eggs, acacia (gum arabic), etc. Where the poison is known to be one that is not likely to exert its influence on the stomach directly but remotely, every effort should be made to neutralize any part of it that may remain unabsorbed, and to as far as possible fortify the system against its action, as by the use of atropia in opium-poisoning, or the placing of the patient under the influence of chloroform or ether when poisoned by strychnine. A poisonous agent may be so gradually introduced into the system as to slowly develop the power of resistance against its action. In other cases, where the poison is introduced slowly, the poisonous action becomes cumulative, and although there is no increase in the quantity taken violent symptoms are suddenly developed, as if the whole amount, the consumption of which may have extended over a considerable period, had been given in one dose. Other agents, poisonous in their nature, tend to deteriorate some of the important organs and interfering with their natural functions are productive of conditions of ill-health which, although not necessarily fatal, are important. Such a class might properly be called chronic poisons. Poisons of themselves dangerous when administered in large doses are used medicinally for curative purposes, and a very large percentage of the pharmaceutical preparations used in the practice of medicine if given in excessive quantities might produce serious results. In the administration of medicines, therefore, care should be exercised not only that the animal is not poisoned by the administration of an excessive dose, but that injury is not done by continued treatment with medicines the administration of which is not called for.

ARSENIC POISONING.

Of the common irritant and corrosive poisons, arsenic, especially one of its compounds (Paris green or arsenite of copper), is likely to be the most dangerous to our class of patients. The common practice of using Paris green as an insecticide for the destruction of potato beetle and other vegetable parasites has had the effect of introducing it into almost all of our farming establishments. White arsenic is also a principal ingredient in many of the popular sheep-dipping preparations, and poisoning from this source occasionally takes place, when, after dipping, the flock are allowed to run in a yard in which there is loose fodder. The drippings from the wool of the sheep falling on the fodder render it poisonous, and dangerous to animal life if eaten. Familiarity with its use has in many instances tended to breed contempt for its potency as a poison. Its action is the same as that of all the soluble chemical compounds of arsenic; it acts as a powerful irritant to the stomach and intestines, setting up acute inflammation of any part of the alimentary tract with which it comes in contact.

The *symptoms* first appear as those of colic; the animal is restless, stamping with the feet, lying down and getting up. There is tenderness on pressure over the abdomen. The acute symptoms increase; in a few hours violent diarrhea is developed; in many cases blood and shreds of detached mucous membrane are mixed with the evacuations. There is irregular and feeble pulse and perspiration, and death is likely to supervene between the eighteenth hour and the third day. If the latter period is past there is a reasonable hope of recovery.

Treatment consists in the use of the stomach-pump. After the stomach is completely emptied there may be a liberal administration of demulcents, such as flaxseed tea, boiled starch, acacia, etc. The freshly precipitated hydrate or dialyzed iron should be given. The amount of the dose must be regulated by the urgency of the symptoms and the amount of poison the animal has probably taken. The safest plan is to give small doses at frequent intervals. The effect of preparations of iron is to entangle the poison and convert it into an insoluble arsenite of iron. The hydrate may be given in ounce doses, repeated every hour until relief is obtained, or until four or five doses have been given.

LEAD POISONING.

The salts of lead, particularly sugar of lead (acetate) are irritant poisons, but not of great activity. Death may result from their continued use, but recovery is probable, unless they are taken in very large quantities. Having a somewhat salty taste, animals are likely to lick old paint pots. Lead poisoning may occur from accidentally taking solutions of the sugar of lead or by means of water drawn from lead pipes.

Symptoms are generally dullness; lying down with the head turned toward the flank; rumbling in the abdomen, loss of control of the limbs when walking, twitching, champing of the jaws, moving in a circle, convulsions, delirium, violent bellowing, followed by stupor and death. The symptoms generally extend over considerable time.

The *treatment* should first be directed toward removing the cause. A large dose of purgative medicine should be given and the brain symptoms be relieved by giving bromide of potassium in half-ounce doses every four or five hours, and the application of cold water to the head. Dilute sulphuric acid in half-ounce doses should be given with the purgative medicine. In this case sulphate of magnesia (Epsom salts) is the best purgative, and it may be given in doses of from 1 to 2 pounds dissolved in warm water. After the acute symptoms have abated, iodide of potassium may be given in doses of 2 drams each, three times a day for a week.

Chronic lead poisoning occasionally occurs in districts where lead mining is the principal industry. The waste products of the mine thrown into streams contaminate the water supply so that the mineral is taken into the system gradually, and a very small per cent of any of the salts taken into the system in this way is pernicious. Water which contains any salt of lead to the extent of more than one-tenth of a grain to the gallon is unfit to drink. It may be conveniently tested by placing it in a white porcelain dish and adding a few drops of sulphureted hydrogen, when if the lead be present the color of the dish will be darkened. Such water when used continually is likely to produce colic from the resulting intestinal irritation and in aggravated cases paralysis more or less severe is likely to be developed. A blue line on the margin of the gums, the last symptom, is regarded as diagnostic, and its presence as conclusive evidence of the nature of the disorder. The free use of purgatives is indicated with iodide of potassium. No treatment is likely to be of avail until the cause is removed.

COPPER POISONS.

The soluble salts of copper, though used as a tonic in the medicinal treatment of cattle, are poisonous when taken in large quantities. Like lead and arsenic they have an irritant effect upon the mucous membrane with which they come in contact in a concentrated form. Cattle are not very likely to be poisoned from this cause unless through carelessness. The salts of copper—the most common of which is the sulphate of copper, commonly called blue vitriol—are occasionally used for disinfecting and cleansing stables, where they might inadvertently be mixed with the food. In animals having the power to vomit it acts as an emetic and tends to work its own cure. Cattle, however, although ruminants and having power to return parts of the food to the mouth for remastication, are unable to empty the stomach in this way, so that when large quantities have been taken the use of the stomach-pump is at once indicated. This should be followed by a liberal supply of demulcents, linseed infusion, boiled starch, whites of eggs, etc. The general symptoms produced are those of intestinal irritation, short breathing, stamping, and tender abdomen.

ZINC POISONS.

Several of the soluble salts of zinc are irritant poisons. In animals which have power to vomit they are emetic in their action. In others, when retained in the stomach, they set up more or less irritation of the mucous membrane and abdominal pain, producing symptoms already described in the action of other poisons which produce the same result. The treatment would consist of emptying the stomach and the use of demulcents.

PHOSPHORUS POISONS.

Only one of the salts of phosphorus in common use—the ordinary yellow—is poisonous. Phosphorus in this form is used for the destruction of rats and mice and other vermin, and is largely used in the manufacture of matches. In the stomach it produces a certain amount of disturbance; vertigo and diarrhea are the usual symptoms. If taken in large quantities, the excreta are occasionally noticed to be luminous when examined in the dark. The irritant symptoms generally subside in a few days and the animal appears to recover its usual health. In a short time depression and loss of appetite are again noticed; the visible mucous membranes are yellow from reabsorption of bile; the function of the liver is imperfectly performed or suspended; fatty degeneration of the structures occur; the feces are light colored; fever of a semi-typhoid nature is present, and death usually takes place in ten days or two weeks from the administration of the poison. Oil of turpentine is a favorite remedy, and, though the best, is unsatisfactory. Recoveries are not common.

ACID POISONS.

The mineral acids, nitric, sulphuric, hydrochloric, etc., when used in a concentrated form, destroy the animal tissues with which they come in contact, and in this respect differ from the poisons previously described. The irritant effect of those already mentioned might be the result of the use of these acids in a dilute form, but when concentrated erosion takes place. When taken into the stomach the mucous membrane of the mouth, pharynx, œsophagus, and stomach is apt to be completely destroyed. If taken in large quantities death is likely to result so speedily that nothing can be done to relieve the patient, and even if time is allowed and the action of the acid can be arrested it can not be done until considerable irreparable damage has been done. The mucous membrane with which it has come in contact in the œsophagus is destroyed by the corrosive action and carried away, leaving the muscular tissues exposed. The raw surface heals irregularly, the cicatrice contracting causes stricture, and the animal is likely to die of starvation. In the stomach even greater damage is likely to be done. The peristaltic action of the œsophagus having carried the irritant along quickly, here it remains quiet in contact with one surface, destroying it. It is likely to perforate the organ, and coming in contact with the abdominal lining or other organ of digestion soon sets up a condition that is beyond repair. In a less concentrated form, when the acid is not sufficiently strong to be corrosive, it exerts an irritant effect. In this form, however, it is not likely to do much harm unless taken in considerable quantity. When it is, the mucous membrane of the stomach and intestines becomes inflamed; pain and diarrhea are likely to result. Any of the alkalies may be used as an antidote. Most convenient of these are chalk, whiting, baking soda, etc.

VEGETABLE ACIDS.

Oxalic acid in particular is corrosive in its action when taken in concentrated solution, losing its corrosive effect and becoming irritant when more dilute. It also exerts a specific effect on the heart, frequently causing death from syncope. Taken in the form either of the crystals or solution it is likely to cause death in a very short time. Failure of heart action and attendant small pulse, weakness, staggering, and convulsions are the more noticeable symptons. Antacids as chalk, whiting, etc., are indicated. The stomach should be emptied as quickly as possible so as to get rid of all trace of the poison which may not have been neutralized by the alkali.

MERCURIAL POISONS.

Corrosive sublimate (bichloride of mercury) is perhaps the most terrible of corrosive poisons. It proves fatal in very small doses. To all animals shortly after it is taken it produces intense pain in the abdomen from destruction of the tissues with which it is brought in contact. If it does not prove fatal from this action, being absorbed, it exerts a powerful influence on the liver and salivary glands, causing diarrhea and discharge of saliva from the mouth. As an antidote the white of egg has the power of completely neutralizing its poisonous effect, provided it can be administered before the poison has had time to exert its deadly influence. In using this remedy the white should be separated from the yolk, mixed with water, and given in large quantities; the stomach should be emptied by means of a stomach pump after the antidote has been given.

Chloride of mercury (calomel) is medicinally used. It is less powerful in its corrosive effect, but produces the same general symptoms when given in large doses.

ALKALINE POISONS.

The carbonates and sulphides of potash and soda and the alkalies themselves in concentrated form cause symptoms of intestinal irritation similar to those produced by mineral acids, though chemically incompatible with the acids, their caustic irritant effects depending on their degree of concentration. When they reach the stomach the symptoms are nearly as well marked as in the case of the acid. The irritation is even more noticeable and purgation is likely to be a more prominent symptom. The treatment will consist as in the case of the acid, of unloading the stomach as soon as practicable. If this can not be done the poisonous effects of the alkali may be neutralized by the administration of dilute acids. The administration of such an antidote and its action must be carefully watched during administration. In the chemical change which takes place when the acid and alkali are combined, carbonic acid gas is liberated, which may be to an extent sufficient to cause considerable distention of the abdomen, even to asphyxia from pressure forward on the diaphragm. Should this danger present itself it may be averted by opening the left flank, permitting the gas to escape. (See Tympanitis or Bloating, p. 29.)

COAL-OIL POISONING.

Coal oil is sometimes administered empirically as a treatment for intestinal parasites. If given in large doses it produces poisonous effects, which are likely to be manifest some time after the administration. It acts as an irritant to the digestive tract, causing dribbling of ropy saliva from the mouth, catharsis, and shreds of mucus in the fecal matter, tenesmus and loss of appetite, with increased temperature and cold extremities. Visible mucous membranes are injected, pupils of the eyes contracted, watery discharge from the eyes and nostrils. Remotely it exerts a depressing influence on the functions of the brain and slight coma and occasionally convulsions from which the animal is easily aroused. The kidneys also suffer. The urine is dark colored and has the characteristic odor of coal oil. Death may result from gastro-enteritis or convulsions. The patient's strength should be fostered by the frequent administration of mild stimulants, of which aromatic spirits of ammonia is perhaps the best. The animal should be encouraged to eat soft food and given mucilaginous drinks.

CARBOLIC-ACID POISONING.

Although one of the most valuable antiseptic remedies, carbolic acid in a concentrated form, when taken internally or used over a large surface externally, is likely to produce poisonous effects. It causes whitening, shrinking, and numbness of the structures with which it comes in contact, and besides its irritant effect exerts a powerful influence on the nervous system. Being readily absorbed it produces its effect whether swallowed, injected into the rectum, inhaled, or applied to wounds or even to a large tract of unbroken skin. Used extensively as a dressing it may produce nausea, dizziness, and black or green colored urine. The last symptom is nearly always noticeable where the poisonous effect is produced. In more concentrated form, or used in larger quantities, convulsions followed by fatal coma are likely to take place. Even in smaller quantities, dullness, trembling, and disinclination for food often continues for several days. In a tolerably concentrated solution it coagulates albumen and acts as an astringent. As an antidote internally, lime-water sweetened with sugar should be given in large quantities or a solution of sulphate of soda. When the poisoning occurs through too extensive applications to wounds or the skin, as in treatment of mange, cold water should be freely applied so as to wash off any of the acid that may still remain unabsorbed. As a surgical dressing a 3 per cent solution is strong enough for ordinary purposes. Water will not hold more than 5 per cent in permanent solution. No preparation stronger than the saturated solution should be used medicinally under any circumstances.

VEGETABLE POISONS.

These may be divided into two classes—those that are likely to be administered to the animal as medicine or such as may be taken in the food, either in the shape of poisonous plants or plant disease affecting the natural herbage of the pasture or meadow from which the animal obtains its food supply.

OPIUM POISONING.

Opium and its alkaloid, morphia, are so commonly used in the practice of medicine that the poisonous result of an overdose is not uncommon in ordinary practice. The common preparations are gum opium, the inspissated juice of the poppy, powdered opium made from the gum, tincture of opium, commonly called laudanum, and the alkaloid or active principle, morphia. Laudanum has about one-eighth the strength of the gum or powder. Morphia is present in good opium to the extent of about 10 per cent. In medicinal quantities it is a most useful agent in allaying pain. It has an effect common to all narcotics of first producing a stimulating effect, which is soon followed by drowsiness, a disposition to sleep or complete anæsthesia, depending on the quantity of the drug used. In poisonous doses a state of exhilaration is apt to be well marked at first. A second stage rapidly supervenes, in which the symptoms are those of congestion of the brain. It has the effect of preventing perfect aëration of the blood. The visible membranes have a bluish tint (cyanotic). The breathing is slow, labored, and later stertorous; the pupils of the eyes are very much contracted; the skin dry and warm. The patient may be aroused by great noise or the infliction of sharp pain, when the breathing becomes more natural. A relapse into the comatose condition soon takes place when the excitement is removed. Later, there is perfect coma and the patient can no longer be aroused from the insensible condition. The contraction of the pupil becomes more marked, the breathing intermittent and slower, there is perspiration, the pulse more feeble and rapid, till death takes place.

Treatment.—The stomach should be emptied by means of a stomach pump, if possible, and the patient kept moving, even though what would otherwise be cruelty is necessarily inflicted. When other means fail to excite, sharp sounds produced close to the ear will sometimes serve to arouse. Stimulants should be given internally, such as aromatic spirits of ammonia, whisky, brandy, and strong infusions of coffee.

STRYCHNINE POISONING.

Nearly all the alkaloids of the genus *Strychnos* are poisonous, more particularly strychnine. Strychnine is a very concentrated poison and produces its effect very quickly, usually only a few minutes being necessary. The first noticeable symptom is a well-marked convulsion; the head is jerked back, the back arched and leg extended, the eyes drawn. The spasm continues for only a few minutes, when it relaxes and returns again in a short time. The return is hastened by excitement and in a short time again disappears, continuing to disappear and reappear until death results. As the poisonous effect advances the intervals between the spasms become shorter and less marked and the spasms more severe until the animal dies in violent struggles.

Treatment.—Emptying the stomach is good treatment if it can be done before the poison is absorbed. After the spasms have been noticed, however, the operation would likely excite the animal and hasten the fatal termination. The best method is to put the patient under the influence of chloroform or ether and keep it there continuously until the effect of the poison has passed off.

ACONITE POISONING.

In recent years tincture of aconite has for some unknown reason become a popular stable remedy. In the hands of some breeders it seems to be used as a panacea for all the ills flesh is heir to. If an animal is ailing aconite is given whether indicated or not. Fortunately the dose used is generally small, and for this reason the damage done much less than probably otherwise would be. Aconite is one of the most deadly poisons known. It produces paralysis of motion and sensation, depresses the heart's action and causes death by syncope. In large doses it causes profuse salivation, champing of the jaws and attempts at swallowing. If not sufficient to cause death there is impaired appetite with more or less nausea for some time after. In poisonous doses it causes the animal to tremble violently, lose power to support itself, and slight convulsions with perspiration. The pulse is depressed, irregular, and afterwards intermittent. If possible, the stomach should be emptied by means of the stomach pump and the animal treated with finely powdered animal charcoal in the hope of absorbing the poison. The only chemical antidote of any value is tannic acid, which forms an insoluble compound with the aconitine. The depressing effect on the heart should be counteracted by the use of ammonia, digitalis, and other diffusible stimulants, which have a physiological effect opposite to aconite.

DIETETIC POISONS.

A small but important group of poisons may be classed under this head. The poisonous principle is a plant product and likely to find its way into the stomach in the food which the animal consumes. In some cases it is poison naturally belonging to the plant; in other cases the poisonous principle is developed in what would otherwise be harmless plants as a plant disease.

LOCO WEED POISONING.

The loco weed (*Astragalus mollissimus*) found in the natural pastures of some of our Western States and Territories produces a remarkable poisonous effect. The plant grows on high, gravelly or sandy soil. It has a rather attractive appearance, and retains its soft, pale green color all winter. A mass of leaves 4 to 10 inches high grow from the very short stem. The leaves are pinnate, similar in form to those of a locust tree, with ten pairs of leaflets and an odd terminal one. The flower scape grows from the center of the plant. The flowers, shaped like pea blossoms, appear in June or July, are yellow tinted with violet. The seeds are contained in a pod about half an inch long. Fortunately a stalk-boring larva has attacked the plant and seems to be doing much toward eradicating it. Horses and cattle seem to acquire a taste for it, although it is not a plant that would be considered as a food or that would be eaten with a relish the first time. In the early spring, when herbage is scarce, its green appearance may attract the animal, and the habit of eating it be thus acquired. Its effect is not noticeable till a considerable quantity has been eaten. It seems to exert its influence on the nervous system. The gait is slow and measured, the step high, the eyes glassy and staring, the vision defective. Sudden excitement will frequently produce convulsions, which, if the disease is well advanced, have a temporarily prostrating effect upon the animal. Although loco poisoning is a nervous affection, emaciation is one of the most noticeable symptoms. The taste for the weed becomes stronger, the victim preferring it to other food until nothing else is eaten. When it is taken in large quantities delirium is produced and the animal becomes vicious. If the cause be removed before too much injury is done, recovery is likely to take place. Medicinal treatment seems to be of little avail. Comfortable stabling, quiet, and a liberal supply of wholesome food tend to counteract the poisonous effect of the plant and build up the depleted forces.

ERGOTISM.

[Plates v, vi.]

The poisonous effects of ergot have so far appeared only in the winter and spring of the year and among cattle. It is developed among grasses grown on rich soil in hot, damp seasons. Rye seems more liable to ergot than any of our other crops. Of the grasses which enter into the composition of hay, blue grass is the most likely to become affected. On the plant the fungus manifests itself on the seeds, where it is easily recognized when the hay is examined in the mow. The ergotized seeds are several times larger than the natural; hard, black, and generally curved in shape. The effect of the protracted use of ergot in the food is pretty well understood to be that of lowering the powers of circulation, which, together with the action of gravitation, is sufficient to completely arrest it in dependent parts of the body, such as are remote from the heart, as the tail and feet, particularly the hind feet. Cattle seem to be more susceptible than other animals to the influence of ergot, possibly on account of the slowness of the heart's action. When the effect of the poison has become sufficient to entirely arrest the circulation in any part the structures soon die. The disorder manifests itself as lameness in one or more limbs; swelling about the ankle which may result in only a small slough, but it is more likely to circumscribe the limb at any point below the knee or hock by an indented ring, below which the tissues become dead. The indentation soon changes to a crack, which, like it, extends completely round the limb, forming the line of separation between the dead and living structures. The crack deepens till the parts below drop off without loss of blood, and frequently with very little pus. This condition is known as dry gangrene, and is the poisonous effect of ergot.

Regarding the treatment, change of food and local antiseptics are of course indicated. The former may be useful as a preventive, but when the symptoms have appeared the animal is necessarily so completely saturated that recovery is likely to be tedious. It has been observed by some writers that the feeding of corn with ergotized food neutralizes the poisonous effect.

LOCAL POISONING.

Local poison may occur from the bites or stings of insects or from contact with poisonous plants in exposed parts of the body, such as poison ivy (*Rhus toxicodendron*), when brought in contact with the udder or teats, or from the external accidental application of caustic acid or alkaline solutions. In the case of the caustic its effect should be neutralized by the application of the proper antidote and the resulting wound treated as a burn or frost-bite. The stings of bees or wasps, and the bites of other poisonous insects, should be treated by the application of turpentine gently applied.

SNAKE BITES.

The poison contained in the fangs of certain venomous reptiles, particularly some of the snakes, which is injected into or under the skin of an animal bitten by the reptile is a very powerful agent. It is likely to produce a serious local irritation, and in the case of the more poisonous snakes serious constitutional disturbances, even to causing death, which it may do in either of two ways. First, when very strong, by exerting a narcotic influence similar to that of some of the powerful poisons, destroying nervous function, with the symptoms of extreme depression, feeble, flickering or intermittent pulse, cold extremities, dilated pupils, insensibility, collapse, and death. Second, when less powerful, by diffused inflammation of the areolar tissue, numerous abscesses, gangrene, and extensive sloughing. Immediately after the bite alarming symptoms of an asthenic character and local swelling rapidly takes place; there is irritation from the first. The extent of the swelling and subsequent gangrene will depend on the potency or amount of the poison introduced. Unless in very large quantities, death ensues so rapidly that the swelling process is not completed. There are many snakes of which the bites are harmless. Post-mortem examination reveals a dark alkaline condition of the blood, intense congestion of the lungs and spleen, and other conditions indicative of death of the blood (*necræmia*). The viscera emit a peculiar sickly odor.

The *treatment* may be divided into local and general. Locally every effort should be made to prevent absorption of the poison. If discovered at once the bitten part had better be excised. If that is impracticable and a ligature can be applied as in the case of a bite to one of the limbs, no time should be lost in applying it above the injury. It should be made sufficiently tight to as far as possible arrest circulation in the bitten part. The poison should be extracted by cupping. If this is not practicable, or when it has been performed, the wound should be seared with a red-hot iron to destroy as far as possible any of the poison that may remain unabsorbed. The depressing effect of the poison on the general system should be counteracted by liberal drenching with stimulants, wine, brandy, whisky, etc. In the human being preparations of arsenic, bromine, bichloride of mercury, and iodide of potassium in frequently-repeated doses are indicated. In animal practice the alcoholic stimulants and local treatment above described are likely to meet with best success. In the emergency which arises when such an accident occurs the means at hand must be used to the best advantage. First the application of a tight ligature can nearly always be made; then opening the wound up to its bottom with a penknife and encouraging free flow of blood will be likely to wash out at least part of the poison, if done promptly. Cupping can not be practiced among cattle with the same facility as it can in the human being, owing to the covering of hair. This obstacle may be overcome by smearing the hair full of tar or balsam on the surface to which the cupping glass is to be applied. The operation may be easily performed, using a jar or bottle with a good-sized neck, but not so large as to prevent its having a firm seat on the skin around the wound. A piece of cloth dipped in oil and lighted is dropped into the bottle, the neck of which is quickly applied to the wound. The flame of the burning cloth consumes the oxygen of the air and creates a partial vacuum into which the blood from the wound should flow freely. The injection hypodermically of a 20 per cent solution of permanganate of potash directly into the wounded tissues aids in neutralizing the effect of the concentrated poison in the immediate vicinity.

DISEASES OF THE HEART AND BLOOD-VESSELS.

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In order to comprehend what is meant by disease, it is essential that one should understand the structure and arrangement of the organs subject to disease, as well as know something of the phenomena or functions of the organs in a state of health, because it must be remembered that disease is but a perversion of health. The blood and circulatory apparatus are not only of the greatest importance in the diseases under this particular head, but they are more or less concerned whenever disease exists. To convey an idea of their importance it may be stated that all vitality and all nutrition depend on the blood. In view of these facts it must be admitted that nothing less than a liberal description of these organs and their functions will suffice in a work of this kind (the principal object of which is instruction), and therefore we will at once proceed to an anatomical and physiological consideration of them.

The heart, blood-vessels, and lymphatics are usually described as the circulatory apparatus.

The heart is located in the thoracic cavity (chest). It is conical in form, with the base or large part uppermost, while the apex or point rests just above the *sternum* (breastbone). It is suspended from the vertebral column (backbone) by the large blood-vessels which enter and leave the heart. It is situated between the right and left lung, the apex inclining to the left, and owing to this circumstance the heartbeats are best felt on the left side of the chest behind the elbow. The heart is composed principally of muscular tissue. It may be considered as a hollow muscle, containing four compartments, two on each side. The compartments of each side are placed one above the other. For convenience, the compartments are called right and left, but in reality those called right are almost in front of those called the left. The upper compartments are called auricles and the lower ones are called ventricles. The right auricle and ventricle are completely separated from the left auricle and ventricle by a thick septum or wall, so that there is no communication between the right and left sides of the heart. Externally the heart appears to be single, but it is really a double organ.

The communication between the auricle and ventricle of either side is called the auriculo-ventricular opening, and both orifices are regulated by valves. The compartments of the heart are manifest on its outer surface by grooves or furrows. There is a transverse groove which marks the division between the auricular and ventricular parts. This groove also marks the location of the auriculo-ventricular openings on the inside. The upper portion of the heart is constricted in the middle of its superior face; the section on either side of the constriction represents one of the auricles. Into the right section are inserted the posterior vena cava, the anterior vena cava, the vena azygos, and coronary vein. Into the left section are inserted the pulmonary veins, usually four in number. The ventricular portion includes all that is below the transverse groove; it is much the greater portion of the organ and gives to it the shape of a cone or pyramid. On either face is seen a groove which marks the division between the right and left ventricle. In cattle an accessory groove runs down behind the left ventricle. All the grooves are occupied by blood-vessels and fatty tissue. The common aorta and the pulmonary artery leave the upper portion of the ventricular mass on the left of the anterior part.

The cavities of the heart are designated as the right and left, and there is no communication between the right and left cavities after the birth of the young animal. During the life of the fetus in the womb there is an opening in the wall between the right and left auricles called the foramen ovale, but at birth this is closed, and there remains only a depression in the wall to mark the place where it existed. It occasionally happens that the foramen ovale remains open after birth, and this exception will be referred to hereafter under the head of Cyanosis. In the cavities are to be seen the orifices of the vessels (through which the blood enters and leaves the heart), the names of which have been given.

At the bottom of each auricle is the auriculo-ventricular opening; each opening is provided with a valve to close it when the heart contracts to force the blood into the arteries. In the interval between the contractions these valves hang down into the ventricles. Little tendinous cords stretching from the free edges of the valves to the walls of the ventricles prevent the blood from forcing the valves too far up into the auricles during contraction of the heart, which prevents the return of blood into the auricles.

The opening of the common aorta and pulmonary artery and the auriculo-ventricular openings are surrounded by rings of fibrous tissue which form the frame on which the muscular tissue of the heart rests. In cattle there are found two small bones in the fibrous tissue of the ring of the common aorta. The fibrous tissue completely surrounds the openings of the aorta and pulmonary artery, but the rings around the auriculo-ventricular openings are incomplete.

The muscular tissue of the heart belongs to that class known as involuntary, because its action—contraction—is not controlled by the will; but it is well to remark that it is a variety of striated or striped muscle, and striped muscle, with but few exceptions, of which this is one, belongs to the class known as voluntary muscle.

The nutrition of the heart is derived from the blood distributed to its muscular tissue by the coronary arteries (and their branches), which are the only vessels given off by the common aorta before it divides into the posterior and anterior aortas. The branches of the coronary arteries are the vessels which occupy the furrows on the external surface of the heart. The venous blood from the structure of the heart is emptied into the right auricle by the coronary vein. The lymphatics of the heart accompany the course of the coronary arteries and empty into the lymphatic glands near the base of the heart. The nervous supply of the heart is from the cardiac plexus, which is derived from the pneumogastric and sympathetic nerves.

The cavities of the heart are lined by a kind of serous membrane called the endocardium. It is very thin and closely adherent and forms the internal surface. The endocardium may be considered as continued into the veins and the arteries, forming their internal lining. In the cavities of the right side the endocardium has a reddish tint, which is deeper in the ventricle; in the cavities of the left side the tint is yellowish. The walls of the ventricles are thicker than those of the auricles, and the walls of the left ventricle are much thicker than those of the right.

The heart is enveloped by a fibrous sac (or bag) called the pericardium, which assumes much of the general shape of the outer surface of the heart. The internal surface of the pericardium is smooth and glistening like the external surface of the heart itself. These smooth surfaces are opposed one to the other, and are in fact the serous membrane of the pericardium; they are kept moist by the serum which exudes from their surface to prevent the serious consequence of friction to the surface of the heart. In health no appreciable quantity of fluid collects in the sac, but in some cases of disease, and in instances of old age, serum accumulates within the pericardium to a greater or less extent.

The heart is the principal organ of the circulatory apparatus, and its function is to assure the movement of the blood by the regular contraction of its walls which force the blood into the vessels called arteries. The auricles may be considered as the reservoirs or receivers of the blood, and the ventricles as the pumps, therefore the function of the heart resembles the action of a force-pump. During the interval between contractions, the heart being in momentary repose, the blood pours into the auricles from the veins; the auriculo-ventricular orifices being widely open, the ventricles also receive blood; the auricles contract and the ventricles are filled; contraction of the ventricles follows; the auriculo-ventricular valves are forced up by the pressure of the blood and close the auriculo-ventricular openings, and prevent the return of blood into the auricles; the contraction of the ventricles forces the blood from the right ventricle into the lungs through the pulmonary artery and its branches, and from the left ventricle into the aorta and all parts of the body through the arteries. After the contraction of the ventricles the heart is again in momentary repose and being filled with blood, while the valves in the aorta and pulmonary artery close to prevent the return of blood into the ventricles. (See Plate VII.)

The heart is the most irritable muscle in the body; it has no rest from the time the first few cells are formed that go to make up the organ until its action is stopped by death, except during the repose or momentary pause between the beats.

The average weight of the heart of an ox is said to be from $3\frac{1}{2}$ to $4\frac{1}{2}$ pounds, but, of course, the weight must be very variable in different animals owing to the many breeds and sizes of cattle.

The vessels that convey the blood from the heart to all parts of the body are called arteries; the vessels which return the blood to the heart are called veins. Between the ultimate ramifications of the arteries and the beginning of the veins there is an intermediate system of very minute vessels called capillaries, which connect the arterial with the venous system of the circulation.

ARTERIES.

The walls of the arteries are possessed of a certain amount of rigidity sufficient to keep the tubes open when they are empty; this fact led the ancients to believe that they contained air and hence their name—arteries. The walls of the arteries are composed of three coats or tunics. The internal coat may be considered a prolongation of the endocardium from the left ventricle. The middle coat is composed of yellow elastic tissue and muscular tissue; the amount of each tissue varies according to the size of the vessel. The muscular tissue being contractile is required in some parts more than in others. In the aorta and large arteries near the heart the elastic tissue predominates; in the vessels of intermediate size the elastic and muscular tissues average about equal proportions, while in the smallest arteries the muscular tissue predominates and even comprises the entire middle coat. The external coat is composed of a layer of thin but remarkably strong fibrous tissue and a small proportion of elastic tissue.

A ligature may be tied sufficiently tight around an artery to completely rupture the middle and internal coats without severing the external coat; and owing to the fact that the union is not complete between the middle and external coats, the ruptured coats retract within the external one, assisting to a great extent in surgery. The blood leaves the left ventricle through a single vessel, the common aorta, which divides into the anterior and posterior aortas, which in turn give off the large arteries.

The arteries divide and subdivide (like the branches of a tree) become smaller and smaller, and ultimately ramify into every part of the body, terminating in a network of very small tubes called capillaries, which can only be recognized by the aid of a microscope. The walls of the capillaries differ considerably from the walls of the arteries and veins, and they also vary according to the size of the capillary tubes; they are so thin and peculiar that white corpuscles and the fluid part of the blood readily pass through them into adjacent tissue. The capillaries terminate in veins.

The veins take the blood from the capillaries in all parts of the body. They begin in very small tubes which unite to become larger in size and less in number as they approach the heart. The veins, like the arteries, have three coats, but are thinner, less muscular, and less elastic than the arteries, and collapse when empty.

In its course an artery is usually accompanied by a vein, and in many instances by two veins; in the latter case it is placed between them, and if but one vein accompanies it, the artery is always the deeper and least exposed of the two vessels. Nerves also generally accompany the arteries. Muscles in many locations serve to point out the situation of arteries, as they often are in contact with them in their course; certain arteries are in contact with bones; and in certain situations they lie in the connective tissue between the skin and bone, which is the case with some of these vessels about the head and legs; such arteries are best for ascertaining the state of the pulse. Arteries deeply seated in certain places are in contact with bones, and the knowledge of their location enables the surgeon to compress them against the bone for the purpose of arresting the flow of blood in a particular vessel in case of hemorrhage or during operations. The more important arteries are placed deep within the body; but in those cases where they are superficial, they are generally found where least exposed to injury, as for example, on the inner side of the legs. Arteries are less numerous than veins, and the total capacity of the arteries is much less than that of the veins. A great number of veins are in the tissue immediately beneath the skin, and these are not generally accompanied by arteries. All the superficial veins, and many of the others, have valves within them to prevent the reflux of blood; the faces of the valves are towards the heart, and when anything interferes to retard the flow of blood to the heart, the valves are closed by the backing of the blood, and effectually prevent its return. By the same means these valves favor the flow of blood to the heart, because of the pressure assured by the contraction of muscles adjacent to the veins. There are no valves in the veins of the lungs.

The blood throughout its course, in the heart, arteries, capillaries, and veins, is inclosed within these vessels. There is no opening into the course of the blood, except where the large lymphatics empty into the venous blood.

The circulation is considered as two systems: The pulmonary, the lesser, is that from the right heart to the lungs, and back to the left heart. The systemic, or greater, is from the left heart to all parts of the body, and back to the right heart. To simplify the subject it may be said at once that the blood of the body is of two colors—bright red, or pure blood, and dark red, or impure blood. All the arteries, except the pulmonary artery and its branches, carry bright red; and all the veins, except the pulmonary veins, carry dark-red blood. The impure dark-red blood is collected from the capillary vessels and carried to the right auricle by the veins; it passes through the auriculo-ventricular openings into the right ventricle and thence into the pulmonary artery, and through its branches to the capillaries of the lungs, where the carbonic acid gas and other impurities are given up to the air in the air-cells of the lungs (through the thin walls between the capillaries and air-cells), and where it also absorbs from the air the oxygen gas necessary to sustain life, which changes it to the bright red, pure blood. It passes from the capillaries to the branches of the pulmonary veins, which convey it to the left auricle of the heart; it then passes through the auriculo-ventricular opening into the left ventricle, the contraction of which forces it through the common aorta into the posterior and anterior aortas, and through all the arteries of the body into the capillaries, where it parts with its oxygen and nutritive elements, and where it absorbs carbonic acid gas and certain other impurities and becomes dark colored. (See theoretical diagram of the circulation, Plate VII.)

The muscular tissue in the walls of the arteries, under the stimulus of the vaso-motor nerves, regulates the caliber of the vessels and the amount of blood supplied to the different parts, and, on account of its contractibility, it assists in controlling a hemorrhage when an artery is cut completely across, by causing the retraction of the severed ends of the vessel.

The flow of blood through the capillaries is very slow, not much more than an inch a minute. The power which forces it through them is the heart; and many physiologists maintain that the changes in the blood which take place in the capillaries favor and compel the blood to flow through them, and as a proof they refer to the fact that arteries are found empty after death, because the capillaries have sent the blood into the veins. On this theory, capillary circulation may be compared to oil rising in the wick of a lamp to burn as the demand requires.

The blood is caused to flow through the veins to the heart by several different forces. The contraction of muscles in proximity to veins causes a pressure on them which assures an onward movement to the heart, since the valves in the veins prevent its backward movement. At each inspiration (or taking in a breath, there is a suction-like action of the chest, which induces the flow to the right auricle. The heart probably exerts a force from behind which assists the flow in the veins.

ANASTOMOSES.

The branches of certain arteries in different parts unite again after subdividing. This reuniting is called anastomosing, and assures a quota of blood to the part if one of the anastomosing arteries should be tied in case of hemorrhage, or should be destroyed by accident or operation. In such cases the blood is supplied by the collateral vessels of the anastomoses, which gradually enlarge, because the increased quantity of blood they are forced to carry distends their walls, and eventually the part receives all the blood it requires. Were it not for these anastomoses, certain parts would be deprived of blood in certain cases of accident and disease, and mortification would ensue.

Anastomoses are effected when two branches, after traversing a certain length, reunite to form a vessel larger than either of the branches; others are formed by transverse communications through smaller arteries between two larger ones running in the same direction; and they may be formed by a combination of both the foregoing methods. Veins also form anastomoses, and they are even more numerous than those of the arteries.

BLOOD.

The various kinds of food, after being digested in the alimentary canal, are absorbed and carried into the blood by the lymphatics, and by the blood to the places where nutrition is required. The blood takes from all parts of the body all that is useless and no longer required, and carries it to the different organs where it is eliminated from the body. It contains within itself all the elements which nourish the body.

The blood may be considered a fluid holding in solution certain inorganic elements and having certain bodies suspended in it. Authorities differ as to the exact amount of each constituent of the blood, but the following is a fair estimate: In 1,000 parts there are: water, 790 parts; corpuscles, 120 parts; albumen, 60 parts; salts and extractive matters, including the elements of fibrin, 30 parts. To facilitate description, the blood may be considered as being made up of the corpuscles and the liquor sanguinis. The corpuscles are of two kinds, the red and the white, the red being the most numerous. The color of the blood is due to the coloring matter in the red corpuscles. The red corpuscles are the oxygen carriers. Both kinds are very minute bodies, which require the aid of the microscope to recognize them. The liquor sanguinis is composed principally of water, salts, albumen, and the elements of fibrin. The most abundant salts are the chloride and the carbonate of soda, with a less quantity of the phosphate and sulphate of potassium and lime. The albumen very much resembles the white of an egg in its composition. Fatty matters exist in the liquor sanguinis in extremely small particles, and also in combination with soda.

The extractives are different elements in such small proportions as to require special means to extract them. Fibrin does not exist in the living blood as fibrin, but the elements are there, ready to form fibrin under certain circumstances. The internal lining of the blood-vessels appears to prevent the formation of fibrin, but when the blood comes in contact with anything foreign to it, fibrin is quickly formed, and coagulation (or the clot of blood) is the result, unless certain means are used to prevent it. Fibrin is a very important factor in surgery. When a wound is made and blood escapes, fibrin is formed, which causes the blood to coagulate or clot, and which materially assists in arresting hemorrhages. Carbonic acid gas is carried by the liquor sanguinis, both in solution and combined with the soda.

The blood is alkaline, due to the salts it contains. Its specific gravity varies from 1.050 to 1.057. The weight of blood in cattle is estimated by a good authority to be 1 pound to every 23 pounds of the weight of the body.

The *lymphatics*, or absorbents, are the vessels which carry the lymph and chyle into the blood. Like the veins, they have three coats or tunics, but much thinner. They begin as capillaries in all parts of the body, and they have valves. Placed along the course of the lymphatic vessels are glands, and in some situations these glands are collected into groups; for example, in the groin, etc. These glands are often involved in inflammation arising from the absorption of deleterious matter. For instance, a sore may be on a finger, and the lymphatic capillaries there may absorb a poisonous or irritable matter, which is carried by the lymphatic vessels to the collection of lymphatic glands in the armpit, and inflammation of the glands results and gives rise to the familiar waxing kernel.

Absorption is the function of the lymphatics. The liquor sanguinis passes from the blood capillaries to supply nutrition to the tissues. All excess of the liquor sanguinis that is not required is absorbed by the lymphatic capillaries and conveyed back to the blood by the lymphatic vessels. The lymphatics which proceed from the intestines convey the chyle into the blood during digestion. The lymph (fluid carried by these vessels) is composed of white corpuscles, albumen, salts, water, extractives, and the elements of fibrin. In fact, it is blood without the red corpuscles. Chyle consists of the same constituents as lymph, with the addition of fatty matters. As a rule, the lymphatic vessels follow the course of the veins. All of the absorbent vessels convey their contents to the thoracic duct and right great lymphatic vein, which empty into the anterior vena cava, where the lymph and chyle mix with the venous blood, and thus maintain the supply of nutritive elements in the blood.

PULSE.

As fully explained, the heart pumps the blood throughout the arterial system. The arteries are always full and overfull, and each contraction of the ventricle pumps more blood into them, which distends their elastic walls and sends a wave along them which gradually becomes less perceptible as it nears the very small arteries, and is lost before the capillaries are reached. This wave constitutes the pulse. The sensation or impression given to the finger when placed upon the artery shows the force exerted by the heart and the condition of the circulation. It must be remarked that it is only in the arteries that there is a pulse wave. What is called the "jugular pulse" will be noticed hereafter. The pulse varies much as to frequency; anger, fear, and exercise increase the number of pulsations. It is faster in hot weather than in cold; in the young and old it is faster than in middle age; it is slower in the male than female. Fevers and inflammation increase the frequency. In cattle the average number of pulsations in a minute (in adults) is from 40 to 50. But in cows the pulse is subject to variations from different causes. In this regard Prof. Williams says:

> Indeed, the pulse of the cow in a state of confinement, in so far as regards the number of beats, cannot be depended upon in the diagnosis of disease; the states of pregnancy and obesity, the effects of artificial food and of the activity of the lactiferous glands, as well as the excitement caused by the act of rumination, generally produce such an impression upon the nervous system as to cause the action of the heart to be much increased, such increase being entirely consistent with a state of perfect health in an animal so circumstanced.

However, the frequency of the pulse is by no means all the information gained by feeling the pulse. Other conditions of the pulse are: Infrequent pulse, which means that the number of pulsations in a given time is less than normal. The quick pulse means that the pulse wave gives the sensation to the finger quicker than natural, and it must not be confounded with the frequent pulse which refers to the number of pulsations; thus the number of pulsations may be frequent while each individual beat or pulsation may be quick or slow. The pulse is intermittent when the pulsations do not follow in regular order. For example, the pulse may beat regularly for a number of beats, then a longer pause between two beats occurs, then beat again regularly for several beats, or in other words, as if a beat was left out at intervals. The large pulse and the small pulse refer to the volume of the pulse, which may be larger or smaller than usual. A pulse may be strong or feeble and at the same time may be either large or small. The strong pulse and the feeble pulse refer to the strength or weakness of the pulsation. It is called the hard pulse when the vessel feels hard and incompressible. The soft pulse is the reverse of the hard one. By dicrotic pulse is meant that kind of pulsation which makes each beat seem double, and therefore it is generally called the double pulse.

The venous or "jugular pulse" is the pulsation so frequently observed in the jugular vein of cattle. It is particularly noticeable while they are ruminating—"chewing the cud." It is not always associated with disease, but may be a symptom of some disease of the heart; in such cases the jugular pulse is continuous.

The location selected for feeling the pulse in cattle is where the submaxillary artery winds around the lower jaw bones, just at the lower edge of the flat muscle on the side of the cheek. Or if the cow is lying down, the metacarpal artery on the back part of the fore fetlock is very convenient for the purpose. Any superficial artery, it may be said, will give the pulsations, but in order to ascertain the peculiarities it is necessary to select an artery which may be pressed against a bone.

TEMPERATURE—ANIMAL HEAT.

The heat of the body is due to chemical and vital changes which occur within the animal, and is maintained at an average temperature, with but slight variations, in all seasons, without regard to the temperature of the surrounding atmosphere. The principal source of animal heat is oxidation, which takes place in the tissues throughout the body. The oxygen in the red corpuscles unites with the carbon (and forms carbonic acid gas) and with hydrogen (and forms water), and the chemical union is always accompanied by heat. Heat is lost from the body by evaporation, radiation, conduction, and with the escape of urine and feces, which prevents increase above the normal temperature. The vasomotor nerves, by regulating the size of the arteries, regulate the supply of blood to the parts, and thus assist in maintaining an average temperature. The average normal temperature of cattle in confinement is about 101° F.; in oxen at work, or cattle at liberty, it is about 102° F. In calves it ranges a fraction of a degree higher. In very old animals it is lower than the average normal temperature. The method of ascertaining the temperature is by inserting the bulb of a clinical thermometer into the rectum, leaving sufficient remaining outside by which to withdraw it. It should remain in the gut between three and four minutes. (Plate III, Fig. 1.)

Some veterinarians are very expert in judging the temperature by inserting their fingers in the mouth, but this method requires much practice, both on the healthy and diseased animal. The hand or finger in the mouth will detect an elevation of temperature, but the thermometer is better, especially in the beginning or incubative stage of disease. The hand on the surface of the body can not give an idea of internal temperature, because the surface may feel cold while the interior is elevated above the normal. Increase above the normal temperature does not point to a particular disease, but in conjunction with other symptoms it is a valuable aid; and during the progress of a disease it is a guide.

The changes which take place in tissues are increased by disease, and as a consequence the temperature is elevated, which, if continued, constitutes fever. Congestion, being an excessive quantity of blood in a part, is accompanied by an elevation of the temperature. Inflammation involves changes in the blood-vessels and circulation; there is escape of fluid blood and corpuscles from vessels, and changes in the inflamed tissues; and therefore it causes increased heat (which may be confined to the parts inflamed, or may be constitutional, as inflammation of the lungs, bowels, etc.).

DISEASE OF THE HEART.

Diseases of the heart among cattle are not very common, but they are by no means unknown, which is proved not so much by meeting with cases in practice as it is by post-mortem examinations. In this class of animals the detection of heart disease is attended with much difficulty. In man the heart is more superficially situated; the natural sounds may be heard distinctly, and any deviation from them is easily recognized; but in cattle the heart is enveloped by large lungs, large flat ribs, thick muscles, more or less fat, and thick skin covered with hair, which are obstacles in the way of detecting the variations of the sounds not to be overcome. However, the writer will endeavor to place before the reader all the important information bearing upon the subject, collected from the best sources, as well as from practical experience.

Extensive heart disease may exist in a cow without any alarming symptoms being manifested. This is due to the fact that cows are not put to severe exertion. Affections, as will be pointed out hereafter, may pass unnoticed until after death, when an examination of the heart will discover a disease of such extraordinary character as to create the wonder how the animal lived without showing signs of serious ailment.

The symptoms of the particular heart affections are in most cases so obscure that it is difficult to lay before the general reader signs which may be termed diagnostic. Therefore in a work of this kind it is not out of place to give a summary of those symptoms which usually accompany diseases of the heart, so that when one or more of them are presented a more careful examination may be made for heart trouble. The following symptoms have been noticed in numerous cases of the different affections of this organ: Megrims or vertigo; dropsical swelling of the legs; swelling under the jaw and on the neck and brisket; persistent palpitation of the heart; constant jugular pulse; fluttering of the heart; irregular, soft, and weak pulse, or strong and hard pulse; inability to undergo exertion; disinclination to move, and grunting when compelled to move; faintness; quickened breathing; irregular spasms of the muscles of the neck, breast, or legs.

HEART SOUNDS.

Corresponding with the beats of the heart two sounds are emitted, which in a state of health are uniform and characteristic. The first is longer and duller than the second, which is short and sharp, and is likened to the sound produced when two pieces of ribbon are snapped together. The interval between the two is very short, the sound of the first almost seems to be continued into the second. After the second sound there is a longer interval until the first is heard again, which corresponds with the interval, or pause, between the beats of the heart. Opinions differ as to the exact cause of these sounds. The first corresponds with, and is said to be due to, the closure of the auriculo-ventricular valves; by some authorities it is thought to be a muscular sound caused by the contraction of the ventricles; others think it is the impulse of the heart against the wall of the chest. The second sound is caused by the closure of the valves at the beginning of the common aorta and pulmonary artery. These sounds, as heard when the ear is placed against the chest, may be said to resemble the pronunciation of the words "lub-dup," "lub-dup," "lub-dup," etc.

To appreciate these sounds, the ear is placed against the left side of the chest, a little above the point where the elbow rests when the animal is standing in a natural position. By having an assistant pull the left fore leg and elbow forward, a better opportunity is afforded to place the ear against the chest in the desired location. If the hand is placed flatly against the chest in the same situation, the beating of the heart will be felt. The impulse of the heart may be felt and the sounds may be heard fairly well in lean cattle, but in fat ones it is difficult and often impossible to detect either impulse or sound with any degree of satisfaction.

The impulse of the heart, as felt by placing the hand against the chest, is of some consequence in arriving at a conclusion in respect to disease of the heart; but it must be remembered that the impulse may be very much increased by diseases other than those of the heart, as for example, inflammation of various organs, severe pains, etc. The impulse may also be increased (when disease does not exist) by work, exercise, fright, or any cause of excitement.

The variations from the natural heart sounds will be pointed out when the diseases, in which they occur, are described.

PALPITATION.

When the impulse of the heart is excessive, that is, when it beats more or less tumultuously, the familiar expression "palpitation of the heart" is applied; and by many it is called "thumps." The hand or ear placed against the chest easily detects the unnatural beating. In some cases it is so violent that the motion may be seen at a distance. Palpitation is but the symptom, and in many instances not connected with disease of the structure of the heart or its membranes. An animal badly frightened may have palpitation. When it comes on suddenly and soon passes away, it depends on some cause other than disease of the heart; but when it is gradually manifested, and becomes constant, although more pronounced at one time than another, heart disease may be suspected, especially if other symptons of heart disease are present.

INJURY TO THE HEART BY FOREIGN BODIES.

Cattle are addicted to the habit of chewing and swallowing many objects not intended by nature or man as articles of food. Every veterinarian of experience has met with instances to remind him of this, and it is well known to butchers. Among the great variety of things that have thus found their way into the stomachs of cattle the following have been noticed: Gold finger-rings, knitting needles, old shoes, table knives, wood, pieces of leather, pieces of wire, buttons, hairpins, brushes, nails, coins, etc. The more sharply-pointed objects often penetrate the wall of the stomach, gradually work their way toward the heart, pierce the pericardium (bag inclosing the heart), wound the heart, and prove fatal to the animal. Cases are recorded in which the foreign body has actually worked its way into one of the cavities of the heart. However, instances are known in which the object took a different course, and finally worked its way toward the surface and was extracted from the wall of the chest. While it is possible that the object may pierce the wall at different parts of the alimentary canal, as it frequently does that of the rumen (paunch), it is thought that in the great majority of cases it passes through the wall of the reticulum (smaller honeycombed compartment, or second stomach) and is drawn toward the heart by the suction-like action of the chest. Post-mortem examinations have demonstrated the course it pursued, as adhesions and other results of the inflammation it caused were plainly to be seen. It is rare that there are any symptoms exhibited to lead one to suppose that there is anything amiss until the pericardium or heart is involved; in fact, the object may be retained for a long time in one of the compartments of the stomach, or, after finding its way through the wall, it may lodge in the tissues, perhaps cause an abscess or but slight trouble, until some circumstance causes it to move on. The object is often found having an eroded appearance, due to the chemical action of the fluid which surrounds it, and it is even recorded that it has been entirely dissolved.

The symptoms of this trouble are not plain, and it is seldom possible to give more than an opinion that certain symptoms have been exhibited in connection with a foreign body wounding the heart or its sac, but Prof. Williams (Veterinary Surgery) says:

> More commonly, however, the symptoms of the lesion have become gradually diagnostic; at first symptomatic of indigestion, with capriciousness of the appetite, flatulence, and eructation of gases, and gradual emaciation. After awhile the pulse becomes exceedingly small; the jugular veins are distended; there is also a well-marked jugular thrill or pulse, extending even as high as the bifurcation of these veins, associated sometimes with palpitation of the heart. To these succeed œdema of the intermaxillary areolar tissue, gradually extending down the neck to the dewlap; in some instances clonic spasms of the superficial, particularly the cervical muscles.

Hill, in his "Bovine Medicine and Surgery," reports the following case, which will serve as an illustration of the trouble:

A cow was near the time of calving, when she became seriously ill, but the symptoms did not indicate any connection with parturition; indeed, they were of such obscure nature that it was impossible to say what was the malady. There were dullness, unwillingness to move, constipation, and œdematous swelling about her. She died on the sixth day. On opening her it appeared that the heart and its investing membrane or bag occupied nearly three times their natural space. The delicate and transparent membrane was thickened until it bore no slight resemblance to a portion of the paunch; and the bag contained a gallon of discolored fluid. A piece of darning-needle, two inches and a half in length, with the eye broken off, was found in the pericardium, and a small ulcer, three-quarters of an inch deep, appeared near the apex or point of the heart. Two sixpenny nails were found in the paunch.

Hill also reports the following case of a cow attended by himself:

I found her breathing short, eyes unusually bright, pulse quick, temperature 105°, milk nearly gone, and no appetite. I was informed by the bailiff that she had appeared well until the day but one previously, and he thought she must have taken cold during one of the bleak nights she was out. There was, however, no grunting or cough; the breathing, which I have stated was short, was to appearance much the same as one observed in a broken-winded horse—a jerking double movement in the flank. On auscultation, congestion of both lungs—particularly the left—was manifest. I ordered mustard to be applied to the sides, and sent a diffusible stimulant to be given in gruel morning and night. She continued in the same state until the 25th, when diarrhea set in, and I observed the slightest perceptible grunt; her pulse had now reached 96, and the temperature was still high. From her disinclination to move, the absence of any cough, the grunt and the peculiarity in the breathing which I have observed before in such cases, I suggested the probability of some foreign body having been swallowed.

The cow died in great agony on the 28th. Post-mortem examination discovered a stocking needle, 3 inches long, in the apex of the heart, and the heart and pericardium diseased to such an extent that they weighed 17 pounds.

As a matter of course, treatment in such cases is useless, but when it is possible to diagnose the case correctly the animal could be turned over to the butcher before the flesh becomes unfit for use. Knowing that cattle are prone to swallow such objects, ordinary care may be exercised in keeping their surroundings as free of them as possible.

PERICARDITIS.

Inflammation of the pericardium (heart-bag) is often associated with pneumonia and pleurisy, rheumatism, and other constitutional diseases. It also occurs as an independent affection, due to causes similar to those of other chest affections, as exposure to cold or dampness, and changes of the weather.

Symptoms.—It may be ushered in with a chill, followed by fever, of more or less severity; the animal stands still and dull, with head hanging low, and anxiety expressed in its countenance. The pulse may be large, perhaps hard; there is also a venous pulse. The hand against the chest will feel the beating of the heart, which is often irregular, sometimes violent, and in other instances weak. Legs are cold; the breathing quickened, and usually abdominal; if the left side of the chest be pressed on or struck, the animal evinces much pain; there also may be a furrow or line extending along the line of the false ribs from below and behind the elbow back to the flank. (It must be remembered that most of these symptoms are also seen in connection with pleurisy, and care must be taken to discriminate.) There may be spasms of the muscles in the region of the breast, neck, or hind legs. After a time, which varies in length, the legs may become swollen, and swelling may also appear under the chest and brisket.

In those animals in which the heart sounds may be heard somewhat distinctly, the ear applied against the chest will detect a to-and-fro friction sound, corresponding to the beats of the heart; this sound is produced by the rubbing of the internal surface of the heart-bag against he external surface of the heart. During the first stages of the inflammation these surfaces are dry, and the rubbing of one against the other during the contraction and relaxation of the heart produces the to-and-fro friction sound. The dry stage is followed by the exudation of fluid into the heart-sac, and the friction is not heard until the fluid is absorbed sufficiently to allow the surfaces to come in contact again. But during the time the friction sound is lost a sound which has been called a "churning noise" may take its place. When the to-and-fro friction sound does not return, adhesion of the surfaces may be suspected. A murmuring sound, likened to that made by a bellows, sometimes takes the place of the friction sound, and signifies that endocarditis is also present.

The friction sound of pericarditis can not be mistaken for the friction sound of pleurisy if the examination is a careful one, because, in the heart affection, the sound is made in connection with the heart beats, while in the pleuritic affection the sound is synchronous with each respiration or breath of air taken in and expelled from the lungs.

Treatment.—When pericarditis is complicated with rheumatism or other diseases, they must be treated as directed in the description of them. The animal must be kept in a quiet, comfortable place, where it will be free from excitement. Warm clothing should be applied to the body and the legs hand-rubbed until the circulation in them is reëstablished, and then snugly bandaged. The food should be nutritive, and in moderate quantity. Bleeding should not be performed unless the case is in the hands of an expert.

At the beginning give as a purgative Epsom salts—1 pound to an average-sized cow—dissolved in about a quart of warm water, and administered as a drench. When there is much pain 2 ounces of laudanum may be given, diluted with a pint of water, every three hours, until relief is given. Do not give the laudanum unless demanded by the severity of the pain, as it tends to constipation. During the acute-ness of the attack 20 drops of tincture of aconite in a few ounces of water every three or four hours as a drench, or in drinking water, is beneficial, but it is far safer for the nonprofessional to give a half ounce of nitrate of potassium (saltpeter), dissolved in drinking water, four or five times a day. After the attack has abated, mustard mixed with water may be rubbed well over the left side of the chest to stimulate the absorption of the fluid contained within the pericardium. The other medicines may be discontinued and the following administered: Sulphate of iron, 2 ounces; powdered gentian, 6 ounces, mix and make eight powders. Give one powder every day at noon; mixed with food, if the animal will eat it, or shaken up with water in a bottle as a drench. Also the following: Iodide of potassium, 2 ounces; nitrate of potassium, 8 ounces; mix and make sixteen powders. Give one in drinking water, or in drench, every morning and evening. The two last prescriptions may be continued for several weeks if necessary.

If at any time during the attack much weakness is manifested, give the following drench every three hours: Spirits of nitrous ether, 3 ounces; rectified spirits, 4 ounces; water, 1 pint; mix, and give as a drench.

In some cases the fluid within the pericardial sac does not readily undergo absorption. In such cases, in addition to the administration of the iron and iodide of potassium preparations before advised, a blister composed of red iodide of mercury, 2 drams, and lard, 10 drams, well rubbed in over the chest in the region of the heart, may have the desired effect. In extreme cases tapping the pericardium with a trocar and canula, to draw off the fluid, is resorted to, but the operation requires exact anatomical knowledge.

After death from pericarditis there is always more or less fluid found in the pericardium; the surfaces are rough and covered with a yellow-colored exudate. There are also, in many cases, adhesions, to a greater or less extent, between the heart and pericardium.

MYOCARDITIS.

Inflammation of the muscular structure of the heart occurs in limited, circumscribed areas, as evidenced by post-mortem examination, and it is probably always somewhat involved in connection with pericarditis and endocarditis. It may readily be inferred that if the whole organ were inflamed death would ensue immediately. When it is complicated there are no symptoms by which it may be distinguished from the other affections. Examination after death has revealed abscesses in the walls of the heart, and spots where inflammation had existed.

ENDOCARDITIS.

When the membrane which lines the cavities of the heart—the endocardium—suffers inflammation the disease is called endocarditis. When it exists it is usually a complication of rheumatism. The symptoms are much the same as those of pericarditis, and it is difficult to discriminate between the two affections. As in other heart troubles, there is a jugular pulse, the legs may become dropsical, and there is a tendency to faint if the head is elevated suddenly. It is said that the bellows-like sound is much more distinct than it is in pericarditis. It is the most fatal of heart diseases, because of the liability of the formation of clots, which may adhere to the valves, change in the structure of the valves, and often a complication with an abnormal condition of the blood. Clots may be formed in the heart and, being carried to other parts, prove fatal by interrupting the circulation in some vital organ.

The same treatment as advised for pericarditis may be followed in this disease. Especial precautions should be observed in the use of aconite.

VALVES OF THE HEART.

The valves are subject to abnormal growths and structural changes. Cases are also reported in which they have been found ruptured. The want of diagnostic symptoms in cattle makes it useless to enumerate signs of no practical value.

TUMORS IN THE HEART.

Post-mortem examinations have revealed tumors of various kinds and shapes in the cavities of the heart of cattle. They may be attached to the walls or valves, or exist in the structure of the wall. They have also been found externally, of enormous size, attached to the apex. On this subject Gamgee remarks:

> It is evident that the importance of these organic disorders varies as much from the position of the growth as from its size and tendency to interfere with the heart's action. The presence of a small obstruction within the heart is calculated to endanger an animal's life far more than an external tumor. Thus, a polypus forming within the auricle may drop on the corresponding auriculo-ventricular opening and arrest the blood's flow. It is remarkable that, as shown by Case II, reported below, a large polypus may have its pedicle in the auricle, and continue growing in the ventricle to the extent of filling the latter, and yet the animal died suddenly without having previously shown signs of ill health.

The polypus referred to in Case II was found in the heart of an ox, and measured over five inches in its greatest length, and over nine inches in its greatest circumference.

HYPERTROPHY OF THE HEART.

This is an enlargement of the heart, and may consist of the thickening of the walls alone, or at the same time the cavities may be either enlarged or diminished in size. Dilatation of the cavities has also been noticed, as existing independently of thickened walls. It is said that in hypertrophy the sounds of the heart are loud and pronounced, and may be heard on both sides of the chest very distinctly, and palpitation to a greater or less extent is constant. Luckily both conditions are very rare in cattle.

ATROPHY.

Atrophy is the technical term for wasting of the muscular tissue. Atrophy of the heart is very rare among cattle, and is usually a result of other diseases.

FATTY DEGENERATION OF THE HEART.

This condition of the heart is met with in cattle, but it must be understood that the accumulation of fat around the heart is not referred to by this designation. In fatty degeneration the elements of the muscular tissue are replaced by fatty or oily granules.

CYANOSIS.

Owing to the most prominent symptom, this condition is also called "blue disease." It is seen occasionally in new-born calves. It is recognized by the blue color of the mucus membrane (easily seen by looking within the mouth and nostrils), the coldness of the surface of the body, and rapid, labored breathing. It is due to nonclosure of the foramen ovale (see description of the heart) and the consequent mixing of the venous with the arterial blood. Calves so affected live but a short time.

MISPLACEMENT OF THE HEART.

Cases are recorded in which the heart has been found out of its natural position, sometimes located outside of the chest. This is a congenital condition, for which there is no remedy.

WOUNDS OF ARTERIES AND VEINS.

When a blood-vessel is opened it may be told at a glance whether it is an artery or a vein by simply bearing in mind that bright red blood comes from arteries and dark red from veins. When a vein or a very small artery is severed the blood flows from the vessel in a continuous and even stream, but when one of the larger arteries is severed the blood comes from it in intermitting jets or spurts, corresponding to the beats of the heart. It is well to call attention to the fact that the dark red blood which flows or oozes from a wound soon becomes bright red, because it gives up its carbonic acid gas to the air, and absorbs oxygen gas from the air, which is exactly the change it undergoes in the capillaries of the lungs.

The general treatment of wounds will be found in another section; here it is only necessary to refer briefly to some of the most practical methods used to arrest hemorrhages, as instances occur where an animal may lose much strength from the loss of blood, or even bleed to death unless action is prompt.

HEMORRHAGE.

The severity of a hemorrhage depends upon the size of the vessel from which the blood escapes, though it may be stated that it is more serious when arteries are severed; however, a great deal depends on the manner in which the vessel is wounded. If the wound in an artery is in the direction of its length, the blood escapes more freely than if the vessel is completely severed, because in the latter instance the severed ends retract, and may aid very much in arresting the flow. When the blood merely oozes from the wound, and even in cases where it flows in a small stream, the forming of the clot, as explained in the description of the blood, arrests the hemorrhage in a comparatively short time.

Slight hemorrhages may be checked by the continuous application to the wound of cold water, ice, or snow, as they cause a contraction of the small vessels. The water may be thrown on a wound from a hose, or dashed on it from the hand or a cup, or folds of cotton cloths may be held on the wound and kept wet. Ice or snow may be held against the wound, or they may be put in a bag and conveniently secured in position.

Hot water of an average temperature of 115° to 120° F. injected into the vagina or womb is often efficient in arresting hemorrhages from those organs. Tow, raw cotton, lint, or sponges may be forced into a wound and held or bound there with bandages. This is an excellent method in checking the flow of blood until the arrival of an expert. If the flow persists these articles may be saturated with tincture of iron, but it is not advisable to use the tincture of iron if it can be avoided, as it is a caustic, and retards healing by causing a slough. The articles may be saturated with vinegar in cases of necessity, or tannic acid, or alum, dissolved in water may be used instead. The article (whichever is used) should be left in the wound sufficiently long to make sure that its removal will not be followed by a renewal of the hemorrhage. It should remain there one or two days in some instances, unless removed by the veterinarian.

An iron heated until it is white and then pressed on the bleeding vessel for three or four seconds is occasionally used. It should be at white heat and applied for a moment only, or else the charred tissue will come away with the iron and thus defeat the purpose of its application.

The best of all means is compression. This may be applied in different ways, but only the most convenient will be mentioned. In most wounds bandages may easily be applied. The bandages may be made of linen, muslin, etc., sufficiently wide and long, according to the nature of the wound and the region to be bandaged. Bed sheets torn in strips the full length make excellent bandages for this purpose. Cotton batting-tow, or a piece of sponge may be placed on the wound and firmly bound there with the bandages.

In many instances ligating the vessel is necessary. A ligature is a piece of thread or string tied around the vessel. Ligating is almost entirely confined to arteries. Veins are not ligated unless very large (and even then only when other means are not available) on account of the danger of phlebitis or inflammation of a vein. The ligature is tied around the end of the artery, but in some instances this is difficult, and it is necessary to include some of the adjacent tissue, although care should be taken that a nerve is not included. To apply a ligature it is necessary to have artery forceps (tweezers or small pincers may suffice) by which to draw out the artery in order to tie the string around it. To grasp the vessel it may be necessary to sponge the blood from the wound so that the end will be exposed. In case the end of the bleeding artery has retracted, a sharp-pointed hook called a tenaculum is used to draw it out far enough to tie. The ligature should be drawn tightly so that the middle and internal coats will be cut through.

Another method of checking hemorrhage is called torsion. It consists in catching the end of the bleeding vessel, drawing it out a little, and then twisting it around a few times with the forceps, which lacerates the internal coats so that a check is effected. It is very effectual in small vessels, and is to be preferred to ligatures, because it leaves no foreign body in the wound. A needle or pin may be stuck through the edges of a wound, and a string passed round between the free ends and the skin (Plate XXVIII, Fig. 10), or it may be passed round in the form of the figure 8, as is often done in the operation of bleeding from the jugular vein.

ARTERITIS.

Inflammation of arteries is of rare occurrence in cattle, and requires no more than mention here.

DEGENERATION OF THE COATS OF ARTERIES.

Three kinds are recognized: (1) Calcareous degeneration, in which phosphate and carbonate of lime are deposited in the middle coat of an artery; the calcification may extend to the external and internal coats; it is associated with old age; (2) cartilaginous degeneration, affecting small arteries; (3) fatty degeneration, usually met with in cases of fatty degeneration of other parts.

ANEURISM.

A circumscribed dilatation of an artery, constituting a tumor which pulsates synchronously with the beats of the heart, is called aneurism. It is due to disease and rupture of one or two of the arterial coats. The true aneurism communicates with the interior of the artery, and contains coagulated blood. They are so deeply seated in cattle that treatment is out of the question. Death is sudden when due to the rupture of an aneurism of a large artery, owing to internal hemorrhage. A false aneurism results from blood escaping from a wounded artery into the adjacent tissue, where it clots, and the wound, remaining open in the artery, causes pulsation in the tumor.

INFLAMMATION OF VEINS—PHLEBITIS.

When bleeding is performed without proper care, or with unclean fleam or lancet, inflammation of the vein may result. It may be caused by the animal rubbing the wound against some object. When inflammation follows the operation the coats of the vein become enlarged, so much so that the vessel may be felt hard and knotted beneath the skin, and when pressed on pain is evinced. A thin, watery discharge, tinged with blood, issues from the wound. When the pin is taken out it is found that the wound has not healed. The blood becomes coagulated in the vessel. In inflammation of the jugular the coagulation extends from the wound upward to the first large branch. Abscesses may form along the course of the vein. The inflammation is followed by obliteration of that part in which coagulation exists. This is of small import, as cattle have an accessory jugular vein which gradually enlarges and accommodates itself to the increased quantity of blood it must carry. (The existence of this accessory jugular vein is the reason why only a small stream of blood is obtained in certain instances; when the large jugular vein is opened, the blood flows through the deeper seated collateral vessel.) The treatment for inflammation of the vein is to clip the hair from along the course of the affected vessel and apply a blister, the cerate of cantharides. Abscesses should be opened as soon as they form, because there is a possibility of the pus getting into the circulation.

In the operation of bleeding the instruments should be clean and free from rust. If the skin is not sufficiently opened, or when closing the wound the skin is drawn out too much, blood may accumulate in the tissue, and if it does it should be removed by pressing absorbent cotton or a sponge on the part. Care should also be used in opening the vein, so that the instrument does not pass entirely through both sides of the vein, and open the artery beneath it. (See Bleeding or Blood-letting, p. 307.)

VARICOSE VEINS.

The following quotation is from Prof. Williams's Veterinary Surgery:

> The veins of the extremities of horned cattle present varicose dilatations along their course in the form of sacculated or knotty protuberances on various parts of the vessels; the contained blood is at first in a fluid state, but an alteration not unfrequently occurs, the blood coagulates, and the vessel becomes obstructed. The formation of these coagula is an effect of inflammation in the coats of the vein; this inflammation may be slight or it may run on to suppuration, giving rise to small abscesses. I have repeatedly met with this form of phlebitis in cattle underfed and

kept in wet, cold situations. It seems to arise from debility of the circulation and relaxation or want of tone in the coats of the vessels. The treatment for dilatation without inflammation: Better food, warmth, and comfort; tonics and pressure by bandages; and, in addition, when suppuration is established, the abscesses are to be opened and blisters applied, but no pressure.

AIR IN VEINS.

Owing to the suction action in the chest (referred to in the description of the blood-vessels), when a large vein is opened in the vicinity of the chest air may be sucked in, which, if in great quantity, will cause death, as the air bubbles are carried by the blood to the capillaries of the lungs, where they impede the circulation by occluding the small vessels.

DISEASES OF THE HEART AND BLOOD-VESSELS.

DESCRIPTION OF PLATE.

PLATE VII:

Diagram illustrating the circulation of the blood. The arrows indicate the direction in which the blood flows. The valves of the heart, situated between the right auricle and ventricle, and left auricle and ventricle, and between the ventricles and large arteries, are represented by curved lines. These valves are intended to prevent the flow of blood in a direction contrary to that indicated by the arrows.

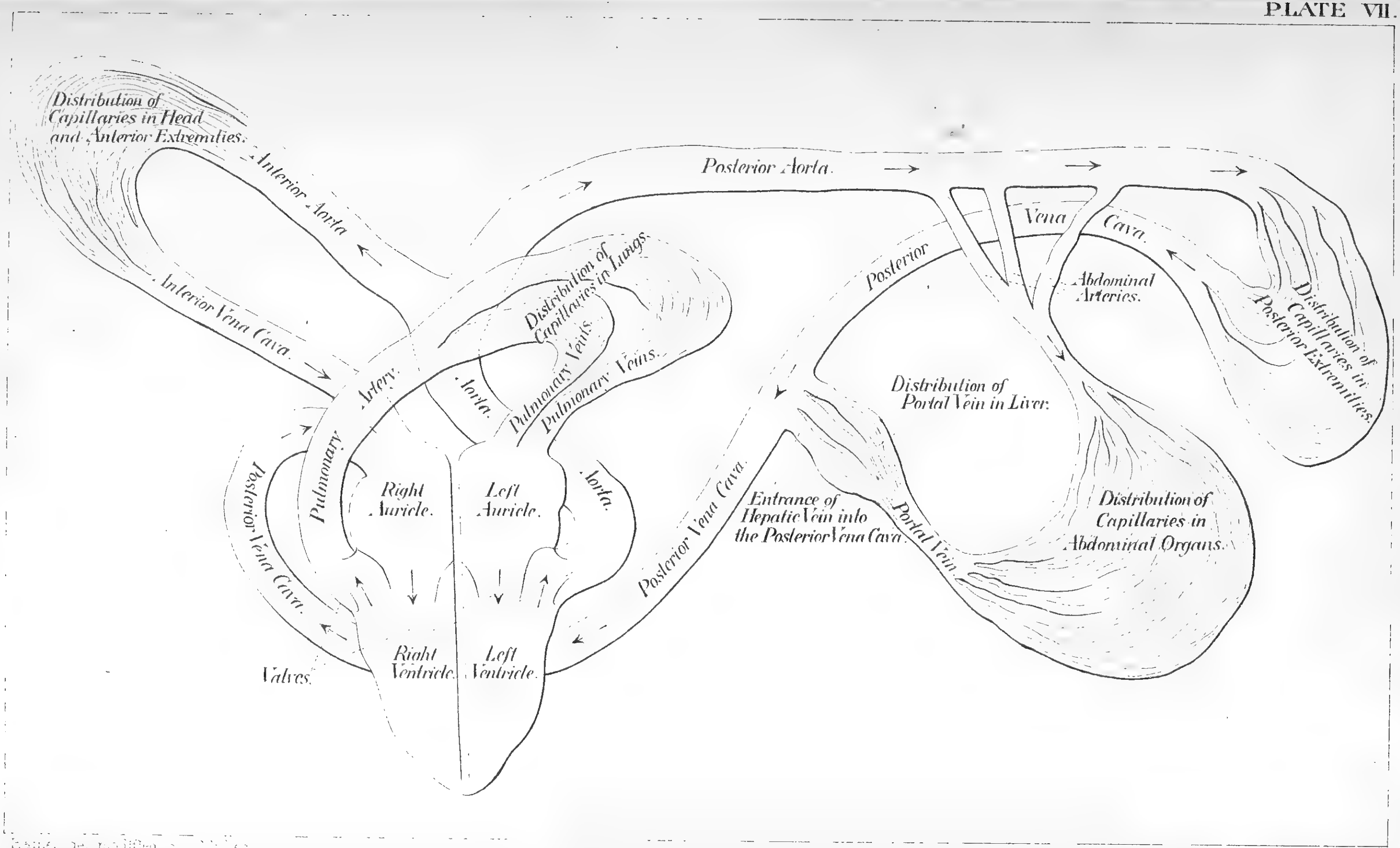


DIAGRAM OF THE CIRCULATION.

NONCONTAGIOUS DISEASES OF THE ORGANS OF RESPIRATION.

By Dr. WILLIAM HERBERT LOWE,

Superintendent of the United States Neat Cattle Quarantine Station for the Port of New York, Garfield, N. J.

In the determination of disease in the human being the physician is aided by both subjective and objective symptoms in making his diagnosis; but the veterinary physician, in a very large majority of cases, is obliged to rely almost solely upon objective symptoms, and perhaps in no class of diseases is this more true than in the exploration of those under consideration. This condition of affairs has a strong tendency to develop observation and discernment in the veterinarian, and not infrequently do we find that the successful veterinary practitioner is a very accurate diagnostician. But in order to make a differential diagnosis it is not only necessary to have a knowledge of the structure and functions of the organs in health, but to adopt a rigid system of details ot examination, without which successful results can not be reached. Therapeutical treatment is worse than useless until the nature and seat of the diseased process have been determined. The history of the case should always be ascertained as far as possible and duly weighed. True, this is often unreliable, but even when this is the case it is advisable to weigh the evidence *pro* and *con.*

As above indicated, it is only the careful and constant examination of animals in health that will enable one to properly appreciate abnormal conditions. One must become familiar with the frequency and character of the pulse and of the respiration—must know the temperature of the animal in health, before changes in abnormal conditions can be properly appreciated.

The pulse in the healthy ox is more frequent than in the horse, beating from forty-five to fifty times per minute, while in the latter it only beats thirty-six to forty. The pulse may be felt wherever an artery passes over a bone close to the skin. Exercise, overfeeding, pregnancy, and other things may affect the frequency and character of the pulse. It assumes various characters according to its rapidity of beat, fre quency of occurrence, resistance to pressure, regularity, and perceptibility. Thus we have the quick and slow, frequent and infrequent, hard and soft, full and imperceptible, large and small pulses, the characters of which may be determined from their names; also that form known as the intermittent, either regular or irregular. We may have a dicrotic or double pulse; a thready pulse, which is extremely small and scarcely perceptible; the venous pulse, the "running down" pulse, and so on. (See p. 84.)

In making an examination of an animal observe the depth, frequency, quickness, facility, and the nature of the respiratory movements. They may be quick or slow, frequent or infrequent, deep or imperfect, labored, unequal, irregular, etc., each of which has its significance to the educated and experienced veterinarian.

Sleep, rumination, pregnancy in cows, etc., modify the respiratory movements even in health. Respiration consists of two acts, inspiration and expiration. The function of respiration is to take in oxygen from the atmospheric air, which is essential for the maintenance of life, and to exhale the deleterious gas known as carbon dioxide.

Cough is a very important symptom, often being diagnostic in diseases of the respiratory organs, but which can be more satisfactorily treated in connection with the special diseases of the organs in question.

The temperature should be taken in all cases of sickness. Experienced practitioners can approximate the patient's temperature with remarkable accuracy, but I would strongly recommend the use of the self-registering clinical thermometer, which is a most valuable instrument in diagnosing diseases. (See Plate III, Fig. 1). It is important that a *tested* instrument be secured, as some thermometers in the market are inaccurate and are worse than useless. The best place to insert the thermometer in the bovine is in the rectum, although it may be inserted in the mouth, or in the vagina of the cow. The instrument should be rested against the walls of the cavity for about three minutes. The normal temperature of the bovine is $101\frac{1}{4}°$ F. to 102° F., which is higher than that of the horse. A cow breathes faster, her heart beats faster, and her internal temperature is higher than that of the horse. Ordinary physiological influences, such as exercise, digestion, etc., give rise to slight variations of internal temperature, but if the temperature rises two or three degrees above the standard some diseased condition is indicated.

Auscultation and percussion are the chief methods employed to determine the various pathological changes that occur in the respiratory organs. Auscultation is the act of listening, and may be either mediate or immediate. Mediate auscultation is accomplished by aid of an instrument known as the stethoscope, one extremity of which is applied to the ear and the other to the chest of the animal. In immediate auscultation the ear is applied directly to the part. Immediate auscultation will answer in a large majority of cases. Auscultation is resorted to in cardiac and certain abdominal diseases, but it is mainly employed for determining the condition of the lungs and air passages. Animals can not give the various phases of respiration on demand, as can the patients of the human practitioner. The organs themselves are less accessible than in man, owing to the greater bulk of tissue surrounding them and the pectoral position of the fore extremities, all of which render it more difficult in determining pathological conditions. (See Plate VIII.)

If the ear be applied to the throat of a healthy bovine the air will be heard passing through the windpipe with a regular, steady, blowing sound; if applied to the chest, a soft, rustling murmur will be heard, caused by the air passing in and out of the fine tubes and air cells of the lungs, which has been likened to a gentle breeze in the tree tops. But when the lungs or throat are diseased the sounds are very much changed, a point which will be dealt with in connection with the treatment of the special diseases of the organs of respiration.

Percussion is that mode of examination by which we elicit sounds by striking or tapping over the part. It may be direct or indirect. If the ends of the fingers of the left hand are placed firmly on the chest and smartly tapped with the ends of the first three fingers of the right hand the sound will be noticed to be more resonant and clear than when the same procedure is practiced on a solid part of the body. This is because the lungs are not solid, but are always in health, well expanded with air. But in certain pulmonary diseases they fill up and become solid, when the sound given out by percussing them is like that on any other solid part of the animal. By practice on healthy animals the character and boundaries of the sounds can be so well determined that any variations from them will be at once detected, and will sometimes disclose the presence of a diseased condition, when nothing else will.

CATARRH—COLD IN THE HEAD.

Nasal catarrh is an inflammation of the mucous membranes of the nostrils and upper air passages. Simple catarrh is not a serious disease in itself, but if neglected is liable to be complicated with laryngitis, bronchitis, pneumonia, pleurisy, and other diseases of the respiratory organs, which are of a serious nature, and sometimes fatal. Catarrh is a common disease among cattle. It is often due to sudden exposure, to wet and cold after they have been accustomed to shelter. It may arise from inhalation of irritating gases. It is sometimes due to certain specific atmospheric conditions, and may assume an enzoötic form; it is very debilitating, and requires prompt and judicious treatment.

Symptoms.—Redness of the mucous membranes of the nose, redness and watering of the eyes. The mucous membrane first becomes dry; afterwards a watery discharge appears, and later on in severe cases the discharge becomes mucopurulent. In mild cases there is little or no fever, but in severe cases the fever may run high. The animal becomes dull, languid, and is not inclined to move about, and the appetite may become impaired; there is variable temperature of the horns and ears. If in a cow giving milk, the secretion diminishes; the mucus from the eyes and nose becomes thicker and yellower. Afterwards, as the symptoms increase in severity, the discharge becomes mucopurulent.

Treatment.—The animal should be housed in a well-ventilated place, with good hygienic surroundings. In cold and damp weather it should be kept warm with blanketing. Give hot, medicated inhalations in severe cases. If the fever is high this may be reduced by giving nitrate of potassium, from 1 to 2 ounces, in the drinking water, three times daily. Diffusible stimulants are beneficial in most cases. Too much importance can not be attached to good nursing. There is no necessity to resort to the old system of bleeding, purging, or the use of powerful sedatives.

EPISTAXIS—BLEEDING FROM THE NOSE.

Bleeding from the nostrils is rather rare in cattle. It may arise from any one of a variety of causes, but usually results from disease or injury to the mucous membranes, or to violent exertions in coughing and sneezing. It is seldom serious. The bleeding generally occurs in drops from one nostril only, accompanied by sneezing, and without frothing. Bleeding from the lungs comes from both nostrils, is bright red, frothy, and accompanied by a cough.

Treatment.—In many cases the bleeding will cease spontaneously, and all that is necessary is to keep the animal quiet and bathe the head and nostrils with cold water. Ascertain the cause of the bleeding and be governed accordingly in the treatment. In severe and exceptional cases, where the hemorrhage is persistent and long continued, tie the animal's head to a high rack or beam and apply cold water, ice, or have recourse to styptic injections. If the hemorrhage is profuse and persistent give either a drench composed of 1½ drams of acetate of lead dissolved in a pint of water, or 1½ drams of gallic acid dissolved in a pint of water.

LARYNGITIS—SORE THROAT.

Laryngitis consists of an inflammation of the mucous membrane lining the larynx. It may be either a primary or a secondary disease, complicated or uncomplicated. In the majority of cases it is due to some form of exposure, a sudden change from warm to cold surroundings, or exposure to cold storms. It may also arise from inhaling irritating gases. It may be the result of external violence. In an acute attack of laryngitis there is an elevation of temperature, pain on pressure over the region of larynx, violent paroxysms of coughing, difficult and noisy respiration. The nostrils are dilated, the nose extended, and the animal has a frightened expression. There is marked difficulty in swallowing.

Treatment.—This consists of fomentations and hot applications over the throat. Stimulating liniments, mustard, or other forms of counter irritation, may be applied in severe cases. Hot inhalations should be frequently resorted to, and often afford much relief to the suffering animal. In this disease medicines should be given as far as possible in the form of electuaries (*soft solid*), on account of the difficulty of deglutition. Large drafts of medicines have a tendency to produce violent spells of coughing, and in this way retard recovery. The subjoined formula for an electuary will be found to answer the purpose in ordinary cases: Chlorate of potassium, pulverized, 8 ounces; fluid extract of belladonna, 2 ounces; powdered opium, 1 ounce; powdered licorice root, 8 ounces; sirup, sufficient quantity, and mix. At frequent intervals place a small tablespoonful of the mixture on the tongue or back teeth. Or the following may be used instead:

Aloes, powdered opium, and gum camphor in equal parts. Mix. Rub an ounce on the molar teeth every four or five hours. The bowels should be kept open and the diet should be such as the patient can easily swallow. Warm sloppy mashes, boiled oatmeal gruel, linseed tea, and the like, are the most suitable substances. If suffocation be threatened during the course of the disease tracheotomy should be performed without delay. The details of the operation are fully described in the chapter on Surgical Operations. (See p. 308.)

When the disease assumes a chronic form strong counter irritation is indicated. A cantharides blister may be applied, or the following ointment may be used: Biniodide of mercury, 1 part; lard, 6 parts. Mix. In some cases it will be found necessary to repeat the above application.

BRONCHITIS.

Bronchitis is an inflammation of the mucous membrane of the bronchial tubes. When a primary disease it is generally the result of what is commonly know as "catching cold." It may be secondary to or complicated with many of the diseases of the respiratory system. It may also be caused by breathing irritating gases, or by the introduction of foreign bodies into the bronchial tubes, which sometimes result from injudicious and careless drenching when the larynx is in a temporarily relaxed state. It may be acute or chronic, and is divided according to the seat of the inflammation into bronchitis proper, where the large tubes are affected, or capillary bronchitis, where the smaller tubes are affected.

Symptoms.—Loss of appetite, elevation of temperature, generally 104° or 105° F. The inspiration is incomplete, short, and painful, and the expiration is prolonged. The pulse is increased in frequency, and is hard. A characteristic and painful cough is present, but it is paroxysmal and incomplete. Auscultation and percussion greatly aid us in a diagnosis. A normal sound is observed on percussion. On auscultation, in the early stages, rhonchus râles are detected if the larger tubes are affected, and sibilus râles if the smaller tubes are affected. Later on mucous râles are noted, and sometimes all sounds in certain parts are absent, which is due to the plugging up of the tubes. This plugging of the tubes if extensive enough is sometimes the cause of death, or death may result from extension of the disease to the lungs or pleura.

Treatment.—The animal should be placed in a light, well ventilated box, and the bowels kept in a soft condition by enemas, etc. Avoid violent purgatives. The body should be kept warm by blanketing. In the early stages give three times daily a draft composed as follows: Extract of belladonna, 2 drams; solution of acetate of ammonium, 4 fluid ounces; water, one-half pint. In the later stage of the disease substitute the following formula, which may be given twice daily: Carbonate of ammonium, 3 drams; solution of the hydrochlorate of strychnine, 2 fluid drams; spirits of nitrous ether, 1 fluid ounce; water, one-half pint.

In some cases the following is preferable to either of the above, and may be given in a pint of linseed tea every four hours: Spirits æther. nit., 1½ ounces; spirits ammon. arom., 2 ounces; camphor, powdered, 2 drams. The food should be light and nutritious.

Bronchitis is liable to assume a chronic form if not properly treated in the earliest stage. Remedial treatment is of little value when the disease becomes chronic.

PLEURISY.

Pleurisy is an inflammation of the serous membrane lining the chest cavity and enveloping the lungs. It rarely occurs as an independent disease, but is generally complicated with pneumonia. It may be circumscribed or diffused, unilateral or double. It arises from exposure to cold and wet, as with pneumonia and bronchitis. It occasionally is caused by a penetrating wound.

Symptoms.—In the first stage there is great pain, due to the dry and inflamed surfaces of the pleura rubbing together. This gives rise to the friction murmur. The temperature ranges from 104° to 105° F. The pulse is small, quick, frequent, and hard. The respirations are abdominal, the breath being taken in short jerking inspirations and emitted in long expirations. The cough is sharp, suppressed, and painful. Pressure in the intercostal spaces give rise to pain, the animal flinching and giving a grunt. The muzzle is dry and hot, the mouth slimy and secretions scant. The symptoms increase in severity as the disease advances, and in the second stage effusions are poured out into the thoracic cavity. The pulse becomes soft and remains frequent and small. The elbows are turned out and the animal has a diagnostic grunt. On percussion a dull sound is observed as high up as the fluid has risen in the chest, and on auscultation there is an absence of all respiratory murmur below this line.

Treatment.—Give the same general care as recommended in bronchitis or pneumonia. In the early stages give a febrifuge to reduce the fever, as directed for pneumonia. For relief of the cough give electuary formula, which will be found in the treatment of laryngitis. The bowels must be kept relaxed and the kidneys secreting freely. In the stage of effusion give the following three times daily: Digitalis tinct., 1 ounce; iodide of potassium, 30 to 60 grains; mix. Apply strong counterirritant to chest and put seton in dewlap. (See Setoning, p. 308.) If collapse of the lung is threatened a surgical operation is sometimes performed, termed *paracentesis thoracis*, which consists in puncturing the chest cavity and drawing off a part of the fluid. The instruments used are a small trocar and canula, which are introduced between the eighth and ninth ribs. Draw the skin forward so that the external wound may not correspond with the puncture of the chest, to prevent the entrance of air. Only a portion of the fluid should be removed. The animal gets immediate relief, but it is generally only temporary, as there is a tendency for the fluid to accumulate again.

PNEUMONIA.

This is an inflammation of the lung substance. It is divided into three different forms, viz: First, croupous; second, catarrhal; and third, interstitial pneumonia. But these various forms can only be differentiated by the expert, and I therefore deem it necessary for the purposes of the present work to treat the subject under the general head of pneumonia.

The causes of pneumonia in general are the same as those of the various other inflammatory diseases of the respiratory tract. It mostly follows congestion of the lungs, but may in rare cases have a parasitic origin.

Symptoms.—In the first stage, that of congestion, the disease is usually ushered in by a chill, although this may not always be observed by the attendant. This is followed by an elevation of temperature, usually 105° to 106° F., or it may be even higher. The respirations are quick and shallow; the nostrils are dilated; the pulse is full and hard. Cough may or may not appear in this stage. The nose is hot and dry; the tongue sometimes protrudes and is slimy; the coat is staring, and the skin dry and harsh. The urine is usually diminished in quantity, high colored, and the bowels constipated. The animal stands with the forelegs wide apart to facilitate respiration. On auscultation crepitation will be observed over the portion of the lung affected. The sounds elicited on percussion are practically normal in this stage.

In the second stage the temperature generally drops one or two degrees, and respiration is performed with much difficulty. The cough is frequent and painful. The animal still stands with the forelegs wide apart and the elbows turned outwards. If it assumes the recumbent position it rests on the sternum. All secretions are more or less suspended, particularly the milk in cows. The animal has a haggard appearance, and the pulse becomes small and wiry at this period. The extremities are hot and cold alternately; the crepitation which was present in the first stage is now absent, and no sound on auscultation will be heard, except it be a slight wheezing or whistling noise. On percussion dullness over the diseased lung is manifested, indicating consolidation. The lung has now assumed a characteristic liver-like appearance.

In the third stage, if the disease is going to terminate favorably, the cough becomes loose; the animal improves; the appetite returns, and the symptoms above detailed rapidly subside. But if, on the other hand, resolution is not progressing, the lung substance is broken down, is heavy, and will sink in water. In fatal cases the breath has a peculiar fetid, cadaverous odor, and is taken in short gasps; the horns, ears, and extremities become cold and clammy, and the pulse is imperceptible. On auscultation, when suppuration is taking place and the lung structure is breaking down, a bubbling or gurgling crepitation, caused by the passage of air through pus, will be heard.

Treatment.—Good hygienic surroundings and good nursing are essential in connection with the medical treatment. The probability of cure depends largely on the extent of the lung tissue involved, as well as on the intensity of the inflammatory process. In the early stage, when the fever is high, give febrifuges. If the pulse be strong and full, aconite (Fleming's tincture, 2 to 5 minims every four or five hours) may be given for a short time, but should be discontinued as soon as the fever begins to abate. Aconite is a valuable drug in the hands of the intelligent practitioner, but my experience leads me to believe that not infrequently animals are lost by its injudicious use. For in many febrile conditions it is positively contraindicated, owing to its action upon the heart. In a plethoric animal, with a strong bounding pulse, bleeding may be resorted to instead of administering aconite. If the bowels are constipated give calomel, one to three drams, which acts as a cathartic and a febrifuge. In the second stage diffusible stimulants are required, viz: Spirits of ether nit., 2 ounces; spirits ammonia aromatic, 1 ounce. Mix and give in gruel three times daily. If the above is not at hand give an alcoholic stimulant. Half a pint of brandy or whisky may be given in a quart of gruel three times daily. In some cases carbonate of ammonia, 2 to 5 drams, has been found beneficial. Most practitioners apply counterirritants externally, such as mustard plasters, turpentine, and ammonia liniment, or cantharides.

EMPHYSEMA—HEAVES.

Emphysema consists of a rupture of the minute air vesicles of the lung substance, and may be either inter-lobular or vesicular. There is an extreme interference with respiration, inspiration being short and expiration prolonged. It is a nonfebrile condition, in which the appetite is not decreased and the milk secretion is kept up. It may be caused by an attack of asthma, or may result from chronic bronchitis. The disease can be diagnosed by the marked interference with respiration. The animal, as a rule, is emaciated, has a staring coat, and is hidebound. If percussion is resorted to, the animal's chest will give a tympanic, drum-like sound. The normal resonant sound is exaggerated.

Treatment.—The disease is incurable, and only a palliative form of treatment can be carried out. The destruction of the animal is often advisable, from a humane as well as from a financial point of view.

PULMONARY CONGESTION.

Cattle that are overdriven or overworked are liable to pulmonary congestion in an acute form, and sometimes pulmonary apoplexy. In such cases the animal should be allowed to rest, and if the weather be hot put in a shady place. Give stimulants internally, and apply stimulating applications to the legs, and bandage.

HÆMOPTYSIS.

This is a term used to signify bleeding from the lungs. The trouble may result from a previous congestion of the lungs, or from a breaking down of the lung substance, or from specific disorders.

Bleeding from the lungs comes from both nostrils and from the mouth. The blood is bright red, frothy, and accompanied by a cough, the flow being somewhat profuse and intermingled with mucus. It may cease of its own accord. Internally hæmostatics are indicated, and locally over the sides cold applications have a tendency to check the hemorrhage. Give the animal a drench composed of 1½ drams of gallic acid dissolved in a pint of water.

ABSCESS OF THE LUNG.

An abscess of the lung sometimes forms during the course of or subsequent to certain pulmonary diseases. An animal affected with abscess of the lung usually has a protracted, feeble cough, and a general appearance of emaciation and anæmia. The pulse is feeble and the breath foul. An offensive discharge from the lungs frequently occurs. Percussion and auscultation will aid in making a diagnosis in this condition. The appetite is poor. Such animals go from bad to worse, and their prompt destruction would, as a rule, be to the interest of the owner.

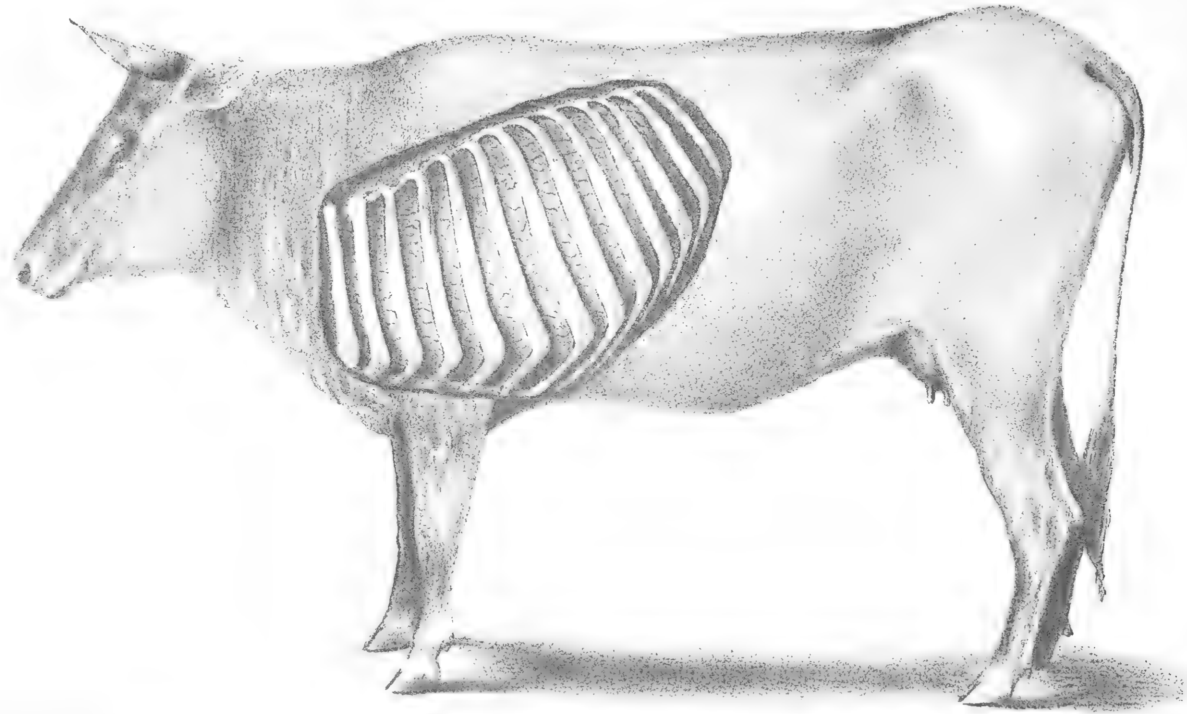
HYDROTHORAX.

Hydrothorax, or dropsy of the chest, is not a disease in itself, but is simply a condition where an effusion takes place in the chest cavity, and is the result or effect of some disease, mostly pleurisy. This condition can be easily diagnosed by physical signs. A loss of the respiratory murmur will be noticed on auscultation, and on percussion dullness or flatness on a line as high as the effusion has taken place. When there is a large amount of effusion present, tapping with the trocar and canula is generally resorted to. The proper method of performing this operation will be found unker the head of Pleurisy.

PNEUMOTHORAX.

An accumulation of gas in the pleural sac is known as pneumothorax. The presence of air may either result from an injury of the lung or a wound communicating from the exterior. The indications for treatment are to exclude the further entrance of the air into the cavity by the closure of the external opening. The air already in the cavity will in most cases be absorbed.

PLATE VIII



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SHOWING THE POSITION OF THE LUNG.

DISEASES OF THE NERVOUS SYSTEM.

By W. H. HARBAUGH, V. S., Richmond, Va.

In a work of this kind anything approaching a detailed description of the anatomy and physiology of this subject is simply out of the question, as the space it would require forbids the attempt; but a few of the important points will be noticed so that what follows will be better understood.

The nervous system is the distinguishing feature of animal life; without it there can be no intelligence, no instinct, no sensibility, no perception; in fact, existence would be nothing more than vegetable life.

The senses—touch, taste, sight, hearing, smell—all depend on the nervous system. Motion depends on it. A muscle can not contract without receiving the stimulus from the nervous system. For example, if a nerve passing from a nerve center to a muscle is severed, the particular muscle that is supplied by the cut nerve is paralyzed.

In the living animal the muscle is the power; but without the stimulus it receives from the nerves it is powerless. The muscle and the nerve, in their relationship, may be compared to the powder and the match in a blast. The hole drilled into the rock may be packed with giant powder, the fuse may be in readiness, but the powder can not rend the rock unless the match is applied to the fuse. The nervous system originates and conveys the stimulus or impulse which excites the muscle. The contraction of the muscle is the source of movement.

In the description of the blood it is stated that all nutrition and all vitality depend on the blood and, although the nervous matter receives its nutrition from the blood, the blood is only capable of fulfilling its proper functions by the aid of the nervous system Without nervous stimulus the heart can not beat. All the other systems in the body are excited and regulated by the nervous system.

The nervous system, for various reasons, is studied in two divisions, but it must be borne in mind that the two divisions are closely connected one with the other.

The cerebro-spinal division consists of the brain and spinal cord, nerves, and ganglia. The nerves of this division convey the impulses of motion and sensation, and supply all parts which are under the control of the will. For example, the voluntary muscular tissue includes all the muscles which act as the will directs. Another example, if anything comes in contact with any part of the skin, the impression is immediately perceived. All the special senses belong to this division.

The *sympathetic division* consists of nerves and ganglia. The muscular tissue which acts independently of the will, as, for example, the stomach, intestines, womb, blood-vessels, ducts, etc., is called involuntary muscular tissue, and receives nervous stimulus from the sympathetic division.

The brain, spinal cord, and the ganglia are the central organs of the nervous system. The nerves conduct the nervous influence. The nerves terminate differently according to their function. The terminations are called end organs. The terminal end organs in the skin and other parts endowed with sensation receive the impressions, which are conveyed to the brain, where they are appreciated. They are so sensitive that the most gentle zephyr is perceived. They are so abundant that the point of the finest needle can not pierce the skin without coming in contact with them, and the sensation of pain is instantly conveyed to the brain. The terminal end organs of the nerves that supply the muscles are different, as they give the impulse which is conveyed by the motor nerves to the elements which constitute the muscle, and this impulse is the excitation which causes the muscle to contract. The terminal end organs of the special senses of taste, smell, etc., receive their respective impressions, and their respective nerves carry the impressions to the brain.

There are two divisions of nerves, the *efferent* and the *afferent*.

The *efferent nerves* are those which convey the nervous impulse outward from the nerve centers, and they are further classified according to the function of their respective centers. For example: Motor fibers carry the impulse from the nerve center to a muscle to cause contraction. Vaso-motor fibers carry the impulse to the muscular tissue in the blood vessels, which regulates their caliber. The secretory fibers convey the impulse to the cells of the glands, and excite the activity of the gland, and its particular product is secreted or evolved, as for instance, milk in the mammary gland. Inhibitory fibers control or inhibit the action of the organ to which they are distributed, as, for instance, the heart.

The *afferent nerves* are those which convey the impulse to the nerve centers. All the sensory nerves belong to this division.

Nerve centers may be considered as a collection or group of nerve cells. Both the cerebro-spinal and the sympathetic divisions have nerve centers. The centers derive their special names from their functions. The brain, as a matter of course, is the great center of the nervous system, as it is the center of intelligence and perception. The centers of all the special senses, as well as the centers of various functions, are located in different parts of the brain. Nerve centers also exist in the spinal cord, and in connection with the sympathetic system. Nerve centers are classed as the automatic and the reflex centers, but these two divisions are subdivided again according to the function of each respective center of either of the great divisions. The action of an automatic center occurs independent of any influence external to the center itself. To illustrate the action of the reflex centers, the familiar example of a piece of food accidentally getting into the larynx (or into the windpipe, as it is popularly termed) may be considered. Nature has endowed the mucous membrane—the internal surface—of the larynx with the most exquisite sensitiveness, which is due to the terminal end organs in the membrane being connected by means of their sensory nerves with a nerve center. No sooner does the particle of food drop into the larynx than the terminal end organs receive the extraordinary irritation it causes, and the impression is conveyed by the fibers of the sensory, or afferent nerve, to a nerve center in the brain, and from the center the nervous impulse is sent by means of the fibers of the motor, or efferent nerves, to the various muscles, the contraction of which causes the forcible expulsion of air from the lungs, which dislodges and ejects from the larynx the offending particle of food. For another example the sensation of pain will suffice. If a finger comes in contact with fire the sensation of pain is received by the end organs of the sensory fibers in the skin of the finger, and conveyed to the brain by the sensory or afferent fibers, and there is instantly carried by the motor or efferent fibers to the muscles of the arm the impulse which causes the muscles to snatch the finger from the fire.

A *nerve* is a cord consisting of a certain number of fibers, inclosed in a sheath of connective tissue. This sheath contains the blood-vessels from which the nerve derives its nutrition. Large nerves are composed of bundles of smaller ones, each of the smaller contained in its respective sheath. Nerves divide and subdivide, sending off branches, which ramify in all parts of the body, and, as they near their terminations, they contain but one or two fibers.

Nerves are the conductors of the nerve current, or impulse.

The *brain and spinal cord* are contained within a bony canal, which forms a protective covering for them.

The *spinal column* consists of a number of bones, especially articulated or joined one to the other, extending from the head to the tail. Through each one of these bones the spinal canal is continued.

The *spinal cord*, or spinal marrow, lodged within the spinal canal, is continuous with the brain anteriorly, and terminates in a point in the sacrum (that part of the spinal column which immediately precedes the tail). The spinal cord is not of uniform size, it being considerably larger at the part covered by the last two bones of the neck and the first two bones of the back than it is immediately before or after this enlargement. It is again enlarged at the part covered by the bones in the region of the loins.

Along its entire length run two fissures, one above and the other below, exactly in the middle line, nearly dividing the cord in two lateral halves. The cord is white externally and gray internally. Between each two of the bones forming the spinal column the cord gives off a pair of nerves, one nerve emerging from either side of the column. These nerves (the spinal nerve) arise from the cord by two roots; the superior root contains sensory fibers, and the inferior root gives the motor fibers. The union of these roots forms a common nerve, which soon divides into two branches, containing motor and sensory fibers; the superior branch to supply the muscles and skin above, and the inferior branch to supply the parts below, including fibers to form the sympathetic division. The spinal cord conducts nervous impressions to the brain and impulses from the brain, and is therefore a conductor of both afferent and efferent currents. It also contains nerve centers, both reflex and automatic.

The fibers that convey motor impulses decussate or cross from one side to the other in the part of the brain called the *medulla oblongata;* therefore a motor impulse going from the right side of the brain crosses over to the left side in the *medulla oblongata* and is carried down the left side of the spinal cord; and in like manner, a motor impulse from the left side of the brain is carried down the right side of the spinal cord.

The nerves that convey sensory impressions go immediately to the opposite side of the spinal cord; therefore, an impression of pain received on the left hind leg, or any part of the left side of the body, is conveyed by the sensory nerve fibers to the spinal cord and passes over to the right side, and is conveyed to the brain by fibers on the right side of the spinal cord. Thus it follows that if a lateral half of the spinal cord be cut, all parts posterior to the cut on the same side will be paralyzed, and all parts on the side opposite to the cut will be deprived of sensation.

The weight of the spinal cord in a cow of average size is estimated to be $7\frac{3}{4}$ ounces. The spinal canal is continuous anteriorly with the cranial cavity.

The *cranial cavity*, formed by bones of the head, is irregular in shape, and contains the brain or encephalon.

The *brain* is continuous with the spinal cord; there is nothing to mark the place where one leaves off and the other begins. Looking at the external surface of the brain, on its superior aspect, the larger mass—the *cerebrum*—is seen to be divided by a longitudinal fissure in the median line into two equal parts, called the cerebral hemispheres, behind which is a smaller mass called the cerebellum, resting on the part called the *medulla oblongata*, which is continuous with the spinal cord. On the under surface of the brain, between the *medulla oblongata* and the cerebral hemispheres, there is a prominent part called the *pons Varolii*, which consists of transverse fibers running across from one side of the cerebellum to the other. Anterior to the *pons Varolii* are two white bundles—the *crura cerebri*. Their continuation with the *medulla oblongata* is covered by the *pons Varolii;* anteriorly they run into the cerebral hemispheres. At the anterior part of the fissure which separates the *crura cerebri* is the pituitary gland and the *tuber cinereum*. From the under surface of each of the cerebral hemispheres proceeds anteriorly an appendage called the *olfactory* lobe.

The arrangement of the gray and white substances of the brain is, to a great extent, the reverse of that of the spinal cord, the gray being external and the white internal, except as regards the *medulla oblongata*, in which the gray matter forms centers in its substance.

The average weight of the brain in cattle as compared to the weight of the entire body, is estimated as 1 to 860; or, in other words, if the weight of the animal be 860 pounds, the weight of the brain will be 1 pound.

The *cranial nerves* are given off by the brain; they are in pairs, as follows: (1) Olfactory—the nerves of the special sense of smell. (2) Optic—the nerves of the special sense of sight. (3) Oculo-motor—supply impulse to all the muscles which move the eyeball, except three. (4) Pathetici—motor nerve to the muscle which rotates the eyeball inward and upward. (5) Trifacial—nerves of various functions. They are in three divisions and each division has numerous branches. The ophthalmic division supplies sensation to the eye and forehead. The superior maxillary division supplies sensation to the skin of the face, to the membrane within the nose, and gives to the teeth in the upper jaw their sensitiveness. The inferior maxillary division supplies sensation to the teeth in the lower jaw, to the tongue, mouth, and the skin over the lower jaw. Some of the fibers of this pair aid in supplying the special sense of taste. This pair also supplies motor fibers to the muscles which move the jaw in the act of mastication. (6) Abducentes—motor nerve to the muscle which turns the eyeball outward. (7) Facial—supplies motor impulses to various muscles about the head. (8) Auditory—the nerves of the special sense of hearing. (9) Glosso-pharyngeal—contains motor and sensory fibers to the tongue and pharynx. It also supplies fibers to aid in the special sense of taste. (10) Pneumogastric—sends fibers to the pharynx, larynx, trachea, bronchi, lungs, esophagus, stomach, heart, and many other parts. Its functions are numerous and important, being both motor and sensory. A branch gives to the mucous membrane of the larynx its extraordinary sensitiveness, while another branch supplies motor impulse to the muscles of the larynx. Another branch is the inhibitory nerve of the heart. Other branches are thought to participate in exciting the production of the gastric juice and the bile. The pneumogastric is connected at different parts with the sympathetic division. (11) Spinal accessory—motor nerves, accessory to the pneumogastric. (12) Hypoglossal—motor nerves of the tongue, and some fibers to a few other muscles.

The foregoing review of the cranial nerves and their functions, brief as it is, will give a superficial idea of the uses of the nervous system and the magnitude of its importance.

The *meninges* are the membranes, three in number, which envelop the brain and spinal cord, and separate them from the bones which form the walls of the cranial cavity and spinal canal. These membranes are called the *dura mater*, external; the *arachnoid*, middle; and the *pia mater*, internal.

The *dura mater* is composed of very strong and dense tissue. By its external surface it adheres more or less closely to the bones which form the walls of the cranial cavity and is continued throughout the whole length of the spinal canal, but does not adhere to the bones of the spinal canal to the same extent as in the cranial cavity.

The *arachnoid* is a serous membrane, and, like all serous membranes, has two layers, which form a closed sack. The external layer is in contact with the dura mater, and the internal layer is in contact with the pia mater. The inner surfaces of the arachnoid (the interior of the sack) are in contact, and are kept moist by the exudation of serum. In the cranial cavity the external layer is not closely attached to the dura mater, but in the spinal canal they are closely united.

The *pia mater*, which is in direct contact with the brain and spinal cord, is a very thin, delicate membrane, having in its structure many blood vessels and small nerves. This membrane, being intimately attached to the nervous matter of the brain and spinal cord, follows all the convolutions, dipping down into the various fissures and inequalities. The arachnoid does not dip into the inequalities, and consequently spaces are left between it and the pia mater. These spaces are filled with a fluid called the subarachnoid fluid, in which the brain and spinal cord may be said to be immersed. This fluid is of vast importance, in so far as it, to a great extent, prevents concussion to the nervous matter of the brain and cord.

The *sympathetic*, also called the ganglionic, division of the nervous system consists of two chains of ganglia, reaching from the head to the tail, situated beneath the spinal column, one on either side. The presence of the ganglia or enlargements on the cords give them their chain-like appearance.

As previously remarked, the sympathetic nerves are closely connected with the cerebro-spinal nerves. In fact, the center for the sympathetic system is located in that part of the brain called the medulla oblongata, but the sympathetic nerves are not under the control of the will. Afferent nerves come from the cerebro-spinal system, as pointed out when describing the spinal nerves. Efferent nerves go from the ganglia (or nerve centers) to all the blood vessels, various organs in the neck, chest, abdomen, etc. The ganglia belonging to the sympathetic system are numerous, and it is thought by some physiologists that they participate in both automatic and reflex acts.

ENCEPHALITIS—STAGGERS.

Inflammation of the brain and its membranes is technically termed encephalitis, but owing to various symptoms, which no doubt depend much on the particular part affected, the disease is known by different names, such as staggers, stomach staggers, mad staggers, sleepy staggers, coma, frenzy, etc.

Inflammation of the nervous matter comprising the brain, without involving the membranes, is a rare disease in cattle, so much so that few authorities notice it as a distinct affection, and then only to point out the fact that it is discovered by post-mortem examination. There are no symptoms exhibited by which it may be positively distinguished from encephalitis—the disease involving the membranes as well as the brain—and therefore it will be included in this description.

Causes.—Severe blows on the head with a hard object, or the head coming violently in contact with the ground or other hard substance in a fall, may be followed by encephalitis. Irritation caused by tumors in the brain may produce inflammation. Food containing deleterious matters, for example, ergot (see Plate V) and other fungi which contain a narcotic principle, is the most frequent cause of this affection, and hence it is often called "grass staggers" and "stomach staggers." In many localities certain plants have the reputation of causing staggers. As, for instance, "Elliott's Botany of South Carolina and Georgia," edition of 1821, says: "Atamasco—stagger-grass. Generally supposed to be poisonous to cattle and produces the disease in calves called staggers." The writer can not say that this particular plant (Atamasco Lily—*Amaryllis atamasco, L.*) produces the disease, but he quotes the supposition to add strength to the point that it is generally believed that certain plants do cause it. European authors describe a variety of the disease "arising from the consumption of the refuse of distilleries." When the disease is not caused by direct violence the quality of the food should be suspected.

Symptoms.—The symptoms vary much, but a careful observer will detect a trouble connected with the nervous system without much uncertainty. The first signs may be those of frenzy, but generally at the start the animal is dull and sleepy, with little or no inclination to move about; the head may be pressed against the wall or fence and the legs kept moving, as if the animal were endeavoring to walk through the obstruction; the body, especially the hind part, may be leaned against the side of the stall or stable, as if for support. The bowels are constipated; the urine, when passed, is small in quantity and darker in color than natural. There may be trembling and even spasms of muscles in different parts. In the dull stage the animal may breathe less frequently than natural, and each breath may be accompanied with a snoring-like sound. The pulse may be large and less frequent than normal. If suddenly aroused from the drowsy state the beast appears startled and stares wildly. When moving about the animal may stagger, the hindquarters swaying from side to side.

When the delirium ensues the cow is commonly said to be mad. She may bellow, stamp her feet, run about wildly, grate the teeth, froth at the mouth. If she is confined in the stable, she rears and plunges; the convulsions are so violent in many instances that it is really dangerous for one to attempt to render aid. The body may be covered with perspiration. She may fall; the muscles twitch and jerk; often the head is raised and then dashed against the ground until blood issues from the nose and mouth; the eyes may be bloodshot and sightless; the limbs stiff and outstretched, or they may be kicked about recklessly; the head may be drawn back and the tail drawn up; the urine may be squirted out in spurts; often the "washer" (membrane nictitans) is forced over the eye. When the convulsions cease they may be followed by a period of quiet unconsciousness—coma—which is more or less prolonged, when the animal may gradually regain consciousness, get up on its feet, and perhaps quietly partake of food, if there be any within reach, while at other times it arises with much difficulty and staggers blindly about the stall or field.

It must be remembered that all the foregoing symptoms are not always seen in the same case. In those cases usually designated sleepy staggers the general symptoms of drowsiness are presented, while in other cases the symptoms of frenzy cause the affection to be called mad staggers. In other cases, when the spinal cord and its membranes are more or less involved, there are symptoms of paralysis, swaying of the hindquarters, inability to rise, etc.

The various symptoms increase in frequency and intensity until they end in death, which is almost invariably the result of an attack of encephalitis in cattle.

It is well to remark that when the disease follows injuries to the head, the symptoms may not be manifested until two or three days (or longer) after the accident.

Treatment.—For reasons which are obvious from the description of the symptoms, treatment of this disease is anything but satisfactory. Recoveries are rare in spite of careful scientific attention, even in those cases which are under the most favorable circumstances. To be of any service whatever the treatment must be prompt and begin with the disease. In the early stage the pulse is large, and in most cases will admit of bleeding. Eight or nine quarts of blood should be taken from the jugular vein. This should be followed immediately by a purgative, the following, for a cow of average size: Epsom salts, 24 ounces; pulverized gamboge, $\frac{1}{2}$ ounce; croton oil, 20 drops; warm water, 3 quarts. Mix all together and give at once, as a drench.

About 2 quarts of warm water or warm soapsuds should be injected with a syringe into the rectum (last gut) every three or four hours. It is best to keep the animal in a quiet, sheltered place, where it will be free from noise or other cause of excitement. All the cold water the animal will drink should be allowed, but food must be withheld, except bran slops occasionally in small quantities, or grass, if in season, which may be cut and carried fresh to the patient.

During the convulsions all possible efforts should be made to prevent the animal injuring itself; the head should be held down on the ground and straw kept under it. Cold water may be continuously poured on the head, or bags filled with ice broken in small pieces may be applied to the head. Different authors recommend different remedies to allay the convulsions, but for two reasons it will be found extremely difficult to administer medicines during the convulsions: (1) While the animal is unconscious the power to swallow is lost, and therefore the medicine is more liable to go down the windpipe to the lungs than it is to go to the paunch. (2) The convulsions are often so violent that it would be utterly useless to attempt to drench the animal. And furthermore it must be borne in mind that during this stage the functions of digestion and absorption are suspended, and as a consequence the medicine (provided it finds its way to the paunch) is likely to remain there unabsorbed and therefore useless.

A blistering compound, composed of mustard, 1 ounce; pulverized cantharides, one-half ounce; hot water, 4 ounces, well mixed together, may be rubbed in over the loins, along the spine, and back of the head on each side of the neck. This is occasionally attended with beneficial effect, and especially so in those cases when paralysis is present.

If the purgative acts, and the animal shows signs of improvement in the course of two or three days, 2 drams of iodide of potassium may be given every night and morning, dissolved in a half bucketful of drinking water, if the animal will drink it, or it may be dissolved in a half pint of water and given as a drench. Great care must be observed in regard to the food, which should be nutritive but not coarse, and at first in small quantities, gradually increased as the patient improves. After some progress is made towards recovery 1½ drams of pulverized nux vomica may be given twice a day, added to the iodide of potassium drench. This should be administered so long as a staggering gait continues.

In those rare cases when recovery takes place, it is only partial as a rule, as there is generally a sequel which remains, such as partial paralysis; however, this is but a slight drawback in cattle, because when it is seen to persist, the medicine should be stopped and the animal fattened for butchering.

Post-mortem examinations discover congestion of the brain and its membranes. The *pia mater* (the vascular membrane) is most congested. In those cases which have exhibited much paralysis before death, the *pia mater* of the cord is congested in the lumbar region (loins). When the disease has been caused by injury to the head the congestion and extravasated blood may be found inside of the cavity in the location corresponding to the place where the injury was inflicted externally. In some cases pus is also discovered. It remains to be said that in all animals that have died from this affection the lungs are found very much congested. This leads the nonprofessional to suppose that the disease was a lung affection, but in fact it is only a natural consequence when death ensues from brain disease.

APOPLEXY.

That form of congestion of the brain known as parturient apoplexy, which is so frequently associated with the period of calving, is described in another part of this work. (See Parturient Apoplexy, p. 247.)

Cerebral apoplexy, not connected with parturition, is a rare disease among cattle. However, it may be due to degeneration and consequent rupture of a blood-vessel in the brain; the pressure of the blood which escapes from the ruptured vessel upon the nervous substance causes the alarming symptoms.

The attack is sudden, the animal in most cases falling as if hit on the head with an ax. Convulsions similar to those described as symptoms of encephalitis may ensue, or the unconsciousness may not be accompanied with any movements of the head or limbs; the eyes are open and blindly staring, the mouth frothy, the body cold; the breathing may be loud or snoring, the pulse frequent and small. There may be remissions in the severity of the symptoms, but the pressure from the continued escape of blood soon causes death.

There is described a form of congestive apoplexy, affecting cattle which are in a plethoric condition. The congestion, or superabundant quantity of blood in the vessels of the brain, may be followed by rupture of the vessels. It is said to occur mostly in hot weather. In this variety the symptoms given are somewhat similar to those exhibited when the affection is due to degeneration of the blood vessels, but not so violent; the animal may show premonitory signs, such as dullness, staggering, and may only fall to the knees, the muzzle resting on the ground.

In such cases bleeding should be resorted to immediately, and when the power of swallowing is not lost purgatives should be administered. Cold applications to the head, and the general treatment recommended for encephalitis are indicated.

CONCUSSION OF THE BRAIN.

Severe blows on the head, striking the head against some hard object while running, or falling on the head, may cause concussion of the brain. The injury may fracture bones of the cranium and produce compression of the brain.

The *symptoms* vary according to the severity of the concussion. After receiving the injury the animal may lie prostrate, entirely unconscious of all surroundings, with complete loss of sensation and power; however, there may be some slight convulsive movements, but they are without any effort of the will.

Death may quickly follow the injury; or, if the injury has not been very serious, recovery may take place in a comparatively short time; or the animal may linger in a more or less unconscious state for a considerable time, or there may be a partial recovery from the injury, followed within a few days by encephalitis.

The injury which produces concussion of the brain may at the same time fracture one or more of the bones of the cranium. The fracture may be simple—a crack in the bone without depression, or the broken bone may be depressed, the pressure on the brain substance constituting compression of the brain. The first step in the treatment of compression of the brain from the latter cause is to elevate the depressed bone, which in some cases may be done with a thin but strong piece of steel, like a knife blade. In many cases it is necessary to remove a portion of bone with a trephine in order to be able to raise the depressed part. Such cases require the skill of an expert veterinarian, but unless the animal is a very valuable one it should be butchered as soon as possible after the accident, and not allowed to linger until the meat becomes unfit for consumption.

Compression of the brain may result from an injury without fracture of a bone. A blow on the head may rupture a blood-vessel within the cranial cavity, and the blood escaping therefrom (either on the surface of the brain or into the structure of the brain) produces compression of the brain substance. Or the injury may cause inflammation, the result of which may be compression due to the formation of pus.

Compression from the escape of blood may be suspected when the insensibility continues. But when due to the formation of pus the animal partially recovers, and after three or four days have elapsed becomes again unconscious.

In concussion of the brain, during the first stage, when the surface of the body is cold, cover the body and legs with warm blankets. It is useless to attempt to administer medicines while the animal is insensible and can not swallow. Cold water or crushed ice should be applied to the head, and when consciousness returns the purgative drench as advised for encephalitis should be administered. The animal should be assisted to its feet and put in a comfortable place, free from light and noise. Only small quantities of food, in the form of bran slops or grass, should be given for some time. Bleeding should not be performed unless the case runs into encephalitis, when the general treatment advised under that head may be followed.

EPILEPSY.

This affection is characterized by the onset of sudden convulsions. The animal may appear to be in a fair state of health, as a general thing, but at any time, in the stable or in the field, it may have an attack, stagger, fall, and violent convulsions ensue; the urine and dung may be voided involuntarily during the fit, and the breathing may be of that snoring description called stertorous. Epilepsy must not be confounded with vertigo—the fainting which is an effect of heart troubles.

The exact cause or causes of epilepsy in the majority of cases are unknown. Post-mortem examinations, in many instances, have failed to discover any lesion in connection with the brain or nervous system; while in other instances disease of the brain has been found in the form of thickening of the membranes, abscesses and tumors; and in some cases the affection has been manifested in connection with a diseased condition of the blood. The cause has also been traced to reflex irritation, due to teething, worms, and chronic indigestion.

Treatment.—When the affection is due to the last-named causes treatment may be successful if the cause is removed. If there are symptoms of worms or of indigestion, follow the general treatment advised for those troubles under their proper heads. If due to irritation caused by teething, the inflamed gums must be lanced. Examination of the mouth often develops the fact that one of the temporary teeth causes much irritation by remaining unshed, and thereby interfering with the growth of a permanent tooth. The offending tooth should be extracted. When the cause of epilepsy can not be discovered, it must be confessed that there is no prospect of a cure in such cases. However, some benefit may be expected from the occasional administration of a purgative dose of medicine. A pound of Epsom salts dissolved in a quart of warm water, for a cow of average size, may be given as a drench once or twice a month. In addition to the purgative, 4 drams of bromide of potassium, dissolved in the drinking water, three times a day, has proved very beneficial in some cases.

SUNSTROKE—PROSTRATION FROM HEAT.

Owing to the fact that cattle are seldom put to work at which they would have to undergo severe exertion, especially in collars, they are not frequently prostrated by the extreme heat of the summer months. When at pasture they select the coolest places in the shade of trees, etc., when the heat becomes oppressive, and thereby avoid, as much as possible, the effects of it. But nevertheless cases are not uncommon when cattle suffer from the so-called sunstroke.

Cattle that have been kept up for the purpose of fattening, when driven some distance in very hot weather, are the most liable to be prostrated, but it must be remembered that it is not really necessary for the animal to be exposed to the rays of the sun, as those confined in hot, close places may suffer. This often happens in shipping, when they are crowded together in cars.

Symptoms.—The premonitory signs are those of exhaustion—dullness, panting, frothing at the mouth, tongue hanging out, irregular gait, uneasiness, palpitation, when, if the circumstances which tend to the prostration are not mitigated, the animal staggers or sways from side to side, falls, struggles for awhile, and then gradually becomes quiet, or the struggles may continue, with repeated but ineffectual efforts to regain a standing position. In serious cases the attack may be very sudden, unconsciousness occurring without any distressing premonitory symptoms. The less serious form is known to the colored cattle drivers as "overhet" (overheated).

Treatment.—At first, when not very serious, removal to a quiet sheltered place, with a few days on a reduced diet, is all that need be done. When the animal has fallen, apply cold water or ice to the head; rub the body and limbs with cloths or wisps of straw, and continue the rubbing for a considerable time. If the power of swallowing is not lost (which may be ascertained by pouring a little cold water into the mouth), give 3 drams of liquor ammonia fort., diluted with a quart of cold water. Be very careful in drenching the animal when lying down. Repeat the drench in a half hour, and an hour after the first one has been given. Instead of the ammonia, a drench composed of 3 ounces of spirits of nitrous ether in a pint of water may be given, if more convenient, but in all cases the ammonia drench is preferable. If unconsciousness continues, so that a drench can not be administered, the same quantity of ammonia and water may be injected with a syringe into the rectum. The popular aqua ammonia, commonly called "hartshorn," will do as well as the liquor ammonia fort., but as it is weaker than the latter, the dose for a cow is about one and a half ounce, which should be diluted with a quart of water before it is given to the animal, either as a drench or an enema. When ammonia can not be obtained quickly, 2 ounces of oil of turpentine (spirits of turpentine), shaken with a pint of milk, may be injected into the rectum, and will act beneficially until the ammonia is procured.

As soon as the animal is able to rise, it should be assisted and moved to the nearest shelter. All the cold water it will drink should be allowed. The ammonia or spirits of nitrous ether drench should be administered every three hours, so long as there is much failure of strength. The diet should be limited for several days; bran slops and a little grass. When signs of returning strength are presented, 12 ounces of Epsom salts dissolved in a quart of warm water may be given in those cases which have been down and unconscious, but do not give it while much weakness remains, which may be for several days after the attack. It is hardly necessary to mention that when an animal is suffering from heat prostration, bleeding should not be resorted to as a remedial measure. The writer is well aware of the fact that they are often slaughtered by butchers to save further trouble and probable loss.

INJURIES TO THE SPINAL CORD.

The spinal cord is liable to concussion from blows and falls, and paralysis, to a greater or less extent, may be the result. Fracture, with displacement of the bones (vertebræ) which form the spinal column, by compressing the spinal cord produces paralysis, which varies in its effect according to the part of the cord that is compressed. If the fracture is above the middle of the neck death soon follows, as communication between the brain and diaphragm—the essential muscle of inspiration—is stopped. The phrenic nerve, which supplies the diaphragm with motor impulse, is formed by the union of spinal nerves below the middle of the neck, and when the cord is compressed between the origin of this nerve and the brain the diaphragm is paralyzed and death must result. When the fracture is farther down in the neck, posterior to the origin of the phrenic nerve, the breathing continues, but there is paralysis in all parts posterior to the fracture, including the fore and hind legs. When the fracture is in the region of the loins the hind legs are paralyzed, but the fore legs are not. If the fracture is in the *sacrum* (the division of the spinal column between the loins and the tail) the tail alone is paralyzed.

As a matter of course, when the back is broken there is no remedy; the animal should be bled to death and converted into meat at once. The animal not being able to rise after the accident, together with the fact that sensation is lost, as evidenced by sticking a pin into the paralyzed parts, should decide the question.

PARALYSIS.

Paralysis, or loss of motion in a part, may be due to a lesion of the brain, of the spinal cord, or of a nerve. It may also be caused by reflex irritation. When the paralysis affects both sides of the body, posterior to a point, it is further designated by the technical name of *paraplegia.* When one side of the body (a lateral half) is paralyzed, the technical term *hemiplegia* is applied to the affection. When paralysis is caused by a lesion of a nerve, the paralysis is confined to the particular part supplied by the affected nerve.

As already pointed out, paralysis may be due to concussion of the spine; fracture of a bone of the spinal column with consequent compression of the spinal cord; concussion of the brain; compression of the brain. An injury to one side of the brain may produce paralysis of the same side of the head, and of the opposite side of the body *hemiplegia.* Paralysis may occur in connection with parturient apoplexy, lead poisoning, ergotism, etc.

Paraplegia, like other diseases, has been traced to moldy food. In one outbreak on record, complete paralysis of the posterior parts of the bodies of seven oxen was attributed to this cause. Reflex paraplegia, associated with indigestion and impaction of the rumen, is recognized by practitioners. This is usually a mild form, and generally passes away in a few days, especially when the cause—indigestion, impaction of the rumen—responds to proper treatment. Cows heavy with calf are sometimes affected with a form of paraplegia, which usually attacks them from about a month to a few days before calving. Apparently they are in good health in every respect except the inability to stand up, on account of the paralysis of the hind quarters. This form is generally attributed to compression of the nerves (and probably the vessels to some extent) of the hind parts by the enlarged condition of the womb. As a rule the animal recovers after calving, and requires only general care, such as good bedding and regular diet, and if the bowels become constipated at any time two quarts of warm soapsuds should be injected into the rectum occasionally. If the enemas are not sufficient to keep the bowels in proper condition, a half pound of Epsom salts dissolved in a quart of warm water may be given as a drench. If the cow desires to shift her position from one side to the other necessary assistance should be given. If the paralysis continues for several days after the calf is born the cow should have a purgative—1 pound of Epsom salts dissolved in a quart of warm water; also 1½ drams of pulverized nux vomica, every night and morning, on the food, if she will eat it, or with some water as a drench. The blistering compound recommended in the treatment of encephalitis may be rubbed well over the loins.

The cow is occasionally attacked with a form of paralysis after calving not connected with parturient apoplexy. It may be associated with inflammation of the womb, and some authorities say that it is caused by injuries to nerves while calving. One or both hind legs may be affected, or more or less of the body may be involved. The treatment is similar to that for the variety occuring before parturition, viz., purgatives, nux vomica, enemas, blistering the loins, and the general care recommended for the former affection. It is sometimes necessary to apply a red hot iron in lines over the loins, but it is best to have a veterinarian perform the operation.

The treatment for the form of paralysis associated with indigestion or impaction of the rumen (paunch) is much the same as in the foregoing cases; but when the paunch is overloaded the purgative should be more drastic. The following compound is perhaps as good as any: 1 pound of Epsom salts; ½ pound common salt; one ounce of pulverized gamboge; 1 ounce of pulverized ginger. These ingredients must be well stirred or shaken with about 6 pints of warm water. The enema of warm soapsuds should be thrown into the rectum at least every half hour. If the bowels do not respond to the purgative within twenty-four hours another pound of Epsom salts may be administered, dissolved in a quart of warm water. After the bowels respond to the purgative, and especially in those cases when the gait remains unsteady for a few days, give the following: pulverized nux vomica, 4 ounces; bicarbonate of soda, 20 ounces; mix and make 16 powders. Give one every night and morning. It is often necessary to unload an engorged paunch by an operation called *rumenotony*, for the description of which, and for fuller particulars of the treatment of indigestion and impaction of the rumen, the reader is referred to the articles on those subjects, under their proper heads. (See p. 31.)

There are instances when cows will persist in lying down (in spite of all efforts that are made to compel them to stand up), when it can not really be said that they are paralyzed. They have sensation in all parts; they can move all their feet; they can change their position; and in fact every function seems to be normally performed, but they obstinately refuse to rise, or even make an effort to do so. Cases of this kind have been slaughtered, as it was an utter impossibility to get the animal on its feet. However, there are instances when a cow after refusing to rise when all other means had been tried, quickly jumped to her feet and showed fright when her inveterate enemy, a dog, was induced to torment her.

Hemiplegia, or paralysis of one side of the body, is a rare affection in cattle. Prof. Williams records a case in his "Veterinary Medicine" as follows:

> In the case of the cow the attack was of an acute kind. The animal was grazing in a field with a lot of others, and was left quite well at milking time in the morning. The field being some distance from the house it was not seen again before evening. It was then found prostrate on the ground, lying upon its left side, and was unable to rise. When I saw it I observed the following symptoms: The left ear was pendulous, left eyelid drooping and closed, the eye squinted outwards. The left cheek hung down, the angle of the mouth was lower than on the opposite side, the muscles were loose and flaccid, and the lips drawn to the right side. The tongue protruded, and when put into the mouth was drawn to the right side. The neck was twisted and the head drawn to the left side. Deglutition was imperfect, but the breathing was not especially affected. The superficial blood-vessels of the right side were engorged with blood, and stood out prominently all over the trunk and neck. The same side was warm, whilst the opposite side was cold, and the hair was pin-feathered. In endeavoring to place the animal on a hurdle for the purpose of removing it to a shed it was observed that it rolled over from the left to the right side, on which side only could it be made to lie. The bowels were constipated and the belly tympanitic, the *sphincter ani* was rather relaxed, the vulva flaccid, and the vagina protruding. The animal was quite conscious, but inclined to somnolency. It was bled, a purgative administered, and the back was fomented and dressed with a strong ammonia liniment. On the following morning it was able to rise, but both the legs of the right side remained partially paralyzed for some weeks. The affection of the face, however, passed away during the first night, and it was able to partake of food on the following morning.

The foregoing quotation so fully describes hemiplegia that it is unnecessary to add any more to it, unless it is to say that, should the reader have a cow with a similar attack, the treatment is about the same as described for paraplegia.

TETANUS—LOCKJAW.

Cattle are subject to tetanus, but it is a comparatively rare affection among this class of animals. The writer practices in a district where tetanus is almost as common among horses and mules as any other disease, and in fact it occasionally appears as an enzoötic among them; but it is one of the rarest diseases in cattle he is called to treat.

Tetanus consists of a continued spasm of the voluntary muscles. The spasmodic contraction of the muscles, although persistent, is sometimes greater or more severe than the average during the course of the disease. The exacerbations, or increase of the violence of the spasm, may occur without any cause other than the nature of the disease itself, but they are frequently due to noises or the manner of going about the animal by those in attendance, and to other causes that excite the patient.

Other technical terms are used to designate the particular forms of tetanus, but they only refer to the regions of the body that are involved in the spasm. Thus if the muscles of the head, particularly those used in mastication (or chewing), are affected, it is called trismus; and it is this form which gives rise to the popular name "lockjaw." When the muscles of the upper part of the neck and back are affected the head and tail are elevated, and the name applied is opisthotonos. If the muscles of one side only are affected, the head is drawn to that side, and the disease is called tetanus lateralis or pleurosthotonos. If the muscles on the lower part of the neck and body are affected, the mouth is drawn towards the breast, when the term emprosthotonos is applied. In cattle the disease is characterized by the symptoms of trismus and opisthotonos combined; the other forms have never been met with in the experience of the writer.

Two varieties of tetanus have been universally recognized: When the disease exists in connection with a visible wound, it is called traumatic tetanus. When no wound is discoverable the affection is called idiopathic tetanus. The writer is of opinion that these distinctions are superfluous, by which he means to infer that in all cases the disease is from the same cause. In the great majority of instances there is no difficulty in finding a wound, and in many cases more than one wound. In the cases called idiopathic one can only say that no wound is discovered; one can not say positively that no wound exists. There may be a wound in the mouth, or in any part of the intestinal canal. When it is considered how small the wound is in the foot from the prick of a nail in so many cases followed by lockjaw in the horse, it is not difficult to recognize the fact that there may be many small wounds that are invisible about an animal. It is a familiar opinion often expressed that there is danger in a pin-scratch. One may easily appreciate the fact that there may be more small scratches than one on the hide of an animal thickly covered with hair, that will defy detection unless the animal is shaved. Holding these views, the writer will not differentiate between the two varieties, but will describe the disease under the general name, tetanus. It must be understood that the writer has no desire to do violence to the opinions of others; nor does he so strongly assert his own opinions merely for the purpose of airing them; the real object is that the most careful examination be made in every instance, so that cases will not be classed as idiopathic simply because a casual glance over the animal fails to detect a wound.

Causes.—Tetanus has been attributed to many different causes by as many different writers, and while some of the theories may appear plausible to one observer, to another they seem ridiculous. To refer to all the conditions that have been ascribed as causes for this affection is a greater task than the writer has desire to attempt. However, a few of them will be mentioned, to convey an idea of the diversity of the opinions held by those who have written on the subject: Hereditary predisposition, bad food, exposure to cold and wet, sudden alterations of temperature, excessive fatigue, overdriving, etc. All authorities agree on one point, however, and that is, that tetanus is most frequently met with in connection with a wound.

It should be remarked that it is not only large wounds, nor very painful wounds, that are followed by tetanus, as the affection is often associated with wounds of the most trivial character. The writer has attended cases where the wounds were so small that they were only discovered after repeated examinations. One case in particular is worthy of mention. When first examined, trismus was so pronounced that the teeth could not be forced more than a half inch apart. A thorough examination failed to find a wound. The next day another examination was as fruitless. On the third day a small nodule was felt on the skin of the cheek; the hair was parted, and a little crust or scab picked off. The hostler then stated, what had escaped his memory until thus reminded, that about a week before, while putting hay in the manger, the point of a prong of the fork came in contact with that part, but the wound was so slight that it was entirely forgotten. That small sore was treated antiseptically, and the animal made a good recovery. The writer has not the least doubt that the cause was in that small wound.

In another instance, after a very careful examination, the case was about to be put down among the number of those which are generally called idiopathic, when a few hairs on the base of the neck were observed to be matted together; and on a closer examination of that part a small abrasion was found which was treated antiseptically until it was healed. The animal was discharged sound in two weeks.

It is a fact (in the experience of the writer) that large or painful wounds are less liable to be followed by tetanus than are the slighter injuries, for the reason that the former usually receive attention, while the latter are neglected.

A wound in any part of the body may be followed by tetanus. The particular place where a wound is located is of small import so far as the cause is concerned, although it is of the greatest importance when the treatment is considered, as, for instance, a wound that is located internally can not be topically treated.

Tetanus may ensue within a few days after the infliction of a wound, but the attack usually occurs between one and two weeks after the injury, when, in many cases, the wound is nearly healed. In instances where healing is retarded, the wound remaining open, neglected, or badly treated, the disease may set in at any time. In one case of which the writer has knowledge the animal was attacked four months after receiving the wound in the foot.

Operations (as well as accidental wounds) may be followed by tetanus. However, it is not now so common a sequel to operations as it formerly was, for the reason that careful veterinarians use antiseptic precautions as much as possible.

It has perhaps followed castration oftener than any other operation, due no doubt, in the great majority of instances, to uncleanliness both in regard to the instruments used and to the hands of the operator, as well as the manner of operating. But of course it may follow the operation in some instances when care has been taken in respect to cleanliness. In such cases the cause gains access to the wound after the operation has been performed.

In an instance of which the writer has knowledge the ordinary operation of tapping for tympany ("wind colic") was followed by lockjaw. In this case certainly the disease could not have been due to the instrument, as it was thoroughly clean and had been immersed in a solution of carbolic acid in water (1 to 20) before the operation. It is evident that the cause of tetanus must have either been on the skin at the time of the puncture, and forced into the wound by the instrument, or else it gained access some time afterwards.

There can be no question that a wound has much to do with the cause of tetanus, but nevertheless the most serious or the most trivial wound can not in itself produce the affection. Something of a specific nature must gain access to the wound for the characteristic symptoms of tetanus to be developed. Long ago, before a germ having this specific property was discovered, many scientific veterinarians and physicians believed in the infectious nature of the disease. Cases frequently occurred in the practice of individual members of the profession that left no doubt in their minds, and consequently, when it was announced that a microbe had been found in wounds of persons suffering with the disease, that would cause the affection in animals when inoculated with the pus containing the microbes, many points which had been clouded in mystery were at once made clear. (See Plate XXIX, Fig. 5.)

Since this discovery in 1884 many successful experiments have been performed to verify the fact. The same microbe has been discovered in earth, and cultivations made from it and injected into animals have produced the disease. It has been found in dirt taken from floors, gardens, yards, fields, streets, and animals inoculated with it have developed the disease. Hence there is not much doubt at present concerning the cause of tetanus, although there are still some eminent practitioners in both the veterinary and medical professions who refuse to receive the results of the numerous experiments as conclusive.

The evidence so far goes to prove that tetanus is the same disease in man and animals, and therefore it is well to bear in mind when attending an affected animal that the wound may contain a germ which, if it gain access to a sore or an abraded surface on yourself, may cause this dreadful disease.

In summing up the matter it may be said in a very few words that there is a well-grounded belief that the specific germs of tetanus find their way into a wound or an abrasion, where they obtain favorable opportunity for cultivation and increase, and the result of their presence is a poisonous chemical product which is absorbed into the system and causes tetanus. In those cases called idiopathic, where no wound can be found, it does not require a stretch of the imagination to suppose that a wound or an injury exists somewhere in the alimentary canal sufficient to harbor the germs, which may have been taken in with the food; and it is even considered possible for the germs to be taken in with the air inhaled and to lodge on a denuded surface of the respiratory tract.

In this view of the subject there is nothing to do violence to existing knowledge, for it is well known that strychnine in poisonous doses acts on the nervous system in the same manner, causing a spasm similar to tetanus.

Cattle lead a quieter life and are less subject to wounds than horses and mules, and it may be that they are better able to withstand the effects of the germs, and to these reasons may be due the fact that tetanus is a rare disease in cattle.

Symptoms.—In the description of the nervous system it was explained that sensory impressions are conducted to the brain by the afferent nerves, and the motor impulses are conducted from the nerve center to the muscle (to cause contraction) by the efferent nerves. Now, in describing the symptoms of tetanus, it is well to point out the fact that the motor centers being greatly irritated by the cause of tetanus, an extraordinary stimulus or current is sent to all the muscles, which produces a persistent violent contraction or spasm of the muscles. Bearing in mind this fact it is easier to recognize the contracted state of the muscles, which are hard and resistant, and stand out prominently as lumps or cords under the skin, especially about the head and neck.

General sensitiveness is also increased; the afflicted beast is ever on the alert, and is startled by the slightest noise. A harsh voice often brings on an increase in the intensity of the spasm; a touch of the hand, however light, excites fear; clapping the hands or the crack of a whip almost causes the animal to fall.

The first symptom noticed is usually some stiffness in the manner of carrying the head. The muzzle is elevated—"poked out;" the ears are also carried stiffly, and moved very little, if any. The haw or "washer" (membrana nictitans) is forced over the eye from the inner corner, and on account of this strange appearance of the eye, many persons who have for the first time seen an animal affected with lockjaw, imagine that all the trouble is in the eyes. In fact the writer has known of several instances where persons, ignorant of the real cause, supposed the animal to be affected with "hooks," and therefore cut out what they concluded to be offensive. The animal moves very stiffly, the legs are almost rigid, and when walking they are used like sticks. When turned the body is kept straight and moves around like a log. When standing still the legs are propped out, and, were it not for the breathing, the beast might be compared to a wooden horse. The tail is elevated and sticks out like a pump handle. The jaws are moved very stiffly during the first part of the attack, and there may be grating of the teeth or champing so long as they can be moved, but at any time if the hand be placed in the mouth to force the jaws apart, rigidity to a greater or less extent will be manifest. The animal will eat as long as it is possible to open the jaws wide enough to take anything into the mouth. On account of the general stiffness the urine and dung are passed with some difficulty. The pulse is usually hard, but does not vary much from normal in other respects, until some time after the attack, when it increases very much in frequency. As the disease progresses all the symptoms become more pronounced. The haw extends further over the eye, and at any time, if the head is forced up by the hand, the eye may be entirely hidden as it is drawn back, and the haw forced over it. The breathing becomes more rapid and difficult; the nostrils are open to their widest extent, showing the congested membranes within the nose; the jaws become more or less set or locked; swallowing, always accomplished with difficulty, becomes almost or quite impossible. At times, and especially if the animal is annoyed or excited by attendants or noises, the intensity of the spasm is increased so as to amount to paroxysms. The animal usually remains on its feet as long as possible, but should it get down after the disease is well established it is seldom able to rise alone, and in its endeavors to do so it struggles convulsively, and as a rule the struggles end in death.

Treatment.—Tetanus in every instance must be considered a very serious affection, but not necessarily always a fatal one. Some cases have recovered in spite of the most brutal and ignorant methods of treatment; some have recovered without much treatment of any kind; and many cases succumb under the treatment of the most eminent practitioners after every measure prompted by science, humanity, and reason has been resorted to. Of paramount importance is to recognize the affection and begin the treatment before the disease has made much advance, for when it is well established the effect is not only harder to overcome, but every aid is more difficult to render.

At the appearance of the first symptoms, when the animal is still able to swallow without much difficulty, give the following drench: Epsom salts, 10 ounces; common salt, 10 ounces; calomel, 2 drams; pulverized gentian, 1 ounce; warm water, 2 quarts. After the administration of the foregoing dose there is to be no more drenching.

Examine closely for wounds; look well between the claws of the feet, search over the body and legs, and even examine the mouth. Note well the location of the wounds; do not neglect the smallest scratch. Place the animal in a darkened, quiet stall, where it will be away from noises or other cause of excitement. With hot soapsuds and a clean rag, thoroughly wash away from the wound (or wounds) all the hardened discharges, crusts or scabs, so that a fresh and clean sore is presented. Then use the following: Bichloride of mercury, 30 grains; pure carbolic acid, 1 ounce; water, 1 quart; mix. Pour some of this solution on the wound, and with a clean piece of white cotton or muslin rub the medicine into all parts of the wound; be certain that it comes in contact with every portion of the wound; literally scour the wound with the cotton and medicine, but do no unnecessary injury. Make soaking wet some absorbent cotton and bind it well on the wound. Once each day change the dressing; clean the wound with the medicine, and bind on fresh absorbent cotton soaking wet with it. Treat every wound or scratch that you can find on the animal in the same manner. If the wound is in the foot, expose it well by cutting away as much of the hoof as necessary in order that the medicine may come in contact with all of it. Painful wounds about the feet should be poulticed twice a day with linseed meal for three or four days, but each time the poultice is changed the wound should be washed with the medicine; and when the poultices are discontinued the wound must be dressed with the absorbent cotton and the medicine once a day. Give the regular food so long as the animal is able to eat it, but when chewing and swallowing become very difficult slops made with bran, cornmeal and small quantities of linseed meal must be prepared. All the cold water the animal will drink must be supplied. The stall must be so arranged that the food and water may be placed within easy reach of the animal's mouth, as it must be remembered that it can reach neither very high nor very low.

Although putting cattle in slings is not a very satisfactory measure under any circumstances, still it may be advisable to have the animal in a stall, where arrangements may be made to support it (not suspend) in canvas. When an animal affected with lockjaw lies down it is a very difficult matter to raise it, as the body and legs are so stiff that the beast is not able to help itself, and raising it is something after the manner of lifting a heavy body with four sticks stuck into it for legs. If the animal becomes very weak the canvas may be arranged so that it may rest in the sling.

Do not allow the patient to be an object of curiosity for the neighborhood. The person who is attending to the animal's necessities should be the only visitor to the stall; and three visits each day, every eight hours, will suffice to render all necessary aid. The food, etc., should be prepared in time to be carried in at the regular visit.

The excitement caused by repeatedly drenching the animal would do much more harm than could be overcome by all the medicines you could pour into it. Therefore do not attempt it. Dissolve 1 ounce of bromide of potassium in every 2 gallons of water the patient will drink. Leave a fresh supply of water with the medicine in it before the animal at each visit, and secure the bucket so that it can not be overturned. Three times a day inject into the rectum 2½ ounces each of the tinctures of conium and cannabis indica, diluted with 1 pint of warm water.

Everything must be done in a quiet, orderly manner, so as not to excite the patient. Do not pay any attention to the numerous recipes for lockjaw advised to be given by different acquaintances. The veterinary expert, governed by the exigencies of the case, is competent to make changes and substitute measures intended to relieve symptoms, but the nonprofessional had best confine himself to an outlined course of treatment and abide by the result of it. No doubt you will be advised to chloroform the animal, or to do one thing or another, to "unlock the jaws," etc., but do not follow the advice, as you will only hasten a fatal termination; all such methods have been tried again and again with no benefit. In those cases where no wound is found the treatment must be the same in all respects, with the exception, of course, that there is no wound to treat. But if there has been a recent wound which is apparently healed, bathe the scar well with warm water, and if there be the slightest sign that it is not entirely healed, use the medicine on it as advised for the other wounds.

When improvement is pronounced, the medicine given in the drinking water and in the rectum should be gradually discontinued by giving only two-thirds of the prescribed quantities of each for a few days, then one-half for a few days longer; then the half doses twice a day, until it is safe to stop the use of the medicine altogether. But at any time after the quantities are decreased if unfavorable symptoms are manifested, the original quantities should be given again as long as necessary. The treatment prescribed for the wounds should be continued until the wounds are healed, and for some time after, if the symptoms of tetanus are still presented.

If the disease is not recognized until after the power of swallowing is entirely lost there is little to be accomplished by treatment. It is true that nourishing food, such as gruels, milk, etc., may be given in the form of enemas, but even if life is prolonged for a short time by this means, such cases terminate fatally.

If it be true that tetanus is due to the effects of a specific germ (*Bacillus tetani*)—and there is not much doubt about it—then a great deal may be done to prevent the disease by the antiseptic treatment of all wounds. If you perform any surgical operations your hands and instruments should be thoroughly cleansed according to antiseptic methods, a description of which will be found under its proper head. It is a fact that an extremely small percentage of wounds are followed by tetanus, but still it is economical in a general sense to properly treat wounds.

LIGHTNING STROKE—ASPHYXIA ELECTRICA.

When an animal is struck by lightning the shock is instantaneously expended on the nervous system, and as a rule death occurs immediately, but when the shock is not fatal animation is suspended to a greater or less extent, as evidenced by prostration, unconsciousness, and paralysis.

Symptoms.—When not fatal, the symptoms vary much, according to the severity of the shock. The animal usually falls, as from an apoplectic attack, and, as a matter of course, the symptoms are such as are generally manifested in connection with concussion of the brain. The muscular system may be completely relaxed; the legs limber; the muscles flabby and soft to the touch, or there may be convulsions, spasms, and twitching of the muscles. The breathing is generally labored, irregular, or interrupted, and slower than normal.

In most instances the electrical fluid leaves its mark by singeing the hair, or by inflicting wounds, burns, or blisters. "Sir B. Brodie tells a curious story of two bullocks, pied white and red, which were struck in different storms. In both cases the white hairs were consumed, while the red ones escaped."

Treatment.—So long as the beating of the heart is perceptible, the endeavor to resuscitate the animal should be continued. Dash cold water over the head and body; rub the body and legs; smartly whip the body with wet towels or switches. Mustard, mixed with water, should be well rubbed over the legs and back of the head on each side of the neck. Inject into the rectum 4 drams of liquor ammonia fortis, or 1½ ounces of hartshorn diluted with a quart of warm water. Cautiously hold an uncorked bottle of hartshorn to the nostrils, so that some of it is inhaled, but care should be taken that too much is not suddenly inhaled.

In desperate cases, artificial respiration should be tried, as follows: With both hands spread out to cover a large surface, press on the abdomen (behind the ribs) and then on the chest (behind the shoulders), and continue in this manner, first on the abdomen and then on the chest in regular order, so that the chest and the abdomen are each pressed on alternately about twenty times a minute. The pressure should be slow and steady, so that the movement given by it to the walls of the chest and abdomen will resemble their motion in breathing. A hand bellows may be used as an aid to the foregoing method, as follows: Each time after the chest is pressed on the nozzle is inserted in the nostril and air slowly and gently forced in by the bellows.

When the animal revives sufficiently to be able to swallow, 4 drams of the liquor ammonia fortis, diluted with a quart of cold water, should be given as a drench, and the dose should be repeated in an hour. One and one-half ounces of ordinary hartshorn may be used instead of the stronger liquor ammonia, but, like the latter, it should be diluted with a quart or more of water, and even then care should be exercised in drenching.

In cases when the shock has not caused complete insensibility recovery may be hastened by the ammonia and water drench, or 4 ounces of brandy diluted with a quart of water, or 8 ounces of whisky diluted with a quart of water. These doses may be given every three or four hours, if necessary. After recovery from the more serious symptoms, 2 drams of sulphate of quinine should be given twice a day until health is restored. If any paralysis remains, 1½ drams of pulverized nux vomica should be given twice a day with the quinine.

The foregoing treatment is also applicable when the electrical shock is given by telephone, electric car, or electric light wires, etc. The wounds, burns, or blisters should be treated according to the antiseptic method of treating wounds.

TUMORS IN THE BRAIN, ETC.

Tumors of different kinds have been found within the cranial cavity, and in many cases there have been no well-marked symptoms exhibited during the life of the animal to lead one to suspect their existence. Cases are recorded where bony tumors have been found in the brain of cattle that died suddenly, but during life no signs of disease were manifested. Post-mortem examinations have discovered tubercular matter in the membranes of the brain (see Tuberculosis, p. 403). Abscesses, usually the result of inflammation of the brain, have been found post-mortem. For the description of hydrocephalus, or dropsy of the brain of calves, the reader is referred to the section on parturition. (See Water in the Head, p. 200.)

Chorea, constant twitching and irregular spasmodic movements of the muscles, has been noticed in connection with, or as a sequel to other affections, as, for example, parturient apoplexy.

Various diseases, the description of which will be found in other sections of this work, affect the nervous system to a greater or less extent. For example, ergotism, lead poisoning, uræmia, parturient apoplexy, colic, and other affections associated with cramps or spasms, etc. Disease of the ovaries, by reflex irritation, may cause œstromania (see Excess of Venereal Desire, p. 170), constant desire for the bull.

DISEASES OF THE URINARY ORGANS.

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Of the materials that have served their purpose in building up the animal body or in sustaining the bodily temperature, and that are now to be thrown out as waste, the greater part are expelled from the system through the lungs and the kidneys. But the agents that pass out by either of these two channels differ in the main from those passing by the other. Thus from the lungs in the form of dioxide of carbon—the same gas that comes from burning of coal or oil—there escapes most of the waste material resulting from the destruction in the system of fats, sugars, starch, and such other foods as are wanting in the element nitrogen, and do not form fibrous tissues, but go mainly to support animal heat. From the kidneys, on the other hand, are thrown out the waste products resulting from the destruction of the foods and tissues containing nitrogen—of, *e. g.*, albumen, fibrin, gluten, casein, gelatin, woody tissue, etc. While much of the waste material containing nitrogen leaves the body by the bowels, this is virtually such only of the albuminoid food as has failed to be fully digested and absorbed, and this has never formed a true constituent part of the body itself or of the blood, but is so much waste food, like that which has come to the table and been carried away again unused. Where the albuminoid food element has entered the blood, whether or not it has been built up into a constituent part of the structure of the body, its waste products, which contain nitrogen, are in the main expelled through the kidneys, so that these organs become the principal channels for the expulsion of all nitrogen-containing waste.

It would be an error, however, to infer that all nitrogenous food, when once digested and absorbed into the blood, must necessarily leave the system in the urine. On the contrary, in the young and growing animal all increase of the fibrous structures of the body is gained through the building up of those flesh-forming constituents into their substance; in the pregnant animal the growth of the offspring and its envelopes has a similar origin, and in the dairy cow the casein or curd of the milk is a means of constant elimination of these nitrogen-containing agents. Thus, in the breeding and, above all, in the milking cow the womb or udder carries on a work in one sense equivalent to that otherwise performed by the kidneys. Not only are these organs alike channels for the excretion of albuminous products, but they are also related to each other structurally and by nervous sympathy, so that suffering in the one is liable to induce some measure of disorder in the other.

This nitrogenous waste matter is mainly present in the urine of cattle, as of other mammals, in the form of urea, but also, to some extent, as hippuric acid, a derivative of vegetable food which, in the herbivora, replaces the uric acid found in the urine of man and carnivora. Uric acid is, however, found in the urine of sucking calves which have practically an animal diet, and it may also appear in the adult in case of absolute and prolonged starvation, and in diseases attended by complete loss of appetite and rapid wasting of the body. In such cases the animal lives on its own substance, and the product is that of the wasting flesh.

The other products containing nitrogen are only present in small amount, and need not be specially referred to. The urine of cattle contains much less of carbonates than does that of the horse, and effervesces less on the addition of an acid. As the carbonates form a large proportion of the solid deposits (gravel, stone) from the horse's urine, the ox may thus be held less liable; yet even in the ox the carbonates become abundant or scanty, according to the nature of the food, and therefore gravel, formed by carbonate of lime, is not infrequent in cattle. When fed on beets, clover hay, or bean straw, carbonates are present in large amount, these aliments being rich in organic acids and alkaline carbonates; whereas upon oat straw, barley straw, and, above all, wheat straw, they are in small amount. In calves fed on milk alone no carbonates are found in the urine.

Phosphates, usually in combination with lime, are, as a rule, present only in traces in the urine of cattle; yet, on a dietary of wheat, bran, or other aliment rich in phosphates, these may be present in large amount, so that they render the liquid cloudy or are deposited in solid crystals. The liquid is rendered transparent by nitric acid.

The cow's urine, on a diet of hay and potatoes, contained:

	Parts.
Urea	18.5
Potassic hippurate	16.5
Alkaline lactates	17.2
Potassium bicarbonate	16.1
Magnesium carbonate	4.7
Lime carbonate	0.6
Potass. sulphate	3.6
Common salt	1.5
Silica	Trace.
Phosphates	0.0
Water and undetermined substances	921.3
Total	1,000.0

The following table after Tereg* gives the different conditions of the urine, and especially the amount of urea and hippuric acid under different rations. The subjects were two oxen, weighing respectively (1), 1,260 pounds, and (2), 1,060 pounds:

Food per day, pounds.	Water.	Urine passed.	Density.	Solids in urine.	Hippuric acid.	Urea.	Nitrogen in hippuric acid and urea.	Total nitrogen.	Urea per day.	Hippuric acid per week.
	Lbs.	*Lbs.*		*Pr. ct.*	*Pr. ct.*	*Pr. ct.*	*Per. ct.*	*Pr. ct.*	*Ozs.*	*Ozs.*
16.90 wheat straw, and 1.30 bean meal	46.46	7.40	1036	8.41	2.66	1.33	0.83	0.94	1.63	3.23
14.70 oat straw, and 2.30 bean meal	61.10	15.26	1039	6.93	2.09	0.84	0.55	0.49	2.2	5.3
10.4 wheat straw, 10.4 clover hay, 0.6 bean meal, and 2.6 starch	71.76	12.36	1043	8.05	0.95	1.85	0.93	0.94	3.83	1.96
10.4 wheat straw, 10.4 clover hay, 2.7 bean meal, 1.4 starch, and 0.8 sugar	80.54	12.46	1044	8.29	0.87	2.41	1.19	1.11	5.8	2.1
10.4 wheat straw, 10.4 clover hay, 5 bean meal, and 0.8 sugar	78.96	17.62	1043	8.41	0.74	3.12	1.45	1.24	9.17	2.17
10 wheat straw, 10 clover hay, 6.4 bean meal, 1.7 starch, 4 sugar, and 0.4 rape oil	110.12	25.86	1038	7.00	0.31	2.49	1.19	1.25	10.9	1.33
10 wheat straw, 10 clover hay, 9.4 bean meal, 3.1 sugar, and 0.4 rape oil	101.80	27.04	1037	7.14	0.20	2.95	1.39	1.58	13.3	0.9
10 wheat straw, 10 clover hay, 11.7 bean meal, 2.8 starch, and 0.6 rape oil	119.00	23.20	1038	7.74	0.21	4.06	1.91	1.69	15.4	0.8
17.86 bean straw, and 1.6 bean meal	54.84	12.60	1043	7.06	0.40	2.53	1.21	1.15	5.3	0.83
14.88 bean straw	55.76	16.34	1036	5.45	0.11	1.41	0.67	0.64	3.83	0.3
16.90 meadow hay	36.26	15.14	1042	7.91	1.30	1.73	0.91	0.92	4.37	3.3

The varying amount of urea (from 1.6 to 15.4 ounces) is most suggestive as to the action of the more or less nitrogenous food and the resulting concentration of the urine and blood. Hippuric acid, on the other hand, is most abundant when the animal is fed on hay and straw.

The specific gravity of the urine of cattle varies from 1.030 to 1.060 in health, water being 1,000. It is transparent, with a yellowish tinge, and has a characteristic musky smell. The chemical reaction is alkaline, turning red litmus paper blue. The quantity passed in 24 hours varies greatly, increasing not only with the amount of water drunk, but with the amount of albuminoids taken within the food and the amount of urea produced. If a solution of urea is injected into the veins the secretion of urine is greatly augmented. Similarly the excess of salts like carbonate of potash in the food, or of sugar, increases the action of the kidneys. Only about 20 per cent of the water swallowed escapes in the urine, the remaining 80 per cent passing mostly from the lungs, and to a slight extent by the bowels. The skin of the ox does not perspire so readily nor so freely as that of the horse, hence the kidneys and lungs are called upon for extra work. The influence of an excess of water in the food is most remarkable in swill-fed distillery cattle, which urinate profusely at frequent intervals and yet thrive and fatten rapidly.

Among the other conditions that increase the flow of urine is over-

* Encyklop. der Thierheilk., Vol. IV, p. 208.

filling of (internal pressure in) the blood vessels of the kidneys. Hence the contraction of the blood-vessels of the skin by cold drives the blood inward, tends to dilate the blood-vessels of the kidneys, and to increase the secretion of urine. Nervous disorders, such as excitement, fear, congestions, or structural injuries to the back part of the base of the brain, have a similar result. Hence, doubtless, the action of certain fungi growing in musty hay or oats in producing profuse flow of urine, whereas other forms of musty fodder cause stupor, delirium, or paralysis.

The amount of urine passed daily by an ox on dry feeding averages 7 to 12 pints, but this may be increased enormously on a watery diet.

The mutual influence of the kidneys and other important organs tends to explain the way in which disease in one part supervenes on pre-existing disorder in another. The introduction of albuminoids in excess into the blood means the formation of an excess of urea, and a more profuse secretion of urine, of a higher specific gravity, and with a greater tendency to deposit its solid constituents, as gravel, in the kidneys or bladder. A torpid action of the liver having the albuminoids in transition forms, less soluble than the urea into which they should have been changed, favors the onset of rheumatism or nervous disorder, the deposit of such albuminoid products in the kidneys, the formation of a deep brown or reddish urine, and congestion of the kidneys. Any abnormal activity of the liver in the production of sugar—more than can be burned up in the circulation—overstimulates the kidneys and produces increased flow of a heavy urine with a sweetish taste. This increased production of sugar may be primarily due to disease of the brain, which, in its turn, determines the disorder of the liver. Disease of the right side of the heart or of the lungs, by obstructing the onward flow of blood from the veins, increases the blood pressure in the kidneys and produces disorder and excessive secretion. Inactivity of the kidneys determines an increase in the blood of waste products, which become irritating to different parts, producing skin eruptions, itching, dropsies, and nervous disorders. Sprains of the loins will produce bleeding from the kidneys and disease of the spinal cord, and determine sometimes albuminous or milky-looking urine.

The kidney of the ox (Plate IX, Fig. 1) is a compound organ made up of fifteen to twenty-five separate lobules like so many separate kidneys, but all pouring their secretion into one common pouch (pelvis) situated in an excavation in the center of the lower surface. While the ox is the only domesticated quadruped which maintains this divided condition of the kidney after birth, this condition is common to all while at an early stage of development in the womb. The cluster of lobules making up a single kidney forms an ovoid mass flattened from above downward, and extending from the last rib backward beneath the loins and to one side of the solid chain of the backbone. The right is more firmly attached to the loins and extends further backward than the left.

Deeply covered in a mass of suet, each kidney has a strong outer white, fibrous covering, and inside this two successive layers of kidney substance, of which the outer is that in which the urine is mainly separated from the blood and poured into the fine microscopic urinary ducts. (Plate X, Fig. 1.) These latter, together with blood vessels, lymph vessels, and nerves, make up the second or internal layer. The outer layer is mainly composed of minute globular clusters of microscopic intercommunicating blood-vessels (Malphigian bodies), each of which is furnished with a fibrous capsule that is nothing else than the dilated commencement of a urine tube. These practically microscopic tubes follow at first a winding course through the outer layer (Ferrein's tubes), then form a long loop (doubling on itself) in the inner layer (Henle's loop), and finally pass back through the inner layer (Bellini's tubes) to open through a conical process into the common pouch (pelvis) on the lower surface of the organ. (Plate X, Figs. 1, 2, 3).

The tube that conveys the urine from the kidney to the bladder is like a white round cord about the size of a goose-quill, prolonged from the pouch on the lower surface of the kidney backward beneath the loins, then inward, supported by a fold of thin membrane, to open into the bladder just in front of its neck. The canal passes first through the middle (muscular) coat of the bladder, and then advances perceptibly between that and the internal coat (mucus), through which it finally opens. By this arrangement in overfilling of the bladder this opening is closed like a valve by the pressure of the urine, and the return of liquid to the kidney is prevented. The bladder (Plate IX, Fig. 2) is a dilatable egg-shaped pouch, closed behind by a strong ring of muscular fibers encircling its neck, and enveloped by looped muscular fibers extending on all sides round its body and closed anterior end. Stimulated by the presence of urine, these last contract and expel the contents through the neck into the urethra. This last is the tube leading backward along the floor of the pelvic bones and downward through the penis. In the bull this canal of the urethra is remarkable for its small caliber and for the S-shaped bend which it describes in the interval between the thighs and just above the scrotum. This bend is due to the fact that the retractor muscles are attached to the penis at this point, and in withdrawing that organ within its sheath they double it upon itself. The small size of the canal and this S-shaped bend are serious obstacles to the passing of a catheter to draw off the urine, yet by extending the penis out of its sheath the bend is effaced, and a small gum-elastic catheter, not over one-quarter of an inch in diameter, may with care be passed into the bladder. In the cow the urethra is very short, opening in the median line on the floor of the vulva about four inches in front of its external orifice. Even in the cow, however, the passing of a catheter is a matter of no little difficulty, the opening of the uretha being very narrow and encircled by their projecting membranous and rigid margins, and on each side of the opening is a blind pouch (canal of Gärtner) into which the catheter will almost invariably find its way. In both male and female, therefore, the passage of a catheter is an operation which demands special skill.

General symptoms of urinary disorders.—These are not so prominent in cattle as in horses, yet when present they are of a similar kind. There is a stiff or straddling gait with the hind limbs and some difficulty in turning, or in lying down and rising—the act drawing forth a groan. The frequent passage of urine in dribblets, the continuous escape of the urine in drops, the sudden arrest of the flow when in full stream, the rhythmic contraction of the muscles under the anus without any flow resulting, the swelling of the sheath, the collection of hard gritty masses on the hair surrounding the orifice of the sheath, the occurrence of dropsies in the limbs, under the chest or belly, or in either of these cavities, and finally the appearance of nervous stupor, may indicate serious disorder of the urinary organs. The condition of the urine passed may likewise lead to suspicion. It may be white, from crystallized carbonate of lime; brown, red, or even black, from the presence of blood or blood-coloring matter; yellow, from biliary coloring matter; it may be frothy, from contained albumen; cloudy, from phosphates ; glairy, from pus ; or it may show gritty masses, from gravel. In many cases of urinary disorder in the ox, however, the symptoms are by no means prominent, and unless special examination is made of the loins, the bladder, and the urine, the true nature of the malady may be overlooked.

DIURESIS—POLYURIA—DIABETES INSIPIDUS—EXCESSIVE SECRETION OF URINE.

A secretion of urine in excess of the normal amount may be looked on as disease, even if the result does not lead to immediate loss of condition. Cattle fed on distillery swill are striking examples of such excess caused by the enormous consumption of a liquid food, which nourishes and fattens in spite of the diuresis. But the condition is unwholesome, and cattle that have passed four or five months in a swill stable have fatty livers and kidneys, and never again do well on ordinary food. Diuresis may further occur from increase of blood pressure in the kidneys (diseases of the heart or lungs which hinder the onward passage of the blood, the eating of digitalis, English broom, the contraction of the blood vessels on the surface of the body in cold weather, etc.); also from acrid or diuretic plants taken with the food (dandelion, burdock, colchicum, digitalis, savin, resinous shoots, etc.); from excess of sugar in the food (beets, turnips, ripe sorghum); also from the use of frozen food (frosted turnip-tops and other vegetables); and from the growths of certain molds in fodder (musty hay, mow-burnt hay, moldy oats, moldy bread, etc.). Finally, alkaline waters and alkaline incrustations on the soil may be active causes. In some of these cases the result is beneficial rather than injurious, as when cattle affected with gravel in the kidneys are entirely freed from this condition by a run at grass, or by an exclusive diet of roots or swill. In other cases, however, the health and condition suffer, and even inflammation of the kidneys may occur.

The *treatment* is mainly in the change of diet to a more solid aliment destitute of the special offensive ingredient. Boiled flaxseed is often the best diet or addition to the wholesome dry food, and by way of medicine, doses of 2 drams each of sulphate of iron and iodide of potassium may be given twice daily. In obstinate cases, 2 drams ergot of rye or of catechu may be added.

BLOODY URINE—RED-WATER—MOOR-ILL—WOOD-ILL—HÆMATURIA—HÆMAGLOBINURIA.

This is a common affection among cattle in certain localities, above all on damp, undrained lands, and under a backward agriculture. It is simple bloody urine or hæmaturia when the blood is found in clots, or when under the microscope the blood globules can be detected as distinctly rounded flattened discs. It is smoky urine—hæmaglobinuria—when no such distinct clots nor blood discs can be found, but merely a general browning, reddening or blackening of the urine by the presence of dissolved blood-coloring matter. The bloody urine is the more direct result of structural disease of the kidneys or urinary passages (inflammation, stone, gravel, tumors, hydatids, kidney worms, sprains of the loins), while the stained urine (hæmaglobinuria) is usually the result of some general or more distant disorder in which the globules are destroyed in the circulating blood and the coloring matter dissolved in and diffused through the whole mass of the blood and of the urine secreted from it. As in the two forms, blood, and the elements of blood, escape into the urine, albumen is always present, so that there is albuminuria with blood-coloring matter superadded. If due to stone or gravel, gritty particles are usually passed, and may be detected in the bottom of a dish in which the liquid is caught. If due to fracture or severe sprain of the loins it is likely to be associated not only with some loss of control over the hind limbs, and with staggering behind, but also with a more or less perfect paralysis of the tail. The blood-stained urine without red globules results from specific diseases, Texas fever (Plate XLIII, Fig. 3), anthrax, and from eating irritant plants (broom, savin, mercury, hellebore, ranunculus, convolvulus, colchicum, oak shoots, ash, privet, hazel, hornbeam, and other astringent, acrid, or resinous plants, etc.). The Maybug or Spanish fly taken with the food or spread over a great extent of skin as a blister has a similar action. Frosted turnips or other roots will bring on the affection in some subjects. Among conditions which act by the direct destruction of the globules in the circulating blood, may be named an excess of water in that fluid; the use of water from soils rich in decomposing vegetable matter, and containing alkaline salts, particularly nitrites, and the presence in the water and food of the ptomaines of bacteria growth—hence the prevalence of "red-water" in marshy districts and on clayey and other impervious soils; hence, too, the occurrence of bloody urine in the advanced stages of several contagious diseases. Some mineral poisons, such as iodine, arsenic, and phosphorus taken to excess, may cause hæmaturia, and finally the symptoms may be the mere result of a constitutional predisposition of the individual or family to bleeding. Exposure of the body to cold or wet will cause the affection in some predisposed subjects.

The *specific symptom* of bloody or smoky water is a very patent one. It may be associated with fever or not, with the presence or absence of abdominal tenderness on pressure, with a very frothy state of the milk or even a reddish tinge, with or without marked paleness of the mucous membranes and general weakness. When direct injury to the kidneys is the immediate cause of the disease the urine will be passed often, in small quantity at a time, and with much straining. When there is bloodlessness (a watery blood) from insufficient nourishment, fever is absent and the red water is at first the only symptom. When the active cause has been irritant plants, abdominal tenderness, colics, and other signs of bowel inflammation are marked features.

Treatment will vary according as the cause has been a direct irritant operating on a subject in vigorous health or a malarious poison acting on an animal deficient in blood and vigor. In the first form of red-water a smart purgative (1 pound to 1½ pounds Glauber salts) will clear away the irritants from the bowels and allay the coexistent high fever. It will also serve to divert to the bowels much of the irritant products already absorbed into the blood, and will thus protect the kidneys. In many such cases a liberal supply of wholesome, easily digestible food will be all the additional treatment required. In this connection demulcent food (boiled flaxseed, wheat bran) is especially good. If much blood has been lost, bitters (gentian, one-half ounce) and iron (sulphate of iron, 2 drams) should be given for a week.

For cases in which excess of diuretic plants have been taken, it may be well to replace the salts by 1 to 2 pints olive oil, adding 1 ounce laudanum and 2 drams gum camphor. Also to apply fomentations or a fresh sheepskin over the loins. Buttermilk or vinegar, one-half pint, or sulphuric acid, 60 drops in a pint of water, may also be employed at intervals as injections. In cases due to sprained or fractured loins, to inflamed kidneys, or to stone or gravel, the treatment will be as for the particular disease in question.

In hæmaturia from anæmia (watery blood), whether from insufficient or badly-adjusted rations, or from the poisonous products of fermentations in impervious or marshy soils, the treatment must be essentially tonic and stimulating. Rich, abundant, and easily digestible food must be furnished. The different grains (oats, barley, wheat, bran, rye) and seeds (rape, linseed, cotton-seed) are especially called for, and may be given either ground or boiled. As a bitter, sulphate of quinia one-half dram, and tincture of muriate of iron 2 drams, may be given in a pint of water thrice a day. In some cases one or two teaspoonfuls of oil of turpentine twice daily in milk will act favorably.

But in this anæmic variety *prevention* is the great need. The drainage and cultivation of the dangerous soils is the main object. Until this can be accomplished young and newly-purchased cattle, not yet inured to the poisons, must be kept from the dangerous fields and turned only on those which are already drained naturally or artificially. Further, they should have an abundant ration in which the local product of grass, hay, etc., is supplemented by grain or other seeds. Another point to be guarded against is the supply of water that has drained from marshes or impervious soils, rich in organic matter, as such is charged with nitrites, ptomaines, etc., which directly conduce to the disorder. Fence out from all such waters, and supply from living springs or deep wells only.

ALBUMEN IN THE URINE—ALBUMINURIA.

In bloody urine albumen is always present as an important constituent of the blood, and in congested and inflamed kidneys it is present as a part of the inflammatory exudate. Apart from these albumen in the urine represents in different cases a variety of diseased conditions of the kidneys or of distant organs. Among the additional causes of albuminuria may be named: (1) An excess of albumen in the blood (after easy calving with little loss of blood and before the secretion of milk has been established, or in cases of sudden suppression of the secretion of milk); (2) under increase of blood pressure (after deep drinking, after doses of digitalis or broom, after transfusion of blood from one animal to another, or in disease of the heart or lungs causing obstruction to the flow of blood from the veins); (3) after cutting (or disease) of the motor nerves of the vessels going to the kidneys, causing congestion of these organs; (4) violent exertion, hence long drives by road; the same happens with violent muscular spasms as from strychnia poisoning, lockjaw, epilepsy, and convulsions; (5) in most fevers and extensive inflammations important organs, like the lungs, or liver, the escape of the albumen being variously attributed to the high temperature of the body and disorder of the nerves, and to resulting congestion and disorder of the secreting cells of the kidneys; (6) in burns and some other congested states of the skin; (7) under the action of certain poisons (strong acids, phosphorus, arsenic, Spanish flies, carbolic acid, and those inducing bloody urine); (8) in certain conditions of weakness or congestion of the secreting cells of the kidneys, so that they allow this element of the blood to escape; (9) when the food is entirely wanting in common salt, albumen may appear in the urine temporarily after a full meal containing an excess of albumen. It can also be produced experimentally by puncturing the back part of the base of the brain (the floor of the fourth ventricle close to the point the injury to which causes sugary urine). In abscess, tumor, or inflammation of the bladder, ureter or urethra, the urine is albuminous.

It follows, therefore, that albumen in the urine does not indicate the existence of any one specific disease, and excepting when due to weakness or loss of function of the kidney cells, it must be looked on as an attendant on another disease, the true nature of which we must try to find out. These affections we must exclude one by one until we are left to assume the non-inflammatory disorder of the secreting cells of the kidney. It is especially important to exclude inflammation of the kidney, and to do this may require a microscopic examination of the sediment of the urine and the demonstration of the entire absence of casts of the uriniferous tubes. (See Nephritis.)

To detect albumen in the urine, the suspected and frothy liquid must be rendered sour by adding a few drops of nitric acid and then boiled in a test tube. If a solid precipitate forms then add a few more drops of nitric acid, and if the liquid does not clear it up it is albumen. A precipitate thrown down by boiling and redissolved by nitric acid is probably phosphate of lime.

Treatment will usually be directed to the disease on which it is dependent. In the absence of any other recognizable disease, mucilaginous drinks of boiled flaxseed, slippery elm, or gum may be given, tannic acid one-half dram twice daily, and fomentations or even mustard poultices over the loins. When the disease is chronic and there is no attendant fever (elevation of temperature), tonics (hydrochloric acid, 6 drops in a pint of water; phosphate of iron, 2 drams, or sulphate of quinia, 2 drams, repeated twice daily) may be used. In all cases the patient should be kept carefully from cold and wet; a warm, dry shed or in warm weather a dry, sunny yard or pasture being especially desirable.

SUGAR IN URINE—DIABETES MELLITUS.

This is a frequent condition of the urine in parturition fever, but is practically unknown in cattle as a specific disease, associated with deranged liver or brain. As a mere attendant on another disease it will demand no special notice here.

INFLAMMATION OF THE KIDNEYS—NEPHRITIS.

This has been divided according as it affects the different parts of the kidneys, as: (1) Its fibrous covering (perinephritis); (2) the secreting tissue of its outer portion (parenchymatous); (3) the connective tissue (interstitial); (4) the lining membrane of its ducts (catarrhal); and (5) its pelvis or sac receiving the urine (pyelitis). It has also been distinguished according to the changes that take place in the kidney, especially as seen after death, according to the amount of albumen present in the urine, and according as the affection is acute or chronic.

For the purposes of this work it will be convenient to consider these as one inflammatory disease, making a distinction merely between those that are acute and those that are chronic or of long standing.

The *causes* are in the main like those causing bloody urine, such as irritant and diuretic plants, Spanish flies applied as a blister or otherwise, exposure to cold and wet, the presence of stone or gravel in the kidneys, injuries to the back or loins, as by riding each other, the drinking of alkaline or selenitious water, the use of putrid, stagnant water, or of that containing bacteria and their products, the consumption of musty fodder, etc. (See Hæmaturia.)

The length of the loins in cattle predisposes these to mechanical injury, and in the lean and especially in the thin working ox the kidney is very liable to suffer. In the absence of an abundance of loose connective tissue and of fat, the kidneys lie in close contact with the muscles of the loins, and any injury to these may tend to put the kidney and its vessels on the stretch, or to cause its inflammation by direct extension of the disease from the injured muscle to the adjacent kidney. Thus, under unusually heavy draft, under slips and falls on slippery ground, under sudden unexpected drooping or twisting of the loins from missteps or from the feet sinking into holes, under the loading and jarring of the loins when animals ride each other in cases of "heat," the kidneys are subject to injury and inflammation. A hard run, as when chased by a dog, may be the occasion of such an attack. A fodder rich in nitrogenous or flesh-forming elements (brans, peas, vetches [*Vicia sativa*], and other leguminous plants), has been charged with irritating the kidneys through the excess of urea, hippuric acid, and allied products eliminated through these organs and the tendency to the formation of gravel. It seems, however, that these foods are most dangerous when partially ripened and yet not fully matured, a stage of growth at which they are apt to contain ingredients irritating to the stomach and poisonous to the brain, as seen in their inducing so-called "stomach staggers." Even in the poisoning by the seeds of ripened but only partially cured rye grass (*Lolium perenne*), and darnel (*Lolium temulentum*), the kidneys are found violently congested with black blood. Also in the indigestions that result from the eating of partially ripened corn and millet, some congestion of the kidneys is an attendant phenomenon.

Cruzel claims that the disease as occurring locally is usually not alone from the acrid and resinous plants charged with inducing hæmaturia, but also from stinking chamomile (*Anthemis cotula*) and field poppy when used in the fresh, succulent condition; also from the great prevalence of dead caterpillars on the pasture, or from dead Spanish flies in the stagnant pools of water. The fresh plants are believed to be injurious only by reason of a volatile oil which is dissipated in drying. In the case of the stagnant water it may be questioned whether the chemical products of the contained ferments (bacteria) are not more frequently the cause of the evil than the alleged Spanish flies, though these are hurtful enough when present.

Inflammation of the kidneys may further be a form or an extension of a specific contagious disease, such as erysipelas, rinderpest, septicæmia, or even of poisoning by the spores of fungi. Rivolta reports the case of a cow with spots of local congestion and blood staining in the kidney, the affected parts being loaded with bacteria. Unfortunately he neither cultivated the bacteria nor inoculated them, and thus the case stands without positive demonstration that these were the cause of disease.

The *symptoms* of nephritis are in certain cases very manifest, and in others so hidden that the existence of the affection can only be certainly recognized by a microscopic examination of the urine. In violent cases there is high fever, increase of the body temperature to 103° F. and upward, hurried breathing with catching inspiration, accelerated pulse, dry, hot muzzle, burning of the roots of the horns and ears, loss of appetite, suspended rumination, and indications of extreme sensitiveness in the loins. The patient stands with back arched and hind legs extended backward and outward, and passes water frequently, in driblets, of a high color and specific gravity, containing albumen and microscopic casts. (Plate XI, Fig. 5.) When moved the patient does so with hesitation and groaning, especially if turned in a narrow circle; and when pinched on the flank, just beneath the lateral bony processes of the loins, especially on that side on which the disease predominates, it flinches and groans. If the examination is made with the oiled hand introduced through the last gut (rectum) the pressure upward on the kidneys gives rise to great pain and efforts to escape by moving away, and by active contractions of the rectum for the expulsion of the hand. Sometimes there is a distinct swelling over the loins or quarter on one or both sides. In uncastrated males the testicle on the affected side is drawn up, or is alternately raised and dropped. In all there is a liability to tremors of the thigh on the side affected.

In some severe cases colicky pains are as violent as in the worst forms of indigestion and spasms of the bowels. The animal frequently shifts from one hind foot to the other, stamps, kicks at the belly, looks anxiously at its flank at frequent intervals, moans plaintively, lies down and quickly gets up again, grinds its teeth, twists its tail, and keeps the back habitually arched and rigid and the hind feet advanced under the belly. The bowels may be costive and the feces glistening with a coat of mucus, or they may be loose and irritable, and the paunch or even the bowels may become distended with gas (bloating) as the result of indigestion and fermentation. In some animals, male and female alike, the rigid arched condition of the back will give way to such undulating movements as are sometimes seen in the act of coition.

The disease does not always appear in its full severity, but for a day or even two there may be merely loss of appetite, impaired rumination, a disposition to remain lying down; yet when the patient is raised, it manifests suffering by anxious looking at the flanks, shifting or stamping of the hind feet, shaking of the tail, and attempts to urinate, which are either fruitless or lead to the discharge of a small quantity of high colored or perhaps bloody urine.

In some recent slight cases, and in many chronic ones, these symptoms may be absent or unobserved, and an examination of the urine will be necessary to reach a safe conclusion. The urine may contain blood, or it may be cloudy from contained albumen which coagulates on heating with nitric acid (see Albuminuria); it may be slightly glairy from pus, or gritty particles may be detected in it. In seeking for casts of the uriniferous tubes, a drop may be taken with a fine tube from the bottom of the liquid after standing and examined under a power magnifying 50 diameters. If the fine cylindroid filaments are seen they may then be examined with a power of 200 or 250 diameters. (Plate XI, Fig. 5.) The appearance of the casts gives some clue to the condition of the kidneys. If made up of large rounded or slightly columnar cells, with a single nucleus in each cell (epithelial), they imply comparatively slight and recent disease of the kidney tubes, the detachment of the epithelium being like what is seen in any inflamed mucous surface. If made up largely of the small disk-shaped and nonnucleated red blood globules, they imply escape of blood, and usually a recent injury or congestion of the kidney—it may be from sprains, blows, or the ingestion of acrid or diuretic poisons. If the casts are made of a clear, waxy, homogeneous substance (hyaline), without any admixture of opaque particles, they imply an inflammation of longer standing, in which the inflamed kidney tubules have been already stripped of their cellular (epithelial) lining. If the casts are rendered opaque by the presence of minute spherical granular cells, like white blood globules, it betokens active suppuration of the kidney tubes. In other cases the casts are rendered opaque by entangled earthy granules (carbonate of lime), or crystals of some other urinary salts. In still other cases the casts entangle clear, refrangent globules of oil or fat, which may imply fatty degeneration of the kidneys or injury to the spinal cord. The presence of free pus giving a glairy, flocculent appearance to the urine is suggestive of inflammation of the urinary pouch at the commencement of the excretory duct (pelvis of kidney) (Plate IX, Fig. 1), especially if complicated with gritty particles of earthy salts. This condition is known as pyelitis. In the chronic cases swelling of the legs or along the lower surface of chest or abdomen, or within these respective cavities, is a common symptom. So, also, stupor or coma, or even convulsions, may supervene from the poisonous action of urea and other waste or morbid products retained in the blood.

In the *treatment* of acute nephritis the first consideration is the removal of the cause. Acrid or diuretic plants in the food must be removed, and what of this kind is present in the stomach or bowels may be cleared away by a moderate dose of castor or olive oil; extensive surfaces of inflammation that have been blistered by Spanish flies must be washed clean with soapsuds; sprains of the back or loins must be treated by soothing fomentations or poultices, or by a fresh sheepskin with its fleshy side applied on the loins, and the patient must be kept in a narrow stall in which it can not turn even its head. The patient must be kept in a warm, dry building, so that the skin shall be kept active rather than the kidneys. Warm blanketing is equally important, and even mustard poultices over the loins will be useful. Blisters of Spanish flies, turpentine, or other agent which may be absorbed and irritate the kidneys must be avoided. The active fever may be checked by 15 drops tincture of aconite every four hours, or by one-third ounce acetanilid. If pain is very acute 1 ounce laudanum, or 2 drams solid extract of belladonna will serve to relieve. When the severity of the disease has passed, a course of tonics (quinia, 2 drams, or gentian powder, 2 drams daily) may be given. Diuretics, too, may be cautiously given at this advanced stage to relieve dropsy and give tone to the kidneys and general system (oil of turpentine, 2 teaspoonfuls; bicarbonate of soda, 1 teaspoonful, repeated twice a day). Pure water is essential, and it should not be given chilled; warm drinks are preferable.

In the chronic forms of kidney inflammation the same protection against cold and similar general treatment are demanded. Tonics, however, are important to improve the general health (phosphate of iron, 2 drams; powdered nux vomica, 20 grains; powdered gentian root, 4 drams, daily). In some instances the mineral acids (nitric acid, 60 drops, or nitro-muriatic acid, 60 drops, daily) may be employed with the bitters. Mustard applied to the loins in the form of a thin pulp made with water and covered for an hour with paper or other impervious envelope, or water hotter than the hand can bear, or cupping may be resorted to as a counterirritant. In cupping shave the loins, smear them with lard, then take a narrow-mouthed glass, expand the air within it by smearing its interior with a few drops of alcohol, setting it on fire and instantly pressing the mouth of the vessel to the oiled portion of the skin. As the air within the vessel cools it contracts, tending to form a partial vacuum, and the skin, charged with blood, is strongly drawn up within it. Several of these being applied at once a strong derivation from the affected kidneys is secured. In no case of inflamed or irritable kidney should Spanish flies or oil of turpentine be used upon the skin.

PARASITES OF THE KIDNEY.

As the kidney is the usual channel by which the bacteria leave the system, this organ is liable to be implicated when microphytes exist in the blood, and congestions and blood extravasations are produced. In anthrax, Southern cattle fever (Texas fever), and other such affections bloody urine is the consequence. Of the larger parasites attacking the kidney may be specially named the cystic form of the echinococcus tapeworm of the dog, the cystic form of the unarmed or beef tapeworm of man, the diving bladderworm—the cystic form of the marginate tapeworm of the dog, and the giant strongyle—the largest of the round worms. These give rise to general symptoms of kidney disease, but the true source of the trouble is only likely to be detected, if the heads or hooklets of the tapeworm or the eggs of the round worm are found on microscopic examination of the urine.

TUMORS OF THE KIDNEY—HYPERTROPHY—ATROPHY.

The kidney may be the seat of cancerous or simple tumors, and it may be unnaturally enlarged or reduced in size, but though there may be signs of urinary disorder the true nature of the disease is seldom manifest until after death. The passing of blood and of large multinucleated cells in the urine (to be detected under the microscope) may betray the existence of an ulcerated cancer of the kidney. The presence of cancerous enlargement of (superficial) lymphatic glands may further assist and confirm the decision.

RETENTION OF URINE.

Inability to pass urine may come from any one of three conditions: 1st, spasm of the neck of the bladder; 2d, paralysis of the body of the bladder; 3d, obstruction of the channel of outlet by a stone (calculus), (see Plate XI), or other obstacle.

In *spasm of the neck of the bladder* the male animal may stand with the tail slightly raised, and making rhythmical contractions of the muscle beneath the anus (*acceleratio urinæ*) (see Plate IX, Fig. 2), but without passing a drop of liquid. In the female the hind legs are extended and widely parted, and the back is arched as if to urinate, but the effort is vain. If the oiled hand is introduced into the rectum or vagina, in the early stages of the affection, the bladder may be felt beneath partially filled, but not overdistended with liquid, and its neck or mouth firm and rigid. In the more advanced stages of the affection the organ is felt as a great, tense, elastic bag, extending forward into the abdomen. In this condition the overdistended muscular coat of the bladder had lost its power of contraction, so that true paralysis has set in, the muscle closing the mouth of the sack alone retaining its normal contractile power.

In *paralysis of the body of the bladder* attention is rarely drawn to the urinary disorder until the bladder has been distended to full repletion, and is almost ready to give way by rupture and to allow the escape of the contained liquid into the abdomen. Overdistention is the most common cause of the paralysis, yet it may occur from inflammation of the muscular wall of the bladder, or even from injury to the terminal part of the spinal marrow. In this last condition, however, the tail is likely to be powerless, and the neck of the bladder may also be paralyzed so that the urine dribbles away continuously.

Causes.—Among the causes of spasm of the neck of the bladder may be named the lodgment of small stones or gravel, the feeding on irritant diuretics (see Bloody Urine, Nephritis), the enforced retention of urine while at work, or during a painful or difficult parturition. The irritation attendant on inflammation of the mucous membrane of the bladder may be a further cause of spasm of the neck, as may also be inflammation of the channel (urethra) back of the neck. Extensive applications of Spanish flies to the skin, the abuse of diuretics, and the occurrence of indigestion and spasms of the bowels are further causes. So long as spasmodic colic is unrelieved retention of water from spasm of the neck of the bladder usually persists.

Treatment will depend largely on the cause. In indigestion the irritant contents of the bowels must be got rid of by laxatives and injections of warm water; Spanish-fly blisters must be washed from the surface; a prolonged and too active exertion must be intermitted. The spasm may be relaxed by injecting one-half ounce solid extract of balladonna in water into the rectum or by a solution of tobacco. Chloroform or ether may be given by inhalation, or chloral hydrate 1 ounce may be given in water by the mouth. Fomentations of warm water may be made over the loins and between the thighs, and the oiled hand inserted into the rectum may press moderately on the anterior part of the bladder, which can be felt as an elastic fluctuating bag of an oval shape just beneath.

All other measures failing, the liquid must be drawn off through a tube (catheter). This is, however, exceedingly difficult alike in male and female, and we can not expect an amateur to succeed in accomplishing it. In the cow the opening into the bladder is found in the median line of the floor of the generative entrance, about 4 inches in front of the external opening, but it is flanked on either side by a blind pouch into which the catheter will pass in 99 cases out of 100 in the hands of any but the most skilled operator. In the bull or steer the penis, when retracted into its sheath, is bent upon itself like the letter S, just above the scrotum and testicles (see Plate IX, Fig. 2), and unless this bend is effaced by extending the organ forward out of its sheath it is quite impossible to pass a catheter beyond this point. When, however, the animal can be tempted by the presentation of a female to protrude the penis so that it can be seized and extended, or when it can be manipulated forward out of the sheath, it becomes possible to pass a catheter of small caliber (one-third inch or under) onward into the bladder. Youatt advised to lay open the sheath so as to reach and extend the penis, and others have advocated opening the urethra in the interval between the thighs or just beneath the anus, but such formidable operations are beyond the stockowner. The incision of the narrow urethra through the great thickness of muscular and erectile bleeding tissue just beneath the anus is especially an operation of extreme delicacy and difficulty. Drawing off the liquid through the tube of an aspirator is another possible resort for the professional man. The delicate needle of the aspirator is inserted in such cases through the floor of the vagina and upper wall of the bladder in the female, or through the floor of the rectum (last gut) and roof of the bladder in the male, or finally through the lower and back part of the abdominal wall, just in front of the bones of the pelvis (pubic bones), and thence through the lower and anterior part of the bladder near its blind anterior end. After relief has been obtained the administration of belladonna in 2 dram doses daily for several days will tend to prevent a recurrence of the retention.

When the body of the bladder has become benumbed or paralyzed by overdistention, we may seek to restore its tone by doses of one-half a dram of powdered nux vomica repeated daily, and by mustard plasters applied over the loins, on the back part of the belly inferiorly, or between the thighs. Small doses (2 drams) balsam of copaiva are sometimes useful in imparting tone to the partly paralyzed organ.

INCONTINENCE OF URINE—PALSY OF THE NECK OF THE BLADDER.

This may occur from disease or injury to the posterior part of the spinal cord, or from broken back, and in these cases the tail is likely to be paralyzed, and it may be also the hind limbs. In this case the urine dribbles away constantly, and the oiled hand in the vagina or rectum will feel the half-filled and flaccid bladder beneath, and may easily empty it by pressure.

Treatment is only successful when the cause of the trouble can be remedied. After these (sprains of the back, etc.) have recovered, blisters (mustard) on the loins, the lower part of the abdomen, or between the thighs, may be resorted to with success. Two drams daily of copaiva, or of solid extract of belladonna, or two grains Spanish flies may serve to restore the lost tone. These failing, the use of electric currents may still prove successful.

URINARY CALCULI—STONE—GRAVEL.

[Plate XI, Figs, 1, 2, 3.]

Stone or gravel consists in hard bodies mainly made up of the solid earthy constituents of the urine which have crystallized out of that liquid at some part of the urinary passage, and have remained as small particles (gravel), or have concreted into large masses (stone, calculus). In cattle it is no uncommon thing to find them distending the practically microscopic tubes in the red substance of the kidney, having been deposited from the urine in the solid form almost as soon as that liquid has been separated from the blood. These stones appear as white objects on the red ground formed by cutting sections of the kidney, and are essentially products of the dry feed of winter, and most common in working oxen which are called upon to exhale more water from the lungs and skins than are the slop-fed and inactive cows. Little water being introduced into the body with the food, and a considerable amount being expelled with the breath and perspiration in connection with the active life, the urine becomes small in amount, but having to carry out all waste material from the tissues and the tissue-forming food, it becomes so charged with solids that it is ready to deposit them on the slightest disturbance. If, therefore, a little of the water of such concentrated urine is reabsorbed at any point of the urinary passages, the remainder is no longer able to hold the solids in solution, and they are at once precipitated in the solid form as gravel or commencing stone. In cattle, on the other hand, which are kept at pasture in summer, or which are fed liberally on roots, potatoes, pumpkins, apples or ensilage in winter, this concentrated condition of the urine is not induced, and under such circumstances, therefore, the formation of stone is practically unknown. Nothing more need be said to show the controlling influence of dry feeding in producing gravel and of a watery ration in preventing it. Calculus in cattle is essentially a disease of winter, and of such cattle as are denied succulent food and are confined to dry fodder as their exclusive ration. While there are exceptions, they are so rare that they do not invalidate this general rule. It is true that stone in the kidney or bladder is often found in the summer or in animals feeding at the time on a more or less succulent ration, yet such masses usually date back to a former period when the animal was restricted to a dry ration.

In this connection it should be noted that a great drain of water from the system, by any other channel than the kidneys, predisposes to the production of gravel or stone. In case of profuse diarrhea, for example, or of excessive secretion of milk, there is a corresponding diminution of the water of the blood, and as the whole amount of the blood is thus decreased, and as the quantity of urine secreted is largely influenced by the fulness of the blood vessels and the pressure exerted upon their walls from within, it follows that with this decrease of the mass of the blood and the lessening of its pressure outward, there will be a corresponding decrease of urine. The waste of the tissues, however, goes on as before, and if the waste matter is passed out through the kidneys it must be in a more concentrated solution, and the more concentrated the urine the greater the danger that the solids will be deposited as small crystals or calculi.

Again, the concentrated condition of the urine which predisposes to such deposits is favored by the quantity of lime salts that may be present in the water drunk by the animal. Water that contains 20 or 30 grains of carbonate or sulphate of lime to the gallon must contribute a large addition of solids to the blood, and urine as compared with soft waters from which lime is absent. In this connection it is a remarkable fact that stone and gravel in the domesticated herbivora are notoriously prevalent on many limestone soils, as on the limestone formations of central and western New York, Pennsylania, Ohio, and Michigan; on the calcareous formations of Norfolk, Suffolk, Derbyshire, Shropshire, and Gloucestershire, in England; in Landes in France, and around Munich in Bavaria. It does not follow that the abundance of lime in the water and fodder is the main cause of the calculi, since other poisons which are operative in the same districts in causing goitre in both man and animal probably contribute to the trouble, yet the excess of earthy salts in the drinking water can hardly fail to add to the saturation of both blood and urine, and thereby to favor the precipitation of the urinary solids from their state of solution.

The known results of feeding cattle a generous or forcing ration in which phosphate of lime is present to excess adds additional force to the view just advanced. In the writer's experience, the Second Duke of Oneida, a magnificent product of his world-famed family, died as the result of a too liberal allowance of wheat bran, fed with the view of still further improving the bone and general form of the Duchess strain of Shorthorns. Lithotomy was performed and a number of stones removed from the bladder and urethra, but the patient succumbed to an inflammation of the bowels, induced by the violent purgatives given before the writer arrived, under the mistaken idea that the straining had been caused by intestinal impaction. In this case not only the Second Duke of Oneida, but the other males of the herd as well, had the tufts of hairs at the outlet of the sheath encased in hard, cylindroid sheaths of urinary salts, precipitated from the liquid as it ran over them. The tufts were in reality resolved into a series of hard, roller-like bodies, more or less constricted at intervals, as if braided.

When it is stated that the ash of the whole grain of wheat is but 3 per cent, while the ash of wheat bran is 7.3 per cent, and that in the case of the former 46.38 per cent of the ash is phosphoric acid, and in that of the latter 50 per cent, it can easily be understood how a too liberal use of wheat bran should prove dangerous if fed dry. The following table shows the relative proportion of ash and phosphoric acid in wheat bran and in some common farm seeds:

	Ash.	Phosphoric acid in ash.	Phosphoric acid in the entire food.
	Per ct.	*Per cent.*	*Per cent.*
Wheat bran	7.3	50	3.65
Wheat, grain	3	46.38	1.3914
Oats, grain	2.50	26.5	0.6625
Barley, grain	3.10	39.6	1.2276
Bean, grain	3.10	31.9	0.9864
Pea, grain	2.75	34.8	0.957
Tare, grain	3	36.2	1.086
Indian corn, grain	1.5	....	....
Rye, grain	1.6	39.9	0.6384

Wheat bran, it will be observed, contains three times as much phosphoric acid as is found in any of the other grains, and four times as much as do oats, beans, peas, or rye; so that if fed in excess it will readily overcharge the urine with phosphates.

There is another point to be considered, however, in estimating this danger. Wheat bran contains a far greater amount of albuminoids and other nitrogen-containing constituents than do the common grains (these being made up mainly of starch which contains no nitrogen), and all nitrogen-bearing products contained in the blood and tissues being expelled from the body mainly through the kidneys in the form of urea and (in cattle) hippuric acid, it follows that the excess of urea found when such food is consumed must load the urine with solids and bring it constantly nearer to the point of saturation, when such solids (or the least soluble of them) must be deposited.

The following table will show the relative amounts of the nitrogen-bearing products in wheat bran and some of our common grains:

	Albuminoids (nitrogenous).	Woody fiber (nitrogenous).	Total nitrogenous-bearing constituents.
	Per cent.	*Per cent.*	*Per cent.*
Wheat bran	16.1	8	24.1
Wheat, grain	12.5	1.8	14.3
Barley, grain	12.4	2.7	15.1
Oats, grain	11.8	9.5	21.3
Rye, grain	10.6	1.7	12.3
Indian corn	10.1	1.7	11.8

It will be observed that, with the exception of oats, none of the grains contain more than two-thirds of the nitrogenous material present in the wheat bran, while in the case of rye and maize there is practically but one-half. Even in the case of oats the albuminoids, which are the more digestible principles, and, therefore, those that are the most easily and speedily converted into urea, are present only to the amount of two-thirds of that which exists in the wheat bran. With such an excess of ash, of phosphates, and of nitrogenous (urea-forming) constituents in wheat bran, its tendency to favor the formation of calculi is fully explained. It must not, however, be inferred that wheat bran is not a valuable food stuff. The inference is only that it should be fed with an abundance of water, as a sloppy mash or in combination with an abundance of roots, potatoes, pumpkins, or other succulent aliment.

In this connection the presence of magnesia in the food or water must be named as favoring calculous formations in the urinary passages. The explanation is that while the phosphate of magnesia thrown out in the urine is soluble in water, the compound phosphate of ammonia and magnesia is insoluble, and, accordingly, if at any time ammonia is introduced into urine containing the phosphate of magnesia, there is instantly formed the ammonio-magnesium phosphate, which is as promptly deposited in the solid form. The common source of ammonia in such cases is from decomposition of the urea in fermenting urine. But in order to produce this a ferment is necessary, and therefore, as an additional prerequisite, the presence of bacteria or fungi in the urine is essential. These ferments may make their way from without along the urinary passage (urethra), and their propagation in the bladder is greatly favored by the prolonged retention of urine, as in case of spasm of the neck of the bladder or obstruction by an already existing stone. Another mode of entrance of the ferment is an uncleanly catheter used to draw off the urine.

Another insoluble salt which enters largely into the composition of many urinary calculi of the ox is carbonate of lime. This is derived mainly from the lime in the food and water and from the carbon dioxide formed by the oxidation of the organic acids in the fodder. These organic acids, being composed of carbon, hydrogen, and oxygen (without nitrogen), are resolved, by the addition of oxygen, into carbon dioxide (CO_2) and water (H_2O). The carbon dioxide unites with the lime in the blood to form carbonate of lime, and in this state passes into the urine. Now, carbonate of lime is soluble in water containing free or uncombined carbon dioxide, but is precipitated whenever the latter is withdrawn. It is only necessary, therefore, to have in the urine sufficient lime or other available base to unite with all the free carbon dioxide in order to bring about the precipitation of the dissolved carbonate of lime in the solid crystallized form. Hence it is that of all sediments in the urine of herbivora this is the most frequent and usually the most abundant.

A less common constituent of urinary calculi is the insoluble oxalate of lime. In this case the lime is derived as before from the food or water, or both, while the oxalic acid is a product of the oxidation of organic acids of the food, less oxygen having been used than in the formation of carbon dioxide. The final product of the complete oxidation of these acids is carbon dioxide, but when less oxygen is furnished owing to some disease of the lungs or a disease of the nerve centers, which lessens the activity of the breathing, then oxalic acid may be produced. Then if this oxalic acid comes in contact with lime it is instantly precipitated as crystals of oxalate of lime.

Another inorganic substance at times found in urinary calculi is silica (SiO_2). This contributes largely to giving stiffness to the stems of growing plants, and in most of our cereals and grasses makes up a large proportion of the ashes of the burnt plant. It is found in the soluble form in combination as silicate of potash, but at times is displaced by oxalic or other acid and then appears as gritty, sandy particles in the stem. This gritty, insoluble silica is especially noticeable among the horsetails (*Equisetaceæ*), bamboos, and sedges. The percentage of silica in the ash of several common fodder plants is given below:

Ash of—	Silica.
	Per cent.
Wheat straw	67.6
Oats and husk	38.6
Oat straw	35.4
Barley straw	73.1
Rye straw	64.4
Rye-grass hay	64.57
Wheat chaff	81.2
Oat chaff	59.9
Barley awn	70.7

It is only soluble silica that is taken up into the system, and it is in this form (usually as silicate of potash or soda) that it enters the urine, but all that is wanted to precipitate it in crystalline form as a gritty sand is the presence of oxalic or other acid having a stronger affinity for its base (potash or soda).

Other conditions, however, enter largely into the causation of stone or gravel. A high density of urine resulting from a highly saturated condition is often present for a length of time without any precipitation of solid materials. Urea and carbonates may be present in excess, the food may be given dry, and drinking water may be deficient in amount without any deposition of stone or gravel. The presence of noncrystalline organic matter in the urine becomes in such cases an exciting cause. Rainey and Ord have shown experimentally that colloid (noncrystallizable) bodies like mucus, epithelial cells, albumen, pus, blood, hyaline casts of the kidney tubes, etc., not only determine the precipitation of crystallizable salts from a strong solution, but they determine the precipitation in the form of globular masses or minute spheres, which, by further similar accessions, become stones or calculi of various sizes. The salts that are deposited by mere chemical reaction without the intervention of colloids appear in the form of sharply defined angular crystals, and hence the rough, jagged crystals of oxalate of lime or ammonio-magnesium phosphate. Heat intensifies the action of the colloids in causing precipitation of the dissolved salts, so that the temperature of the kidneys and bladder constitute favorable conditions. Colloids that are undergoing decomposition are also specially powerful, so that the presence of bacteria or fungi causing fermentation are important factors.

In looking, therefore, for the immediate causes of urinary calculi, we must accord a high place to all those conditions which determine the presence of excess of mucus, albumen, pus, blood, kidney casts, blood coloring matter, etc., in the urine. A catarrhal inflammation of the pelvis of the kidney, the ureter of the bladder, generating excess of mucus or pus; inflammation of the kidneys causing the discharge into the urinary passages of blood, albumen or hyaline casts; inflammation of the liver, lungs, or other distant organ resulting in the escape of albumen in the urine; disorders of the liver or of the blood-forming functions resulting in hæmaturia or hæmoglobinuria; sprains or other injuries to the back, or disease of the spinal marrow which cause the escape of blood with the urine; the presence in the bladder of a bacterian ferment which determines the decomposition of the mucus and urea, the evolution of ammonia and the consequent destruction of the protecting cellular (epithelial) lining of the bladder; or the irritation caused by the presence of an already formed calculus may produce the colloid or uncrystallizable body that proves so effective in the precipitation of stone or gravel. It has long been known that calculi will almost infallibly form around any foreign body introduced into the kidney or bladder, and I have seen a large calculous mass surrounding a splinter of an arrow that had penetrated and broken off in the body of a deer. The explanation is now satisfactory—the foreign body carries in with it bacteria which act as ferments upon the urine and mucus in addition to the mechanical injury caused by its presence. If such a body has been introduced through the solid tissues there is in addition the presence of the blood and lymph derived from the wounded structures.

CLASSIFICATION OF URINARY CALCULI.

Urinary calculi are most conveniently divided according to the locality in which they are found. Thus we find first *renal calculi*, formed in the kidney (Plate XI, Fig. 1), and which for cattle must be again divided into *calculi of the uriniferous tubes*, and *calculi of the pelvis*. The second class are named *uretral calculi*, because they are found in the duct leading from the kidney to the bladder (ureter). The third class are the *vesical calculi*, from the bladder or vesicle in which they are found. The fourth class are the *urethral calculi*, and are found in the duct leading outward from the bladder through the penis (urethra). The fifth and last class are the *preputial calculi*, since they are found within the sheath of the penis (prepuce).

Calculi may also be classed according to their chemical composition, and this has the advantage of suggesting the special cause of each as found in the food, water, soil, or general condition of health. This classification affords no guide to their location nor symptoms, as calculi of the same chemical composition may be found at any part of the urinary passages, as those formed in the kidney may pass on through all the various passages outward, unless it is found at any point of their progress that they have grown so large that the passage will not admit them. The following are among the concretions found in the various parts:

(1) *Coralline calculi.*—These are of a dull white color and irregular surface, like coral. They are made up of hard and resistant layers evenly deposited around a central nucleus. (Plate XI, Fig. 3.) Their

specific gravity is 1760, water being 1000, and they contain 74 per cent of carbonate of lime with some carbonate of magnesia, organic matter, and a trace of carbonate of iron. Yellowish-white, smooth, round calculi of the same chemical composition are met with.

(2) *Pearly calculi.*—These are more frequent than the first named variety. They are very hard and smooth on the surface, reflecting a play of various colors after the fashion of a pearl. This peculiarity appears to be caused by the thinness and semi-transparency of the superposed layers. They have a specific gravity of 2109 to 2351, and nearly the same chemical composition as the coralline variety. Golding Bird found a specimen of this kind formed of carbonate of lime and organic matter only.

(3) *Green calculi.—Metalloid calculi.*—These are usually small and numerous, as they are exceedingly common. They are of a very hard consistency, and have a clear, polished, greenish surface of almost metallic brilliancy. They have a specific gravity of 2301, and a composition almost identical with the second variety.

(4) *White calculi.*—Pure, white, smooth, lustrous calculi are rare. They have a specific gravity of 2307, and contain as much as 92 per cent of carbonate of lime with carbonate of magnesia and organic matter.

(5) *Ammonio-magnesium calculi.*—These are of a grayish color and a very rough crystalline surface, which proves very irritating to the mucous membrane. They have a specific gravity of 1109 to 1637, and are composed chiefly of ammonio-magnesium phosphate, oxalate of lime, and organic matter, with some little carbonate of lime and magnesia.

(6) *Siliceous calculi.*—These are clear, smooth, and hard, and usually spherical. They have a specific gravity of 1265 to 1376, and contain 57 per cent of silica with carbonates of iron and magnesia, organic matter, and traces of iron. In other specimens of siliceous calculi there was a specific gravity of 3122, and there was 79 to 85 per cent of carbonate of lime together with carbonate of magnesia, and iron, silica, and organic matter. Others are almost exclusively made of silica.

(7) *Oxalate of lime calculi.—Mulberry calculi* (Plate XI, Fig. 2).—These are characterized by their extremely rough, angular surface, formed by the octahedral crystals of oxalate of lime. Their specific gravity may be 3441, and they contain oxalate of lime to the extent of 81 per cent, together with carbonates of lime and magnesia and organic matter.

(8) *Gravel.—Pultaceous deposits.*—Simple crystals may be met with at any point from the kidneys to the external opening at the end of the prepuce (sheath), and they may appear singly, as crystals, or they may accumulate in masses of fine spherical crystals almost like dirty powdered chalk suspended in water. In the ox this is especially common as a collection in the sheath, distending that into a soft doughy swelling.

FORMS OF CALCULI IN DIFFERENT SITUATIONS.

Apart from the rough crystalline surfaces of the calculi of oxalate of lime and ammonio-magnesium phosphate, the general tendency is to a smooth, round outline. At times, however, they show more or less flattening with rounded angular edges, caused by the contact and mutual friction of two calculi. Sometimes two or more stones lying together become united into one by a new external deposit, and the resulting mass then shows rounded swellings on opposite sides. The large calculi occupying the pelvis of the kidneys usually shows a central part having the outline of the main cavity of the pelvis and two or more projections that have been molded into corresponding branches or channels which lead to corresponding lobes of the kidney. In winter and spring small concretions in the form of plates are often met with in the branches of the pelvis, having been formed and molded in the confined space between the projecting papilla and the surrounding cup-like branch of the pelvis. Finally, the pulp-like deposits in the sheath and elsewhere are made up of globular masses, individually so small as to be often practically microscopic.

STONE IN THE KIDNEY—RENAL CALCULI.

[Plate XI, Fig. 1.]

In an animal leading the quiet, uneventful life of the ox, stones of large size may be present in the kidney without producing any disorder appreciable to the people about him. In cattle fattened on dry food in winter, on our magnesian limestone of New York, it is exceptional to find the substance of the kidney free from calculi about the size of a grain of wheat or less, and standing out as white objects in the general red of the cut surface of the organ. Similarly around the papillæ in the cup-like arms of the pelvis we find minute flattened or more or less rounded yellowish-white concretions. Even the large concretions may prove apparently harmless. I have a calculus several ounces in weight filling the entire pelvis of the kidney, which was found by accident in a fat carcass while being dressed. In work oxen, however, such concretions may give rise to symptoms of kidney disease, such as stiffness of the loins, shown especially in the acts of rising or turning, weakness of the hind parts when set to pull a heavy load, an irritability of the kidneys, shown by the frequent passage of urine in small quantity, tenderness of the loins, shown when they are pinched or lightly struck, and it may be the passage of blood or minute gritty masses with the urine. If the attack is severe, what is called renal colic (kidney colic) may be shown by frequent uneasy shifting of the hind limbs, shaking or twisting of the tail, looking round at the flanks, and lying down and rising again at short intervals without apparent cause. The frequent passage of urine, the blood or gritty masses contained in it, and perhaps the hard stony cylinders around the tufts of hair of the sheath, show that the source of the suffering is the urinary organs. In bad cases active inflammation of the kidneys may set in. (See Nephritis.)

URETERAL CALCULI.

These are small stones which have passed from the pelvis of the kidney into the canal (ureter) leading from the kidney to the bladder, but being too large to pass on easily have blocked that canal and forced the urine back upon the kidney. The result is the production of symptoms more violent than in renal calculi, though not varying, save in intensity, from those of renal colic. In case of complete and unrelieved obstruction, the secretion of the kidney on that side is entirely abolished, and it becomes the seat of passive congestion, and it may even be absorbed in greater part or as a whole, leaving only a fibrous sac containing fluid with a urinous odor. In small cattle, in which the oiled hand introduced into the last gut may reach the affected part, the distended ureter may be felt as a tense, elastic cord, extending forward from the point of obstruction on the lateral wall of the pelvis and beneath the loins toward the kidney. If relief is obtained by the onward passage of the stone a free flow of urine usually follows, in the midst of which may often be found gritty masses. If the outlets from both kidneys are similarly blocked, the animal becomes poisoned by the retention in the blood of the elements of the urine, and by their reabsorption after secretion.

Treatment of renal and ureteral calculi.—Treatment is not very successful, as only the smallest calculi can pass through the ureter and enter the bladder, and even if they should do so they are liable to a progressive increase there, so that later they may cause the symptoms ot stone in the bladder. Fortunately, ordinary dairy, growing, or fattening cattle rarely show evident symptoms of illness, and though they should do so they can usually be fattened and slaughtered before the health is seriously impaired. In work oxen the case is different, and acute symptoms may develop, but even then the animal may often be fitted for the butcher. When treatment is demanded it is primarily soothing and antispasmodic. Fomentations with warm water over the loins should be persisted in without intermission until relief has been secured. The soothing effect on the kidney will often relieve inflammation and irritation, should the stone be in that situation, while if in the ureter the warm fomentations will at once soothe irritation, relax spasm of the muscular coat of the canal, and favor an abundant secretion from the kidney, which, pressing on the obstructing stone, may slowly push it on into the bladder. Large doses of laudanum (2 ounces) or of solid extract of belladonna (2 drams) will not only soothe the pain but relax the spasm and favor the onward passage of the calculus. The animal should be encouraged to drink large quantities of cool water to favor the free secretion of a very watery urine, which will not only serve to obviate irritation and continued deposit caused by a highly concentrated urine, but will press the stone onward toward the bladder, and even in certain cases will tend to disintegrate it by solution of some of its elements, and thus to favor its crumbling and expulsion. This is a principle which must never be lost sight of in the treatment of calculi: The immersion of the stone in a liquid of a lower specific gravity than that in which it has formed and grown tends to dissolve out the more soluble of its component parts, and thus to destroy its density and cohesion at all points, and thereby to favor its complete disintegration and expulsion. This explains why cattle taken from a herd on our magnesian limestone in spring, after the long dry feeding of winter, usually furnish renal calculi, while cattle from the same herd in the fall, after a summer's run on a succulent pasture, are almost aways free from concretions. The abundance of liquid taken in the green food and expelled through the kidneys and the low density or watery nature of the urine have so opened the texture and destroyed the density of the smaller stones and gravel that they have all been disintegrated and removed. This, too, is the main reason why benefit is derived from a prolonged stay at mineral springs by the human victims of gravel. If they had swallowed the same number of quarts of pure water at home, and distributed it at suitable intervals over each day, they would have benefited largely without a visit to the springs.

It follows from what has been just said that a succulent diet, including a large amount of water (gruels, sloppy mashes, turnips, beets, potatoes, apples, pumpkins, ensilage, succulent grasses), is an important factor in the relief of the milder forms of stone and gravel.

Prevention of calculus especially demands this supply of water and watery rations on all soils and in all conditions in which there is a predisposition to this disease. It must also be sought by attempts to obviate all those conditions mentioned above as causative of the malady. Sometimes good rainwater can be furnished in limestone districts, but putrid or bad smelling rainwater is to be avoided as probably more injurious than that from the limestone. Unsuccessful attempts have been made to dissolve calculi by alkaline salts and mineral acids respectively, but their failure as a remedy does not necessarily condemn them as preventives. One dram of caustic potash or of hydrochloric acid may be given daily in the drinking water. In diametrically opposite ways these attack and decompose the less soluble salts and form new ones which are more soluble and therefore little disposed to precipitate in the solid form. Both are beneficial as increasing the secretion of urine. In cases where the diet has been too highly charged with phosphates (wheat bran, etc.), these aliments must be restricted and water allowed *ad libitum.* Where the crystals passed with the urine are the sharp angular (octahedral) ones of oxalate of lime, then the breathing should be made more active by exercise, and any disease of the lungs subjected to appropriate treatment. If, the crystals are triangular prisms of ammonia-magnesium phosphate or star-like forms with feathery rays, the indications are to withhold the food or water that abounds in magnesia and check the fermentation in the urine by attempts to destroy its bacteria. In the latter direction plenty of pure water, diuretics, and a daily dose of oil of turpentine in milk, or a dose thrice a day of a solution containing one-tenth grain each of biniodide of mercury and iodide of potassium would be indicated.

In considering the subject of prevention it must never be forgotten that any disease of a distant organ which determines the passage from the blood into the urine of albumen or any other colloid (uncrystallizable) body is strongly provocative of calculus, and should, if possible, be corrected. Apart from cases due to geological formation, faulty feeding, and other causes, the grand preventive of calculus is a long summer's pasturage of succulent grasses, or in winter a diet of ensilage or other succulent food.

The calculi formed in part of silica demand special notice. This agent is secreted in the urine in the form of silicate of potash and is thrown down as insoluble silica when a stronger acid displaces it by combining with the potash to its exclusion. In cases of siliceous calculi, accordingly, the appropriate chemical prevention is caustic potash, which being present in the free state would attract to itself any free acid and leave the silica in its soluble condition as silicate of potash.

STONE IN THE BLADDER—VESICAL CALCULUS—URETHRAL CALCULUS.

Stone in the bladder may be of any size, but in the ox does not usually exceed half an inch in diameter. There may, however, be a number of small calculi; indeed, they are sometimes so small and numerous as to form a small pulpy magma by which the bladder is considerably distended.

The *symptoms* of stone in the bladder may be absent until one of the masses escapes into the urethra, but when this occurs the escape of urine is prevented, or it is allowed to pass in drops or dribblets only, and the effect of such obstruction becomes manifest. The point of obstruction is not always the same, but it is most frequently at the S-shaped curve of the penis, just above the testicles or scrotum. In cows and heifers the urethra is so short and becomes so widely dilated during the urination that the calculi easily escape in the flow of liquid and dangerous symptoms practically never appear.

Even in the male the signs of illness are at first very slight. A close observer may notice the cylinders of hard earthy materials encircling the tufts of hair at the opening of the prepuce. It may further be observed that the stall remains dry and that the animal has not been seen to pass water when out of doors. The tail may at times be gently raised and contractions of the muscle (*accelerator urinæ*) beneath the anus (Plate IX, Fig. 2) may take place in a rythmical or pulsating manner. But as a rule no symptom is noticed for a couple of days, only the animal is lacking in his usual spirits. By this time the constantly accumulating urine has distended the bladder beyond its power of resistance and a rupture occurs, allowing the urine to escape into the cavity of the abdomen. Then dullness increases; the animal lies down most of his time; he becomes stupid and sometimes drowsy, with reddish brown congestion of the lining membrane of the eyelids; pressure on the abdomen causes pain, flinching, and perhaps groaning, and the lowest part of the belly fluctuates more and more as the escaping urine accumulates in greater and greater amount. If at this stage the oiled hand is introduced into the rectum (last gut) the animal flinches when pressure is made downward on the floor of the pelvis, and no round distended bladder is felt. If the same examination is made prior to the rupture the rounded, tense, elastic bladder is felt extending forward into the abdomen containing one or two gallons of liquid. There may be uneasy shifting of the hind limbs and twisting of the tail, also frequent lying down and rising, but these symptoms are exceptional.

When the obstruction is low down between the thighs (at the S-shaped flexure), the line of the pulsating urethra from the anus downward may be felt distended with liquid, and though it is seldom easy to distinguish the exact seat of the stone by the hard swelling of the urethra, yet there is usually tenderness at the point of obstruction, and from this it may be accurately located.

The *treatment* of stone in the bladder or urethra consists in the removal of the stone by incision and the use of forceps. (Plate XI, Fig. 4.) When the stone has been arrested at the S-shaped flexure just above the scrotum, the patient being lean, the thickened tender part of the penis may be seized between the fingers and thumb of the left hand, while the calculus is exposed by a free incision with the knife held in the right. If there is no other obstruction between this point and the bladder, and if the latter has not yet ruptured, a flow of urine should take place from the opening. If there is no escape of liquid a catheter or sound, one-fourth of an inch in diameter, must be passed up through the canal (urethra) until it is arrested by the next stone, on which a similar incision should then be made to effect its extraction. In case the stone has been arrested in the portion of the urethra which is in front of the arch of the hip bone and inside the pelvis, it can only be reached by making an opening into the urethra beneath the anus and over the arch of the hip bone, and from this orifice exploring the urethra with fine forceps to the neck of the bladder or until the stone has been reached and extracted. The operation requires a very accurate knowledge of the parts, owing to the small size of the canal (urethra) to be opened and the great thickness of erectile tissue to be cut through, while the free flow of blood is blinding to the operator. A staff should always be passed up through the urethra from the lower wound if such has been made, or, in case of its absence, through the whole length of the penis, that organ having been drawn out of its sheath until the S-shaped curve has been effaced and the course of the canal rendered straight. Upon the end of this staff the incision can be made with far more confidence and certainty. The operation can only be undertaken by a skilled veterinary anatomist, but the hints given above may be valuable in showing the stock owner when he is being properly served in such a case.

In outlying districts, where no skilled operator can be had, a transverse incision may be made with a clean sharp knife through the root of the penis, just over the arch of the hip bone, when the urine will flow out in a full stream. The attendant bleeding may be ignored, or if profuse it may be checked by packing the wound firmly with cotton wool for some hours. The urine will continue to escape by the wound, and the ox should be fattened for the butcher.

The immediate relief is not to be looked upon as a permanent cure, as the calculi in the affected ox are usually numerous, and later attacks are, therefore, to be looked for. Hence it is desirable to fatten and kill such cases after a successful operation. If a breeding animal is too valuable to be killed he should be subjected to preventive measures, as laid down under Stone in the Kidney.

It should be added that when the bladder is filled with a soft magma a catheter may be introduced through the whole length of the urethra, to be employed in pumping water into the bladder. This water is extracted through the same channel when it has been charged with the suspended solids by manipulations of the bladder with the oilep hand introduced through the rectum.

Calculi or gravel in the prepuce or sheath.—This is usually a collection of gravel, or a soft putty-like material which causes a distinct swelling of the sheath and gives it a soft, doughy feeling when handled. It may be removed in part by the oiled fingers introduced into the cavity, assisted by manipulation from without, or a tube may be inserted behind the collection and water pumped in until the whole mass has been evacuated. Should even this fail of success the sheath may be slit open from its orifice back in the median line below until the offending matter can be reached and removed. In all such cases the interior of the sheath should be finally lubricated with sweet oil or vaseline. It is unnecessary to stitch up the wound made in the sheath. (See Inflammation of the Sheath.)

DISEASES OF THE URINARY ORGANS.

DESCRIPTION OF PLATES.

PLATE IX:

Fig. 1. Kidney of the ox. Taken from *Handbuch des Vergleichenden Anatomie des Haus Säugethiere,* Vol. 7, 1890: A, renal artery carrying blood into the kidney; V, renal vein carrying blood from the kidney back to the heart; H, ureter, the tube carrying the urine from kidney to bladder. It is formed by the union of a number of branches which begin as cups (calices), each inclosing the tip of a conical mass of tissue from which the urine exudes. 1, Showing such papilla through the cups or calyx surrounding it; 2, papillæ with the cups inclosing them cut in half to show their relation to each other.

Fig. 2. The male genital organs of the ox. Taken from Leisering, Mueller & Ellenberger, *Handbuch des Verg. Anat. des Haus Säugethiere:* 1, scrotum, or the pouch containing the testicles; 2, tunica vaginalis, the serous membrane enveloping the testicles; 3′, right testicle, outer view; 3′, left testicle, inner view; 4, epididymis, or the beginning of the excretory canal of the testicle; 4′, globus major, or the head of the epididymis; 4″, globus minor, or the tail of the epididymis; 5, vas deferens, the duct through which the seminal fluid reaches the ejaculatory ducts; 5′, pelvic dilatation of the vas deferens; 6, vesicula seminalis. The vesiculæ seminales are two oval pouches, which, in addition to their own secretions, receive the semen conveyed by the seminal ducts and hold it in reserve until copulation; 7, membranous or intrapelvic portion of the urethral canal covered by Wilson's muscle; 8, part of the prostate gland covered by Wilson's muscle; 9, Cowper's gland. This gland, like the prostate gland, secretes a fluid which is thrown into the urethral canal in abundance immediately before ejaculation; the expulsion of the semen is by this means facilitated; 10, ejaculator seminis, or accelerator urinæ muscle; 11, penis; 11′, cut portion of same; 12, cut suspensory ligaments of penis; 13, sheath, or prepuce laid open; 14, retractor muscles of sheath; 15, cremaster muscle cut at superior extremity; 16, duplicature of peritoneum; 17, ureters carrying urine from the kidneys to the bladder.

PLATE X:

Fig. 1. In this figure the minute apparatus for the secretion, collection, and discharge of the urine into the pelvis of the kidney (see preceding plate) is shown. The course is as follows: The urine is secreted from the blood-vessels in the little round bodies called glomeruli (12), and by the minute cells in the curved tubes (11, 9, 10, 8), and passes through the convoluted and straight tubes (7, 6) into the larger tube (1), and then out into the pelvis, thence through the ureters into the bladder. The fluid and salts dissolved in the urine are taken from the blood, and the minute blood vessels are therefore very abundant in the kidneys, as is shown by the branches and network on the left of the figure. The blood passes into the kidney in the artery (13), then divides into branches which pass into the glomeruli (12) and also

PLATE X—Continued.

form networks around the secreting tubules (11, 9). The urine and salts pass from these vessels through the cells lining the tubules into the latter, and are discharged as described above. The blood is again collected in veins drawn black in the figure.

Fig. 2. Illustrates the manner in which the blood is distributed in the glomerulus *f*, and also to the secreting tubules (*e*).

Fig. 3. Shows the relation between the blood vessel in the glomerulus (e) and the tubule which conducts the urine therein secreted from the blood vessel; (c) represents a glomerulus from which the urinary tubule has been removed.

PLATE XI:

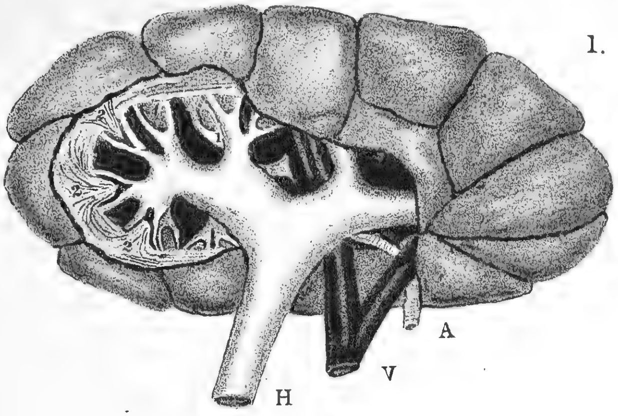
Fig. 1. Calculus or stone from the kidney. These are located in the pelvis or portion of the ureter receiving the urine. The prolongations are casts of the branches of the pelvis. See the plates of the kidney for further description.

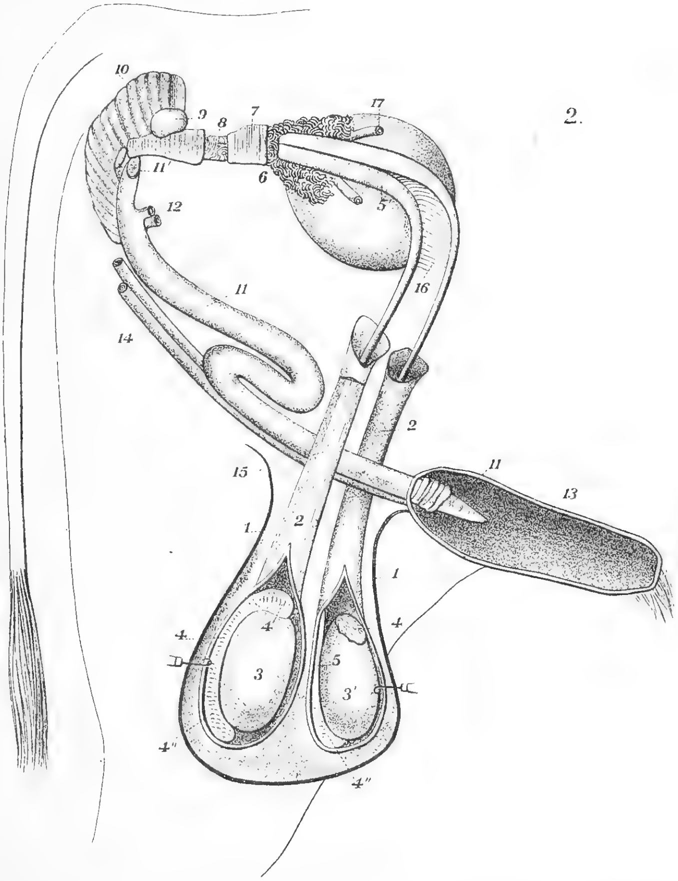
Fig. 2. Calculus made up of oxalate of lime magnified 215 times.

Fig. 3. Phosphatic calculus containing a nucleus of uric acid, sawn through to show concentric layers.

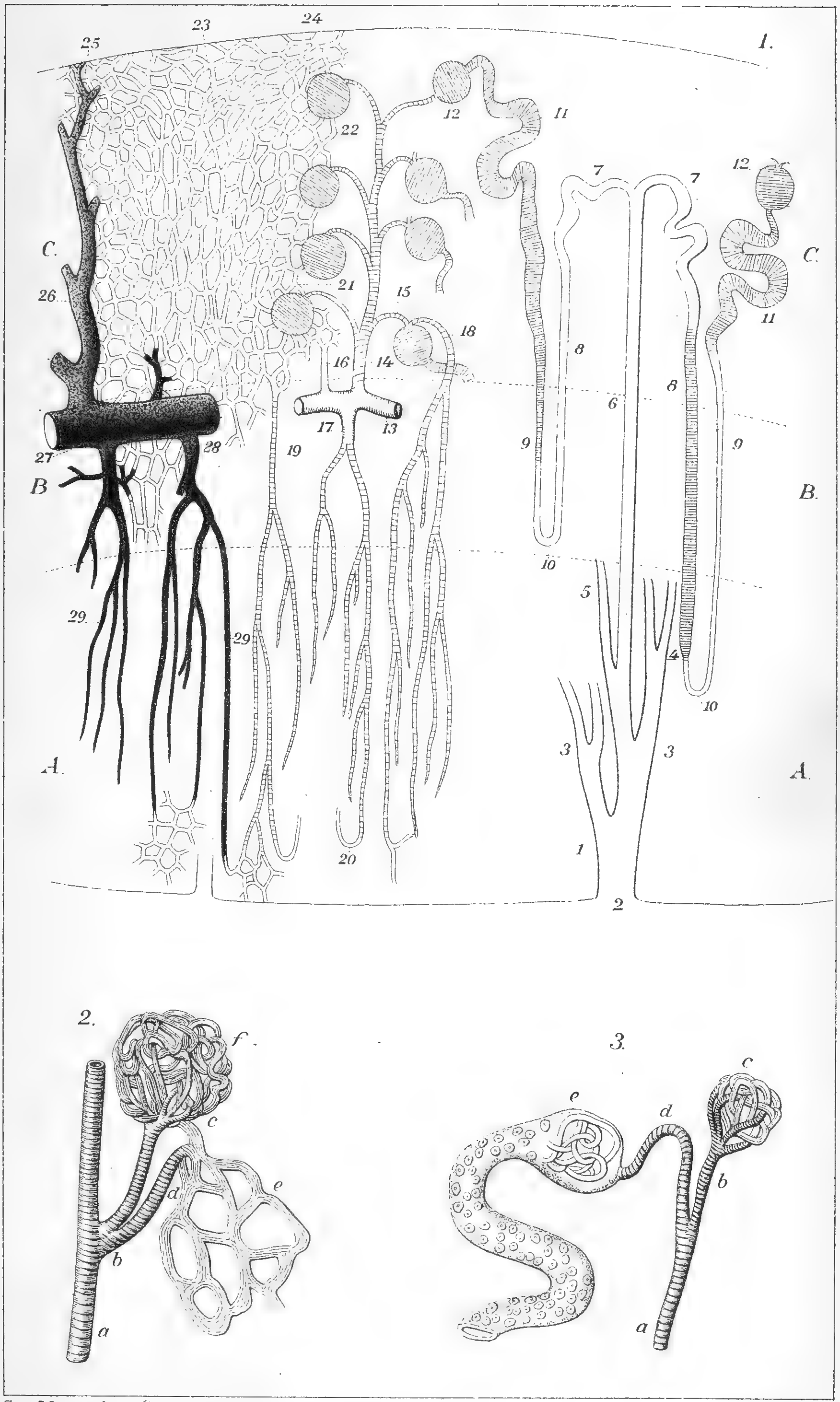
Fig. 4. Straight forceps used in removing stones from the bladder.

Fig. 5. Casts of the minute tubules of the kidney found in the urine in various kinds of kidney disease. Highly magnified.





KIDNEY AND GENERATIVE ORGANS.



Geo. Marx, after D'Arboval.

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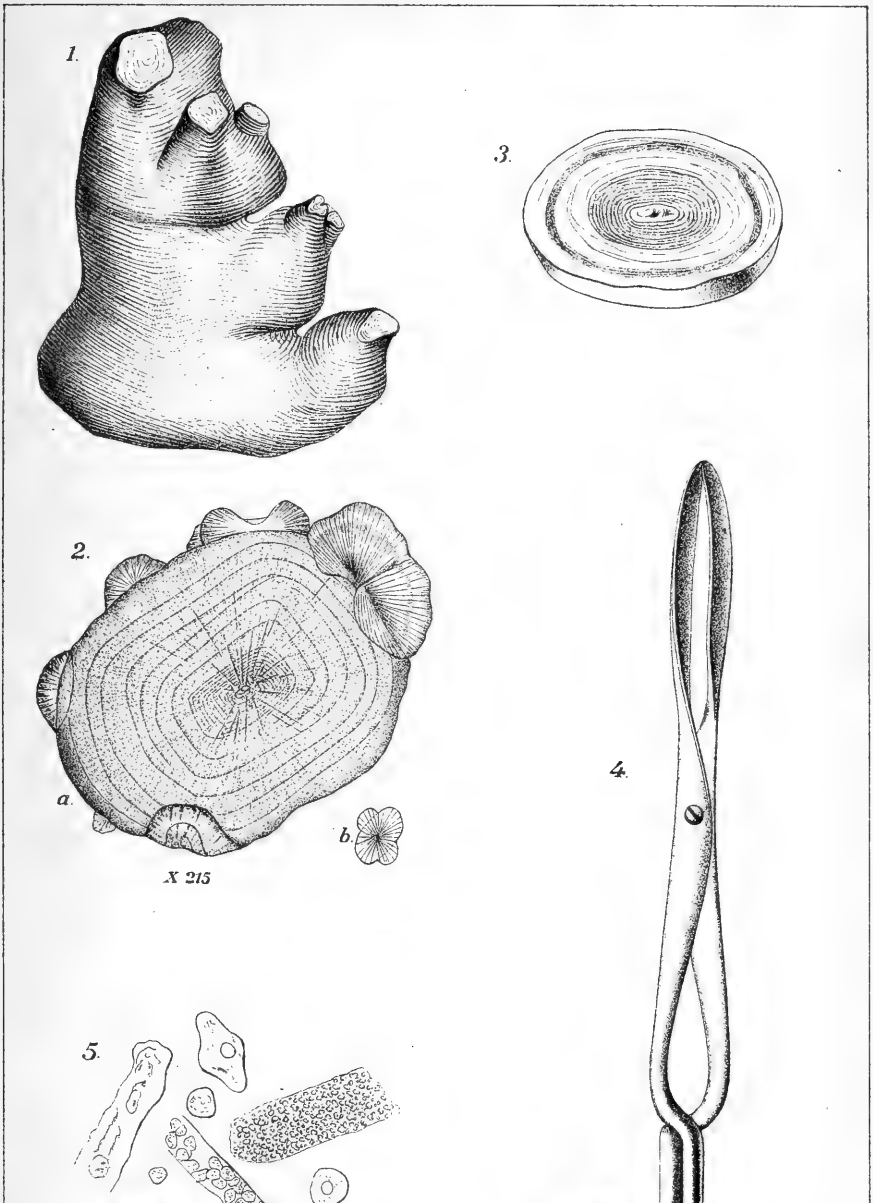
MICROSCOPIC ANATOMY OF THE KIDNEY.



Haines del. after Hurtrel D'Arboval.

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CALCULI OF KIDNEY AND BLADDER.

DISEASES OF THE GENERATIVE ORGANS.

By JAMES LAW, F. R. C. V. S.,
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Diseases of the generative organs are practically confined to animals which are kept for reproduction and the dairy. The castration of the bull condemns these organs to inactivity and protects them from the many causes of injury attendant on the engorged blood-vessels in the frequent periods of sexual excitement, on the exposure to mechanical violence, and on the exposure to infective inoculation. In three respects the castrated male is especially subject to disease: (1) To inflammation and tumefaction of the cut end of the cord that supported the testicle and of the loose connective tissue of the scrotum; (2) to inflammation of the sheath and penis from the accumulation of gravel in the former, from which the penis is not usually protruded in passing water; and (3) to bruising, abrasion, and inflammation of the sheath and penis during suspension in the stocks for the purpose of shoeing. Apart from these the ox is practically almost exempt from the inflammations and injuries of the genital organs. The same applies to the castrated heifer. Inflammation may occur in the broad ligament of the womb whence the ovary has been removed, or inflammation in the abdominal cavity (peritonitis) in case the operation has been performed through the flank, as it usually is in the young heifer. Apart from these the castrated heifer is practically immune from any trouble of the generative apparatus. Even the virgin heifer is little subject to such troubles, though she is not exempt from inflammations, and above all, morbid growths in the ovaries which remain in place and are functionally very active after the first year, or in precocious animals after the first few months of life. The breeding cow on the other hand is subjected to all the disturbances attendant on the gradual enlargement of the womb, the diversion of a large mass of blood to its walls, the constant drain of nutrient materials of all kinds for the nourishment of the fetus, the risks attendant and consequent on abortion and parturition, the dangers of infection from the bull, the risks of sympathetic disturbance in case of serious diseases of other organs, but preëminently of the urinary organs and the udder, and finally the sudden extreme derangements of the circulation and of the nervous functions which attend on the sudden revulsion of a great mass of blood from the walls of the contracting womb into the body at large immediately after calving.

In reviewing this class of diseases, therefore, we have to note, first, that they are almost exclusively restricted to breeding animals; and, second, that in keeping with the absolute difference of the organs in the male and female we find two essentially distinct lists of diseases affecting the two sexes.

EXCESS OF VENEREAL DESIRE—SATYRIASIS IN MALE—NYMPHOMANIA IN FEMALE.

This may occur in the male from too frequent sexual intercourse, or from injury and congestion of the base of the brain (vaso-dilator center in the medulla), or of the posterior end of the spinal cord, or it may be kept up by congestion or inflammation of the testicles or of the mucous membrane covering the penis. It may be manifested by a constant or frequent erection, by attempts at sexual connection, and sometimes by the discharge of semen without connection. In bad cases the feverishness and restlessness lead to loss of flesh, emaciation, and physical weakness.

It is, however, in the female especially that this morbid desire is most noticeable and injurious. It may be excited by the stimulating quality of the blood in cows fed to excess on highly nitrogenous food, as the seeds of the bean, pea, vetch, tare, wheat bran, middlings, etc., especially in the case of such as have no free exercise in the fields, and are subject to constant association with a vigorous young bull. A more frequent cause is the excitation or congestion of some part of the genital organs. Disease of the ovaries is preëminently the cause, and this may be by the formation of cysts (sacs containing liquid), or of solid tumors or degenerations, or, more commonly than all, the deposition of tubercle. Indeed, in case of tuberculosis attacking the abdominal organs of cows the ovaries or the serous membranes that support and cover them (the broad ligaments of the womb) are peculiarly subject to attack and the animal has constant sexual excitement, incessantly riding or being ridden by other cattle, having no leisure to eat nor chew the cud, but moving restlessly, wearing the flesh off its bones and gradually wasting. In some localities these cows are known as "bullers," because they are nearly always disposed to take the bull, but they do not conceive, or if they do they are subject to early abortions. They are therefore useless alike for the dairy and for the feeder, unless the removal of the ovaries subdues the sexual excitement, when in the absence of tuberculous disease elsewhere they may be fattened for the butcher.

Among the other sources of irritation charged with causing nymphomania are tumors and cancers of the womb, rigid closure of the neck of the womb, so that conception can not occur and the frequent services by the male stimulate the unsatisfied appetite, and inflammation and a purulent discharge from the womb or vagina.

The *treatment* in each case will vary with the cause, and is most satisfactory when that cause is a removable one. Overfeeding on richly nitrogenous food can be stopped, exercise in the open field secured, diseased ovaries may be removed (see Castration, p. 317), catarrhs of the womb and passages overcome by antiseptic astringent injections (see Leucorrhœa), and tumors of the womb may often be detached and extracted, the mouth of that organ having been first dilated by sponge tents or otherwise. The rubber dilator (impregnator) though sometimes helpful in the mare is rarely available for the cow, owing to the different condition of the mouth of the womb.

DIMINUTION OR LOSS OF VENEREAL DESIRE—ANAPHRODISIA.

This will occur in either sex from low condition and ill health. Long standing chronic diseases of important internal organs leading to emaciation and weakness, or a prolonged semi-starvation in winter, may be a sufficient cause. It is, however, much more common as the result of degeneration or extensive and destructive disease of the secreting organs (testicles, ovaries), which elaborate the male and female sexual products respectively. Such diseases are therefore a common cause of sterility in both sexes. The old bull, fat and lazy, becomes sluggish and unreliable in serving, and finally gets to be useless for breeding purposes. This is not due to his weight and clumsiness alone, but largely to the fatty degeneration of his testicles and their excretory ducts, which prevents the due formation and maturation of the semen.

If he has been kept in extra high condition for exhibition in the show ring this disqualification comes upon him sooner and becomes more irremediable.

Similarly the overfed, inactive cow, and above all the show cow, fails to come in heat at the usual intervals, shows little disposition to take the bull, and fails to conceive when served. Her trouble is the same in kind, namely, fatty degeneration of the ovaries and of their excretory ducts (Fallopian tubes), which prevents the formation or maturation of the ovum, or when it has formed, hinders its descent into the womb. Another common defect in such old fat cows is a rigid closure of the mouth of the womb, which prevents conception, even if the ovum reaches the interior of that organ, and even if the semen is discharged into the vagina.

The *true preventive* of such conditions is to be found in a sound hygiene. The breeding animal should be of adult age, neither over nor under fed, but well fed and moderately exercised; in other words, the most vigorous health should be sought, not only that a strong race may be propagated, but that the whole herd, or nearly so, may breed with certainty. Fleming gives 79 per cent as the general average of cows that are found to breed in one year. Here more than a fifth of the progeny is sacrificed, and a fifth of the product of the dairy. With careful management the proportion of breeders should approach 100 per cent. The various local and general obstacles to conception should be carefully investigated and removed. The vigorous health which comes from a sufficiently liberal diet and abundant exercise should be solicited, and that comparative bloodlessness and weakness which advances with undue fattening should be sedulously avoided. In bull or cow which is becoming unduly fat and showing indications of sexual indifference the treatment must be active. Turning out on a short pasture where it must work hard for a living will often suffice. The bull which can not be turned out to pasture may sometimes be utilized in the yoke or tread power, or he may be kept a part of his time in a field or paddock chained by the ring in his nose to a strong wire extending from one side of the lot to the other, attached securely to two trees or posts. The wire should be higher than the back of the bull, which will move from end to end at frequent intervals. If he is indisposed to take sufficient exercise in this way he may be safely driven. An instance of the value of exercise in these incipient cases of fatty degeneration is often quoted. The cow "Dodona," condemned as barren at Earl Spencer's, was sold cheap to Jonas Webb, who had her driven by road a distance of 120 miles to his farm at Wilbraham, soon after which she became pregnant. In advanced cases, however, in which the fatty degeneration is complete, recovery is impossible.

In case of rigid closure of the mouth of the womb the only resort is dilatation. This is far more difficult and uncertain in the cow than in the mare. The neck of the womb is longer, is often tortuous in its course, and its walls so approximated to each other and so rigid that it may be all but impossible to follow it, and there is always danger of perforating its walls and opening into the cavity of the abdomen, or short of that of causing inflammation and a new rigid fibrous formation which, on healing, leaves matters worse than before. The opening must be carefully made with the finger, and when that has entered the womb further dilatation may be secured by inserting a sponge tent or by careful stretching with a mechanical dilator. (Plate XX, Fig. 6.)

STERILITY FROM OTHER CAUSES.

The question as to whether a bull is a sure stock-getter and whether a cow is a breeder are so important that it would be wrong to pass over other prominent causes of sterility. Breeding at too early an age is a common source of increasing weakness of constitution which has obtained in certain breeds. Jerseys have especially been made the victims of this mistake, the object being to establish the highest milking powers in the smallest obtainable body which will demand the least material and outlay for its constant repair of waste. With success in this line there has been the counterbalancing disadvantage of impaired vigor, with too often lessened fertility as well as increased predisposition to disease. When the heifers of the race have for generation after generation been bred under a year old, the demand for the nourishment of the fetus is too great a drain on the immature animal, which accordingly remains small and stunted. As it fails to develop in size so every organ fails to be nourished to perfection. Similarly with the immature bull put to too many cows; he fails to develop his full size, vigor, or stamina, and transfers his acquired weakness to his progeny. An increasing number of barren females and an increasing proclivity to abortions are the necessary results of both courses. When this early breeding has occurred accidentally it is well to dry up the dam just after calving, and to avoid having her served again until full grown.

Some highly-fed and plethoric females seem to escape conception by the very intensity of the generative ardor. The frequent passage of urine accompanied by contractions of the womb and vagina and a profuse secretion from their surfaces, leads to the expulsion of the semen after it has been lodged in the genital passages. This may be remedied somewhat by bleeding the cow shortly before putting to the bull, so as to diminish the richness and stimulating quality of the blood; or better by giving a pound and a half of Epsom salts a day or two before she comes in heat, and subjecting her at the same time to a spare diet. Should the excessive ardor of the cow not be controllable in this way she may be shut up for a day or two, until the heat is passing off, when under the lessened excitement the semen is more likely to be retained.

The various diseases of the ovaries, their tubes, the womb, the testicles and their excretory ducts, as referred to under Excess of Generative Ardor, are causes of barrenness. In this connection it may be named that the discharges consequent on calving are fatal to the vitality of semen introduced before these have ceased to flow, hence service too soon after calving, or that of a cow which has had the womb or genital passages injured so as to keep up a muco-purulent flow until the animal comes in heat, is liable to fail of conception. Any such discharge should be first arrested by repeated injections as for leucorrhœa, after which the male may be admitted.

Feeding on a very saccharine diet, which greatly favors the deposition of fat, seems to have an even more direct effort in preventing conception during such regimen. Among other causes of barrenness are all those that favor abortion, ergoted grasses, smutty wheat or corn, laxative or diuretic drinking water, and any improper or musty feed that causes indigestions, colics, and diseases of the urinary organs, notably gravel; also savin, rue, cantharides and all other irritants of the bowels or kidneys.

Hermaphrodites are barren, of course, as their sexual organs are not distinctively either male or female. The heifer born as a twin with a bull is usually hermaphrodite and barren. But the animals of either sex in which development of the organs is arrested before they are fully matured, remain as in the male or female prior to puberty, and are barren. Bulls with both testicles retained within the abdomen may go through the form of serving a cow, but the service is unfruitful; the spermatozoa are not fully elaborated. So I have examined a heifer with a properly formed but very small womb, and an extremely narrow vagina and vulva, the walls of which were very muscular, that could never be made to conceive. A post-mortem examination would probably have disclosed an imperfectly formed ovary incapable of bringing ova to maturity.

A bull and cow that have been too closely inbred in the same line for generations may prove sexually incompatible and unable to generate together, though both are abundantly prolific when coupled with animals of other strains of blood.

Finally a bull may prove unable to get stock, not from any lack of sexual development, but from disease of other organs (back, loins, hind limbs), which renders him unable to mount with the energy requisite to the perfect service.

CONGESTION AND INFLAMMATION OF THE TESTICLES—ORCHITIS.

This usually results from blows or other direct injuries, but may be the result of excessive service or of the formation of some new growth (tumor) in the gland tissue. The bull moves stiffly, with straddling gait, and the right or left half of the scrotum in which the affected testicle lies is swollen, red, and tender, and the gland is drawn up within the sac and dropped down again at frequent intervals. It may be treated by rest, 1½ pounds Epsom salts given in 4 quarts water, by a restricted diet of some succulent food; by continued fomentations with warm water by means of sponges or rags sustained by a sling passed around the loins and back between the hind legs. The pain may be allayed by smearing with a solution of opium or of extract of belladonna. Should a soft point appear indicating the formation of matter it may be opened with a sharp lancet and the wound treated daily with a solution of a teaspoonful of carbolic acid in a half pint of water. Usually, however, when the inflammation has proceeded to this extent the gland will be ruined for purposes of procreation and must be cut out. (See Castration, p. 316.)

INFLAMMATION OF THE SHEATH.

While this may occur in bulls from infection during copulation and from bruises, blows, and other mechanical injuries, the condition is more common in the ox in connection with the comparative inactivity of the parts. The sheath has a very small external opening, the mucous membrane of which is studded with sebaceous glands secreting a thick unctuous matter of a strong, heavy odor. Behind this orifice is a distinct pouch, in which this unctuous matter is liable to accumulate when the penis is habitually drawn back. Moreover, the sheath has two muscles which lengthen it (protractors) passing into it from the region of the navel, and two that shorten it (retractors) passing into it from the lower surface of the pelvic bones above. (Plate IX, Fig. 2.) The protractors keep the sheath stretched so that it habitually covers the penis, while the retractors shorten it up in the act of service, so that the penis can project to its full extent. In stud bulls the frequent protrusion of the erect and enlarged penis and the retraction and dilatation of the opening of the sheath serve to empty the pouch and prevent any accumulation of sebaceous matter or urine. In the ox, on the other hand, the undeveloped and inactive penis is usually drawn back so as to leave the anterior preputial pouch empty, so that the sebaceous matter has space to accumulate and is never expelled by the active retraction of the sheath and protrusion of the erect penis in service. Again, the ox rarely protrudes the tip of the penis in urination, the urine is discharged into the preputial pouch and lodges and decomposes there so that there is a great liability to the precipitation of its earthy salts in the form of gravel. The decomposing ammoniacal urine, the gritty crystals precipitated from it, and the fetid, rancid, sebaceous matter set up inflammation in the delicate mucous membrane lining the passage. The membrane is thickened, reddened, rendered friable and ultimately ulcerated, and the now narrowed sheath is blocked by the increasing mass of sebaceous and urinous material and the decomposing mucus and pus. The penis can no longer be protruded, the urine escapes in a small stream through the narrowing sheath, and finally the outlet is completely blocked and the urine distends the back part of the sheath. This will fluctuate on being handled, and soon the unhealthy inflammation extends on each side of it, causing a thick, doughy, tender swelling under the belly and between the thighs. The next step in the morbid course is over-distension of the bladder, with the occurrence of colicky pains, looking at the flanks, uneasy movements of the hind limbs, raising or twisting of the tail, pulsatory contractions of the urethra under the anus, and finally a false appearance of relief, which is caused by rupture of the bladder. Before this rupture takes place the distended bladder may press on the rectum and obstruct the passage of the bowel dejections. Two mistakes are therefore probable: first, that the bowels alone are to be relieved, and, second, that the trouble is obstruction of the urethra by a stone. Hence the need of examining the sheath and pushing the finger into its opening to see that there is no obstruction there, in all cases of retention of urine, over-distended bladder, or blocked rectum in the ox. The disease may be acute or chronic, the first by reason of acute adhesive inflammation blocking the outlet, the second by gradual thickening and ulceration of the sheath and blocking by the sebaceous and calculous accretions.

The *treatment* of this affection will depend on the stage. If recent and no instant danger of rupture of the bladder, the narrow opening of the sheath should be freely cut open in the median line below, and the sac emptied out with a finger or spoon, after which it should be thoroughly washed with tepid water. To make the cleansing more thorough a catheter or a small rubber tube may be inserted well back into the sheath, and water may be forced through it from a syringe or a funnel inserted into the other end of the tube and considerably elevated. A fountain syringe, which should be found in every house, answers admirably. The sheath may be daily washed out with tepid water, with a suds made with castile soap, or with a weak solution of sulphate of zinc (one-half dram to a quart of water). If these attentions are impossible, most cases, after cleansing, will do well if merely driven through clean water up to the belly once a day.

In case the disease has progressed to absolute obstruction, with the bladder ready to rupture any moment, no time must be lost in opening into the urethra with a sharp knife over the bony arch under the anus, where the pulsations are seen in urinating. This incision is best made in the median line from above downward, but in the absence of a skillful operator a transverse incision with a sharp knife over the bone in the median line until the urine flows with a gush is better than to let the patient die. Considerable blood will be lost and the wound will heal tardily, but the ox will be preserved. Then the slitting and cleansing of the sheath can be done at leisure as described above. In case the bladder is ruptured the case is hopeless.

INFLAMMATION OF THE SHEATH AND PENIS FROM BRUISING.

This also is an affection of work oxen, caused by the pressure and friction of the sling when the animals are held in the stocks for shoeing. This crushing of both sheath and penis for half an hour or more leads to the development, some hours later, of a hard, hot, and painful swelling, extending from the scrotum as far as the opening of the sheath. Fever sets in, with dry muzzle, red eyes, hard, full, rapid pulse, accelerated breathing and elevated temperature. The ox stands obstinately with his hind legs drawn apart and urine falling drop by drop from the sheath. Appetite and rumination are suspended. In twenty-four hours there may be indications of advancing gangrene (mortification), the swelling becomes cold, soft, and doughy; it may even crack slightly from the presence of gas, a reddish brown fetid liquid oozes from the swelling, especially around the edges, and if the animal survives it is only with a great loss of substance of the sheath and penis.

The *prevention* of such an injury is easy. It is only necessary to see that the slings shall not press upon the posterior part of the abdomen. They must be kept in front of the sheath.

Treatment, to be effective, must be prompt and judicious. Put a strap around the patient with soft pads in contact with the affected parts, constantly soaked in cold water for at least twenty-four hours. A pound or two of Epsom salts in 4 quarts of hot water should also be given. The second day the parts may be washed with 1 quart of witch-hazel (extract), 2 drams sugar of lead, and 1 ounce laudanum, or the cold water irrigations may be continued if the active inflammation persists. In case the swelling continues hard and resistant it may be pricked at the most prominent points to the depth of one-third of an inch, with a lancet first dipped in dilute carbolic acid, and the whole surface should be washed frequently with chlorine water or other antiseptic.

When softening occurs in the center of a hard mass and fluctuation can be felt between two fingers pressed on different parts of such softening, it should be freely opened to let out the putrid pus and the cavity should be syringed often with chlorine water.

In bad cases extensive sloughs of dead skin, of the whole wall of the sheath, and even of the penis, may take place, which will require careful antiseptic treatment. The soaking of the urine into the inflamed and softened tissue, and the setting up of putrefactive action not only endangers great destruction of the tissues from putrid inflammation, but even threatens life itself from a general blood poisoning (septicæmia.) Every case should have skillful treatment to meet its various phases, but in the severe ones this is most urgently demanded.

INFLAMMATION OF THE URETHRA—GONORRHŒA.

Like other males, the bull sometimes suffers from inflammation of the canal which conveys the urine through the penis, and forms a consequent whitish muco-purulent discharge. It may have originated in gravels, the excitement of too frequent service, infection from a cow with leucorrhœa, or from extension of inflammation from the sheath. Beside the oozing of the whitish liquid from the end of the penis and sheath, there is tenderness and pain when handled, and while there is no actual arrest of the urine, its flow is subject to frequent voluntary checks, as the scalding liquid irritates the tender surface. If recognized before the discharge sets in a dose of 1½ pounds of Epsom salts, and local warm fomentations would be appropriate. After the onset of the whitish discharge a daily injection into the penis of a solution of 20 grains of permanganate of potash in a pint of water will be beneficial.

WARTS AND PAPILLARY GROWTHS ON THE PENIS.

These are not frequent in bull or ox. They may interfere with the protrusion of the organ from its sheath or with service, and always give rise to a bad smelling discharge. They may be twisted off with the thumb and forefinger, or cut off with a pair of scissors and the seat burned with a pencil of lunar caustic. To get hold of the penis in the bull bring him up to a cow. In the ox it will be necessary to push it out by manipulation through the sheath. In difficult cases the narrow opening of the sheath may be slit open.

WOUNDS OF THE PENIS.

The most common wounds are those sustained by blows of horns, sticks, etc. The blood-vessels and sacs are ruptured to a greater or less extent and considerable swellings filled with coagulated blood and inflammatory products occur, leading to distortion of the organ, and it may be to the impossibility of protruding it. A lotion of a dram of alum in a quart of water may be applied (injected into the sheath, if necessary), and a large sponge constantly irrigated by a stream of cold water may be kept applied by means of a surcingle to the outer side of the sheath. Incisions are rarely applicable to an organ of this kind, but in case of the existence of an extensive clot which is unlikely to be absorbed the lancet may be resorted to.

If the injury leads to paralysis of the penis and hanging out of its sheath, it should be supported in a sling and astringents used freely until inflammation subsides. Then the restoration of power may be sought by a blister between the thighs, by the use of electricity, or by the careful use of nerve stimulants, such as strychnia (2 grains daily).

ULCERS ON THE PENIS.

Sores on the penis of the bull may result from gravel or sebaceous masses in the sheath, or from having served a cow with leucorrhœa. They may be treated by frequent injections into the sheath of a lotion made with 1 dram sugar of lead, 60 drops carbolic acid and 1 quart water.

POLYPUS OF THE VAGINA OR UTERUS.

A polypus is a tumor growing from the mucous membrane, and often connected to it by a narrow neck. A definite cause can not always be assigned. If growing in the vagina a polypus may project as a reddish, rounded tumor from the vulva, especially during the act of passing water. It can be distinguished from descent of the womb by the absence of the orifice of that cavity, which can be felt by the oiled hand beyond the tumor in the depth of the vagina. From a vaginal hernia caused by the protrusion of some abdominal organ enveloped by the relaxed wall of the vagina it may be distinguished by its persistence, its firm substance and the impossibility of returning it into the abdomen by pressure. A hernia containing a portion of bowel gurgles when handled and can be completely effaced by pressure, the gut passing back into the abdomen.

A polypus in the womb is less easily recognized. At the time of calving it may be felt through the open mouth of the womb and recognized by the educated touch (it must be carefully distinguished from the mushroom-formed cotyledons (Plate XIII, Fig. 2), to which in ruminants the fetal membranes are attached). At other times, unless the womb is opened in the effort to expel it, the polypus can only be detected by examining the womb with the oiled hand introduced through the rectum.

Polypi may cause a muco-purulent discharge, or they may only be suspected when they prove an obstacle to parturition. The best way to remove them is to put the chain of an ecraseur around the neck or pedicel of the tumor and tear it through; or the narrow neck may be torn through by the emasculator, or in an emergency it may be twisted through by rotating the tumor on its own axis. The removal of the tumor will allow calving to proceed, after which the sore may be treated by a daily injection of one-half dram sulphate of zinc, 1 dram carbolic acid, and 1 quart milk-warm water.

SIGNS OF PREGNANCY.

If a cow remains for three or four weeks after service without showing signs of heat (bulling) she is probably pregnant. There are very exceptional cases in which the well-fed cow will accept the bull weeks or months after actual conception, and others equally exceptional in which the well-thriven but unimpregnated female will refuse the male persistently, but these in no way invalidate the general rule.

The bull, no matter how vigorous nor how ardent his sexual instinct, can not be made to pay any attention to a cow which is not in heat; hence indications of pregnacy can be had from both the male and female side. When she has conceived the cow usually becomes more quiet and docile, and lays on flesh and fat more rapidly, especially during the first four months of gestation. The stimulus to digestion and nutrition created by the demands of the growing fetus, added to the quieter and more uneventful life, contributes to this result. Some feeders avail of this disposition to prepare heifers and cows speedily for the butcher.

The enlargement of the abdomen, and its dropping so that it bulges below and to each side, while it falls in at the flank, between the outer angle of the hip bone and the last rib, are significant features which, though they may be caused by abdominal tumor or dropsy, are usually marks of pregnancy. From the same increasing weight of the abdomen the spine in the region of the loins sinks so that the bones of the croup seem to rise, especially back towards the root of the tail. In the early stages of pregnancy the udder develops slowly, and towards its completion quite rapidly. For a long time there is merely a sense of greater fullness when handled; the wrinkles in the skin become shallower and are effaced, and the teats are materially enlarged. Beginning a few weeks after conception, this tends to a steady development, though slight alternations in the sense of successive growth and shrinkage are not uncommon. In milking-cows this does not hold, as the milk usually tends to a steady diminution and the udder shrinks slowly until near the completion of the period, when it undergoes its sudden remarkable development, and yields at first a serous liquid and then the yellow colostrum, which coagulates when heated. As pregnancy advances the mucous membrane lining the vulva becomes swollen and of a darker bluish red hue, and the mucous secretion increases, becoming very abundant just before calving. When the feeding has not been altered nor restricted a steady diminution of the salts of lime, excreted in the urine, is an attendant on pregnancy, the lime being demanded for the growing body of the fetus.

After the fifth month the movements of the calf may often be observed in the right flank, nearly in front of the stifle, when the cow is drinking cold water. The sensation of cold on the side of the first stomach, which lies to the left and directly below the womb (Plate I), stimulates the calf to active movements, which are detected on the sudden jerking outward of the abdominal wall as if from blows delivered from within. In a loose pendant abdomen in the latter months of gestation the skin may often be seen pushed out at a sharp angle, irrespective of the period of drinking.

Another mode of examination through the flank is by touch. The palm of the hand is pressed strongly inward, about 8 inches in front of the stifle and a little below, several times in succession and is then brought to rest with the pressure maintained. Presently there are felt distinct and characteristic movements of the fetus, which has been disturbed and roused to action. Another mode is to press the closed fist strongly inward in the same situation and hold it so, forming a deep indentation in the abdominal wall. Presently the knuckles are felt to be struck by a solid body, which is no other than the fetus that had been displaced to the left by the push of the hand, and now floats back in its liquid covering (amniotic fluid—see Plate XII) downward and to the right.

Of all the modes of examination by touch, that done through the rectum gives the earliest satisfactory indications. The hand and arm well oiled are introduced, and the excrement having been removed if necessary, the palm of the hand is turned downward and the floor of the pelvis carefully examined. There will be felt in the median line the pear-shaped outline of the bladder, more or less full, rounded or tense, according to the quantity of urine it contains. Between this and the hand will be felt a soft, somewhat rounded tubular body, which divides in front into two smaller tubes or branches, extending to the right and left into the abdomen. This is the womb, which in its virgin or unimpregnated condition is of nearly uniform size from before backward, the main part or body being from 1½ to 2 inches across, and the two anterior branches or horns being individually little over an inch wide. Immediately after conception the body and one of the horns begin to enlarge, the vacant horn remaining disproportionately small, and the enlargement will be most marked at one point where a solid rounded mass indicates the presence of the growing embryo. In case of twins both horns are enlarged. At a more advanced stage, when the embryo begins to assume the form of the future animal, the rounded form gives place to a more or less irregular nodular mass, while later still the head, limbs, and body of the fetus may be distinctly made out. The chief source of fallacy is found in the very pendant abdomen of certain cows, into which in advanced gestation the fetus has dropped so low that it can not be felt by the hand in the rectum. The absence of the distinct outline of the vacant womb, however, and the clear indications obtained on external examination through the right flank will serve to prevent any mistake. The fetus may still be felt through the rectum if the abdomen is raised by a sheet passed from side to side beneath it.

Still another sign is the beating of the fetal heart, which may be heard in the latter half of pregnancy when the ear is pressed on the flank in front of the right stifle, or from that downward to the udder. The beats, which are best heard in the absence of rumbling, are about 120 per minute, and easily distinguished from any bowel sounds by their perfect regularity.

DURATION OF PREGNANCY.

From extended statistics it is found that the average duration of pregnancy in the cow is 285 days. A calf born at the two hundred and fortieth day may live, and a case is reported by Dietrichs of a calf born on the three hundred and thirty-fifth day, and another by the *American Journal of Medical Science* as born on the three hundred and thirty-sixth day. It is the general observation that in the majority of prolonged pregnancies the offspring is male. Lord Spencer found a preponderance of males between the two hundred and ninetieth and the three hundredth days, but strangely enough all born after the three hundredth day under his observation were females. It might be reasonably inferred that while the prevailing tendency is to carry the males overtime, yet that the smaller and comparatively much less developed female sometimes fails to stimulate the womb to contraction until very far beyond the regular date.

HYGIENE OF THE PREGNANT COW.

Among domestic animals considerations of hygiene must be made subservient to profit, and therefore the first consideration is not to secure the most robust health, but such a measure of vigor and stamina as is compatible with the most profitable utilization of the animal. The breeding cow must carry a calf every year, and this notwithstanding that she is at the same time suckling another large growing calf. The dairy cow must breed every year, and at the same time must furnish a generous flow of milk for from nine to eleven months yearly. If her health is lowered thereby, or her life shortened, the question of profit must still hold sway and she must yield her place to another when disqualified. There are exceptions, of course, but this rule generally holds.

There are certain points, however, in which the interests of hygiene may be considered. The pregnant cow should have exercise, and as regards both exercise and food, nothing is better than a run on a smooth pasture. She should be withheld from all violent excitement, hunting with dogs, riding or being ridden by cows in heat, driving in herd rapidly through narrow gateways, causing to jump ditches or fences, subjecting to blows with the horns of pugnacious cattle, driving on icy or otherwise slippery ground, carrying in railroad cars, kicking by vicious attendants, and fastening or throwing down for operations. The diet should be good, not of a kind to fatten, but with a generous amount of nitrogenous constituents which will favor at once the yield of milk and the nourishment of the fetus. Aliments rich in lime and phosphates, like wheat bran, middlings, etc., can be used to advantage, as there is a constant drain of earthy salts for the building of the body of the calf, and thereby the danger of undue concentration of the urine is lessened.

Hard, innutritious, and indigestible aliments, musty grain or hay, partially ripened rye-grass, millet, Hungarian grass, vetches, peas, or maize are objectionable, as they are liable to cause indigestion or even paralysis; and corn or hay affected by smut or ergot, or that has been spoiled by wet, overripened, and rendered fibrous and innutritious, are equally objectionable. The food should be in the main laxative, as costiveness and straining are liable to cause abortion. Roots and green food that have been frosted are objectionable, as being liable to cause indigestion, though in their fresh condition most wholesome and desirable. Ice-cold water should be avoided, as calculated to check the flow of milk, to derange digestion, and to cause abortion. A good temperature for the drink of the dairy cow is 55° F.

In the case of plethoric and heavy milking cows of mature age and in the prime of life, the hitherto liberal diet must be changed at the last week for the scantiest possible fare, and the bowels must be kept open by laxatives, if need be, if the owner would avoid milk fever. The pregnant cow should be kept away from the sight and odor of dead carcasses, from the smell of decomposing animal matter, and from stagnant and corrupting water. Her stall should not incline downward from shoulder to croup, lest the pressure of the abdominal organs should produce protrusion or abortion. She should be kept aloof from all causes of acute diseases, and all existing diseases should be remedied speedily and with as little excitement of the abdominal organs as possible. Strong purgatives and diuretics are to be especially avoided, unless it be in the very last days of gestation in very plethoric cows.

Finally, in the case of pure breeds, close association with animals of other breeds or crosses, or with animals of other colors, forms, or with defects, is to be carefully guarded against. The effects shown in the progeny may be exceptional, yet they are none the less sources of preventible loss.

PROTRUSION OF THE VAGINA—PROLAPSUS VAGINÆ.

This is common during pregnancy, from chronic relaxation of the vaginal walls and from lying in stalls that are lower behind than in front. The protrusion is of a rounded form and smooth, and if it embraces both sides of the canal it is double with a passage between. It may sometimes be remedied by raising the hind part of the stall higher than the front part. This failing, a truss may be applied as for eversion of the womb, and worn until the period of calving approaches. (Plates XXII, XXIII.)

HERNIA (BREACH) OF THE UTERUS.

This occurs usually in advanced pregnancy, from a gradual relaxation and distension of the lower wall of the abdomen, in the region of the udder, so that the latter is displaced downward, and in the sac above and in front of it may be felt the form and movements of the fetus. In other cases the womb escapes through a great laceration of the abdominal muscles to one side of the udder, and the hernial mass extends down to one side of that organ. However unsightly, this often allows the animal to complete its pregnancy naturally, and a broad supporting bandage placed around the abdomen is about all that can be recommended. After calving it is best to fatten the cow.

CRAMPS OF THE HIND LIMBS.

The compression by the womb and fetus of the nerves passing through the pelvis sometimes causes cramp and inability to move the limb, but it disappears under friction and motion and is never seen after calving.

DROPSY OF THE HIND LIMBS AND BETWEEN THE THIGHS.

In the latter months of pregnancy the hind legs may swell beneath the hocks, or a soft swelling which pits on pressure with the finger appears from the vulva down between the thighs to the udder and in front. It is mainly due to the pressure of the enlarged womb on the blood-vessels, is not dangerous, and disappears after calving.

DROPSY OF THE MEMBRANES OF THE FETUS—DROPSY OF THE WOMB.

The unimpregnated womb may be filled with a dropsical fluid, but the pregnant womb is more liable to become overdistended by an excess of fluid in the inner water-bag in which the fetus floats. (Plate XII.) From an unhealthy state of this membrane or of the blood of the fetus (watery blood) this liquid may go on accumulating until the cow seems almost as broad as she is long. If the trouble has not originated in the ill health of the cow, the result is still to draw on her system, overtax her strength, and derange her digestion so that the result may prove fatal to both mother and offspring. On the other hand, I have known extreme cases come to the natural term without help, and produce a living calf, after which the dam did well. The natural resort is to draw off a portion of the fluid through a hollow needle passed through the neck of the womb or through its tense wall adjacent. This may be repeated several times, as demanded to relieve the cow from the injurious distension.

PARALYSIS OF THE HIND PARTS.

In ill-fed, weak, unthrifty cows palsy of the hind limbs and tail may appear in the last weeks of pregnancy. The anus and rectum may participate in the palsy so far as to prevent defecation, and the rectum is more or less completely impacted. Exposure to wet and cold are often accessory causes, though the low condition, general weakness, and the pressure on the nerves going to the hind limbs are not to be forgotten. Something may be done for these cases by a warm dry bed, an abundant diet fed warm, frictions with straw wisps or with a liniment of equal parts of oil of turpentine and sweet oil on the loins, croup, and limbs, by the daily use of ginger and gentian, by the cautious administration of strychnia (2 grains twice daily), and by sending a current of electricity daily from the loins through the various groups of muscles in the hind limbs. The case becomes increasingly hopeful after calving, though some days may still elapse before the animal can support herself upon her limbs.

EXTRA-UTERINE GESTATION—FETUS DEVELOPING OUTSIDE THE WOMB.

These curious cases are rare and are usually divided into three types: (1) That in which the fetus is formed in or on the ovary (ovarian gestation); (2) that in which it is lodged in the fallopian tube or canal between the ovary and womb (tubal gestation); and (3) that in which it is lodged in the abdominal cavity and attached to one or more of its contents from which it draws its nourishment (abdominal gestation). Undoubted cases of the first and last varieties are recorded as occurring in the cow. The explanation of such cases is to be found in the fact that the actively moving sperm cells (spermatozoa) thrown into the womb have made their way through the fallopian tubes to the ovary. If they met and impregnated an ovum in the tube, and if the consequent growth of that ovum prevented its descent and caused its imprisonment within the tube, it developed there, getting attached to and drawing nourishment from the mucous walls. Such product has its development arrested by compression by the undilatable tube, or bursting through the walls of the tube it escapes into the abdomen and perishes. If, on the contrary, the spermatozoa only meet and impregnate the ovum on or in the ovary, the development may take place in the substance of the ovary from which the fetus draws its nourishment, or the impregnated ovum escaping between the ovary and the open end of the tube falls into the abdominal cavity, and becomes adherent to, and draws nourishment from, some of the abdominal organs (womb, bowel, liver, stomach, etc.).

The *symptoms* are those of pregnancy, which may be suddenly complicated by inflammation (peritonitis), owing to rupture of the sac containing the fetus; or at full term signs of calving appear but no progress is made, an examination with the oiled hand in the vagina or rectum finds the womb empty and its mouth closed. Further examination will disclose the fetal sac attached in some part of the abdominal cavity, and containing the more or less perfectly developed body of a calf. In the most hopeful cases the fetus perishes at an early stage of gestation, becomes inclosed in a fibrous sac, and is slowly absorbed, its soft parts becoming liquefied and removed and the bones remaining encysted. In some cases the bones have finally sloughed into the rectum or through an artificial opening in the side of the belly.

Little can be done in such cases except to quiet pain and excitement by anodynes (opium, chloral, etc.) and leave the rest to nature. A fistula discharging bones may be dilated and the bones extracted, the sac being then washed out with a solution of 10 grains bichloride of mercury in a quart of water. In certain cases with a live calf a skillful operator might be justified in cutting into the abdomen and extracting the calf with its membranes, using the lotion just named as an antiseptic.

PROLONGED RETENTION OF THE FETUS.

Even when the fetus has developed within the womb it may fail to be delivered at the proper time; labor pains have quickly subsided and the cow resumed her usual health. In such cases the calf dies, and its soft parts are gradually liquefied and absorbed, while its bones remain for years in the womb inclosed in the remains of the fetal membranes. These may be expelled at any time through the natural channels, or they may remain indefinitely in the womb, not interfering with the general health, but preventing conception.

If the true condition of things is recognized at the time of the subsidence of the labor pains, the mouth of the womb may be dilated by the fingers, by the insertion of sponge tents, or by a mechanical dilator (Plate XX, Fig. 6) the fetal membranes may be ruptured and the calf extracted. After the removal of the calf and its membranes the danger of putrid poisoning may be obviated by injecting the antiseptic solution advised in the last paragraph.

ABORTION—SLINKING THE CALF.

Technically, abortion is the term used for the expulsion of the offspring before it can live out of the womb. Its expulsion after it is capable of an independent existence is premature parturition. In the cow this may be after seven and one-half months of pregnancy. Earl Spencer failed to raise any calf born before the two hundred and forty-second day. Dairymen use the term abortion for the expulsion of the product of conception at any time before the completion of the full period of a normal pregnancy, and in this sense it will be employed in this article.

Abortion in cows is either contagious or noncontagious. It does not follow that the contagium is the sole cause in every case in which it is present. We know that the organized germs of contagion vary much in potency at different times, and that the animal system also varies in susceptibility to their attack. The germ may therefore be present in a herd without any manifest injury, its disease-producing power having for the time abated considerably, or the whole herd being in a condition of comparative insusceptibility. At other times the same germ may have become so virulent that almost all pregnant cows succumb to its force, or the herd may have been subjected to other causes of abortion which, though of themselves powerless to actually cause abortion, may yet so predispose the animals that even the weaker germ will operate with destructive effect. In dealing with this disease, therefore, it is the part of wisdom not to rest satisfied with the discovery and removal of one specific cause, but rather to exert oneself to find every existent cause and to secure a remedy by correcting all the harmful conditions.

CAUSES OF NONCONTAGIOUS ABORTION.

As abortion most frequently occurs at those three weeks intervals at which the cow would have been in heat if nonpregnant, we may assume a predisposition at such times due to a periodicity in the nervous system and functions. Poor condition, weakness, and a too watery state of the blood is often a predisposing cause. This in its turn may result from poor or insufficient food, from the excessive drain upon the udder while bearing the calf, from the use of food deficient in certain essential elements, like the nitrogenous constituents or albuminoids, from chronic wasting diseases, from round or tape worms in the bowels, from flat worms (flukes, trematodes) in the liver, from worms in the liver, from worms in the lungs, from dark, damp, unhealthy buildings, etc. In some such cases the nourishment is so deficient that the fetus dies in the womb and is expelled in consequence. Excessive loss of blood, attended as it usually is by shock, becomes a direct cause of abortion.

Acute inflammations of important organs are notorious causes of abortion, and in most contagious fevers (lung plague, rinderpest, foot and mouth disease) it is a common result. Affections of the chest which prevent due aëration of the blood induce contractions of the womb, as shown experimentally by Brown-Sequard. Pregnant women suffocated in smoke aborted in many cases.*

* Retoul.

Chronic diseases of the abdominal organs are fertile sources of abortion, especially those that cause bloating (tympany of the first stomach) or diarrhea, or the diseases of the ovaries, kidneys, or bladder. The presence of gravel or stone in the kidneys, bladder, or urinary canals, is an especial predisposing or even an exciting cause, in magnesian limestone districts and in winter. The presence of tubercles in the ovaries, the broad ligaments of the womb, and even on the outer surface of the womb itself, must be added as efficient causes.

Fatty degeneration of the heart, a common disease in old cows of improved beef breeds, lessens the circulation in the placenta (and fetus) and, arresting nutrition, may cause abortion.

Indigestions of all kinds are especially dangerous, as they are usually associated with overdistension of the first stomach (paunch) with gas. As this stomach lies directly beneath and to the left side of the womb, any disorder, and above all an excessive distension of that organ, presses on or affects the womb and its contents dangerously. It further causes contractions of the womb by preventing aëration of the blood. Hence all that tends to indigestion is to be carefully guarded against. Privation of water, which hinders rumination and digestion; ice-cold water, which rouses the womb to contraction and the calf to vigorous movement; green, succulent grass, to which the cow has been unaccustomed; clover which has just been wet with a slight shower; all green food, roots, potatoes, apples, pumpkins that are frozen or have been, or that are simply covered with hoar frost; food that has been grown in wet seasons or that has been badly harvested; growing corn, oats, etc., if the animal is unused to them; a too dry food or a too stimulating food (wheat bran, pease, maize, and cotton-seed) fed too lavishly may, any one of them, induce abortion. The dry and stimulating foods last named bring on constipation with straining, and also elevated temperature of the body, which, in itself, endangers the life of the fetus.

Putrid, stagnant water is hurtful both to digestion and the fetus, and abortions in cows have been repeatedly traced to this source and have ceased when pure water was supplied. Ergoted grasses have long been known as a cause of widespread abortions in cows. The ergot is familiar as the dark purple or black, hard, spur-like growths which protrude from the seeds of the grasses at the period of their ripening. (Plate V.) It is especially common in damp, cloudy seasons and localities, on meadows shaded by trees and protected against the free sweep of the winds. The same is to a large extent true of smut. Hence, wet years have been often remarkable for the great prevalence of abortions. Abortions have greatly increased in New Zealand among cows since the introduction of rye grass, which is specially subject to ergot. As abortion is more prevalent in old dairying districts the ergot may not be the sole cause in this instance.

The smut of maize, wheat, barley, and oats is fostered by similar conditions and is often equally injurious. It should be added that the ergots and smuts of certain years are far more injurious than those of others. This may be attributed to the fact that they have grown under different conditions, and therefore have developed somewhat different properties, a habit of fungi which has been often observed; or that in certain seasons the cows have been more powerfully predisposed by other operative causes of abortion.

Both ergot and smut vary in potency according to the stage of growth. Dr. Kluge found that the ergot gathered before the grain had fully ripened was much more powerful than that from the fully ripened grain. McGugen found the ergot of wheat more potent than that of rye. It should be added that both ergot and smut are robbed somewhat of their deleterious properties if fed with an abundance of water, so that it may prove harmless if fed with roots, ensilage, etc., whereas it will prove hurtful when fed in the same amount with dry hay. It is also more liable to injure if fed for a long time in succession in winter, though it may be in smaller quantity.

Rust is also charged with causing abortions.* That other cryptograms found in musty fodder are productive of abortion has been well established. In Germany and France the wet years of 1851, 1852, and 1853 were notorious for the prevalence of abortions.† Fodders harvested in such seasons are always more or less musty, and musty hay and grain have been long recognized as a prolific cause of digestive, urinary, and cerebral disorders. Impactions and bloatings of the stomachs, excessive secretion of urine (diuresis) and red-water are common results of such musty fodder, and we have already seen that such disorders of the digestive and urinary organs are very liable to affect the pregnant womb and induce abortion.

The riding one another by cows is attended by such severe muscular exertion, jars, jolts, mental excitement, and gravitation of the womb and abdominal organs backward that it may easily cause abortion in a predisposed animal.

Keeping in stalls that slope too much behind (over 2 inches) acts in the same way, the compression due to lying and the gravitation backward proving more than a predisposed cow can safely bear.

Deep gutters behind the stalls, into which one or both hind limbs slip unexpectedly, strain the loins and jar the body and womb most injuriously. Slippery stalls in which the flooring boards are laid longitudinally in place of transversely, and on which no cleats nor other device is adopted to give a firm foothold, are almost equally dangerous. Driving on icy ground, or through a narrow doorway where the abdomen is liable to be jammed, are other common causes. Offensive odors undoubtedly cause abortion. To understand this one must take into account the preternaturally acute sense of smell possessed by cattle. By this sense the bull instantly recognizes the pregnant cow and refrains from disturbing her, while man, with all his boasted skill and

* Gerlach. Haselbach. † Baumeister, Rueff, Rondaud, Trelut.

precise methods finds it difficult to come to a just conclusion. The emanations from a cow in heat, however, will instantly draw the bull from a long distance. Carrion in the pasture fields or about slaughter-houses near by, the emanations from shallow graves, dead rats or chickens about the barns, and dead calves, the product of prior abortions, are often chargeable with the maintenance of abortions. Aborting cows often fail to expel the afterbirth, and if this remains hanging in a putrid condition it is most injurious to pregnant cows in the near vicinity. So with retained afterbirth in other cows after calving. That some cows kept in filthy stables or near by slaughterhouses may become inured to the odors and escape the evil results is no disproof of the injurious effects so often seen in such cases.

The excitement, jarring, and jolting of a railroad journey will often cause abortion, especially as the cow nears the period of calving, and the terror or injury of railway or other accidents prove incomparably worse.

All irritant poisons cause abortions by the disorder and inflammation of the digestive organs, and if such agents act also on the kidneys or womb the effect is materially enhanced. Powerful purgatives or diuretics should never be administered to the pregnant cow.

During pregnancy the contact of the expanding womb with the paunch, just beneath it, and its further intimate connection through nervous sympathy with the whole digestive system, leads to various functional disorders and especially to a morbid craving for unnatural objects of food. In the cow this is shown in the chewing of bones, pieces of wood, iron bolts, articles of clothing, lumps of hardened paint, etc. An unsatisfied craving of this kind, producing constant excitement of the nervous system, will strongly conduce to abortion. How much more so if the food is lacking in the mineral matter and especially the phosphates necessary for the building up of the body of both dam and offspring, to say nothing of that drained off in every milking. This state of things is present in many old dairy farms, from which the mineral matters of the surface soil have been sold off in the milk or cheese for generations and no return has been made in food or manure purchased. Here is the craving of an imperative need, and if it is not supplied the health of the cow suffers and the life of the fetus may be sacrificed.

Among other causes of abortion must be named the death or the various illnesses of the fetus, which are about as numerous as those of the adult; the slipping of a young fetus through a loop in the navel string so as to tie a knot which will tighten later and interrupt the flow of blood with fatal effect; and the twisting of the navel string by the turning of the fetus until little or no blood can flow through the contorted cord. There is in addition a series of diseases of the mucous membrane of the womb, and of the fetal membranes (inflammation, effusion of blood, detachment of the membranes from the womb, fatty or other degenerations, etc.), which interfere with the supply of blood to the fetus or change its quality so that death is the natural result, followed by abortion.

CONTAGIOUS ABORTION—ITS CAUSE.

While any one of the above conditions may concur with the contagious principle in precipitating an epizoötic of abortion, yet it is only by reason of the *contagium* that the disease can be indefinitely perpetuated and transferred from herd to herd. When an aborting cow is placed in a herd that has hitherto been healthy, and shortly afterwards miscarriage becomes prevalent in that herd and continues year after year, in spite of the fact that all the other conditions of life in that herd remain the same as before, it is manifest that the result is due to contagion. When a bull, living in a healthy herd, has been allowed to serve an aborting cow, or a cow from an aborting herd, and when the members of his own herd, subsequently served by him abort in considerable numbers, contagion may be safely inferred. Mere living in the same pasture or building does not convey the infection. Cows brought into the aborting herd in advanced pregnancy carry their calves to the full time. But cows served by the infected bull, or that have had the infection conveyed by the tongue or tail of other animals, or by their own, or that have had the external genitals brought in contact with wall, fence, rubbing post, litter, or floor previously soiled by the infected animals, will be liable to suffer. The Scottish abortion committee found that when healthy, pregnant cows merely stood with or near aborting cows they escaped, but when a piece of cotton wool lodged for twenty minutes in the vagina of the aborting cow was afterwards inserted into the vagina of a healthy, pregnant cow or sheep, the latter invariably aborted within a month. So Roloff relates that in two large stables at Erfurt, without any direct intercommunication, but filled with cows fed and managed in precisely the same way, abortion prevailed for years in the one, while not a single case occurred in the other. Galtier finds that the virus from the aborting cow causes abortions in the sow, ewe, goat, rabbit, and guinea-pig; and that if it has been intensified by passing through either of the two last-named animals, it will affect also the mare, bitch, and cat.

The precise germs or germ causing abortion have not yet been demonstrated beyond question. Twenty years ago Franck, of Munich, drew attention to a chain form of cells (*Leptothrix vaginalis*) as the efficient cause. The Scottish Commission have isolated in gelatin cultures five different bacteria obtained from the vaginal mucus of the aborting cow, and Nocard, of Alfort, speaks of a germ existing abundantly between the womb and fetal membranes of aborting cows which was never found in the healthy.

Symptoms of abortion.—In the first two or three months of pregnancy no symptoms may have been observed, and unless the aborted product is seen the fact of abortion may escape notice. Some soiling of the tail with mucus, blood, and the waters may be observed, or the udder may show extra firmness, and in the virgin heifer or dry cow the presence of a few drops of milk may be suggestive, or the fetus and its membranes may be found in the gutter or elsewhere as a mere clot of blood or as a membraneous ball in which the forming body of the fetus is found. In water the villi of the outer membrane (chorion, Plate XII) float out, giving it a characteristically shaggy appearance.

In advanced pregnancy abortion is largely the counterpart of parturition, so that a special description is superfluous. The important thing is to distinguish the early symptoms from those of other diseases, so that the tendency may be arrested and the animal carried to full time if possible. A cow is dull, sluggish, separate from the herd, chewing the cud languidly, or there may be frequent lying down and rising, uneasy movements of the hind feet or of the tail, and slightly accelerated pulse and breathing, and dry muzzle. The important thing is not to confound it with digestive or urinary disorder, but in a pregnant cow to examine at once for any increase of mucus in the vagina, or for blood or liquid there or on the root of the tail; for any enlargement, firmness, or tenderness of the udder, or in dry cows milk, and above all for any slight straining suggestive of labor pains.

In many cases the membranes are discharged with the fetus; in others, in advanced pregnancy, they fail to come away, and remain hanging from the vulva, putrefying and falling piecemeal—finally resulting in a fetid discharge from the womb. According to the size of the herd contagious abortions will follow one another at intervals of one to four or more weeks, in the order of their infection or of the recurrence of the period of activity of the womb which corresponds to the occurrence of heat.

Prevention.—Weakness and bloodlessness are to be obviated by generous feeding, and especially in aliments (wheat bran, rape cake, cotton seed, oats, barley, beans, pease, etc.), rich in earthy salts, which will also serve to correct the morbid appetite. This will also regenerate the exhausted soil if the manure is returned to it. In the same way the application of ground bones or phosphates will correct the evil, acting in this case through the soil first and raising better food for the stock. The ravages of worms are to be obviated by avoiding infested pastures, ponds, streams, shallow wells or those receiving any surface leakage from land where stock go, and by feeding salt at will, as this agent is destructive to most young worms.

The tendency to urinary calculi in winter is avoided by a succulent diet (ensilage, steamed food, roots, pumpkins, apples, potatoes, slops), and by the avoidance of the special causes named under Gravel. (See p. 153). Furnishing water inside the barn in winter in place of driving once a day to take their fill of ice-cold liquid will obviate a common evil. Putrid and stagnant water are to be avoided. Sudden changes of food are always reprehensible, but much more so in the pregnant animal. Let the change be gradual. So with what is spoiled or unwholesome.

In case of prevalence of ergot in a pasture it should be kept eaten down, or cut down with a mower, so that no portion runs to seed. (See Plate V.) In case of a meadow the grass must be cut early before the seeds have filled. The most dangerous time appears to be between the formation of the milky seed and the full ripening. Yet the ergot is larger in proportion to the ripeness, so that the loss of potency is made up in quantity. The ripe seed and ergot may be removed by threshing and the hay safely fed. It may also be noted that both ergot and smut may be safely fed in moderate quantity, provided it is used with succulent food (ensilage, roots, etc.) or with free access to water, and salt is an excellent accessory as encouraging the animal to drink. Both ergot and smut are most injurious in winter when the water supply is frozen up or accessible only at long intervals. The ergoted seed when threshed out can not be safely sown, but if first boiled it may be fed in small amount or turned into manure. The growth of both ergot and smut may be to a large extent prevented by the time-honored Scotch practice of sprinkling the seed with a saturated solution of sulphate of copper before sowing.

Fields badly affected with ergot or smut may be practically renewed by plowing up and cultivating, for a series of years under crops (turnips, beets, potatoes, buckwheat, etc.), which do not harbor the fungus, and which require much cultivation and exposure of the soil. Drainage and the removal of all unnecessary barriers to the free action of sunshine and wind are important provisions.

Other precautions concerning separation from cows in heat, a proper construction of stalls, the avoidance of carrion and other offensive odors, protection from all kinds of mechanical injuries, including overdriving and carrying by rail in advanced pregnancy, the exclusion of all irritants, or strong purgatives and diuretics from food or medicine, and the guarding against all causes of indigestion and bloating have been sufficiently indicated under *Causes*. For protection of the womb and fetus against the various causes of disease available methods are not so evident. For cows that have aborted in the last pregnancy chlorate of potash, 3 drams daily before the recurrence of the expected abortion, is often useful. Prevention of contagious abortion will naturally come with the treatment.

Treatment of non-contagious abortion.—Although the first symptoms of abortion have appeared it does not follow that it will go on to completion. So long as the fetus has not perished, if the waters have not been discharged, nor the water-bags presented, attempts should be made to check its progress. Every appreciable and removable cause should be done away with, the cow should be placed in a quiet stall alone, and agents given to check the excitement of the labor pains. Laudanum in doses of 1 ounce for a small cow or 2 ounces for a large one should be promptly administered and repeated in three or four hours, should the labor pains recur. This may be kept up for days or even weeks if necessary, though that is rarely required, as the trouble either subsides or abortion occurs. If the laudanum seems to lack permanency of action use bromide of potassium, or better, extract of viburnum prunifolium (40 grains) at intervals of two or three hours until five or six doses have been given.

Treatment of contagious abortion.—So far as this differs from the treatment of sporadic abortion, it consists in the free use of germicides or disinfectants.

(1) Scrape and wash the back part of the stall and gutter and water it with a solution of 5 ounces sulphate of copper (bluestone) in 1 gallon pure water. Repeat this cleaning and watering at least once a week. This should in all cases be applied to every stall where an aborting cow has stood and to those adjacent. To treat the whole in the same way would be even better, as it is impossible to say how many of the cows harbor the germ. This is the more needful that in three or four years, if the aborting cow is kept on, she becomes insusceptible and carries her calf to full time. A cow may therefore be infecting to others though she no longer aborts herself.

(2) Dissolve 1 dram corrosive sublimate, 1 ounce each of alcohol and glycerine, and shake this up in a gallon of water, to use as an injection into the vagina and a wash for the parts about the vulva and root of the tail. Being very poisonous, it should be kept in a wooden barrel out of the way of animals or children. Every morning the vulva, anus, back of the hips, and root of the tail should be sponged with this liquid, and this is best applied to the whole herd.

(3) When any case of abortion has occurred the fetal membranes must be removed by the hand without delay, and together with the fetus destroyed by burning, or boiling, or buried deeply, and the stall should be cleansed and watered freely with the copper solution. Then the womb should be washed out with 1½ gallons of the corrosive sublimate solution injected through a rubber tube introduced to the depth of the womb and with a funnel in its outer elevated end. This should be repeated daily for a week. In the case of the other cows of the herd one injection of the same kind should be made into the vagina, after which they need only have their external parts and tail washed with the solution daily.

As a certain number of the cows will harbor the germ in the womb when treatment is started, it is not to be expected that abortions will cease at once, but by keeping up the treatment the trouble may be got quit of in the following year. As an aborting cow is usually of little use for the dairy, it is best to separate and fatten her and apply treatment to those that remain. In this, as in other delicate manipulations, the stockowner will consult his own interest by employing an accomplished veterinarian, and avoiding such as have not had the privileges of a thorough professional education. In addition to the above the removal of all manure and contaminated litter and the sprinkling of the surface with the sulphate of the copper solution is called for. Drains should no less be thoroughly rinsed and disinfected. Milking stools and other implements may be treated in the same way, or with carbolic acid or boiling water. Great care should be taken to guard against bull or cows from an aborting herd or district; streams even may be suspected if there is an aborting herd near by and higher up on that stream. Cows sent to bull from an aborting herd are to be denied, and workmen that have attended on such a herd should be made to wash and disinfect their clothes and persons.

SYMPTOMS OF CALVING.

In the cow the premonitions of calving are the enlargement of the udder, which becomes firm and resistant to the touch, with more or less swelling in front, and yields a serous milky fluid; the enlargement and swelling of the vulva, which discharges an abundant stringy mucus; the drooping of the belly, and the falling in of the muscles at each side of the root of the tail, so as to leave deep hollows. When this last symptom is seen calving may be counted on in twenty-four hours or in two or three days. When the act is imminent, the cow becomes uneasy, moves restlessly, leaves off eating, in the field leaves the herd, lies down and rises again as if in pain, shifts upon her hind feet, moves the tail, and may bellow or moan. When labor pains come on the back is arched, the croup drooped, the belly is drawn up, and straining is more or less violent and continuous. Meanwhile blood may have appeared on the vulva and tail, and soon the clear water-bags protrude between the lips of the vulva. They increase rapidly, hanging down toward the hocks, and the fore or hind feet can be detected within them. With the rupture of the bags and escape of the waters the womb contracts on the solid angular body of the fetus, and is at once stimulated to more violent contractions, so that the work proceeds with redoubled energy to the complete expulsion. This is the reason why it is wrong to rupture the water-bags if the presentation is normal, as they furnish a soft uniform pressure for the preliminary dilatation of the mouth of the womb and passages, in anticipation of the severe strain put upon them as the solid body of the calf passes.

The cow often calves standing, in which case the navel-string is broken as the calf falls to the ground. If, however, she is recumbent this cord is torn through as she rises up. The after pains come on three or four hours later and expel the membranes, and these should never be left longer than twenty-four hours.

NATURAL PRESENTATION.

When there is but one calf the natural presentation is that of the fore feet with the front of the hoofs and knees turned upward toward the tail of the dam and the nose lying between the knees. (Plate XV.) If there are twins the natural position of the second is that of the hind feet, the heels and hocks turned upward toward the cow's tail. (Plate XVIII, Fig. 1.) In both of these natural positions the curvature of the body of the calf—the back arched upward—is the same with the curvature of the passages, which descend anteriorly into the womb, ascend over the brim of the pelvis, and descend again toward the external opening (vulva). Any presentation different from the above is abnormal.

OBSTACLES TO PARTURITION.

With a well-formed cow and calf and a natural presentation as above, calving is usually prompt and easy. Obstacles may, however, come from failure of the mouth of the womb to dilate; from twisting of the neck of the womb; from tumors in the vagina; from dropsy in the womb or abdomen; from overdistension of the rectum or bladder; from undue narrowing of the passages; from excess of fat in the walls of the pelvis; from the disturbance of a nervous cow by noises; from stone or urine in the bladder; from wrong presentation of the calf, its back being turned downward or to one side in place of upward toward the spine of the dam; from the bending backward into the body of the womb of one or more limbs or of the head; from presentation of the back, shoulder, or croup, all four limbs being turned back; from presentation of all four feet at once; from obstruction caused by an extra head or extra limbs, or double body on the part of the offspring (Plate XIX); from dropsy or other disease of the calf; from excessive or imperfect development of the calf; from the impaction of twins at the same time into the passages; or it may be at times from the mere excessive volume of the fetus.

GENERAL MAXIMS FOR THE ASSISTANT IN DIFFICULT PARTURITION.

Do not interfere too soon. "Meddlesome midwifery is bad" with animals as with women. After labor pains set in, give a reasonable time for the water-bags to protrude and burst spontaneously, and only interfere when delay suggests some mechanical obstruction. If there is no mechanical obstruction let the calf be expelled slowly by the unaided efforts of the cow. Bruises and lacerations of the passages and flooding from the uncontracted womb may come from the too speedy extraction of the calf. When assistance is necessary, the operator should dress in a thick flannel shirt from which the sleeves have been cut off clear up to the shoulders. This avoids danger of exposure, and yet leaves the whole arm free and untrammeled. Before inserting the hand, it and the arm should be smeared with oil, lard, or vaseline, care being taken that the oil or lard is fresh, neither salted nor rancid, and that it has been purified by boiling or rendered antiseptic by the addition of a teaspoonful of carbolic acid to the pound. This is a valuable precaution against infecting the cow by introducing putrid ferments into the passages, and against poisoning of the arm by decomposing discharges in case the calving is unduly protracted. When labor pains have lasted some time without any signs of the water bags, the dropping in at the sides of the rump, and the other preparations for calving being accomplished, the hand should be introduced to examine. When the water-bags have burst and neither feet nor head appear for some time, examination should be made. When one fore foot only and the head appears, or both fore feet without the head, or the head without the fore feet, examine. If one hind foot appears without the other, make examination. The presenting limb or head should be secured by a rope with a running noose, so that it may not pass back into the womb and get lost during the subsequent manipulations, but may be retained in the vagina or brought up again easily. In searching for a missing member, it is usually better to turn the head of the cow down hill, so that the gravitation of the fetus and abdominal organs forward into the belly of the cow may give more room in which to bring up the missing limb or head. If the cow is lying down turn her on the side opposite to that on which the limb is missing, so that there may be more room for bringing the latter up. Even if a missing limb is reached it is vain to attempt to bring it up during a labor pain. Wait until the pain has ceased, and attempt to straighten on the limb before the next pain comes on. If the pains are violent and continuous they may be checked by pinching the back or by putting a tight surcingle round the body in front of the udder. These failing, 1 ounce or $1\frac{1}{2}$ ounces of chloral hydrate in a quart of water may be given to check the pains. If the passages have dried up or lost their natural lubricating liquid, smear the interior of the passages and womb, and the surface of the calf as far as it can be reached, with pure fresh lard; or pure sweet oil may be run into the womb through a rubber tube (fountain syringe). In dragging up the fetus apply strong traction only while the mother is straining, and drag downward toward the hocks as well as backward. You thus follow the natural curvature of both fetus and passages, and render the extraction easier.

LABOR PAINS BEFORE RELAXATION OF THE PASSAGES.

Any of the various causes of abortion may bring on labor pains before the time. Straining comes on days or weeks before the time, and there is not the usual enlargement, swelling and mucous discharge from the vulva. There is little or no falling in by the sides of the root of the tail; the abdomen has not dropped to the usual extent, and the udder is less developed and yields little or no milk. In spite of the pains no water bags appear, and the oiled hand cautiously introduced into the vagina finds the neck of the womb firmly closed, rigid, and undilatable. If it is known that the cow has not reached her proper time of calving, the examination through the vagina should be omitted and the animal should be placed in a dark, quiet place by herself, and be given 1 to 2 ounces laudanum. Viburnum prunifolium, 1 ounce, may be added, if necessary, and repeated in three hours. The pains will usually subside.

In some instances the external parts are relaxed and duly prepared, but the neck of the womb remains rigidly closed. In such a case the solid extract of belladonna should be smeared around the constricted opening and the animal left quiet until it relaxes.

DISEASED INDURATION OF THE MOUTH OF THE WOMB.

From previous lacerations or other injuries the neck of the womb may have become the seat of fibrous hardening and constriction, so as to prevent its dilatation when all other parts are fully prepared for calving. The enlarged, flabby vulva, the sinking at each side of the rump, the full udder and drooping abdomen indicate the proper time for calving, but the labor pains secure no progress in the dilatation of the mouth of the womb, and the oiled hand introduced detects the rigid, hard, and, in some cases, nodular feeling of the margins of the closed orifice, which no application of belladonna or other antispasmodic suffices to relax. Sponge tents may be inserted or the mechanical dilator (Plate XX, Fig. 6) may be used if there is opening enough to admit it, and if not a narrow-bladed probe-pointed knife (Plate XXIV, Fig. 2) may be passed through the orifice and turned upward, downward, and to each side, cutting to a depth not exceeding a quarter of an inch in each case. This done a finger may be inserted, then two, three, and four, and finally all four fingers and thumb brought together in the form of a cone and made to push in with rotary motion until the whole hand can be introduced. After this the labor pains will induce further dilatation, and finally the presenting members of the calf will complete the process.

TWISTING OF THE NECK OF THE WOMB.

This is not very uncommon in the cow, the length of the body of the womb and the looseness of the broad ligaments that attach it to the walls of the pelvis favoring the twisting. It is as if one were to take a long sack rather loosely filled at the neck and turn over its closed end so that its twisting should occur in the neck. The twist may be one-quarter round, so that the upper surface would come to look to one side, or it may be half round, so that what was the upper surface becomes the lower. The relation of the womb of the cow to the upper and right side of the paunch favors the twisting. The paunch occupies the whole left side of the abdomen and extends across its floor to the right side. Its upper surface thus forms an inclined plane, sloping from the left downward and to the right, and on this sloping surface lies the pregnant womb. It is easy to see how, in the constant movements of the paunch upon its contents and the frequent changes of position of the growing fetus within the womb, to say nothing of the contractions of the adjacent bowels and the more or less active movements of the cow, should lead the womb to roll downward to the right. And yet, in many cases, the twist is toward the left, showing that it is not the result of a simple rolling downward over the paunch, but rather of other disturbances. The condition may be suspected when labor pains have continued for some time without any sign of the water-bags, and it is confirmed when the oiled hand, introduced through the vagina, finds the mouth of the womb soft and yielding, but furnished with internal folds running forward in a spiral manner. If the folds on the upper wall of the orifice run toward the right, the womb is twisted to the right; if, on the contrary, they turn toward the left it indicates that the womb is turned over in that direction. The direction of the twist must be known before treatment can be undertaken. Then, if the twist is toward the right, the cow is laid upon her right side, with her head down hill, the hand of the operator is introduced through the spirally constricted neck of the womb, and a limb or other portion of the body of the calf is seized and pressed firmly against the wall of the womb. Meanwhile two or three assistants roll the cow from her right side over her back to her left side. The object is to hold the womb and calf still while the body of the cow rolls over. If successful, the twist is undone, its grasp on the wrist is slackened, and the water bags and calf press into the now open passage. If the first attempt does not succeed it is to be repeated until success has been attained. If the spiral folds on the upper wall of the opening turn toward the left, the cow is laid on her left side and rolled over on her back and on to the right side, the hand being, as before, within the womb and holding the fetus, so that all may not rotate with the cow. In introducing the hand it will usually be found needful to perforate the membranes, so that a limb of the calf may be seized direct and firmly held. Among my occasional causes of failure with these cases have been, first, the previous death and decomposition of the fetus, leading to such overdistension of the womb that it could not be made to rotate within the abdomen; and, second, the occurrence of inflammation and an exudate on the twisted neck of the womb, which hindered it from untwisting.

In obstinate cases, in which the hand can be made to pass through the neck of the womb easily, additional help may be had from the use of the instrument shown in Plate XX, Fig. 5. Two cords, with running nooses, are successively introduced and made fast on two limbs of the calf; the cords are then passed through the two rings on the end of the instrument, which is passed into the womb and the cords drawn tight and fixed round the handle. Then, using the handle as a lever, it is turned in the direction opposite to the twist. The hand should meanwhile be introduced into the womb and the snared limbs seized and pressed against its walls so as to secure the rotation of the uterus along with the body of the fetus. The relaxation of the constriction and the effacement of the spiral folds will show when success has been gained, and the different members at one end of the body should then be brought up so as to secure a natural presentation.

NARROW PELVIS FROM FRACTURE OR DISEASE.

In a small cow the pelvis may be too small to pass a calf sired by a bull of a large breed, but this is exceptional, as the fetus usually accommodates itself to the size of the dam and makes its extra growth after birth. When the pelvic bones have been fractured repair takes place with the formation of a large permanent callus, which, projecting internally, may be a serious obstacle to calving. Worse still, if the edge of the broken bone projects internally as a sharp spike or ridge, as the vaginal walls are cut upon this during the passage of the calf, with serious or fatal result. In other cases, where the cow has suffered from fragility of bone (*fragilitas ossium*), the thickening of the bone causes narrowing of the long passage of the pelvis and the crumbling fractures poorly repaired, with an excess of brittle new material, may form an insuperable obstacle to parturition. Cows affected in any of these ways should never again be bred, but if they do get pregnant and reach full time a careful examination will be necessary to determine whether natural parturition can take place, or if the calf must be extracted in pieces. (See Embryotomy.)

OBSTRUCTION BY MASSES OF FAT.

This is not unknown in old cows of the beef breeds, the enormous masses of fat upon and within the pelvis being associated with weakness or fatty degeneration of the muscles. If the presentation is natural little more is wanted than a judicious traction upon the fetus to compress and overcome the soft resisting masses.

OBSTRUCTION BY A FULL BLADDER OR RECTUM, OR BY STONE.

In all cases of delayed or tardy parturition the evacuation of rectum and bladder is important, and it is no less so in all difficult parturitions. Stone in the bladder is fortunately rare in the cow, but when present it should be removed to obviate crushing and perhaps perforation of the organ during calving.

CALVING RETARDED BY NERVOUSNESS.

In a public fair-ground I have seen labor pains begin early in the day and keep up in a weak and insufficient manner for many hours, until the stall was thoroughly closed in and the cow secluded from the constant stream of visitors and the incessant noise, when at once the pains became strong and effective and the calf was soon born.

COAGULATED BLOOD UNDER THE VAGINAL WALLS.

This is common after calving, but will sometimes occur before, as the result of accidental injury. The mass may be recognized by its dark hue and the doughy sensation to the touch. It may be cut into and the mass turned out with the fingers, after which it should be washed frequently with an antiseptic lotion (carbolic acid 1 dram, in 1 quart water).

CONSTRICTION OF A MEMBER BY THE NAVEL STRING.

In early fetal life the winding of the navel-string round a limb may cause the latter to be slowly cut off by absorption under the constricting cord. So, at calving, the cord wound round a presenting member may retard progress somewhat, and though the calf may still be born tardily by the unaided efforts of the mother, it is liable to come stillborn because the circulation in the cord is interrupted by compression before the offspring can reach the open air and commence to breathe. If, therefore, it is possible to anticipate and prevent this displacement and compression of the navel string it should be done, but if this is no longer possible, then the extraction of the calf should be effected as rapidly as possible, and if breathing is not at once attempted it should be started by artificial means.

WATER IN THE HEAD (HYDROCEPHALUS) OF THE CALF.

This is an enormous distention of the cavity holding the brain, by reason of the accumulation of liquid in the internal cavities (ventricles) of the brain substance. The head back of the eyes rises into a great rounded ball (Plate XIX, Figs. 4 and 5), which proves an insuperable obstacle to parturition. The fore feet and nose being the parts presented, no progress can be made, and even if the feet are pulled upon, the nose can not by any means be made to appear. The oiled hand introduced into the passages will feel the nose presenting between the fore limbs, and on passing the hand back over the face the hard rounded mass of the cranium is met with. A sharp pointed knife or a canula and trocar should be introduced in the palm of the hand, and pushed into the center of the rounded mass so as to evacuate the water. The hand is now used to press together the hitherto distended but thin and fragile walls, and the calf may be delivered in the natural way. If the enlarged head is turned backward it must still be reached and punctured, after which it must be brought up into position and the calf delivered.

If the hind feet present first, all may go well until the body and shoulders have passed out, when further progress is suddenly arrested by the great bulk of the head. If possible the hand, armed with a knife or trocar, must be passed along the side of the shoulder or neck so as to reach and puncture the distended head. Failing in this the body may be skinned up from the belly and cut in two at the shoulder or neck, after which the head can easily be reached and punctured. In such a case the fore limbs have been left in the womb, and these may now be brought up into the passage and when dragged upon, the collapsed head will follow.

If the distention is not sufficient to have rendered the bony walls of the cranium thin and fragile, so that they can be compressed with the hand after puncture, a special method may be necessary. A long incision should be made from behind forward in the median line of the cranium with an embryotomy knife (Plate XXI, Fig. 1) or with a long embryotome (Plate XX, Fig. 3). By this means the bones on the one side are completely separated from those on the other, and may be made to overlap and perhaps to flatten down. If this fails they may be cut from the head all around the base of the rounded cranial swelling, by means of a guarded chisel (Plate XX, Fig. 8) and mallet, after which there will be no difficulty in causing them to collapse.

DROPSY OF THE ABDOMEN OF THE CALF—ASCITES.

This is less frequent than hydrocephalus, but no less difficult to deal with. With an anterior presentation the fore limbs and head may come away easily enough, but no effort will advance the calf beyond the shoulders. The first thought should be dropsy of the belly, and the oiled hand introduced by the side of the chest will detect the soft and fluctuating yet tense sac of the abdomen. If there is space to allow of the introduction of an embryotomy knife the abdomen may be freely cut with this, when the fluid will escape into the womb and parturition may proceed naturally. If this can not be effected a long trocar and canula may be passed between the first two ribs and straight on beneath the spine until it punctures the abdomen. (Plate XVIII, Fig. 2.) Then the trocar is to be withdrawn and the liquid will flow through the canula and will be hastened by traction on the fore limbs. In the absence of the trocar and canula, two or three of the first ribs may be cut from the breastbone so that the hand may be introduced through the chest to puncture the diaphragm with an embryotomy knife and allow an escape of the water. In some slighter cases a tardy delivery may take place without puncture, the liquid bulging forward into the chest as the abdomen is compressed in the pelvic passages. With a posterior presentation the abdomen may be punctured more easily either in the flank or with a trocar and canula through the anus.

GENERAL DROPSY OF THE CALF.

This occurs from watery blood or disease of some internal organ, like the liver or kidney, and is recognized by the general puffed up and rounded condition of the body, which pits everywhere on pressure but without crackling. If not too extreme a case the calf may be extracted after it has been very generally punctured over the body, but usually the only resort is to extract it in pieces. (See Embryotomy).

SWELLING OF THE CALF WITH GAS.

This is usually the result of the death and decomposition of the fetus when extraction has been delayed for a day or more after the escape of the waters. It is impossible to extract it whole, owing to its large size and the dry state of the skin of the calf, the membranes, and the wall of the womb. These dry surfaces stick with such tenacity that no attempt at traction leads to any advance of the calf out of the womb or into the passages. When the fetus is advanced the adherent womb advances with it, and when the strain is relaxed both recede to where they were at first. The condition may be helped somewhat by the free injection of oil into the womb, but it remains impossible to extract the enormously bloated body, and the only resort is to cut it in pieces and extract it by degrees. (See Embryotomy).

RIGID CONTRACTIONS OF MUSCLES.

In the development of the calf, as in after life, the muscles are subject to cramps, and in certain cases given groups of muscles remain unnaturally short, so that even the bones grow in a twisted and distorted way. In one case the head and neck are drawn round to one side and can not be straightened out, even the bones of the face and the nose being curved around to that side. In other cases the flexor muscles of the fore legs are so shortened that the knees are kept constantly bent and can not be extended by force. The bent neck may sometimes be sufficiently straightened for extraction by cutting across the muscles on the side to which it is turned, and the bent knees by cutting the cords on the back of the shank bones just below the knees. If this fails there remains the resort of cutting off the distorted limbs or head. (See Embryotomy).

TUMORS OF THE CALF—INCLOSED OVUM.

Tumors or new growths grow on the unborn calf as on the mature animal, and by increasing the diameter of the body render its passage through the passage of the pelvis impossible. In my experience with large fleshy tumors of the abdomen, I have cut open the chest, removed the lungs and heart, cut through the diaphragm with the knife, and removed the tumor piecemeal by alternate tearing and cutting until the volume of the body was sufficiently reduced to pass through. Where this failed it would remain to cut off the anterior part of the body, removing as much of the chest as possible, and cutting freely through the diaphragm; then, pushing back the remainder of the body, the hind limbs may be seized and brought into the passages, and the residue extracted thus. The tumor, unless very large, will get displaced backward so as not to prove an insuperable obstacle.

In many cases the apparent tumor is a blighted ovum which has failed to develop, but has grafted itself on its more fortunate twin and from it has drawn its nourishment. These are usually sacs containing hair, skin, muscle, bone, or other natural tissues, and only exceptionally do they show the distinct outline of the animal.

MONSTROSITY IN THE CALF.

As a monstrous development in the calf may hinder calving, it is well to consider shortly the different directions in which these deviations from the natural form appear. Their origin and significance will be rendered clearer if we divide them according to the fault of development in individual cases. Monsters are such—

(1) From absence of parts—absence of head, limb, or other organ—arrested development.

(2) From some organ being unnaturally small, as a dwarfed head, limb, trunk, etc.—arrested development.

(3) From unnatural division of parts—cleft lips, palate, head, trunk, limbs, etc.—abnormal growth.

(4) From the absence of natural divisions—absence of mouth, nose, eye, anus, the cloven foot of ox or pig becomes solid like that of the horse, etc.—confluence of parts which are rightfully separate.

(5) From the fusion of parts—both eyes replaced by central one, both nostrils merged into one central opening, etc.—confluence of parts.

(6) From unnatural position or form of parts—curved nose, neck, back, limbs, etc.—lack of balance in the growth of muscles during development.

(7) From excessive growth of one or more organs—enormous size of head, double penis, superfluous digits, etc.—redundancy of growth at given points.

(8) From imperfect differentiation of the sexual organs—hermaphrodites (organs intermediate between male and female), male organs with certain feminine characters, female organs with certain well-marked male characters.

(9) From the doubling of parts, or of the entire body—double monsters, double heads, double bodies, extra limbs, etc.—redundant development. (Plate XIX, Figs. 1, 2, 3.)

The *causes* of monstrosities are varied. Some, like extra digits, lack of horns, etc., run in families, which produce them with absolute certainty when bred in the direct line, although they were originally acquired peculiarities, which have merely been fixed by long habit in successive generations. The earliest horse had five toes, and even the most recent fossil horse had three toes, of which the two lateral ones are still represented in the modern horse by the two splint bones. Yet if our horse develops an extra toe it is pronounced a monstrosity. A more genuine monstrosity is the solid-hoofed pig, in which two toes have been merged into one. Another of the same kind is the solid shank bone of the ox, which consists of two bones united into one, but which are still found apart in the early fetus. Though originally acquired peculiarities, these now breed as invariably as color or form.

Other monstrosities seem to have started in too close breeding, by which the powers of symmetrical development are impaired, just as the procreative power weakens under continuous breeding from the closest blood relations. A monstrosity consisting in the absence of an organ often depends on a simple lack of development, the result of disease or injury, as a young bone is permanently shortened by being broken across the soft part between the shaft and the end, the only part where increase in length can take place. As the result of the injury the soft growing layer becomes prematurely hard and all increase in length at that end of the bone ceases. This will account for some cases of absence of eye, limb, or other organ.

Sometimes a monstrosity is due to the inclosure of one ovum in another, while the latter is still but a soft mass of cells and can easily close around the first. Here each ovum has an independent life, and they develop simultaneously, only the outer one having direct connection with the womb, and being furnished with abundant nourishment advances most rapidly and perfectly, while the inclosed and starved ovum is dwarfed and imperfect often to the last degree.

In many cases of excess of parts, the extra part or member is manifestly derived from the same ovum, and even the same part of the ovum, being merely effort of a redundancy and vagary of growth. Such cases include most instances of extra digits or other organs, and even of double monsters, as manifested by the fact that such extra organs grow from the normal identical organs. Hence the extra digit is attached to the normal digit, the extra head to the one neck, and extra tail to the croup, extra teeth to the existing teeth, and even two similarly formed bodies are attached by some point common to both, as the navels, breastbones, back, etc. (Plate XIX, Figs. 1, 2, 3.) This shows that both have been derived from the same primitive layer of the embryo, which possessed the plastic power of building up a given structure or set of organs. An inclosed ovum, on the other hand, has no such identity or similarity of structure to the part with which it is connected, showing an evident primary independence of both life and the power of building tissues and organs. The power of determining extra growth along a given natural line is very highly developed in the early embryo, and is equally manifest in the mature example of some of the lower forms of animal life. Thus a newt will grow a new tail when that member has been cut off, and a starfish will develop as many new starfishes as the pieces made by cutting up the original one. This power of growth in the embryo and in the lower forms of animals is comparable to the branching out again of a tree at the places from which branches have been lopped. The presence of this vegetable-like power of growth in the embryo accounts for most double monsters.

The influence of disease in modifying growth in the early embryo, increasing, decreasing, distorting, etc., is well illustrated in the experiments of St. Hilaire and Valentine in varnishing, shaking, or otherwise disturbing the connections of eggs, and thereby producing monstrosities. One can easily understand how inflammations and other causes of disturbed circulation in the womb, fetal membranes, or fetus would cause similar distortions and variations in the growing offspring. It is doubtless largely in the same way that certain mental disturbances of a very susceptible dam affect the appearance of the progeny. The monstrosities which seriously interfere with calving are mainly such as consist in extra members or head, which can not be admitted into the passages at the same time; where some organ of the body has attained to extra size; where a blighted ovum has been inclosed in the body of a more perfect one, or where the body or limbs are so contracted or twisted that the calf must enter the passages doubled up.

Extraction is sometimes possible by straightening the distorted members by the force of traction; in other cases the muscles or tendons must be cut across on the side to which the body or limbs are bent, to allow of such straightening. Thus the muscles on the concave side of a wry neck, or the cords behind the shank bones of a contracted limb may be cut to allow of these parts being brought into the passages, and there will still be wanting the methods demanded for bringing up missing limbs or head, for which see paragraphs below. In most cases of monstrosity by excess of overgrowth it becomes necessary to cut off the supernumerary or overdeveloped parts, and in this the same general principles must be followed as laid down in Embryotomy.

TABLE OF WRONG PRESENTATIONS OF THE CALF.

Simultaneous presentation of twins.

Anterior presentations.	Fore limbs	Limbs curved at the knee. Flexor tendons shortened.
		Limb crossed over the back of the neck.
		Limb bent back at the knee.
		Limb bent back from the shoulder.
	Head	Head bent downward on the neck.
		Head and neck turned downward beneath the breast.
		Head turned to one side upon the side of the neck.
		Head and neck turned back on the side of the chest and abdomen
		Head turned upward and backward on the back.
	Hind limbs	Hind limbs rotated outward. Toes and stifles turned outward.
		Hind limbs bent forward, their feet resting in the pelvis.
	Transverse	Back of the calf turned to the right or left side.
	Inverted	Back of the calf turned to the floor of the pelvis and udder.
Posterior presentation.	Hind limbs	Hind limb bent on itself at the hock. Hock and buttocks present.
		Hind limb bent at the hips. Buttocks present.
	Transverse	Back of calf turned to the right or left side.
	Inverted	Back of calf turned to the floor of the pelvis and udder.

Trunk presentations.	Back and loins presented.	Position of calf vertical....	Head up toward the spine, croup toward udder.
			Head down toward udder, croup toward spine.
		Position of calf transverse...	Head toward the right side, croup toward the left.
			Head toward the left side, croup toward the right.
	Breast and abdomen presented.	Position of calf transverse...	Head toward right side, croup toward left.
			Head toward left side, croup toward right.

These include all general presentations, yet other subsidiary ones will at once occur to the attentive reader. Thus, in each anterior or posterior presentation, with the back of the calf turned downward or to one side, the case may be complicated by the bending back of one or more members as a whole, or at the joint just above the shank-bones (knee or hock). So also in such anterior presentation the head may be turned back.

HEAD AND FORE FEET PRESENTED—BACK TURNED TO ONE SIDE.

The calf has a greater diameter from above down (spine to breast-bone) than it has from side to side, and the same is true of the passage of the pelvis of the cow, which measures, on an average, $8\frac{7}{10}$ inches from above downward, and $7\frac{9}{10}$ inches from side to side. Hence, the calf passes most easily with its back upward, and when turned with its back to one side calving is always tardy and may be difficult or impossible. The obvious remedy is to rotate the calf on its own axis until its spine turns towards the spine of the cow. The operation is not difficult if the body of the calf is not yet fixed in the passages. The presenting feet are twisted over each other in the direction desired, and this is continued until the head and spine have assumed their proper place. If the body is firmly engaged in the passages the skin of the whole engaged portion should be freely lubricated with lard, and the limbs and head twisted over each other as above. The limbs may be twisted by an assistant where the head is manipulated by the operator, who drags on the rope turned halfway round the limbs, and assists in the rotation with his other hand in the passages.

HEAD AND FORE FEET PRESENTED—BACK TURNED DOWN TOWARD THE UDDER.

This position (Plate XVI, Fig. 6) is unnatural, and the parturition is difficult for two reasons: first, the natural curvature of the fetus is opposed to the natural curvature of the passages; and, second, the thickest part of the body of the calf (the upper) is engaged in the narrowest part of the passage of the pelvis (the lower.) Yet unless the calf is especially large and the pelvis of the cow narrow, parturition may usually be accomplished in this way spontaneously, or with very little assistance in the way of traction on the limbs. If this can not be accomplished two courses are open: first, to take the calf as when the back is turned to one side, and, second, to push back the presenting fore limbs and head, and search for and bring up the hind limbs, when the presentation will be a natural posterior one.

PRESENTATION OF THE HIND FEET WITH THE BACK TURNED TO ONE SIDE OR DOWNWARD.

These are the exact counterparts of the two conditions last described, are beset with similar drawbacks, and are to be dealt with on the same general principles. (Plate XVII, Fig. 4.) With the back turned to one side, the body should be rotated until the back turns toward the spine of the dam, and with the back turned down it must be extracted in that position (care being taken that the feet do not perforate the roof of the vagina), or it must be rotated on its own axis until the back turns upward, or the hind limbs must be pushed back and the fore limbs and head advanced, when the presentation will be a natural anterior one.

IMPACTION OF TWINS IN THE PASSAGE.

It is very rare to have twins enter the passages together so as to become firmly impacted. As a rule each of the twins has its own separate membranes, and as the water-bags of the one will naturally first enter and be the first to burst, so the calf which occupied those membranes will be the first to enter the passage and the other will be thereby excluded. When the membranes of both twins have burst without either calf having become engaged in the pelvis, it becomes possible for the fore legs of the one and the hind legs of the other to enter at one time, and if the straining is very violent they may become firmly impacted. (Plate XVIII, Fig. 1.) The condition may be recognized by the fact that two of the presenting feet have their fronts turned forward, while the two others have their fronts turned backward. If the four feet belonged to one natural calf they would all have the same direction. By means of this difference in direction we can easily select the two feet of one calf, place running nooses upon them just above the hoofs or fetlocks, and have an assistant drag upon the ropes while the feet of the other calf are pushed back. In selecting one of the twins to come first several considerations should have weight. The one that is most advanced in the passage is, of course, the first choice. Though the forefeet of one are presented, yet if the head is not in place, the calf presenting by its hind feet is to be chosen as being less likely to obstruct. Again, if for either calf one limb only is presented and the other missing, the one presenting two feet should be selected to come first. As soon as the one calf has been advanced so as to occupy the pelvis, the other will be crowded back so that it will not seriously obstruct.

FORE LIMBS CURVED AT THE KNEE—LIMBS SPRAWLING OUTWARD.

In this case not only are the knees somewhat bent in a curve but the calf has a position as if it rested on its breastbone, while the legs were drawn apart and directed to the right and left. The shoulder blades being drawn outward from the chest and the elbows turned out, the muscles extending from the trunk to the limb are unduly stretched and keep the knees bent and the feet directed outward so as to press on the sides of the passages. They become retarded in their progress as compared with the more rapidly advancing head, and may bruise or even lacerate the walls of the vagina. It would seem easy to rectify this by extending the legs, but the already tense and overstretched muscles operate against extension in the present position, and it is not easy to rotate the limbs so as to apply the shoulder flat against the side of the chest. Under these circumstances a repeller (Plate XX, Fig. 7) may be planted in the breast, and the body of the calf pushed backward into the womb, when the limbs will extend easily under traction and the presentation becomes at once natural.

FORE LIMBS CURVED AT KNEE—FLEXOR TENDONS SHORTENED.

In this case the feet will press against the floor of the pelvis though the limb has no outward direction, and the shoulder meanwhile presses against the roof of the same passage. Unless the knees can be sufficiently straightened by force a knife must be employed to cut across the cords behind the knee, when the limbs may be straightened sufficiently.

FORE LIMBS FLEXED AT KNEE—FLEXOR TENDONS UNSHORTENED.

This is mostly seen in cases in which the body of the calf is in the proper position, its back being turned up toward the back of the dam, and in cows with a drooping abdomen. The feet have been supposed to catch beneath the brim of the pelvis and being retarded while the head advances into the passages they get bent at the knee, and the nose and knees present. (Plate XVI, Fig. 2.) The calf, however, is not an inanimate body advanced by the mere contraction of the womb, but it moves its limbs freely under the stimulus of the unwonted compression, and in moving the feet as they are advanced they slip down over the pelvic brim and finding no other firm support they bend back until, under the impulsion, they can no longer straighten out again. The knees, therefore, advance with the neck and head, but the feet remain bent back. The result is that the upper part of the limb is also flexed, and the shoulder blade and arm bone with their masses of investing muscles are carried backward and applied on the side of the chest, greatly increasing the bulk of this already bulky part. As the elbow is carried back on the side of the chest, the forearm from elbow to knee further increases the superadded masses of the shoulder and renders it difficult or impossible to drag the mass through the passages. When the fore limbs are fully extended, on the contrary, the shoulder blade is extended forward on the smallest and narrowest part of the chest; the arm bone with its muscles is in great part applied against the side of the back part of the neck, and the forearm is continued forward by the side of the head so that the nose lies between the knees. In this natural presentation the presenting body of the calf forms a long wedge or cone, the increase of which is slow and gradual until it reaches the middle of the chest.

The difficulty of extending the fore limbs will be in proportion to the advance of the head through the pelvic cavity. In the early stage all that is necessary may be to introduce the oiled hand, the left one for the right leg or the right one for the left, and passing the hand from the knee on to the foot to seize the foot in the palm, bend it forcibly on the fetlock, and lift it up over the brim of the pelvis, the knee being, of course, pressed upward against the spine. As soon as the foot has been raised above the brim of the pelvis (into the passage) the limb can be straightened out with the greatest ease.

When, however, the shoulders are already engaging in the pelvis the feet can not thus be lifted up, and to gain room a repeller (Plate XX, Fig. 7) must be used to push back the body of the calf. This is an instrument with a long straight stem, divided at the end into two short branches (2 to 3 inches long) united to the stem by hinges so that they can be brought into a line with the stem for introduction into the womb and then spread to be implanted in the breast. In the absence of a repeller a smooth round fork-handle may be used, the prongs having been removed from the other end. A third device is to have an assistant strip his arm to the shoulder and, standing back to back with the operator, to introduce his right arm into the passages along with the operator's left (or *vice versa*) and push back the body of the calf while the operator seeks to bring up a limb. The repeller or staff having been planted safely in the breast of the calf, an assistant pushes upon it in a direction either forward or slightly upward so as not only to follow the natural curve of the body and favor its turning in the line of that curve within the womb, but also to carry the shoulders upward toward the spine and secure more room for bringing up the missing feet. It is good policy to first put a halter (Plate XXI, Figs. 4*a* and 4*b*) on the head or a noose (Plate XXI, Fig. 3) on the lower jaw and a rope round each limb at the knee so as to provide against the loss of any of these parts when the body is pushed back into the womb. This offers the further advantage that by dragging upon these ropes the body can be advanced in the passage until the foot is reached, when the rope must be slackened and the repeller used to secure room for bringing up the foot. If the cow is lying, the operator should first secure the foot on the upper side and then, if necessary, turn the cow on its opposite side so as to bring up the other.

In using the instruments some precautions are demanded. They must be invariably warmed before they are introduced, and they should be smeared with lard or oil to make them pass easily and without friction. The assistant who is pushing on the instrument must be warned to stop if at any time resistance gives way. This may mean the turning of the fetus, in which case the object of repulsion has been accomplished; but much more probably it implies the displacement of the instrument from the body of the fetus, and unguarded pressure may drive it through the walls of the womb.

When the calf entered the passage with its back turned down toward the belly and udder, the bending back of the fore limbs is rare, probably because the feet can find a straighter and more uniform surface of resistance in the upper wall of the womb and the backbone, and do not slide over a crest into an open cavity as they do over the brim of the pelvis. The weight of the calf, too, gravitating downward, leaves more room for the straightening of the bent limbs, so that the desired relief is much more easily secured. The manipulation is the same in principle, only one must add the precaution of a steady traction on the feet in extraction, lest, owing to the adverse curvature of the fetus, the hoofs be suddenly forced through the roof of the vagina, and, perhaps, the rectum as well, during a specially powerful labor pain.

When the back of the calf is turned to the right side or the left, the main difference is that in addition to straightening the limbs the fetus must be rotated to turn its back upward before extraction is attempted. In this case, too, it may be difficult to bring up and straighten the lower of the two limbs until the body has been rotated into its proper position. Cord the upper straightened limb and head, then rotate the body, and search for the second missing limb.

FORE LIMBS BENT BACK FROM THE SHOULDERS.

This is an exaggeration of the condition just named, and is much more difficult to remedy, owing to the distance and inaccessibility of the missing limb. It usually happens with the proper position of the body, the back of the calf being turned toward the back of the mother. The head presents in the passage, and may even protrude from the vulva during an active labor pain, but it starts back like a spring when the straining ceases. Examination with the oiled hand in the intervals between the pains fails to detect the missing limb or limbs. (Plate XVI, Fig. 1.) If, however, the hand can be introduced during a pain it may be possible to reach the elbow or upper part of the fore arm. In the absence of a pain a halter or noose on the head may be used to advance the whole body until the forearm can be seized just below the elbow. This being firmly held, and the head or body pushed back into the womb, room may be secured for bringing up the knee. The forearm is used as a lever, its upper part being strongly forced back while its lower part is pressed forward. If a pain supervenes the hold must be retained, and whatever gain has been made must be held if possible.

Then during the next pain, by pushing back the body and continuing to operate the forearm as a lever, a still farther advance may be made. As the knee is brought up in this way, the hand is slid down from the elbow toward the knee, which is finally brought up over the brim of the pelvis and into the passage. It is now corded at the knee, and the subsequent procedure is as described in the last article. In a large roomy cow with a small calf the latter may pass with one or both fore legs bent back, but this is a very exceptional case, and as early assistance is the most successful, there should never be delay in hope of such a result.

ONE FORE LIMB CROSSED OVER THE BACK OF THE NECK.

This is a rare obstacle to calving, but one that is not altogether unknown. The hand introduced into the passage feels the head and one fore foot, and farther back on the same side the other foot, from which the limb can be traced obliquely across the back of the neck. (Plate XVI, Fig. 3.) This foot projecting transversely is liable to bruise or tear the vagina. If still deeply engaged in the vagina, it may be seized and pushed across to the opposite side of the neck, when the presentation will be natural.

THE HEAD BENT DOWN BENEATH THE NECK.

In this case, with drooping belly and womb allowing the brim of the pelvis to form a ridge, the advancing calf having unduly depressed its nose strikes it on the brim of the pelvis, and the neck advancing, the head is bent back and the poll and ears either enter the pelvis or strike against its brim. The two fore feet present, but they make no progress, and the oiled hand introduced can detect no head until the poll is felt at the entrance of the pelvis, between the fore arms. The two fore feet must be fixed with running nooses, and dragged on moderately while the oiled hand seeks to bring up the head. The hand is slid down over the forehead and brim of the pelvis until the nose is reached, when it is passed into the mouth, the muzzle resting in the palm of the hand. The legs are now pushed upon, and in the space thus gained the muzzle is drawn up so as to enter it into the pelvis. In doing this the operator must carefully see that the mouth does not drop open so that the sharp front teeth cut through the floor of the womb. Should this danger threaten, the hand should be made to cover the lower jaw as well. The lessened security of the hold is more than compensated by the safety of the procedure. With the nose in the pelvis it has only to be drawn forward and the parturition is natural.

HEAD BENT DOWN BENEATH THE BREAST.

This is an exaggerated condition of that last named. The head arrested by the brim of the pelvis and already bent back on the neck, is pressed farther with each successive throe until it has passed between the fore legs and lodges beneath the breast bone. (Plate XVI, Fig. 4.) On examination the narrow upper border of the neck is felt between the fore arms, but as a rule the head is out of reach below. Keeping the hand on the neck and dragging on the feet by the aid of ropes, the hand may come to touch and seize the ear, or still better, one or two fingers may be inserted into the orbit of the eye. Then, in pushing back upon the limbs, with or without the aid of a repeller applied against the shoulder, space may be secured to draw the head into a vertical position, and even to slip down the hand so as to seize the nose. Should it prove impossible to draw up the head with the unassisted fingers, a blunt hook (Plate XXI, Fig. 6) may be inserted into the orbit, on which an assistant may drag while another pushes upon the limbs or repeller. Meanwhile the operator may secure an opportunity of reaching and seizing the nose or of passing a blunt hook into the angle of the mouth. Success will be better assured if two hooks (Plate XXI, Fig. 7) are inserted in the two orbits so as to draw up the head more evenly. In other cases a noose may be placed on the upper jaw, or even around both jaws, and traction made upon this and on the hooks in the orbits while the legs are pushed back, and while the operator pushes back on the poll or forehead. In still more difficult cases in which even the orbits can not be reached a sharp hook on the end of a straight iron rod (Plate XX, Fig. 2) may be inserted over the lower jaw as far forward as it can be reached, and by dragging upon this while the body is pushed back the head will be brought up sufficiently to allow the operator to reach the orbit or nose. If even the jaw can not be reached the hook may be inserted in the neck as near to the head as possible and traction employed so as to bring the head within reach.

In all such cases the cow's head should be turned downhill, and in case of special difficulty she should be turned on her back and held there until the head is secured. In old standing cases, with the womb closely clasping the body of the calf, relaxation may be sought by the use of chloroform or a full dose of chloral hydrate, 2 ounces; and the free injection of warm water into the womb will also be useful.

HEAD TURNED BACK ON THE SHOULDER.

With a natural anterior presentation this may happen because of the imperfect dilatation of the mouth of the womb. Under the throes of the mother the fore feet pass through the narrow opening into the vagina, while the nose striking against it, and unable to enter, is pressed backward into the womb and turns aside on the right or left shoulder. The broad muzzle of the calf forms an especial obstacle to entrance and favors this deviation of the head. The worst form of this deviation is the old standing one with shortening of the muscles of the neck on that side, and oftentimes distortion of the face and neck bones, as noticed under monstrosities.

When the head is bent on the shoulder the feet appear in the natural way, but no progress is made, and examination reveals the absence of the nose from between the knees, and farther back from above and between the elbows a smooth rounded mass is felt extending to the right or left, which further examination will identify with the neck. Following the upper border of this the hand reaches the crown of the head with the ears, and still farther the eyes, or even in a small calf the nose.

As the bulky head of the calf can not be extracted along with the shoulders it becomes necessary to push back the body of the fetus and straighten out the head and neck. The cow should be laid with its head downhill and with that side up toward which the head is turned. If the throes are very violent, or the womb strongly contracted on the calf, it may be best to seek relaxation by giving chloroform, or 2 ounces of laudanum, or 2 ounces chloral hydrate. If the calf or the passages are dry, sweet oil may be injected, or the whole may be liberally smeared with fresh lard. In the absence of these, warm water rendered slightly slippery by castile soap may be injected into the womb in quantity. Ropes with running nooses are placed on the presenting feet and the oiled hand introduced to find the head. If, now, the fingers can be passed inside the lower jaw bone, and drag the head upward and toward the passage, it unwinds the spiral turn given to the neck in bending back, and greatly improves the chances of bringing forward the nose. If, at first, or if now, the lower jaw can be reached, a noose should be placed around it behind the incisor teeth and traction made upon this so that the head may continue to be turned, forehead up, toward the spine and jaws down, thereby continuing to undo the screw-like curve of the neck. If, on the contrary, the nose is dragged upon by a cord passing over the upper border of the neck, the screw-like twist is increased and the resistance of the bones and joints of the neck prevents any straightening of the head. As soon as the lower jaw has been seized by the hand or noose, a repeller (Plate XX, Fig. 7), planted on the inside of the elbow or shoulder most distant from the head, should be used to push back the body and turn it in the womb so that the head may be brought nearer to the outlet. In this way the head can usually be brought into position and the further course of delivery will be natural.

But sometimes the lower jaw can not be reached with the hand, and then the orbit or, less desirably, the ear, may be availed of. The ear may be pulled by the hand, and by the aid of the repeller on the other shoulder the calf may be so turned that the lower jaw may be reached and availed of. Better still, a clamp (Plate XVIII, Figs. 3 and 4) is firmly fixed on the ear and pulled by a rope, while the repeller is used on the opposite shoulder, and the hand of the operator pulls on the lower border of the neck and lifts it toward the other side. To pull on the upper border of the neck is to increase the spiral twist, while to raise the lower border is to undo it. If the outer orbit can be reached, the fingers may be inserted into it so as to employ traction, or a blunt finger hook (Plate XXI, Fig. 8) may be used, or a hook with a rope attached, or, finally, a hook on the end of a long staff. Then, with the assistance of the repeller, the body may be so turned and the head advanced that the lower jaw may be reached and availed of.

In case not even the ears nor orbit can be reached, a cord should be passed around the neck of the calf as near to the head as possible, and traction made upon that while the opposite shoulder is pushed toward the opposite side by the repeller, assisted by the hand dragging on the lower border of the neck. To aid the hand in passing a rope round the neck a cord-carrier (Plate XXI, Fig. 5) is in use. It fails, however, to help us in the most difficult part of the operation, the passing of the cord down on the deep or farthest side of the neck, and, to remedy this, I have devised a cord-carrier, furnished with a ring at the end, a joint 6 or 8 inches from the end, and another ring on the handle, close to this joint. (Plate XX, Fig. 4.) A cord is passed through both rings and a knot tied on its end, just back of the terminal ring. The instrument, straightened out, is inserted until it reaches just beyond the upper border of the neck, when, by dragging on the cord the movable segment is bent down on the farther side of the neck, and is pushed on until it can be felt at its lower border. The hand now seizes the knotted end of the cord beneath the lower border of the neck and pulls it through while the carrier is withdrawn, the cord sliding through its rings. The cord, pushed up as near to the head as possible, is furnished with a running noose by tying the knotted end round the other, or better, the two ends are twisted around each other so as to give a firm hold on the neck without dangerously compressing the blood vessels. By pushing on the opposite shoulder with the repeller, and assisting with the hand on shoulder, breastbone, or lower border of the neck, such a change of position will be secured as will speedily bring the head within reach. Afterward proceed as described above.

These cases are always trying, but it is very rarely necessary to resort to embryotomy. When absolutely required first remove one fore limb, and then, if still unsuccessful, the other, after which the head can easily be secured. (See Embryotomy, p. 222.)

HEAD TURNED UPWARD AND BACKWARD.

In this case the face rests upon the spine; the fore feet appear alone in the passage, but fail to advance, and on examination the rounded inferior border of the neck can be felt, extending upward and backward beneath the spine of the dam, and if the calf is not too large the hand may reach the lower jaw or even the muzzle. (Plate XVI, Fig. 5.)

A repeller is planted in the breast and the body of the calf pushed backward and downward so as to make room and bring the head nearer to the passage. Or in some cases the body may be pushed back sufficiently by the use of the fore limbs alone. Meanwhile the head is seized by the ear or the eye socket, or, if it can be reached, by the lower jaw, and pulled downward into position as space is secured for it. If the hand alone is insufficient the blunt hooks may be inserted in the orbits or in the angle of the mouth, or a noose may be placed on the lower jaw, and by traction the head will be easily advanced. In case of a large fetus, the head of which is beyond reach, even when traction is made on the limbs, a rope may be passed around the neck and pulled, while the breast-bone is pressed downward and backward by the repeller, and soon the change of position will bring the orbit or lower jaw within reach. With the above position the standing position is most favorable for success. But if the calf is placed with its back down toward the udder, and if the head is bent down under the brim of the pelvis, the best position for the cow is on her back, with her head downhill.

In neglected cases, with death and putrefaction of the fetus and dryness of the passages, it may be necessary to extract in pieces. (See Embryotomy.)

OUTWARD DIRECTION OF THE STIFLES—ABDUCTION OF HIND LIMBS.

As an obstacle to parturition, this is rare in cows. It is most likely to take place in cows with narrow hip bones, and when the service has been made by a bull having great breadth across the quarter. The calf, taking after the sire, presents an obstacle to calving in the breadth of its quarters; and if at the same time the toes and stifles are turned excessively outward and the hocks inward the combined breadth of the hip bones above and the stifles below may be so great that the pelvis will not easily admit them. After the fore feet, head, and shoulders have all passed out through the vulva further progress suddenly and unaccountably ceases, and some dragging on the parts already delivered does not serve to bring away the hind parts. The oiled hand introduced along the side of the calf will discover the obstacle on the stifle joints turned directly outward and projecting on each side beyond the bones which circumscribe laterally the front entrance of the pelvis. The evident need is to turn the stifles inward, and this may be attempted by the hand introduced by the side of the calf, which is meanwhile rotated gently on its own axis to favor the change of position. To correct the deviation of the hind limb is, however, very difficult, as the limbs themselves are out of reach and can not be used as levers to assist. If nothing can be done by pushing back the body of the calf and rotating it, and by pressure by the hand in the passages, the only resort appears to be to skin the calf from the shoulder back, cut it in two as far back as can be reached, then push the buttocks well forward into the womb and bring up the hind feet and so deliver.

THE HIND LIMBS EXCESSIVELY BENT ON THE BODY AND ENGAGED IN THE PELVIS.

In this case the presentation is apparently a normal anterior one; fore limbs and head advance naturally and the parturition proceeds until half the chest has passed through the external passages, when suddenly progress ceases and no force will secure farther advance. An examination with oiled hand detects the presence in the passages of the hind feet and usually the hind legs up to above the hocks. (Plate XVII, Fig. 1.)

The indications for treatment are to return the hind limbs into the body of the womb. If they have not advanced too far into the pelvis this may be done as follows: A rope with running noose is passed over each hind foot and drawn tight around the lower part of the hock; the ropes are then passed through the two rings in the small end of the rotating instrument (Plate XX, Fig. 5) which is slid into the passages until it reaches the hocks, when the ropes, drawn tight, are tied round the handle of the instrument. Then in the intervals between the pains the hocks are pushed forcibly back into the womb. If by this means flexion can be effected in hocks and stifles success will follow; the hind feet will pass into the womb and clear of the brim of the pelvis, and the body may now be advanced without hindrance, the hind limbs falling into place when the hip joints are extended. At the same time the pressure upon hind limbs must not be relaxed until the buttocks are engaged in the pelvis, as otherwise the feet may again get over the brim and arrest the progress of delivery.

When the hind limbs are already so jammed into the pelvis that it is impossible to return them, the calf must be sacrificed to save the mother. Cords with running nooses are first put on the two hind feet. The body must be skinned from the shoulders back as far as can be reached, and is to be then cut in two, if possible, back of the last rib. The remainder of the trunk is now pushed back into the body of the womb, and by traction upon the cords the hind feet are brought up into the passages, and the extraction will be comparatively easy.

HIND PRESENTATION WITH ONE OR BOTH LEGS BENT AT THE HOCK.

After the bursting of the water bags, though labor pains continue, no part of the fetus appears at the vulva unless it be the end of the tail. On examination the buttocks are felt wedged against the spine at the entrance of the pelvis, and beneath them the bent hock joints resting on the brim of the pelvis below. (Plate XVII, Fig. 3.) The calf had been caught by the labor pains while the limb was bent beneath it, and has been jammed into or against the rim of the pelvis so that extension of the limb became impossible. With the thigh bent on the flank, the leg on the thigh, and the shank on the leg, and all at once wedged into the passage, delivery is practically impossible.

The obvious remedy is to push the croup upward and forward and extend the hind legs, and in the early stages this can usually be accomplished in the cow. A repeller (Plate xx, Fig. 7) is planted across the thighs and pointed upward toward the spine of the cow, and pushed forcibly in this direction during the intervals between labor pains. Meanwhile the oiled hand seizes the shank just below the hock and uses it as a lever, pushing back the body and drawing forward the foot, thus effectually seconding the action of the repeller. Soon a distinct gain is manifest, and as soon as the foot can be reached it is bent back strongly at the fetlock, held in the palm of the hand and pulled up, while the repeller, pressing on the buttocks, assists to make room for it. In this way the foot may be brought safely and easily over the brim of the pelvis without any risk of laceration of the womb by the foot. After the foot has been lifted over the brim the whole limb can be promptly and easily extended. In cases presenting special difficulty in raising the foot over the brim, help may be had by traction on a rope passed around in front of the hock, and later still by a rope with a noose fastened to the pastern. In the worst cases, with the buttocks and hocks wedged deeply into the passages, it may prove difficult or impossible to push the buttocks back into the abdomen, and in such a case the extension of the hind limb is practically impossible without mutilation. In some roomy cows a calf may be dragged through the passages by ropes attached to the bent hocks, but even when this is possible there is great risk of laceration of the floor of the vagina by the feet. The next resort is to cut the hamstring just below the point of the hock and the tendon on the front of the limb (flexor metatarsi) just above the hock, and even the sinews behind the shank bone just below the hock. This allows the stifle and hock to move independently of each other, the one undergoing extension without entailing the extension of the other; it also allows both joints to flex completely, so that the impacted mass can pass through a narrower channel. If now, by dragging on the hocks and operating with the repeller on the buttocks, the latter can be tilted forward sufficiently to allow of the extension of the stifle, the jam will be at once overcome, and the calf may be extracted with the hock bent, but the stifle extended. If even this can not be accomplished it may now be possible to extract the whole mass with both hocks and stifles fully bent. To attempt this, traction may be made on the rope around the hocks and on a sharp hook (Plate xx, Fig. 2) passed forward between the thighs and hooked on to the brim of the pelvis. Everything else failing, the offending limb or limbs may be cut off at the hip joint and extracted, after which extraction may proceed by dragging on the remaining limb, or by hooks on the hip bones. Very little is to be gained by cutting off the limb at the hock, and the stifle is less accessible than the hip, and amputation at the stifle gives much poorer results.

HIND LIMBS BENT FORWARD FROM THE HIP—BREECH PRESENTATION.

This is an exaggeration of the condition last described, only the hocks and stifles are fully extended and the whole limb carried forward beneath the belly. (Plate XVII, Fig. 2.) The water-bags appear and burst, but nothing presents unless it may be the tail. Examination in this case detects the outline of the buttocks with the tail and anus at its upper part.

The remedy, as in the case last described, consists in pushing the buttock upward and forward with a repeller, the cow being kept standing and headed down hill, until the thigh bone can be reached, and used as a lever. Its upper end is pushed forward and its lower end raised until the joints becoming fully flexed, the point of the hock can be raised above the brim of the pelvis. If necessary a noose may be passed around the leg as far down toward the hock as possible and pulled on forcibly, while the hand presses forward strongly on the back of the leg above. When both hocks have been lodged above the brim of the pelvis the further procedure is as described under the last heading.

If, however, the case is advanced and the buttocks wedged firmly into the passages, it may be impossible to safely push it back into the womb, and the calf must either be dragged through the passage as it is or the limbs or pelvis must be cut off. To successfully extract with a breech presentation, the cow must be large and roomy and the calf not too large. The first step in this case is to separate the pelvic bones on the two sides by cutting from before backward, exactly in the median line below and where the thighs come together above. This may be done with a strong embryotomy knife, but is most easily accomplished with the long embryotome. (Plate XX, Fig. 3.) The form which I have designed (Plate XX, Fig. 1), with a short cutting branch jointed to the main stem, is to be preferred, as the short cutting piece may be folded on the main stem so that its cutting edge will be covered, and it can be introduced and extracted without danger. This is pushed forward beneath the calf's belly, and the cutting arm opened and inserted in front of the brim of the pelvis and pulled forcibly back through the whole length of the pelvic bones. The divided edges are now made to overlap each other and the breadth of the haunch is materially reduced. One end of the cord may then be passed forward by means of a cord-carrier (Plate XXI, Fig. 5), on the inner side of one thigh until it can be seized at the stifle by the hand passed forward on the outer side of that thigh. This end is now pulled back through the vagina, and the other end passed through the cord-carrier and passed forward on the inner side of the other thigh until it can be seized at the stifle by the hand passed forward outside that thigh. This end is drawn back through the vagina like the first, and is tied around the other so as to form a running noose. The rope is now drawn through the ring until it forms a tight loop, encircling the belly just in front of the hind limbs. On this strong traction can be made without interfering with the full flexion of the limbs on the body, and if the case is a suitable one, and the body of the fetus and the passages are both well lubricated with oil or lard, a successful parturition may be accomplished. A less desirable method is to put a rope round one thigh or a rope round each and drag upon these, but manifestly the strain is not so directly on the spine, and the limbs may be somewhat hampered in flexion.

This method being inapplicable, the next resort is to cut off one or both hind limbs at the hip joint. Free incisions are made on the side of the haunch so as to expose the hip joint, and the muscles are cut away from the head of the thigh bone down to its narrow neck, around which a rope is passed and firmly fixed with a running noose. The joint is now cut into all around, and while traction is made on the cord the knife is inserted into the inner side of the joint and the round ligament severed. The cord may now be dragged upon forcibly, and the muscles and other parts cut through as they are drawn tense, until finally the whole member has been extracted. Traction on the rope round the other thigh will now suffice to extract, in the majority of cases, but if it should fail the other limb may be cut off in the same manner, and then hooks inserted in front of the brim of the pelvis or in the openings in the bones of its floor (*obturator foramina*) will give sufficient purchase for extraction. Another method is to insert a knife between the bone of the rump (*sacrum*) and the hip bone and sever their connections; then cut through the joint (*symphysis*) between the two hip bones in the median line of the floor of the pelvis, and then with a hook in the opening on the pelvic bones (*obturator foramen*) to drag upon the limb and cut the tense soft parts until the limb is freed and extracted.

PRESENTATION OF THE BACK.

In this presentation straining may be active, but after the rupture of the water-bags no progress is made, and the hand introduced will recognize the back with its row of spinous processes and the springing ribs at each side pressed against the entrance to the pelvis. (Plate XVII, Fig. 6.) The presence or absence of the ribs will show whether it is the region of the chest or the loins. By feeling along the line of spines until the ribs are met with we shall learn that the head lies in that direction. If, on the contrary, we follow the ribs until they disappear, and a blank space is succeeded by hip bones, it shows that we are approaching the tail. The head may be turned upward, downward, to the right side or to the left.

The object must be to turn the fetus so that one extremity or the other can enter the passage, and the choice of which end to bring forward will depend on various considerations. If one end is much nearer the outlet than the other, that would naturally be selected for extraction, but if both ends are equidistant the choice would fall on the hind end, as having only the two limbs to deal with, without any risk of complication from the head. When the head is turned upward and forward it will usually be preferable to bring up the hind limb, since, owing to the drooping of the womb into the abdomen, rotation of the fetus will usually be easier in that direction, and if successful the resulting position will be a natural posterior presentation, with the back of the calf turned toward the rump of the cow. Similarly with the croup turned upward and forward, that should be pushed on forward, and if the forefeet and head can be secured it will be a natural anterior presentation with the back of the calf turned upward toward the rump of the cow.

The womb should be injected with warm water or oil, and the turning of the calf will demand the combined action of the repeller and the hand, but in all such cases the operator has an advantage that the body of the fetus is wholly within the body of the womb, and therefore movable with comparative ease. No part is wedged into the pelvic passages as a complication. The general principles are the same as in faulty presentations fore and hind, and no time should be lost in making the manipulations necessary to bring the feet into the pelvis, lest they get in bent or otherwise displaced and add unnecessary complications.

With a transverse direction of the calf, the head being turned to one side, the pressure must be directed laterally, so that the body will glide around on one side of the womb, and the extremities when reached must be promptly seized and brought into the passages. Sometimes a fortunate struggle of a live fetus will greatly aid in rectifying the position.

BREAST AND ABDOMEN PRESENTED—ALL FOUR FEET IN THE PASSAGES.

In this form the calf lies across the womb with its roached back turned forward and its belly toward the pelvis. All four feet may be extended and engaged in the passages, or one or more may be bent on themselves so as to lie in front of the pelvis. The head, too, may usually be felt on the right side or the left, and if detected it serves to identify the exact position of the fetus. The position may further be decided upon by examination of the feet and limbs. With the limbs extended the front of the hoofs and the convex aspect of the bent pasterns and fetlocks will look toward that flank in which lie the head and shoulders. On examination still higher the smooth, even outline of the knee and its bend, looking toward the hind parts, characterize the fore limb, while the sharp prominence of the point of the hock and the bend on the opposite side of the joint, looking toward the head, indicate the hind limb. (Plate XVII, Fig. 5.)

The remedy for this condition is to be sought in repelling into the womb those limbs that are least eligible for extraction, and bringing into the passages the most eligible extremities. The most eligible will usually be those which project farthest into the passages, indicating the nearer proximity of that end of the calf. An exception may, however, be made in favor of that extremity which will give the most natural presentation. Thus if, owing to obliquity in the position of the fetus, the hind extremities promised a presentation with the back of the fetus turned down toward the udder, and the anterior extremities one with the back turned up toward the spine, the latter should be selected. Again, if the choice for the two extremities is evenly balanced, the hind may be chosen as offering less risk of complication, there being no head to get displaced.

Treatment.—The first step in the treatment is to place a running noose on each of the four feet, marking those of the fore limbs to distinguish them from those of the hind. In case it is proposed to bring the anterior extremities into the passage, a noose should also be placed on the lower jaw. Then run the ropes attached to the two feet that are to be pushed back through the ring of a cord-carrier (Plate XXI, Fig. 5), passing the rings down to the feet, and by the aid of the carrier push them well back into the womb and hold them there. Meanwhile drag upon the ropes attached to the two other feet so as to bring them into the passage (or in case of the anterior extremity on the two foot ropes and the head one). The other feet must be pushed back into the womb until the body of the calf is fully engaged in the passages. After this they can no longer find an entrance, but must follow as the body escapes.

NEGLECTED AND AGGRAVATED CASES.

In laying down the above rules for giving assistance in critical cases of calving it is not intimated that all cases and stages can be successfully dealt with. Too often assistance is not sought for many hours or even days after labor pains and the escape of the waters intimate the danger of delay, and not seldom the long delay has been filled up with unintelligent and injurious attempts at rendering assistance, violent pulling when resistence is insurmountable without change of position, injuries to the vagina and womb by ill-considered but too forcibly executed attempts to change the position, the repeated and long-continued contact with rough hands and rougher ropes and hooks, the gashes with knives and lacerations with instruments in ignorant hands, the infecting material introduced on filthy hands and instruments, and the septic inflammations started in the now dry and tender passages and womb, and not unfrequently the death, putrefaction, and bloating of the calf in the womb, rendering the case extremely unpromising, and making it impossible to successfully apply many of the measures above recommended. The labor pains of the cow may have practically ceased from exhaustion; the passages of the vagina may be so dry, tender, friable, red, and swollen that it requires considerable effort even to pass the oiled hand through them, and the extraction of the calf or any portion of it through such a channel seems a hopeless task; the womb may be equally dry and inflamed and swollen, so that its lining membrane or even its entire thickness is easily torn; the fetal membranes have lost their natural unctuous and slippery character, and cling firmly to the dry walls of the womb, to the dry skin of the calf, or to the hands of the operator; the dead and putrefying calf may be so bloated with gases that the womb has been overdistended by its presence, and the two adhere so closely that the motion of the one on the other is practically impossible. In other cases reckless attempts to cut the calf in pieces have left raw surfaces with projecting bones which dangerously scratch and tear the womb and passages.

In many cases the extreme resort must be had of cutting the fetus to pieces (embryotomy), or the still more redoubtable one of Cæsarean section (extraction through the flank).

DISSECTION OF THE UNBORN CALF—EMBRYOTOMY.

In some cases the dissection of the calf is the only feasible means of delivering it through the natural passages, and while it is especially applicable to the dead calf, it is also on occasions called for in the case of the living. As a rule, a living calf should be preserved if possible, but if this threatens to entail the death of the cow, it is only in the case of offspring of rare value that its presentation is to be preferred. To those acquainted with the toil, fatigue, and discomfort of embryotomy, no dissuasion is necessary so long as there is a prospect of success from the simple and generally easier method of rectifying the faulty position of the calf. But when the correction of the position is manifestly impossible, when distortions and monstrosities of the fetus successfully obstruct delivery; when the pelvic passages are seriously contracted by fractures and bony growths; when the passages are virtually almost closed by swelling, or when the calf is dead and excessively swollen, no other resort may be available. In many cases of distortion and displacement the dismemberment of the entire calf is unnecessary, the removal of the offending member being all that is required. It will be convenient, therefore, to describe the various suboperations one by one, and in the order in which they are usually demanded.

AMPUTATION OF THE FORE LIMB.

In cutting off a fore limb it is the one presenting that should be selected, since it is much more easily operated on, and its complete removal from the side of the chest affords so much more space for manipulation that it is not often difficult to bring the missing limb or head into position. The first consideration is to skin the limb from the fetlock up and leave the skin attached to the body. The reasons for this are: (*a*) That the skin is the most resistant structure of the limb, and when it has been removed the entire limb can be easily detached; (*b*) the tough skin left from the amputated limb may be used as a cord in subsequent traction on the body of the calf; (*c*) the dissection and separation of the limb are far more safely accomplished under the protection of the enveloping skin than if the operator's hands and instruments were in direct contact with the walls of the passages or womb; (*d*) the dissection can be much more easily effected while the skin is stretched by the left hand so as to form a comparatively firmer resistant point for the knife than when it is attempted to cut the soft, yielding, and elastic tissues which naturally offer little solid resistance, but constantly recede before the cutting edge of the instrument. The preservation of the skin is, therefore, a cardinal principle in the amputation of all parts in which it is at all feasible.

The presenting foot is inclosed in a noose and drawn well out of the passages. Then a circular incision through the skin is made around the limb just above the fetlock. From this the skin is slit up on the inner side of the limb to the breast. Then the projecting part of the limb is skinned up to the vulva, traction being made on the foot by an assistant so as to expose as much as possible. The embryotomy knife may now be taken (Plate XXI, Fig. 2), and a small hole having been cut in the free end of the detached portion of skin, that is seized by the left hand and extended while its firm connections with the deeper structures are cut through. The looser connections can be more quickly torn through with the closed fist, or the tips of the four fingers held firmly together in a line, or with the spud, of which there are several kinds. Much of the upper part of the limb can be skinned more speedily without the knife, but that must be resorted to to cut across tough bands whenever these interrupt the progress. The skinning should be carried upward on the outer side of the shoulder blade to the spine, or nearly so. Then with the knife the muscles attaching the elbow and shoulder to the breastbone are cut across, together with those on the inner side of the shoulder joint, and in front and behind it so far as these can be reached. Steady traction is now made upon the foot, the remaining muscles attaching the shoulder blade to the trunk are torn through with a crackling noise, and the whole limb, including the shoulder blade and its investing muscles, comes away. If the shoulder blade is left the bulk of the chest is not diminished, and nothing has been gained. Before going farther it is well to see whether the great additional space thus secured in the passages will allow of the missing limb or head to be brought into position. If not, the other presenting part, limb or head, is to be amputated and extracted. For the limb the procedure is a repetition of that just described.

AMPUTATION OF THE HEAD.

The head is first seized and drawn well forward, or even outside the vulva, by a rope with a running noose placed around the lower jaw just behind the incisor teeth, by a sharp hook inserted in the arch of the lower jaw behind the union of its two branches and back of the incisor teeth, or by hooks inserted in the orbits, or, finally, in case the whole head protrudes, by a halter. (Plate XXI, Fig. 4*a* and 4*b*.)

In case the whole head protrudes, a circular incision through the skin is made just back of the ear, and the cut edge being held firmly by the left hand, the neck is skinned as far as it can be reached. Then the great ligamentous cord above the spine is cut across at the farthest available point, together with the muscles above and below the spine. Strong traction on the head will then detach it at this point and bring it away, but should there still be too much resistance the knife is inserted between the bodies of two vertebræ just behind one of the prominent points felt in the median line below, and their connecting fibrous cartilage is cut through, after which comparatively moderate pulling will bring it away. The detached neck and body at once slip back into the womb, and if the fore limbs are now brought up and pulled they are advanced so far upon the chest that the transverse diameter of that is greatly diminished, and delivery correspondingly facilitated.

If the head is still inclosed in the vagina two methods are available: (1) The removal of the lower jaw and subsequent separation of the head from the neck; (2) the skinning of the whole head and its separation from the neck.

To remove the lower jaw the skin is dissected away from it until the throat is reached. Then the muscles of the cheeks and side of the jaw (masseters) are cut through and those connecting the jaw with the neck. When traction is made on the rope round the lower jaw it will usually come away with little trouble. Should it resist, its posterior extremity on each side (behind the grinding teeth) may be cut through with bone forceps, or with a guarded bone chisel. (Plate XX, Fig. 8.) After the removal of the lower jaw the way will be open to separate the head from the neck, the knife being used to cut into the first or second joint from below, or the bone forceps or chisel being employed to cut through the bones of the neck. Then traction is made on the head by means of hooks in the orbits, and the hand, armed with an embryotomy knife, is introduced to cut through the tense resisting ligament and muscles above the bones. The skin and the strong ligamentous cord attached to the poll are the essential things to cut, as the muscles can easily be torn across. Unless there are great difficulties in the way it is well to skin the head from the eyes back, and on reaching the poll to cut through the ligament and then bring the head away by pulling.

If it is decided to remove the entire head at once, it may be skinned from the front of the eyes back to behind the lower jaw below and the poll above, then cut through the muscles and ligaments around the first joint and pull the head away, assisting, if need be in the separation of the head, by using the knife on the ligament of the joint.

If the calf is a double-headed monster the skinning of the head must be carried backward until the point has been reached where both heads branch from the single neck, and the separation must be made at that point. The muscles and ligaments are first to be cut through, and if the part cannot then be detached by pulling, the bodies of the vertebræ may be separated by passing the knife through the joint. The second head may now be secured by a noose round the lower jaw or hooks in the orbits and brought up into place, the body being pushed back toward the other side by a repeller so as to make room.

It should be added that, excepting in the case of a double-headed monster, or in case of the head protruding or nearly so, and one or both fore limbs presenting, it is rarely desirable to undertake amputation of the head. The space desirable in the passages can usually be secured by the much simpler and easier procedure of removing one or both fore limbs.

AMPUTATION OF THE HIND LIMBS.

This is sometimes demanded on the one extended limb when the other can not be brought up and delivery can not be effected; also in case of monsters having extra hind limbs; in cases where the calf is dead, putrid, and bloated with gas, and in some cases of breech presentation as described under that head.

When the limb is extended the guiding principles are as in the case of the fore limbs. The skin is cut through circularly above the fetlock and slit up beneath the pelvic bones on the inner side of the thigh. It is then dissected from the other parts as high as it has been slit on the inner side and to above the prominence (*trochanter major*) on the upper end of the thigh bone on the outer side of the joint. In this procedure the hands and spud can do much, but owing to the firmer connections the knife will be more frequently required than in the case of the fore limb. The muscles are now cut through all around the hip joint and strong traction is made by two or three men on the limb. If there is still too much resistance a knife is inserted into the joint on the inner side and its round ligament cut through, after which extraction will be comparatively easy. This accomplished, it will often be possible to extract the fetus with the other leg turned forward into the womb. If the calf is bloated with gas it may be necessary to remove the other leg in the same way, and even to cut open the chest and abdomen and remove their contents before extraction can be effected. In the case of extra limbs it may be possible to bring them up into the passages after the presenting hind limbs have been removed. If this is not practicable they may be detached by cutting them through at the hip joint as described under Breech Presentation.

Another method of removing the hind limb is, after having skinned it over the quarter, to cut through the pelvic bones from before backward, in the median line below, by knife, saw, or long embryotome (Plate xx, Fig. 1), and then disjoint the bones of the spine (*sacrum*) and the hip bone (*ilium*) on that side with embryotome, knife, or saw, and then drag away the entire limb, along with all the hip bones on that side. This has the advantage of securing more room and thereby facilitating subsequent operations. Both limbs may be removed in this way, but on the removal of the second the operator is without any solid point to drag upon in bringing away the remainder of the fetus.

DIVISION ACROSS THE MIDDLE OF THE BODY.

In cases of extra size, monstrosity, or distortion of one end of the body, it may be requisite to cut the body in two and return the half from the passages into the womb, even after one half has been born. The presenting members are dragged upon forcibly by assistants to bring as much of the body as possible outside. Then cut through the skin around the body at some distance from the vulva, and with hand, knife, and spud detach it from the trunk as far back into the passages as can be reached. Next cut across the body at the point reached, beginning at the lower part (breast, belly) and proceeding up toward the spine. This greatly favors the separation of the backbone when reached, and further allows of its being extended so that it can be divided higher up. When the backbone is reached, the knife is passed between the two bones, the prominent ridges across their ends acting as guides, and by dragging and twisting the one is easily detached from the other. With an anterior presentation the separation should, if possible, be made behind the last rib, while with a posterior presentation as many of the ribs should be brought away as can be accomplished. Having removed one half of the body, the remaining half is to be pushed back into the womb, the feet sought and secured with nooses, and the second half removed in one piece, if possible, and, if not, then after the removal of the extra limb or other cause of obstruction.

REMOVAL OF THE CONTENTS OF CHEST OR ABDOMEN.

If the body of the calf sticks fast in the passages by reason of the mere dryness of its skin and of the passages, the obstacle may be removed by injecting sweet oil past the fetus into the womb through a rubber or other tube, and smearing the passages freely with lard. When the obstruction depends on excess of size of the chest or abdomen, or thickening of the body from distorted spine, much advantage may be derived from the removal of the contents of these great cavities of the trunk. We have already seen how the haunches may be narrowed by cutting the bones apart in the median line below and causing their free edges to overlap each other. The abdomen can be cut open by the embryotomy knife or the long embryotome in the median line, or at any point, and the contents pulled out with the hand, the knife being used in any case when especial resistance is encountered. If the abdomen is so firmly impacted that it can not be dealt with in this way, one hind limb and the hip bone on the same side may be removed as described under Amputation of the Hind Limbs. This will allow the introduction of the hand into the abdomen from behind, so as to pull out the contents. By introducing an embryotomy knife in the palm of the hand and cutting through the muscle of the diaphragm the interior of the chest can be reached in the same way and the heart and lungs removed.

When, in dealing with an anterior presentation, it becomes necessary to remove the contents of the chest, the usual course is to cut through the connections of the ribs with the breastbone (the costal cartilages) close to the breastbone on each side, and from the abdomen forward to the neck. Then cut through the muscles connecting the front of the breastbone with the neck, and its hinder end with the belly, and pull out the entire breastbone. Having torn out the heart and lungs with the hand, make the rib cartilages on the one side overlap those on the other, so as to lessen the thickness of the chest, and proceed to extract the body. If it seems needful to empty the abdomen as well, it is easy to reach it by cutting through the diaphragm, which separates it from the chest.

DELIVERY THROUGH THE FLANK—CESAREAN SECTION—LAPAROTOMY.

This is sometimes demanded, when the distortion and narrowing of the hip bones are such as to forbid the passage of the calf, or when inflammation has practically closed the natural passages and the progeny is more valuable and worthy of being saved than the dam; also in cases in which the cow has been fatally injured, or is ill beyond possibility of recovery and yet carries a living calf. It is too often a last resort after long and fruitless efforts to deliver by the natural channels, and in such cases the saving of the calf is all that can be expected, the exhausted cow, already the subject of active inflammation, and too often also of putrid poisoning, is virtually beyond hope. The hope of saving the dam is greatest if she is in good health and not fatigued, in cases, for example, in which the operation is resorted to on account of broken hip bones or abnormally narrow passages.

The stock-owner will not attempt such a serious operation as this. Yet, where the mother has just died or is to be immediately sacrificed, no one should hesitate at resorting to it in order to save the calf. If alive it is important to have the cow perfectly still. Her left fore leg being bent at the knee by one person, another may seize the left horn and nose and turn the head to the right until the nose rests on the spine just above the shoulder. The cow will sink down gently on her left side without shock or struggle. One may now hold the head firmly to the ground, while a second, carrying the end of the tail from behind forward on the inside of the right thigh, pulls upon it so as to keep the right hind limb well raised from the ground. If time presses she may be operated on in this position, or if the cow is to be sacrificed a blow on the head with an ax will secure quietude. Then the prompt cutting into the abdomen and womb and the extraction of the calf requires no skill. If, however, the cow is to be preserved, her two fore feet and the lower hind one should be safely fastened together and the upper hind one drawn back. Two ounces chloral hydrate, given by injection, should induce sleep in twenty minutes, and the operation may proceed. In case the cow is to be preserved, wash the right flank and apply a solution of 4 grains of corrosive sublimate in a pint of water. Then, with an ordinary scalpel or knife dipped in the above solution, make an incision from 2 inches below and in front of the outer angle of the hip bone in a direction downward and slightly forward to a distance of 12 inches. Cut through the muscles, and more carefully through the transparent lining membrane of the abdomen (peritoneum), letting the point of the knife lie in the groove between the first two fingers of the left hand as they are slid down inside the membrane and with their back to the intestines. An assistant, whose hands, like those of the operator, have been dipped in the sublimate solution, may press his hands on the wound behind the knife to prevent the protrusion of the intestines. The operator now feels for and brings up to the wound the gravid womb, allowing it to bulge well through the abdominal wound, so as to keep back the bowels and prevent any escape of water into the abdomen. This is seconded by two assistants, who press the lips of the wound against the womb. Then an incision 12 inches long is made into the womb at its most prominent point, deep enough to penetrate its walls, but not so as to cut into the water bags. In cutting, carefully avoid the cotyledons, which may be felt as hard masses inside. By pressure the latter may be made to bulge out as in natural parturition, and this projecting portion may be torn or cut so as to let the liquid flow down outside of the belly. The operator now plunges his hand into the womb, seizes the fore or hind limbs, and quickly extracts the calf and gives it to an attendant to convey to a safe place. The womb may be drawn out, but not until all the liquid has flowed out, and the fetal membranes must be separated from the natural cotyledons, one by one, and the membranes removed. The womb is now emptied with a sponge, which has been boiled or squeezed out of a sublimate solution, and if any liquid has fallen into the abdomen it may be removed in the same way. A few stitches are now placed in the wound in the womb, using carbolized catgut. They need not be very close together, as the wound will diminish greatly when the womb contracts. Should the womb not contract at once it may have applied against it a sponge squeezed out of a cold sublimate solution, or it may be drawn out of the abdominal wound and exposed to the cold air until it contracts. Its contraction is necessary to prevent bleeding from its enormous network of veins. When contracted the womb is returned into the abdomen and the abdominal wound sewed up. One set of stitches, to be placed at intervals of 2 inches, are passed through the entire thickness of skin and muscles and tied around two quills or little rollers resting on the skin. (Plate XXVIII, Fig. 7.) These should be of silver, and may be cut at one end and pulled out after the wound has healed. The superficial stitches are put in every half inch and passed through the skin only. They, too, may be of silver; or pins may be inserted through the lips and a fine cord twisted round their ends like a figure eight. (Plate XXVIII, 9.) The points of the pins may be snipped off with pliers. The edges may be still further held together by the application of Venice turpentine, melted so as to become firmly adherent, and covered with a layer of cotton wool. Then the whole should be supported by a bandage fixed around the loins and abdomen.

DISEASES OF THE GENERATIVE ORGANS.

DESCRIPTION OF PLATES.

PLATE XII:

Fetus with its membranes at mid term. The uterus is opened on the left side. In the uterus the fetus is surrounded by several membranes, which are known as the amnion or inner layer, the allantois or central layer, and the chorion or outer layer. The amnion or inner membrane is nearest the fetus, and forms a closed sac around it, filled with a fluid known as liquor amnii, in which the fetus floats.

The allantois is the central membrane, and is composed of two layers which form a closed sac in connection with the urachus or the tube which extends from the fetal bladder through the umbilical cord. The one layer of the allantois is spread over the outer surface of the amnion, and the other over the inner surface of chorion. The allantois also contains a fluid which is known as the allantoic liquid.

The chorion is the outer envelope or membrane of the fetus, completely inclosing the fetus with its other membranes. On the outer surface of this membrane are found the fetal placentulæ or cotyledons, which, through their attachment to the maternal cotyledons, furnish the fetus with the means of sustaining life. The relation of the fetal and maternal cotyledons to each other is illustrated on the following plate.

PLATE XIII:

Fig. 1. Uterus of the cow during pregnancy, laid open to show the cotyledons (*d*) on the internal surface of uterus (*c*). The ovary (*a*) is shown cut across, and the two halves laid open to show the position of the discharged ovum at *a′*.

Fig. 2. Illustrates the relation of the fetal and maternal parts of a cotyledon. A portion of the uterus (*A*) is shown with the maternal cotyledon (*BB*) attached to it. The fetal portion (*D*) consists of a mass of very minute hairlike processes on the chorion (*E*), which fit into corresponding depressions or pits of the maternal portion. Each portion is abundantly supplied with blood vessels, so that a ready interchange of nutritive fluid may take place between mother and fetus.

PLATE XIV:

Fig. 1. Taken from *Fürstenberg-Leisering, Anatomie und Physiologie des Rindes.* Fetal calf with a portion of the wall of the abdominal cavity of the right side and the stomach and intestines removed to illustrate the nature of the umbilical or navel cord. It consists of a hollow tube (1–1′) into which pass the two umbilical arteries (3) carrying blood to the placenta in the uterus or womb and the umbilical vein (4) bringing the blood back and carrying it into the liver. The cord also contains the urachus (2′), which carries urine from the bladder (2) through the cord. These vessels are all obliterated at birth. 5, liver; 5′, lobe of same known as the lobus Spiegelii; 5″, gall bladder; 6, right kidney; 6′, left kidney; 6″, ureters, or the tubes conducting the urine from the kidneys to the bladder; 7, rectum where it has been severed in removing the intestines; 8, uterus of the fetus, cut off at the anterior extremity; 9, aorta; 10, posterior vena cava.

PLATE XIV—Continued.

Fig. 2. Taken from Quain's Anatomy, Vol. II, showing the blood vessels passing through the umbilical cord in a human fetus: *L*, liver; *K*, kidney; *I*, intestine; *U C*, umbilical cord; *Ua*, umbilical arteries. The posterior aorta coming from the heart passes backward and gives rise to the internal iliac arteries, and of these the umbilical arteries are branches. *Uv*, umbilical vein; this joins the portal vein; passes onward to the liver, breaks up into smaller vessels which reunite in the hepatic vein; this empties into the posterior vena cava, which carries the blood back to the heart.

PLATE XV:

Showing the most favorable position of the calf or fetus in the womb at birth, and the position in which it is most frequently found. This is known as the normal anterior position. The back of the fetus is directly towards that of the mother, the fore legs are extended back towards the vulva of the mother, and the head rests between them. The birth of the calf in this position usually takes place without artificial assistance.

PLATE XVI:

Fig. 1. Anterior presentation; one fore limb completely retained. From Fleming's Veterinary Obstetrics. The retained limb must be reached if possible, and brought forward joint by joint and the fetus then extracted.

Fig. 2. Anterior presentation; fore limbs bent at knee. From Fleming's Veterinary Obstetrics. The limbs must be extended before delivery can be accomplished.

Fig. 3. Anterior presentation; fore limb crossed over neck. From Fleming's Veterinary Obstetrics. The leg should be grasped a little above the fetlock, raised, drawn to its proper side, and extended in the genital canal.

Fig. 4. Anterior presentation; downward deviation of head. After St. Cyr, from Hill's Bovine Medicine and Surgery. The head must be brought into position seen in Plate XV before delivery can take place.

Fig. 5. Anterior presentation; deviation of the head upwards and backwards. From Fleming's Veterinary Obstetrics. Retropulsion is the first indication, and will often bring the head into its normal position.

Fig. 6. Anterior presentation; head presenting with back down. From D'Arboval, *Dict. de Med. et de Chir.* The fetus should be turned by pushing back the fore parts and bringing up the hind so as to make a posterior presentation.

PLATE XVII:

Fig. 1. Anterior presentation, with hind feet engaged in pelvis. A very serious malpresentation, in which it is generally impossible to save the fetus if delivery is far advanced. The indications are to force back the hind feet.

Fig. 2. Thigh and croup presentation, showing the fetus corded. From Fleming's Veterinary Obstetrics. The cord has a ring or noose at one end. The two ends of the cord are passed between the thighs, brought out at the flanks, and the plain end passed through the noose at the top of the back and brought outside the vulva. The fetus must be pushed back and an attempt made to bring the limbs properly into the genital passage.

Fig. 3. Croup and hock presentation. From Fleming's Veterinary Obstetrics. The indications in this abnormal presentation are the same as described for Fig. 2.

Fig. 4. Posterior presentation; the fetus on its back. From D'Arboval, *Dict. de Med. et de Chir.* Turn the fetus so at so make a normal anterior presentation.

Fig. 5. Sterno-abdominal presentation. From D'Arboval, *Dict. de Med. et de Chir.* The fetus is on its side with limbs crossing and presenting. The limbs least eligible for extraction should be forced back into the uterus.

Fig. 6. Dorso-lumbar presentation; the back presenting. From D'Arboval, *Dict. de Med. et de Chir.* The fetus must be turned so that one or the other extremity can enter the passage.

PLATE XVIII:

Fig. 1. Twin pregnancy, showing the normal anterior and posterior presentations. From Fleming's Veterinary Obstetrics.

Fig. 2. Abdominal dropsy of the fetus; normal presentation; fore limbs corded. After Armatage. The drawing illustrates the method of puncturing the abdomen through the chest with a long trocar and canula, The fluid is represented escaping from the canula after the withdrawal of the trocar.

Fig. 3. Tallich's short, bent, crotchet forceps. The forceps have bent and toothed jaws, which are intended to take hold of the fetus where neither cords or hooks can be applied, as the ear, nose, or skin of cheek.

Fig. 4. Clamp for ear, skin, etc: 1–1, blades with hooks and corresponding holes; 2, ring to close the blades; 3, stem with female screw for handle; 4, handle, which may be either straight or jointed and flexible.

PLATE XIX:

This plate illustrates various malformations and diseases of the fetus which act as the cause of difficult parturition.

Figs. 1, 2, 3. Represent the fetuses with portions of their bodies double. Fig. 1 (from Fleming's Veterinary Obstetrics), double head, neck, and fore limbs. Fig. 2 (from *Encyclop. der Gesam. Thierheilkunde*, 1886), double head, neck, fore limbs, and body. Fig. 3 (from Fleming's Veterinary Obstetrics), double faced.

Fig. 4. Fetus with head very much enlarged. From Fleming's Veterinary Obstetrics. This affection is known as hydrocephalus or dropsy of the brain, and is due to a more or less considerable quantity of fluid in the cranial cavity of the fetus.

Fig. 5. Skull of the calf represented in Fig. 4. The roof of the skull is absent. From Fleming's Veterinary Obstetrics.

PLATE XX:

Fig. 1. Long embryotome with joint.

Fig. 2. Long sharp hook. This instrument is about 3 feet in length, including the handle. Hooks of this kind, both blunt and sharp, are applied directly to the fetus to assist in delivery.

Fig. 3. Günther's long-handled embryotome. This instrument and that represented in Fig. 1 are of special value in cutting through muscular tissue and in separating the limbs from the trunk when the fetus can not be removed entire. These embryotomes are usually 30 inches long, but may be made either longer or shorter.

Fig. 4. Jointed cord-carrier, used in difficult parturition to carry a cord into regions which can not be reached by the arm.

Fig. 5. Instrument used to rotate or turn the fetus, known as a rotator.

Fig. 6. Dilator of the neck of the womb, used when conception can not take place owing to a contracted condition of the neck of the womb.

Fig. 7. Repeller. An instrument from 2 to 3 feet long, used to force the fetus forward into the womb. This operation is generally necessary when the presentation is abnormal and the fetus has advanced too far into the narrow inlet to the uterus to be moved.

Fig. 8. Cartwright's bone chisel. Including the handle this instrument is about 32 inches in length, the chisel portion is a little more than 2 inches long and 1 to 1½ broad. Only the middle portion is sharp, the projecting corners are blunt and the sides rounded. This instrument is used for slitting up the skin of a limb and as a bone chisel when it is necessary to mutilate the fetus in order to effect delivery.

PLATE XXI:

Fig. 1. Embryotome, an instrument used when it is necessary to reduce the size of the fetus by cutting away certain parts before birth can be affected. This instrument may be long or short, straight or curved.

PLATE XXI—Continued.

Fig. 2. Also an embryotome. The blade can be made to slide out of or into the handle. The instrument can thus be introduced into or withdrawn from the genital passage without risk of injury to the mother.

Fig. 3. Schaack's traction cord. This is merely a cord with a running noose at one end and a piece of wood at the other, to offer a better hold for the hand.

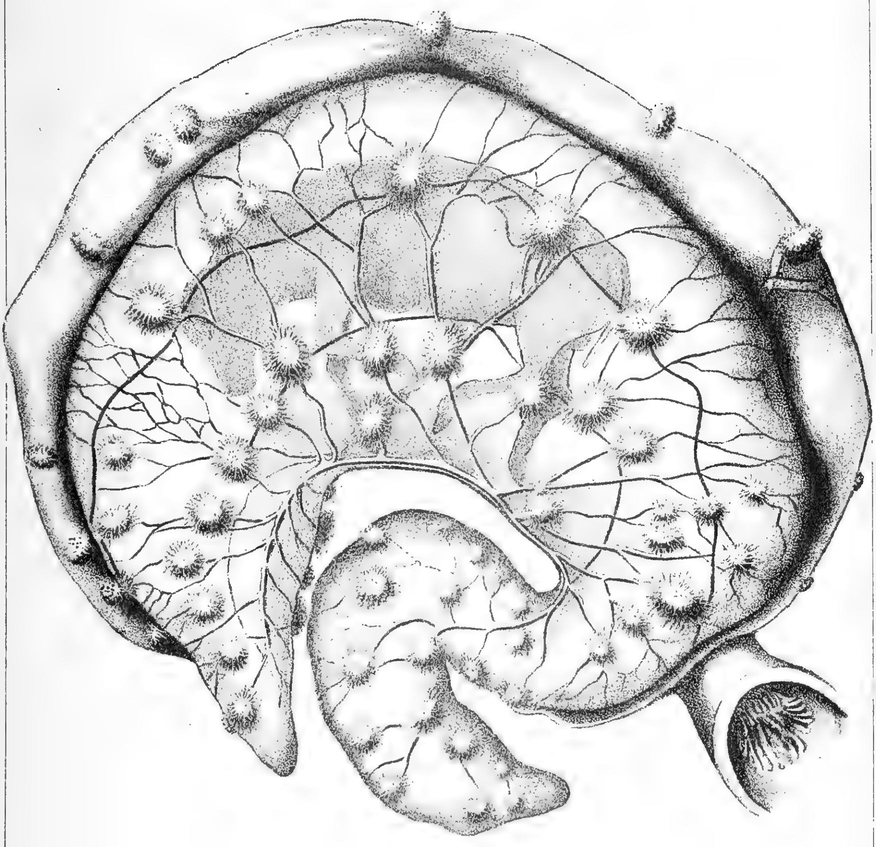
Figs. 4*a* and 4*b*. Reuff's head collar for securing the head of the fetus.

Fig. 5. Curved cord-carrier, used in difficult parturition to carry a cord into regions which can not be reached by the arm.

Fig. 6. Blunt hook, used in difficult parturition.

Fig. 7. Short hook forceps, used in difficult parturition.

Fig. 8. Blunt finger hook.



Haines, after Colon.

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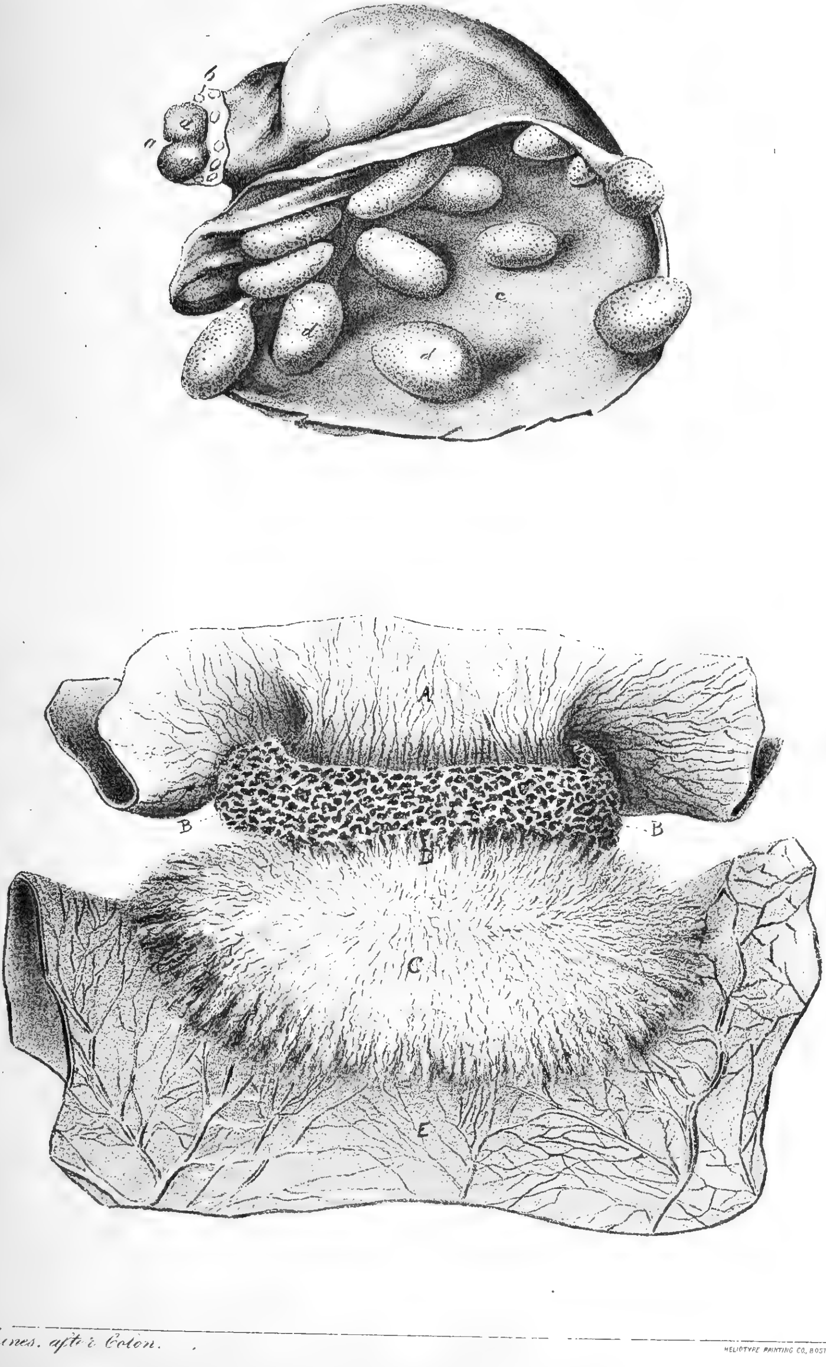
FOETAL CALF WITHIN ITS MEMBRANES.



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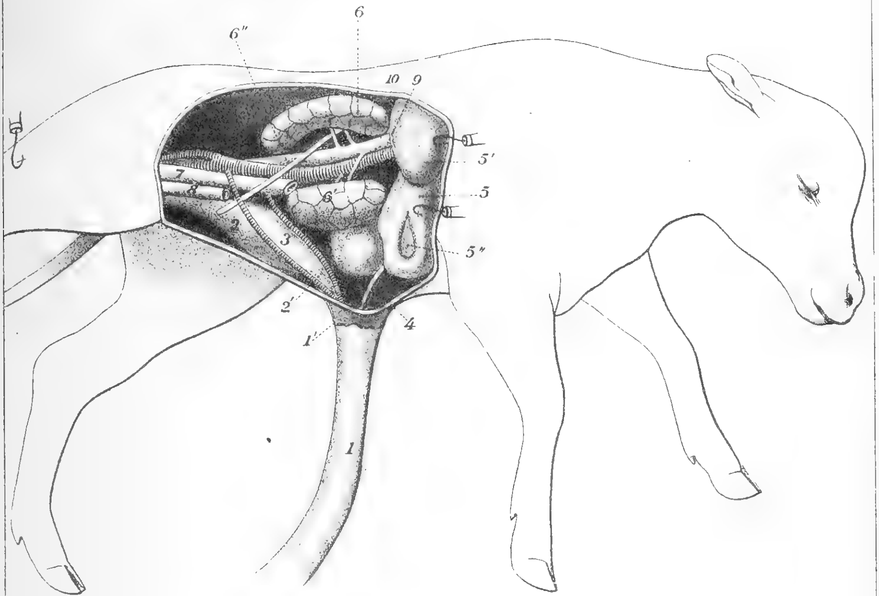
PREGNANT UTERUS WITH COTYLEDONS.

1.



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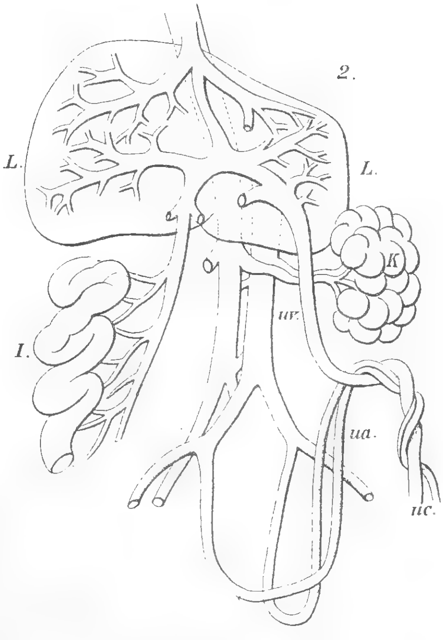

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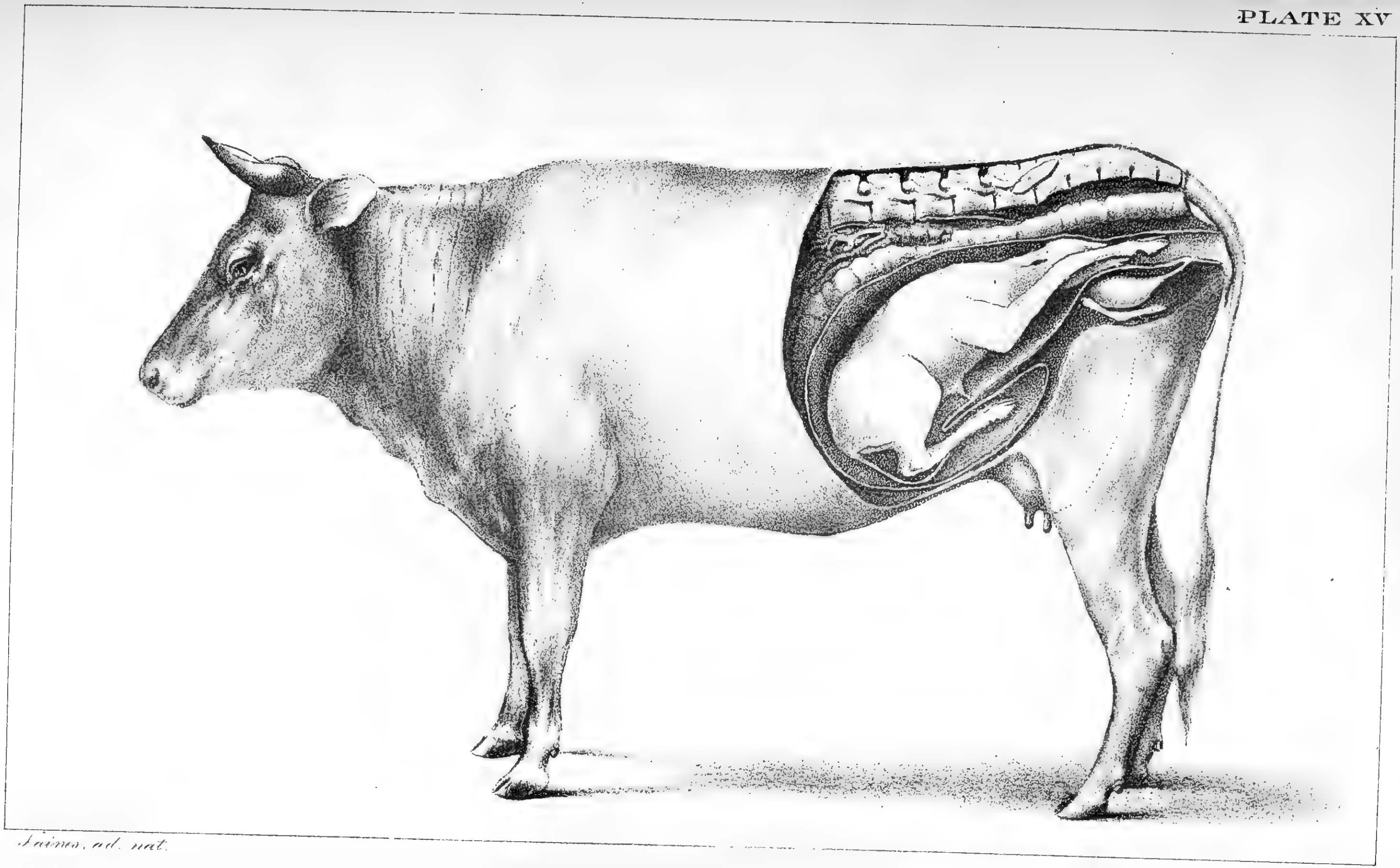
VESSELS OF UMBILICAL CORD.

PLATE XV



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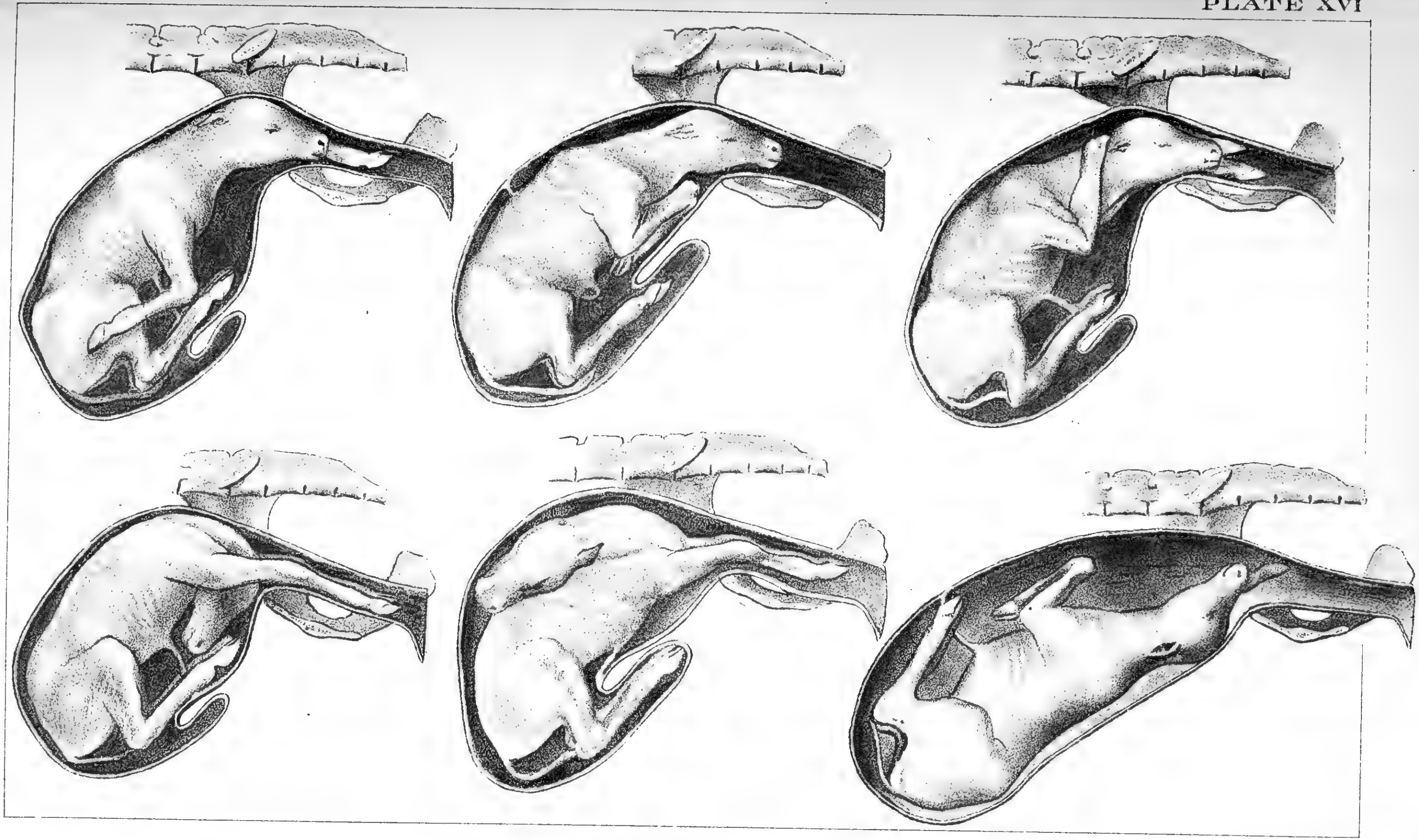
NORMAL POSITION OF CALF IN UTERO.



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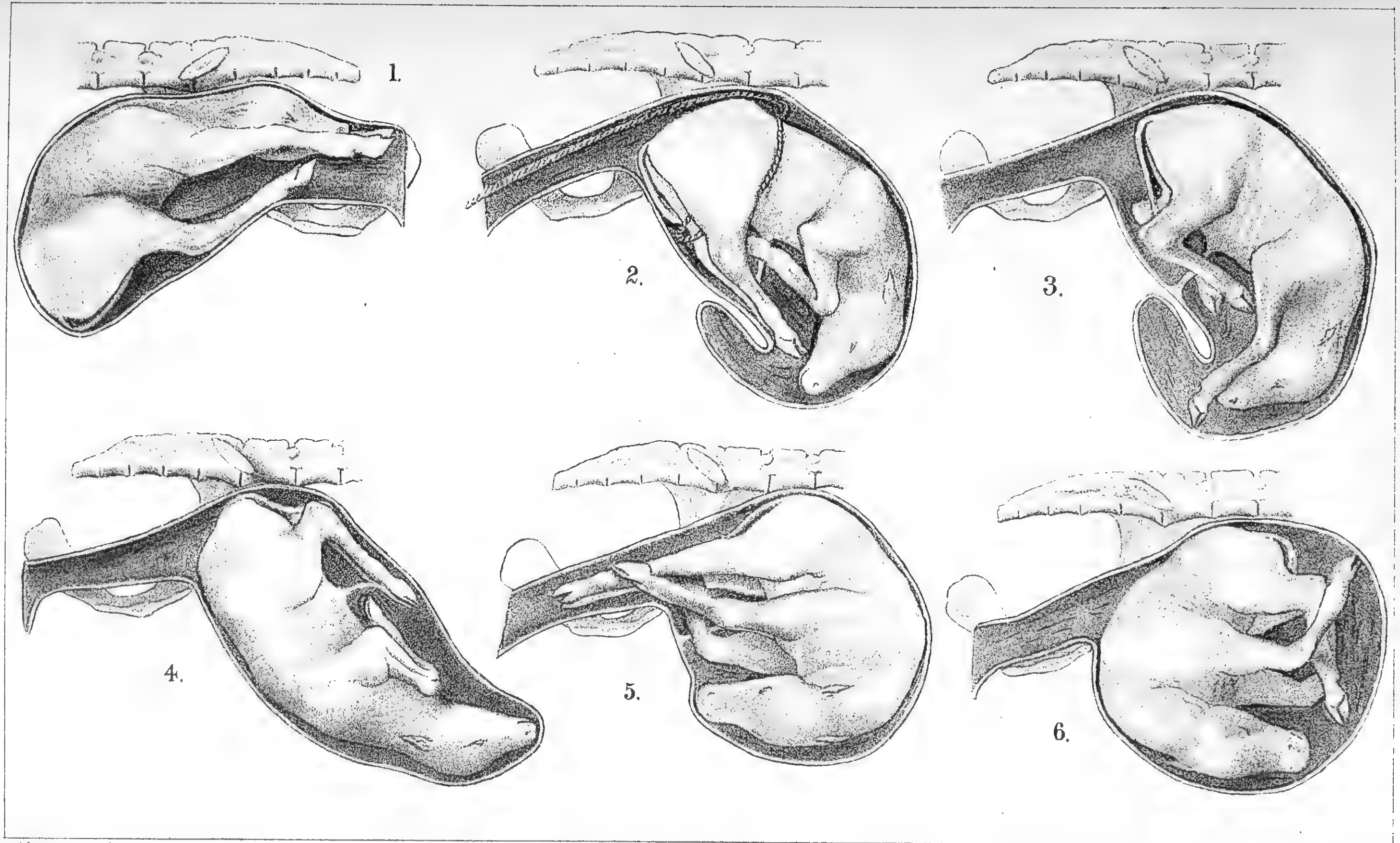
ABNORMAL POSITION OF CALF IN UTERO.

PLATE XVII



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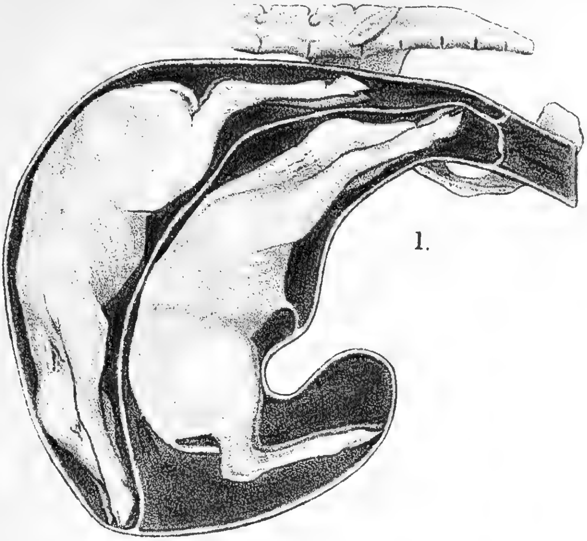
ABNORMAL POSITION OF CALF IN UTERO.



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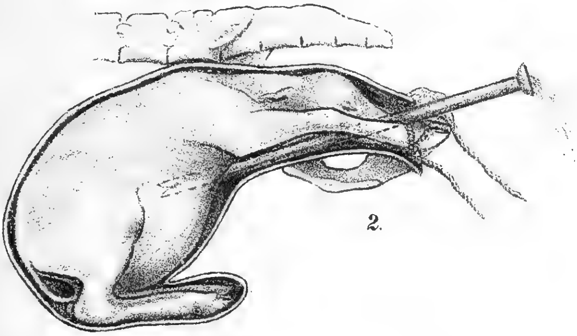

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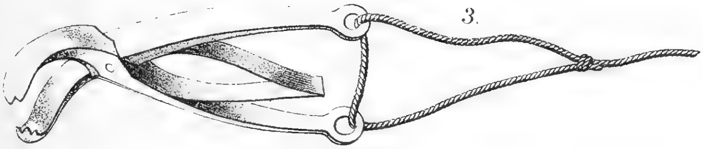

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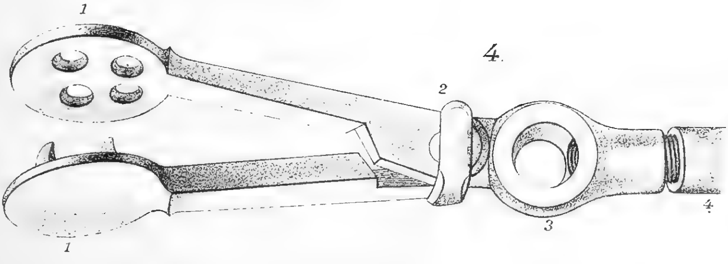

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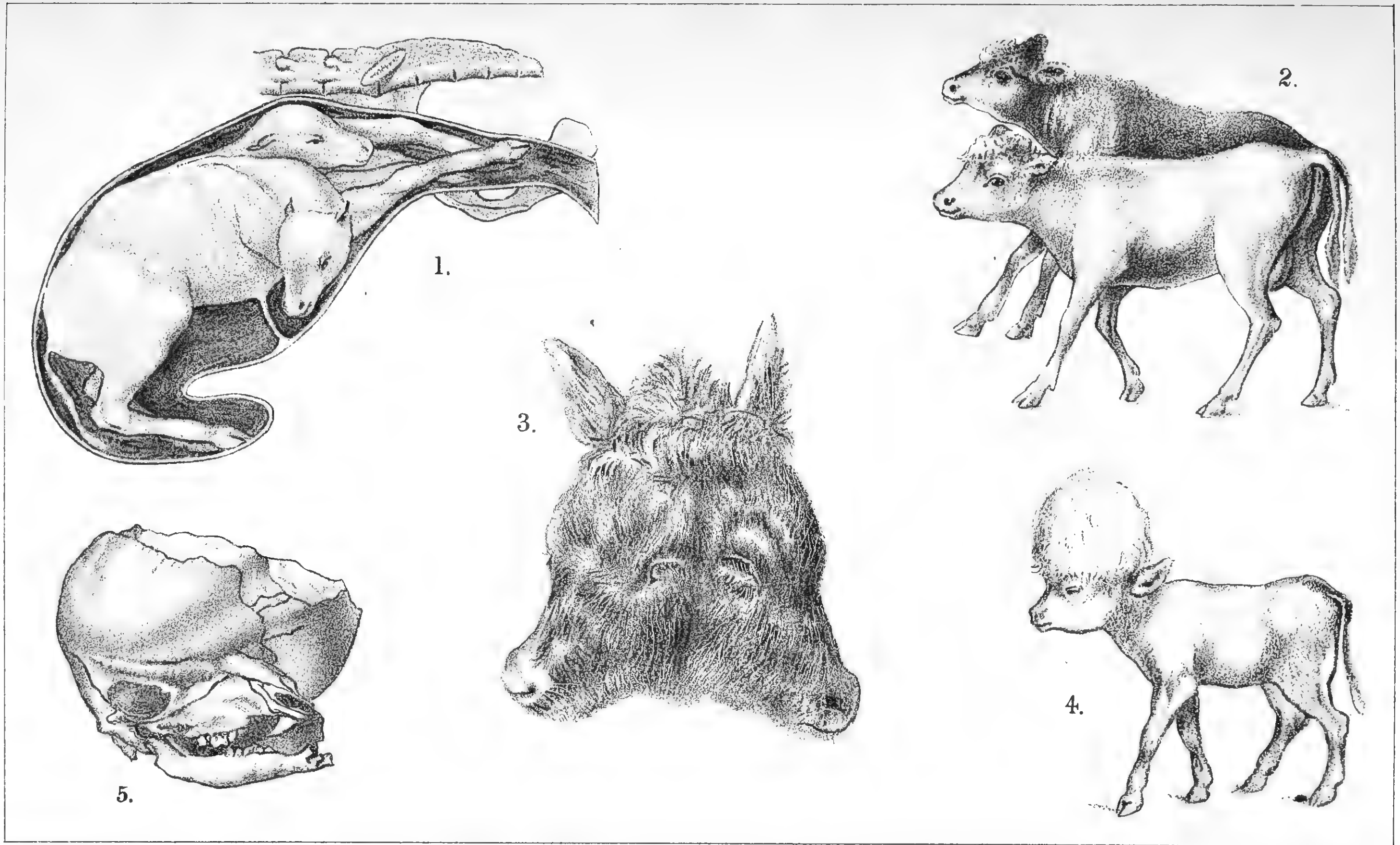

S.aines. del.

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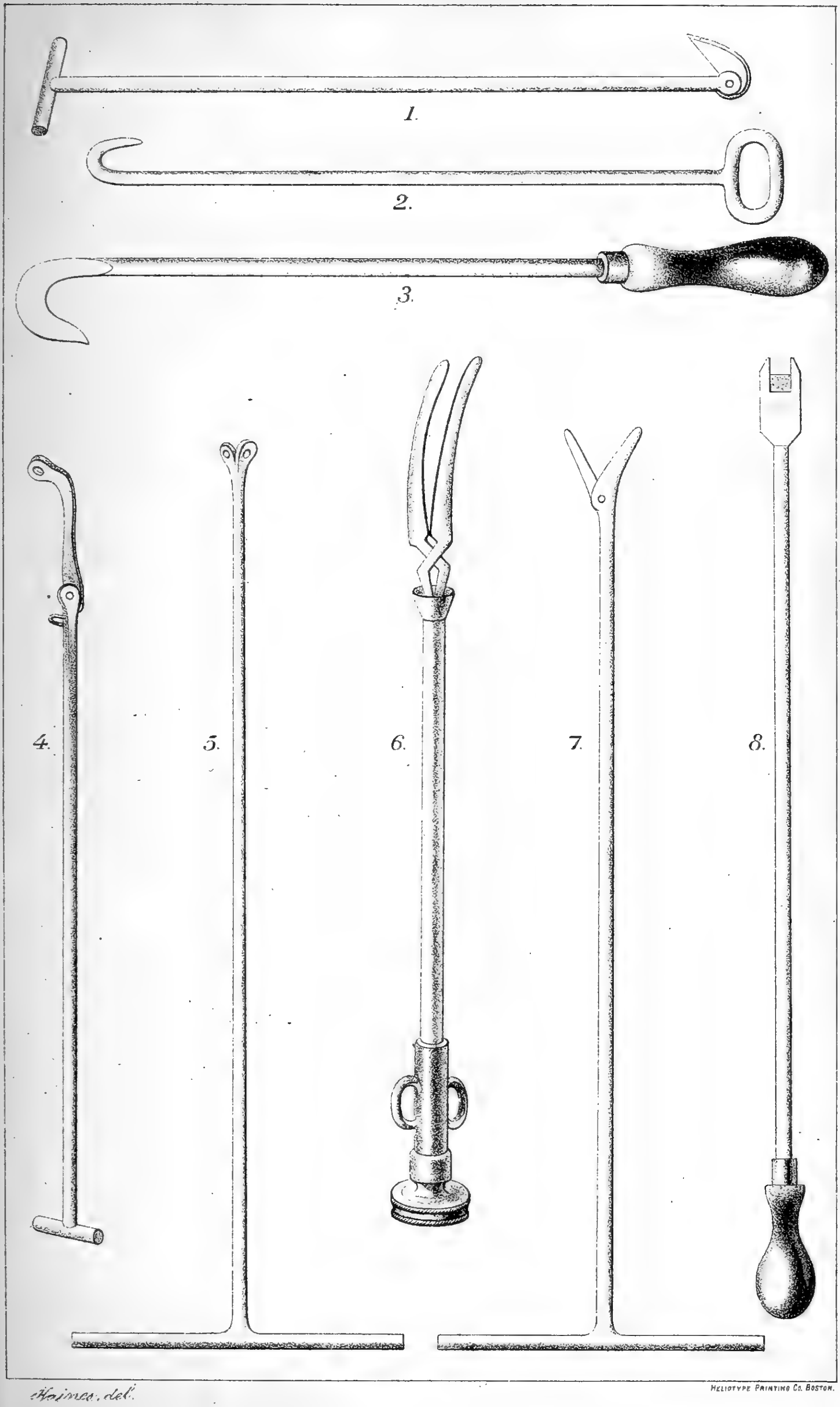
MONSTROSITIES.



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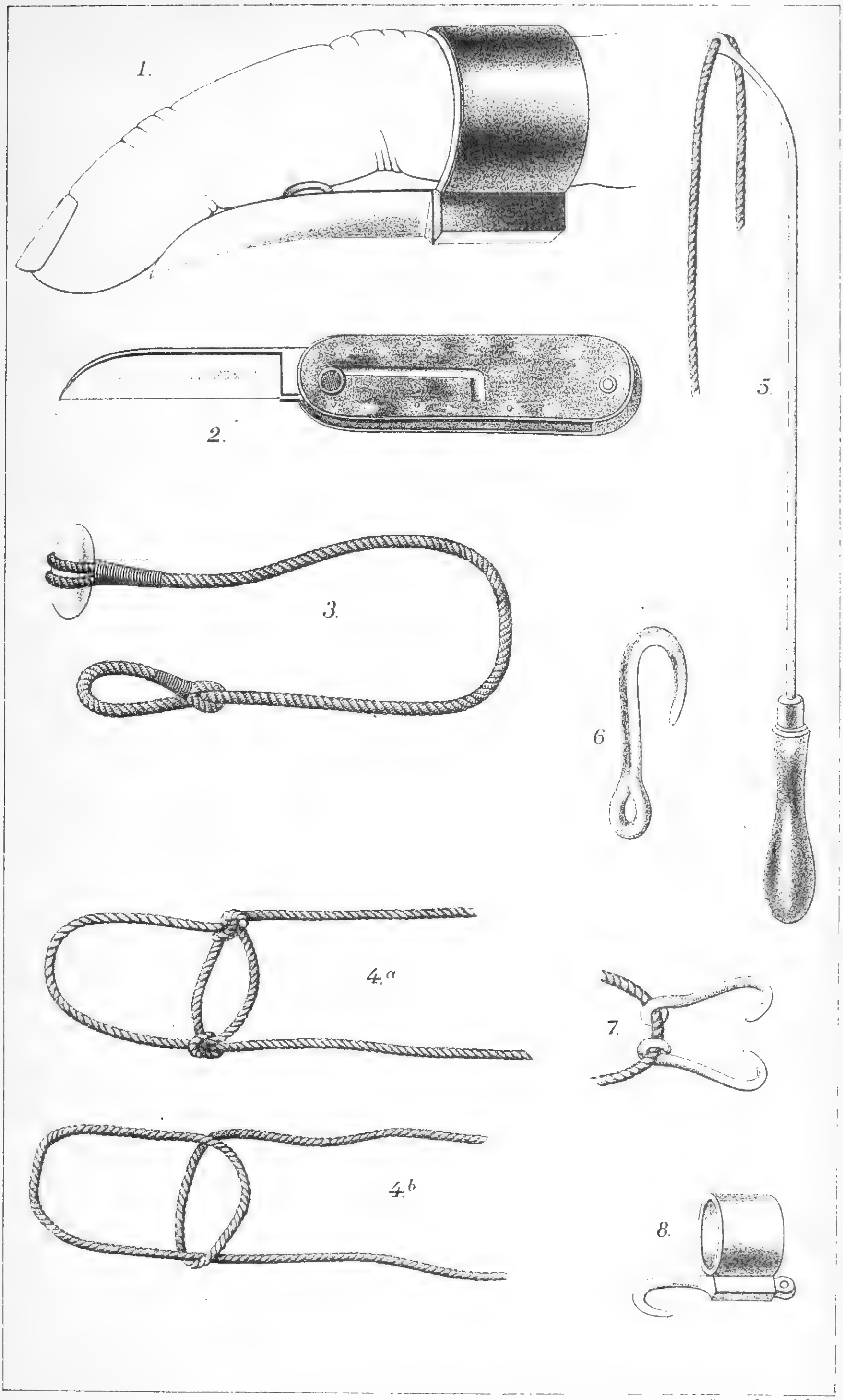
INSTRUMENTS USED IN DIFFICULT LABOR.



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INSTRUMENTS USED IN DIFFICULT LABOR.

DISEASES FOLLOWING PARTURITION.

By JAMES LAW, F. R. C. V. S.,
Professor of Veterinary Science, etc., in Cornell University.

FLOODING—BLEEDING FROM THE WOMB.

Though not so common in the cow as in the human female, flooding is sufficiently frequent to demand attention. It may depend on a too rapid calving, and a consequent failure of the womb to contract when the calf has been removed. The pregnant womb is extraordinarily rich in blood-vessels, and especially in large and tortuous veins, which become compressed and all but obliterated under contraction, but remain overfilled and often bleed into the cavity of the womb should no contraction take place. Cox records cases in which the labor pains had detached and expelled the fetal membranes, while the calf, owing to large size or wrong presentation, was detained in the womb, and the continued dilatation of the womb in the absence of the fetal membranes led to a flow of blood which accumulated in clots around the calf. Other causes are laceration of the cotyledons of the womb, or from an antecedent inflammation of the placenta, and the unnatural adhesion of the membranes to the womb, which bleeds when the two are torn apart. Weakness of the womb from overdistension, as in dropsy, twins, etc., is not without its influence. Finally, eversion of the womb (casting the withers) is an occasional cause of flooding. The trouble is only too evident when the blood flows from the external passages in drops or in a fine stream. But when it is retained in the cavity of the womb it may remain unsuspected until it has rendered the animal almost bloodless. The symptoms in such a case are paleness of the eyes, nose, mouth, and of the lips of the vulva, a weak rapid pulse, violent and perhaps loud beating of the heart (palpitations), sunken, staring eyes, coldness of the skin, ears, horns, and limbs, perspiration, weakness in standing, staggering gait, and finally inability to rise, and death in convulsions. If these symptoms are seen the oiled hand should be introduced into the womb, which will be found open and flaccid, and containing large blood clots.

Treatment consists in the removal of the fetal membranes and blood clots from the womb (which will not contract while they are present), the dashing of cold water on the loins, right flank, and vulva, and if these measures fail, the injection of cold water into the womb through a rubber tube furnished with a funnel. In obstinate cases a good-sized sponge soaked in tincture of muriate of iron should be introduced into the womb and firmly squeezed, so as to bring the iron in contact with the bleeding surface. This is at once an astringent and a coagulant for the blood, besides stimulating the womb to contraction. In the absence of this agent, astringents (solution of copperas, alum, tannic acid, or acetate of lead), may be thrown into the womb, and one-half-dram doses of acetate of lead may be given by the mouth, or 1 ounce powdered ergot of rye may be given in gruel. When nothing else is at hand, an injection of oil of turpentine will sometimes promptly check the bleeding.

EVERSION OF THE WOMB—CASTING THE WITHERS.

Like flooding, this is the result of failure of the womb to contract after calving. If that organ contracts naturally, the afterbirth is expelled, the internal cavity of the womb is nearly closed, and the mouth of the organ becomes so narrow that the hand can not be forced through, much less the whole mass of the matrix. When, however, it fails to contract, the closed end of one of the horns may fall into its open internal cavity, and under the compression of the adjacent intestines, and the straining and contraction of the abdominal walls, it is forced farther and farther until the whole organ is turned outside in, slides back through the vagina, and hangs from the vulva. The womb can be instantly distinguished from the protruding vagina or bladder by the presence over its whole surface of 50 to 100 mushroom-like bodies (cotyledons), each 2 to 3 inches in diameter, and attached by a narrow neck. (Plates XII, XIII.) When fully everted it is further recognizable by a large, undivided body hanging from the vulva, and two horns or divisions which hang down toward the hocks. In the imperfect eversions the body of the womb may be present with two depressions leading into the two horns. In the cases of some standing the organ has become inflamed and gorged with blood until it is as large as a bushel basket, and its surface has a dark, red, blood-like hue, and tears and bleeds on the slightest touch. Still later lacerations, raw sores, and even gangrene are shown in the mass. At the moment of protrusion the general health is not altered, but soon the inflammation and fever with the violent and continued straining induce exhaustion, and the cow lies down, making no attempt to rise.

Treatment will vary somewhat, according to the degree of the eversion. In partial eversion, with the womb protruding only slightly from the vulva and the cow standing, let an assistant pinch the back to prevent straining while the operator pushes his closed fist into the center of the mass and carries it back through the vagina, assisting in returning the surrounding parts by the other hand. In more complete eversion, but with the womb as yet of its natural bulk and consistency, and the cow standing, straining being checked by pinching the back, a sheet is held by two men so as to sustain the everted womb and raise it to the level of the vulva. It is now sponged clean with cold water, the cold being useful in driving out the blood and reducing the bulk, and finally it may be sponged over with laudanum or with a weak solution of carbolic acid (1 dram to 1 quart water). The closed fist may now be planted in the rounded end of the largest horn and pushed on so as to turn it back within itself and carry it on through the vagina, the other hand being used meanwhile to assist in the inversion and in pushing the different masses in succession within the lips of the vulva. In case of failure, resort should be had at once to a plan which I have successfully followed for many years, but which has never been described save by a short notice in my "Farmers' Veterinary Adviser," eighth edition. Take a long linen or cotton bandage, 5 or 6 inches wide, and wind it around the protruding womb as tightly as it can be drawn, beginning at the free end and gradually covering the entire mass up to the vulva. By this means the greater part of the blood will be forced out of the organ and its bulk greatly reduced, so that its reduction is much facilitated. An additional advantage is found in the protection given to the womb by its investing bandage, while it is being pushed forward into the vagina and abdomen. In manipulating the exposed womb there is always danger of laceration, but when the organ is covered with a sheet it is next to impossible to tear it. The subsequent manipulation is as in the other case by pushing the blind end forward within itself with the closed fist and carrying this on through the vagina into the abdomen with the constant assistance of the other hand. It will often be found convenient to use the edge of the left hand to push the outer part of the protruding mass inside the lips of the vulva, while the right hand and arm are carrying the central portions forward through the vagina. An intelligent assistant, pushing with the palms of both hands on the outer portion of the mass, will also afford material assistance. As the womb is turned within itself the wrapping bandage will gradually loosen, but once the great mass has entered the passages it is easy to compel the rest to follow, and the compression by the bandage is no longer so important. When the womb is fully replaced the bandage is left in its interior in a series of loose folds, and can be easily withdrawn. It is well to move the hand from side to side to insure that the two horns of the womb are fully extended and on about the same level before withdrawing the arm and applying a truss.

When the womb has been long everted and is gorged with blood, inflamed and friable, there is often the additional disadvantage that the animal is unable or unwilling to rise. When lying down the straining can not be controlled so effectually, and the compression of the belly is so great as to prove a serious obstacle to reduction, even in the absence of straining. The straining may be checked by 2 or 3 ounces of laudanum, or 2 ounces of choral hydrate, or by inhalation of chloroform to insensibility, and then by raising the hind parts on straw bundles the gravitation of the abdominal organs forward may be made to lessen the resistance. If success can not be had in this way the cow may be further turned on her back, and if return is still impossible, the hind limbs may be tied together and drawn up to a beam overhead by the aid of a pulley. In this position, in place of the pressure backward of the bowels proving a hindrance, their gravitation forward proves a most material help to reduction. In seeking to return the womb the sponging with ice-cold water, the raising on a sheet and the wrapping in a tight bandage should be resorted to. Another method which is especially commendable in these inflamed conditions of the womb is to bring a piece of linen sheet 30 inches by 36 under the womb with its anterior border close up to the vulva, then turn the posterior border upward and forward over the organ, and cross the two ends over this, and over each other above. The ends of the sheet are steadily drawn so as to tighten its hold on the womb, which is thus held on the level of the vulva or above, and cold water is constantly poured upon the mass. The reduction is further sought by compression of the mass with the palms applied outside the sheet. Fifteen or twenty minutes are usually sufficient to cause the return of the womb, provided straining is prevented by pinching of the back or otherwise.

In old and aggravated cases, with the womb torn, bruised, or even gangrenous, the only resort is to amputate the entire mass. This is done by tying a strong waxed cord round the protruding mass close up to the vulva, winding the cord round pieces of wood so as to draw them as tightly as possible, cutting off the organ below this ligature, tying a thread on any artery that may still bleed, and returning the stump well into the vagina.

Retention of the returned womb is the next point, and this is most easily accomplished by a rope truss. Take two ropes, each about 18 feet long and an inch in thickness. Double each rope at its middle, and lay the one above the other at the bend so as to form an ovoid of about 8 inches in its long diameter. Twist each end of the one rope twice round the other so that this ovoid will remain when they are drawn tight. (Plates XXII and XXIII.) Tie a strap or rope around the back part of the neck and a surcingle around the body. Place the rope truss on the animal so that the ovoid ring shall surround the vulva, the two ascending ropes on the right and left of the tail and the two descending ones down inside the thighs on the right and left of the udder. These descending ropes are carried forward on the sides of the body and tied to the surcingle and to the neck collar. The ascending ropes proceed forward on the middle of the back, twisting over each other, and are tied to the surcingle and collar. The upper and lower ropes are drawn so tightly that the rope ring is made to press firmly all around the vulva without risk of displacement. This should be worn for several days until the womb shall have closed, and all risk of further eversion is at an end. Variations of this device are found in the use of a narrow triangle of iron applied around the vulva and fixed by a similar arrangement of ropes, surcingle, and collar (Plate XXIII, Fig. 3), a common crupper similarly held around the vulva (Plate XXII, Fig. 1), stitches through the vulva, and wires inserted through the skin on the two hips (Plate XXIII, Fig. 2), so that they will cross behind the vulva; also pessaries of various kinds inserted in the vagina. None of these, however, presents any advantage over the simple and comparatively painless rope truss described above. Such additional precautions as keeping the cow in a stall higher behind than in front, and seeing that the diet is slightly laxative and nonstimulating may be named. If straining is persistent, ounce doses of laudanum may be employed twice a day, and the same may be injected into the vagina.

If the womb has been cut off, injections of a solution of a teaspoonful of carbolic acid in a quart of water should be employed daily, or more frequently, until the discharge ceases.

EVERSION OF THE BLADDER.

A genuine eversion of the bladder is almost unknown in the cow, owing to the extreme narrowness of its mouth. The protrusion of the bladder, however, through a laceration in the floor of the vagina sustained in calving, and its subsequent protrusion through the vulva, is sometimes met with. In this case the protruding bladder contains urine, which can never be the case in a real eversion, in which the inner surface of the bladder and the openings of the ureters are both exposed outside the vulva. The presence of a bag containing water, which is connected with the floor of the vagina, will serve to identify this condition. If the position of the bladder in the vulva renders it impracticable to pass a catheter to draw off the urine, pierce the organ with the nozzle of a hypodermic syringe, or even a very small trocar and canula, and draw off the water, when it will be found an easy matter to return the bladder to its place. The rent in the vagina can be stitched up, but as there would be risk in any subsequent calving it is best to prepare the cow for the butcher.

RUPTURE OF THE BLADDER.

This has been known to occur in protracted parturition when the fetus finally passed while the bladder was full. The symptoms are those of complete suppression of urine and tenderness of the abdomen, with a steady accumulation of liquid and fluctuation on handling its lower part. If the hand is introduced into the vagina it is felt to be hot and tender, and perhaps slightly swollen along its floor. As a final test, if the lower fluctuating part of the abdomen is punctured with a hypodermic needle a straw-colored liquid of an urinous odor flows out. The condition has been considered as past hope. The only chance for recovery would be in opening the abdomen, evacuating the liquid, and stitching up the rent in the bladder, but at such a season and with inflammation already started there would be little to hope for.

RUPTURE OF THE WOMB.

When the womb has been rendered friable by disease this may occur in the course of the labor, but much more frequently it occurs from violence sustained in attempting assistance in difficult parturition. It is also liable to occur during eversion of the organ through efforts to replace it.

If it happens while the calf is still in the womb, it will usually bleed freely and continuously until the fetus has been extracted, so that the womb can contract on itself and expel its excess of blood. Another danger is that in case of a large rent the calf may escape into the cavity of the abdomen and parturition become impossible. Still another danger is that of the introduction of septic germs and the setting up of a fatal inflammation of the lining membrane of the belly (peritoneum). Still another is the escape of the small intestine through the rent and on through the vagina and vulva, so as to protrude externally and receive perhaps fatal injuries. In case of rupture before calving, that act should be completed as rapidly and carefully as possible, the fetal membranes removed and the contraction of the womb sought by dashing cold water on the loins, the right flank, or the vulva. If the calf has escaped into the abdomen and can not be brought through the natural channels it may be permissible to fix the animal and extract it through the side, as in the Cæsarian section. If the laceration has happened during eversion of the womb it is usually less redoubtable, because the womb contracts more readily under the stimulus of the cold air so recently applied. In case the abdomen has been laid open it is well to stitch up the rent, but if not it should be left to nature, and will often heal satisfactorily, the cow even breeding successfully in after years.

LACERATIONS AND RUPTURES OF THE VAGINA.

Rupture of the floor of the vagina has been already referred to as allowing the protrusion of the bladder. Laceration of the roof of this passage is also met with as the result of deviations of the hind limbs and feet upward when the calf lies on its back. In some such cases the opening passes clear into the rectum, or the foot may even pass out through the anus, so that that opening and the vulva are laid open into one.

Simple superficial lacerations of the vaginal walls are not usually serious, and heal readily unless septic inflammation sets in, in which case the cow is likely to perish. They may be treated with soothing and antiseptic injections, such as carbolic acid, 1 dram; water, 1 quart.

The more serious injuries depend on the complications. Rupture of the anterior part of the canal, close to the mouth of the womb, may lead to the introduction of infecting germs into the cavity of the abdomen, or protrusion of the bowel through the rent and externally, either of which is likely to prove fatal. If both these conditions are escaped the wound may heal spontaneously. Rupture into the bladder may lead to nothing worse than a constant dribbling of urine from the vulva. The cow should be fattened if she survives. Rupture into the rectum will entail a constant escape of feces through the vulva, and of course the same condition exists when the anus as well has been torn open. I have successfully sewed up an opening of this kind in the mare, but in the cow it is probably better to prepare for the butcher.

CLOTS OF BLOOD IN THE WALLS OF THE VAGINA.

During calving the vagina may be bruised so as to cause escape of blood beneath the mucous membrane and its coagulation into large bulging clots. The vulva may appear swollen, and on separating its lips the mucous membrane of the vagina is seen to be raised into irregular rounded swellings of a dark blue or black color, and which pit on pressure of the finger. If the accumulation of blood is not extensive it may be reabsorbed, but if abundant it may lead to irritation and dangerous inflammation, and should be incised with a lancet and the clots cleared out. The wounds may then be sponged twice a day with a lotion made with 1 dram sulphate of zinc, 1 dram carbolic acid, and 1 quart water.

RETAINED AFTERBIRTH.

The cow, of all our domestic animals, is especially subject to this accident. This may be partly accounted for by the firm connections established through the fifty to one hundred cotyledons (Plate XIII, Fig. 2) in which the fetal membranes dovetail with the follicles of the womb. It is also most liable to occur after abortion, in which preparation has not been made by fatty degeneration for the severance of these close connections. In the occurrence of inflammation, causing the formation of new tissue between the membranes and the womb, we find the occasion of unnaturally firm adhesions which prevent the spontaneous detachment of the membranes. Again, in low conditions of health and an imperfect power of contraction we find a potent cause of retention, the general debility showing particularly in the indisposition of the womb to contract, after calving, with sufficient energy to expel the afterbirth. Hence we find the condition common with insufficient or innutritious food, and in years or localities in which the fodder has suffered from weather. Ergoted (Plate V), smutty or musty fodder, by causing abortion, is a frequent cause of retention. Old cows are more subject than young ones, probably because of diminishing vigor. A temporary retention is sometimes due to a too rapid closure of the neck of the womb after calving, causing strangulation and imprisonment of the membranes. Conditions favoring this are the drinking of cold (iced) water, the eating of cold food (frosted roots), and (through sympathy between udder and womb) a too prompt sucking by the calf or milking by the attendant.

The *symptoms* of retention of the afterbirth are usually only too evident, as the membranes hang from the vulva and rot away gradually, causing the most offensive odor throughout the building. When retained within the womb by closure of its mouth, and similarly in cases in which the protruded part has rotted off, the decomposition continues and the fetid products escaping by the vulva appear in offensively smelling pools on the floor and mat together with hairs near the root of the tail. The septic materials retained in the womb cause inflammation of its lining membrane, and this, together with the absorption into the blood of the products of putrefaction, leads to ill health, emaciation, and drying up of the milk.

Treatment will vary according to the conditions. When the cow is in low condition, or when retention is connected with drinking iced water or eating frozen food, hot drinks and hot mashes of wheat bran or other aliment may be all-sufficient. If, along with the above conditions, the bowels are somewhat confined, an ounce of ground ginger, or half an ounce of black pepper, given with a quart of sweet oil, or a pound and a half of Glauber salts, the latter in at least 4 quarts of warm water, will often prove effectual. A bottle or two of flaxseed tea, made by prolonged boiling, should also be given at frequent intervals. Other stimulants, like rue, savin, laurel, and carminitives like anise, cumin, and coriander are preferred by some, but with very questionable reason, the more so that the first three are not without danger. Ergot of rye, 1 ounce, or extract of the same, 1 dram, may be resorted to to induce contraction of the womb. The mechanical extraction of the membranes is, however, often called for; of this there are several methods. The simplest is to hang a weight of 1 or 2 pounds to the hanging portion, and allow this, by its constant dragging and by its jerking effect when the cow moves, to pull the membranes from their attachments and to stimulate the womb to expulsive contractions. But in the neglected cases, when the dependent mass is already badly decomposed, it is liable to tear across under the added weight, leaving a portion of the offensive material imprisoned in the womb. Again, this uncontrolled dragging upon a relaxed womb will (in exceptional cases only, it is true) cause it to become everted and to protrude in this condition from the vulva.

A second resort is to seize the dependent part of the afterbirth between two sticks, and roll it up on these until they lie against the vulva; then, by careful traction, accompanied by slight jerking movements from side to side, the womb is stimulated to expulsive contractions and the afterbirth is wound up more and more on the sticks until, finally, its last connections with the womb are severed and the remainder is expelled suddenly en masse. It is quite evident that neglected cases with putrid membranes are poor subjects for this method, as the afterbirth is liable to tear across, leaving a mass in the womb. During the progress of the work any indication of tearing is the signal to stop and proceed with greater caution, or altogether abandon the attempt in this way.

The third method (that with the skilled hand) is the most promptly and certainly successful. For this the operator had best strip and dress as for a parturition case. Again, the operation should be undertaken within twenty-four hours after calving, since, later, the mouth of the womb may be so closed that it becomes difficult to introduce the hand. The operator should smear his arms with carbolized lard or vaseline to protect them against infection, and particularly in delayed cases with putrid membranes. An assistant holds the tail to one side while the operator seizes the hanging afterbirth with the left hand, while he introduces the right along the right side of the vagina and womb, letting the membranes slide through his palm until he reaches the first cotyledon to which they remain adherent. In case no such connection is within reach, gentle traction is made on the membranes with the left hand until the deeper parts of the womb are brought within reach, and the attachments to the cotyledons can be reached. Then the soft projection of the membrane, which is attached to the firm fungus-shaped cotyledon on the inner surface of the womb, is seized by the little finger, and the other fingers and thumb are closed on it so as to tear it out from its connections. To explain this it is only necessary to say that the projection from the membrane is covered by soft conical processes, which are received into cavities of a corresponding size on the summit of the firm mushroom-shaped cotyledon growing from the inner surface of the womb. To draw upon the former, therefore, is to extract its soft villous processes from within the follicles or cavities of the other. (Plate XIII, Fig. 2.) If it is at times difficult to start this extraction it may be necessary to get the finger nail inserted between the two, and once started the finger may be pushed on, lifting all the villi in turn out of their cavities. This process of separating the cotyledons must be carefully conducted, one after another, until the last has been detached and the afterbirth comes freely out of the passages. I have never found any evil result from the removal of the whole mass at one operation, but Shaack mentions the eversion of the womb as the possible result of the necessary traction, and in cases in which those in the most distant part of the horn of the womb can not be easily reached, he advises to attach a cord to the membranes inside the vulva, letting it hang out behind, and to cut off the membranes below the cord. Then, after two or three days' delay, he extracts the remainder, now softened and easily detached. If carefully conducted, so as not to tear the cotyledons of the womb, the operation is eminently successful; the cow suffers little, and the straining roused by the manipulations soon subsides. Keeping in a quiet, dark place, or driving a short distance at a walking pace, will serve to quiet these. When the membranes have been withdrawn the hand, half closed, may be used to draw out of the womb the offensive liquid that has collected. If the case is a neglected one, and the discharge is very offensive, the womb must be injected as for leucorrhœa.

INFLAMMATION OF THE VAGINA—VAGINITIS.

This may occur independently of inflammation of the womb, and usually as the result of bruises, lacerations, or other injuries sustained during calving. It will be shown by swelling of the lips of the vulva, which, together with their lining membrane, become of a dark red or leaden hue, and the mucous discharge increases and becomes whitish or purulent, and it may be fetid. Slight cases recover spontaneously, or under warm fomentations or mild astringent injections (a teaspoonful of carbolic acid in a quart of water), but severe cases may go on to the formation of large sores (ulcers), or considerable portions of the mucous membrane may die and slough off. Baumeister records two cases of diphtheritic vaginitis, the second case in a cow four weeks calved, contracted from the first in a newly calved cow. Both proved fatal, with formation of false membranes as far as the interior of the womb. In all severe cases the antiseptic injections must be applied most assiduously. The carbolic acid may be increased to one-half ounce to a quart, or chlorine water, or peroxide of hydrogen solution may be injected at least three times a day. Hyposulphite of soda, 1 ounce to a quart of water, is an excellent application, and the same amount may be given by the mouth.

LEUCORRHŒA—MUCO-PURULENT DISCHARGE FROM THE PASSAGES.

This is due to a continued or chronic inflammation of the womb, the vagina, or both. It usually results from injuries sustained in calving, or from irritation by putrid matters in connection with retained afterbirth, or from the use of some object in the vagina (pessary) to prevent eversion of the womb. Exposure to cold or other cause of disturbance of the health may affect an organ so susceptible as this at the time of parturition so as to cause inflammation.

The main *symptom* is the glairy white discharge flowing constantly or intermittently (when the cow lies down), soiling the tail and matting its hairs and those of the vulva. When the lips of the vulva are drawn apart the mucous membrane is seen to be red with minute elevations, or pale and smooth. The health may not suffer at first, but if the discharge continues and is putrid the health fails, the milk shrinks, and flesh is lost. If the womb is involved the hand introduced into the vagina may detect the mouth of the womb slightly open and the liquid collected within its cavity. Examination with the oiled hand in the rectum may detect the outline of the womb beneath, somewhat enlarged, and fluctuating under the touch from contained fluid. In some cases heat is more frequent or intense than natural, but the animal rarely conceives when served, and if she does is likely to abort.

Treatment with the injections advised for vaginitis is successful in mild or recent cases. In obstinate ones stronger solutions may be used after the womb has been washed out by a stream of tepid water until it comes clear. A rubber tube is inserted into the womb, a funnel placed in its raised end, and the water and afterward the solution poured slowly through this. If the neck of the womb is so close that the liquid can not escape, a second tube may be inserted to drain it off. As injections may be used chloride of zinc, one-half dram to the quart of water, or sulphate of iron 1 dram to the quart. Three drams of sulphate of iron and one-half ounce ground ginger may also be given in the food daily.

INFLAMMATION OF THE WOMB—METRITIS—INFLAMMATION OF WOMB AND ABDOMEN—METRO-PERITONITIS.

Inflammation of the womb may be slight or violent, simple or associated with putrefaction of its liquid contents and general poisoning, or it may extend so that the inflammation affects the lining membrane of the whole abdominal cavity. In the last two cases the malady is a very grave one. The *causes* are largely the same as those causing inflammation of the vagina. Greater importance must, however, be attached to exposure to cold and wet, and septic infection.

The *symptoms* appear two or three days after calving, when the cow may be seen to shiver, or the hair stands erect, especially along the spine, and the horns, ears, and limbs are cold. The temperature in the rectum is elevated by one or two degrees, the pulse is small, hard, and rapid (70 to 100), appetite is lost, rumination ceases, and the milk shrinks in quantity or is entirely arrested, and the breathing is hurried. The hind limbs may shift uneasily, the tail be twisted, the head and eyes turn to the right flank, and the teeth are ground. With the flush of heat to the horns and other extremities, there is redness of the eyes, nose, and mouth, and usually a dark redness about the vulva. Pressure on the right flank gives manifest pain, causing moaning or grunting, and the hind limbs are moved stiffly, extremely so if the general lining of the abdomen is involved. In severe cases the cow lies down and can not be made to rise. There is usually marked thirst, the bowels are costive, and dung is passed with pain and effort. The hand inserted into the vagina perceives the increased heat, and when the neck of the womb is touched the cow winces with pain. Examination through the rectum detects enlargement and tenderness of the womb. The discharge from the vulva is at first watery, but becomes thick, yellow, and finally red or brown, with a heavy or fetid odor. Some cases recover speedily and may be almost well in a couple of days; a large proportion perish within two days of the attack, and some merge into the chronic form, terminating in leucorrhœa. In the worst cases there is local septic infection and ulceration, or even gangrene of the parts, or there is general septicæmia, or the inflammation involving the veins of the womb causes coagulation of the blood contained in them, and the washing out of the clots to the right heart and lungs leads to blocking of the vessels in the latter and complicating pneumonia. Inflammations of the womb and passages after calving are always liable to these complications, and consequently to a fatal issue. Franck records three instances of rapidly fatal metritis in cows, all of which had been poisoned from an adjacent cow with retained and putrid afterbirth. Others have had similar cases.

Treatment in the slight cases of simple inflammation does not differ much from that adopted for vaginitis, only care must be taken that the astringent and antiseptic injections are made to penetrate into the womb. After having washed out the womb a solution of chloride of lime or permanganate of potash (1 ounce to 1 quart of water), with an ounce each of glycerine and laudanum to render it more soothing, will often answer every purpose. It is usually desirable to open the bowels with 1½ pounds Glauber salts and 1 ounce ginger in 4 quarts of warm water, and to apply fomentations of warm water or even mustard poultices or turpentine to the right flank.

In the violent attacks with high temperature and much prostration, besides the salts, agents must be given to lower the temperature and counteract septic poisoning. Salicylate of soda one-half ounce, or quinia 2 drams, repeated every four hours, will help in both ways, or ounce doses of hyposulphite of soda or dram doses of carbolic acid may be given at equal intervals until six doses have been taken. Tincture of aconite has often been used in 20-drop doses every six hours. If the temperature rises to 106° or 107° F., it must be met by the direct application of cold or iced water to the surface. The animal may be covered with wet sheets, and cold water poured on these at intervals until the temperature in the rectum is lowered to 102° F. In summer the cow may be allowed to dry spontaneously, while in winter it should be rubbed dry and blanketed. Even in the absence of high temperature much good may be obtained from the soothing influence of a wet sheet covering the loins and flanks and well covered at all points by a dry one. This may be followed next day by a free application of mustard and oil of turpentine. When the animal shows extreme prostration alcohol (1 pint) or carbonate of ammonia (1 ounce) may be given to tide over the danger, but such cases usually perish.

In this disease, even more than in difficult and protracted parturition or retained placenta, the attendants must carefully guard against the infection of their hands and arms from the diseased parts. The hand and arm before entering the passages should always be well smeared with lard impregnated with carbolic acid.

MILK FEVER—PARTURITION FEVER—PARTURIENT APOPLEXY—PARTURIENT COLLAPSE.

This disease is not only peculiar to the cow, but it may be said to be virtually confined to the improved and plethoric cow. It further occurs only at or near the time of calving. Indeed, these two factors, calving and plethora, may be set apart as preëminently the causes of this disease. It is the disease of cows that have been improved in the direction of early maturity, power of rapid fattening, or a heavy yield of milk, and hence it is characteristic of those having great appetites and extraordinary power of digestion. The heavy milking breeds are especially its victims, as in these the demand for the daily yield of 50 to 100 pounds of milk means even more than a daily increase of 2 to 3 pounds of body weight, mainly fat. The victims are not always fat when attacked, but they are cows having enormous powers of digestion, and which have been fed heavily at the time. Hence the stall-fed city dairy cow, and the farm cow on a rich clover pasture in June or July, are especially subject. The condition of the blood globules in the suffering cow attest the extreme richness and density of the blood, yet this peculiarity appears to have entirely escaped the notice of veterinary writers. I have never examined the blood of a victim of this disease without finding the red blood-globules reduced to little more than one-half their usual size. Now, these globules expand or contract according to the density of the liquid in which they float. If we dilute the blood with water they will expand until they burst, whereas if solids, such as salt or albumen, are added they shrink to a large extent. Their small size, therefore, in parturition fever indicates the extreme richness of the blood, or, in other words, plethora.

Confinement in the stall is an accessory cause, partly because stabled cattle are highly fed, partly because the air is hotter and fouler, and partly because there is no expenditure by exercise of the rich products of digestion.

High temperature is conducive to the malady, though the extreme colds of winter are no protection against it. Heat, however, conduces to fever, and fever means lessened secretion, which means a plethoric state of the circulation. The heats of summer are, however, often only a coincidence of the real cause, the mature rich pastures and especially the clover ones being the greater.

Electrical disturbances have an influence of a similar kind, disturbing the functions of the body, and favoring sudden variations in the circulation. A succession of cases of the malady often accompany or precede a change of weather from dry to wet, from a low to a high barometric pressure.

Costiveness, which is the usual concomitant of fever, may in a case of this kind become an accessory cause, the retention in the blood of what should have passed off by the bowels tending to increase the fulness of the blood vessels and the density of the blood.

Mature age is a very strong accessory cause. The disease never occurs with the first parturition, and rarely with the second. It appears with the third, fourth, fifth, or sixth, after the growth of the cow has ceased, and when all her powers are devoted to the production of milk.

Calving is an essential condition, as the disturbance of the circulation, consequent on the contraction of the womb and the expulsion into the general circulation of the enormous mass of blood hitherto circulating in the walls of the womb, fills to repletion the vessels of the rest of the body, and very greatly intensifies the already existing plethora. If this is not speedily counterbalanced by a free secretion from the udder, kidneys, bowels, and other excretory organs, the most dire results may ensue. Calving may thus be held to be an exciting cause, and yet the labor and fatigue of the act are not active factors. It is after the easy calving, when there has been little expenditure of muscular or nervous energy, and no loss of blood, that this malady is seen. Difficult parturitions may be followed by metritis, but they are rarely connected with parturition fever.

All these factors coincide in intensifying the one condition of plethora, and point to that as the most essential cause of this affection. It is needless to enter here into the much-debated question as to the mode in which the plethora brings about the characteristic symptoms and results. As the results show disorder or suspension of the nervous functions mainly, it may suffice to say that this condition of the blood and blood-vessels is incompatible with the normal functional activity of the nerve centers. How much is due to congestion of the brain and how much to bloodlessness may well be debated, yet in a closed box like the cranium, in which the absolute contents can not be appreciably increased or diminished, it is evident that apart from dropsical effusion or inflammatory exudation, there can only be a given amount of blood; therefore, if one portion of the brain is congested another must be proportionately bloodless, and as congestion of the eyes and head generally, and great heat of the head are most prominent features of the disease, congestion of the brain must be accepted. This, of course, implies a lack of blood in certain other parts or blood-vessels.

Symptoms.—There may be said to be two extreme types of this disease with intervening grades. In both forms there is the characteristic plethora, and more or less sudden loss of voluntary movement and sensation indicating a sudden collapse of nervous power, but in one there is such prominent evidence of congestion of head and brain that it may be called the congestive form, par excellence, without thereby intimating that the torpid form is independent of congestion.

In the *congestive* form there is sudden dullness, languor, hanging back in the stall, or drooping the head, uneasy movements of the hind limbs or tail; if the cow is moved she steps unsteadily or even staggers; she no longer notices her calf or her food; the eyes appear red and their pupils dilated; the weakness increases and the cow lies down or falls and is thenceforward unable to rise. At this time the pulse is usually full and bounding and the temperature raised; the head, horns, and ears being especially hot and the veins of the head full, while the visible mucous membranes of nose and eyes are deeply congested. The cow may lie on her breastbone with her feet beneath the body and her head turned sleepily round, with the nose resting on the right flank; or, if worse, she may be stretched full on her side, with even the head extended, though at times it is suddenly raised and again dashed back on the ground. At such times the legs, fore and hind, struggle convulsively, evidently through unconscious nervous spasm. By this time the unconsciousness is usually complete; the eyes are glazed, their pupils widely dilated, and their lids are not moved when the ball of the eye is touched with the finger. Pricking the skin with a pin also fails to bring any wincing or other response. The pulse, at first from 50 to 70 per minute, becomes more accelerated and weaker as the disease advances. The breathing is quickened, becoming more and more so with the violence of the symptoms, and at first associated with moaning (in exceptional cases bellowing), it may, before death, become slow, deep, sighing, or rattling (stertorous). The temperature, at first usually raised, tends to become lower as stupor and utter insensibility and coma supervene. The bowels, which may have moved at the onset of the attack, become torpid or completely paralyzed, and, unless in case of improvement, they are not likely to operate again. Yet this is the result of paralysis and not of induration of the feces, as often shown by the semiliquid pultaceous condition of the contents after death. The bladder, too, is paralyzed and fails to expel its contents. A free action of either bladder or bowels or of both is always a favorable symptom. The milk secretion may fail, yet often the udder continues to yield its product for a considerable time, and to draw off this and encourage free secretion by rubbing is always indicated.

In nearly all cases the torpor of the digestive organs results in gastric disorder; the paunch becomes the seat of fermentation, producing gas which causes it to bloat up like a drum. There are frequent eructations of gas and liquid and solid food, which, reaching the paralyzed throat, pass in part into the windpipe and cause inflammations of the air passages and lungs.

In the *torpid* form of the disease there is much less indication of fever or violence. There may be no special heat about the horns, ears, or forehead, nor any marked redness or congestion of the eyes or nose, nor engorgement of the veins of the head. The attack comes on more slowly, with apparent weakness of the hind limbs, dullness, drowsiness, suspension of rumination and appetite, and a general indifference to surrounding objects. Soon the cow lies down, or falls and is unable to rise, but for one or two days she may rest on the breastbone and hold the head in the flank without showing any disorderly movements.

Meanwhile there is not only loss of muscular power and inability to stand, but also considerable dullness of sensation, pricking the skin producing no quick response, and even touching the edge of the eyelids causing no very prompt winking. Unless she gets relief, however, the case develops all the advanced symptoms of the more violent form and the animal perishes.

In advanced and fatal cases of either form the insensibility becomes complete; no irritation of skin or eye meets any response; the eye becomes more dull and glassy; the head rests on the ground or other object; unless prevented the cow lies stretched fully on her side; the pulse is small, rapid, and finally imperceptible; the breathing is slow, deep, stertorous, and the expirations accompanied by puffing out of the cheeks, and death comes quietly or with accompanying struggles.

For such fatal disease *prevention* is of far more consequence than treatment. Among the most efficient preventives may be named a spare diet (amounting to actual starvation in very plethoric, heavy-milking cows), for a week before calving and at least four days after. A free access to salt and water is most important, as the salt favors drinking and the water serves to dilute the rich and dense blood. Iced water, however, is undesirable, as a chill may favor the onset of fever. A dose of Epsom salts (1 to 2 pounds) should be given twelve to twenty-four hours before calving is due, so that it may operate at or just before that act. In case calving has occurred unexpectedly in the heavy milker, lose no time in giving the purgative thereafter. If Epsom salts are not at hand use saltpeter (1 ounce) for several days. If the udder is greatly engorged before calving it may be milked for several days before, and should be not less than thrice a day after. A hungry calf is a good auxiliary, but for a very heavy milker the new-born calf gives but a very imperfect relief, and must be supplemented by the hand of the milker. Daily exercise is also of importance, and excepting in midsummer, when the heat of the sun may be injurious, the value of open air is unquestionable. Even in summer an open shed or shady grove is incomparably better than a close, stuffy stall. A rich pasture (clover especially), in late May, June, or July, when at its best, is to be carefully avoided. Better keep the cow indoors on dry straw with plenty of salt and water than to have access to such pastures. It is safest to avoid breeding again from a cow that has once suffered.

Treatment of the most varied kind has succeeded in particular cases and failed in others. Cows attacked in the first two days after calving usually die, but not always; those attacked at the end of a week nearly all recover. In those attacked from the third to the seventh day the mortality steadily decreases. In the following suggestions for treatment a distinction is made between the two extreme types of the disease—the *congestive* and the *paretic*, or *torpid*.

If the cow is seen before she goes down the abstraction of blood is demanded, and may usually be carried to the extent of 4 or even 6 quarts. The fullness and force of the pulse must determine the amount; if it is weak and rapid or scarcely perceptible the vein must be instantly closed, and it may even be necessary to give ammoniacal stimulants. If the cow is lying down, unable to rise, and above all if no winking is caused by touching the eyeball, bleeding must be done, if at all, with great precaution. A pint or a quart may be all that can be safely taken, and in case the pulse has been small and weak no more should be drawn unless the pulse-beat strengthens. The fatal collapse already threatening is often precipitated by unguarded bleeding. The jugular vein may be opened as coming directly from the brain, and as the object is to lessen the density of the blood and the tension in the blood vessels without shock, it is not so essential to draw it in a full stream as in other cases of blood-letting. As the blood is withdrawn the place is speedily taken by liquids (mainly water), absorbed from all available parts of the body, and thus the blood is helpfully diluted.

It is a good practice to give a dose of purgative medicine (Epsom salts 2 pounds, carbonate of ammonia ½ ounce, nux vomica ½ dram). If it is absorbed it will find its way to the bowels and start active secretion, thereby relieving the plethora; if it is not absorbed it will do no harm. Enemas of warm water and soap or oil may be beneficially employed.

Iced water or bags of ice to the head (tied around the horns and covering the forehead and upper part of the neck), are of the very greatest value in cases in which the heat of the horns, ears, and head, the redness of the eyes and fixed dilatation of the pupils, are marked features. Like bleeding, it may be uncalled for in those cases in which the heat and general congestion of the head are absent.

In these congestive cases, too, benefit is often derived from large and frequent doses (20 drops every four hours) of tincture of aconite. It acts not alone as a sedative to the heat and circulation, but also by favoring a free circulation in the skin. In what may be called the non-congestive cases it is of little avail.

Harms claims excellent results from large doses of tartar emetic, 1 ounce for the first dose, 3 drams more after four hours, and 2 drams after four hours. If absorbed it will act after the manner of aconite as a sedative by causing a free circulation in the skin.

This increased circulation in the skin serves to draw away blood from the internal organs, and thus to relieve the brain, and to secure the same result a variety of resorts are had with varying success in different cases. The application of hot (almost scalding) water to the back and loins, or to the limbs, acts in this way. So do mustard plasters, frictions with oil of turpentine, the prolonged movement over the part of a hot smoothing-iron with a thin cloth between it and the skin, or finally the application of strong liquor ammonia, covered up for fifteen minutes with a close rug.

In cases with a high body temperature an excellent plan is to wrap the whole body in a blanket slightly wrung out of cold water, and cover this closely at all points with dry blankets to exclude the air and prevent evaporation and cooling. In fifteen or twenty minutes a reaction will have taken place, the whole body will have been cooled somewhat by the blood returning from the skin since the blanket was applied, and the free perspiration will now serve to relieve both by cooling and by carrying off waste matters from the blood. This may be repeated several times a day if the temperature rises again. In cold weather the skin should be rubbed dry on each occasion.

A similar method of drawing off the blood from the brain is by frequent rubbing of the udder and drawing off the milk.

In case of extreme prostration and weak pulse one-half ounce carbonate of ammonia may be given and repeated at the end of an hour or two if needed. It may be given as a roller-formed bolus made up with a very little flour to give it consistency, or if the cow can not swallow it may be dissolved in water and poured through a probang (Plate III, Fig. 2), or tube introduced into the stomach.

Bloating of the left side (paunch) is a common and dangerous complication of the disease, as it at once aggravates the pressure on the brain, partly by expression of blood from the abdominal organs and partly by nervous action through the vagus and sympathetic nerves. It may often be checked by the use of carbonate of ammonia; or hyposulphite of soda ($\frac{1}{2}$ ounce) may be substituted; or oil of turpentine (1 ounce). In obstinate cases the paunch should be punctured in the upper part of the left flank by a trocar and canula (Plate III, Figs. 5*a* and 5*b*), and the latter left in place until it is no longer needed.

Another most important precaution is to draw off the urine from the bladder several times a day, as a full bladder greatly aggravates the case.

A weak induction current of electricity may be sent through the brain for ten minutes at a time in cases of extreme insensibility, and through the affected limb in case of remaining paralysis.

In the torpid or noncongestive form of the disease, the treatment is the same as regards purgatives, stimulants, nux vomica, antiseptics for bloating, attention to the bladder and udder, counterirritants to spine or limbs, and even bleeding. The cold, wet sheets, and even the ice to the head, may often be dispensed with.

One other precaution may be named applicable to all cases, but especially so to the more distinctly congestive ones. This is to keep the head above the level of the body and prevent injury from the striking of it on the ground or other hard body. The cow is to be packed up with bundles or bags of straw against the shoulders and hips, so as to let her rest on her breast and belly with her limbs under her. Then the head and neck are to be similarly supported, so as to keep them elevated and give them a soft yielding cushion if dashed from side to side. It may be even desirable to support the head by a rope round the horns, or a halter, the end of which is passed over a beam above.

This serves to unload the head by favoring the gravitation backward of its blood, and protects the brain against injurious shocks.

Cases often recover very quickly. A cow is found up and eating which was down utterly insensible a few hours before. Others recover more slowly, and require careful, restricted feeding and a daily dose of saltpeter and nux vomica for several days. Other complications must be met according to their nature.

PALSY AFTER CALVING—DROPPING AFTER CALVING.

This consists in a more or less complete loss of control of the hind limbs occurring after calving, and due either to low condition, weakness and exposure to cold, or to injurious compression of the nerves of the hind limbs by a large calf passing through the pelvis. Its symptoms do not differ from those of palsy of the hind limbs, occurring at other times, and it may be treated in the same way, excepting so far as bruises of the vagina may demand special soothing treatment.

CONGESTION OF THE UDDER—GARGET.

In heavy milkers, before and just after calving, it is the rule that the mammary gland is enlarged, hot, tense and tender, and that a slight exudation or pasty swelling extends forward from the gland on the lower surface of the abdomen. This physiological congestion is looked upon as a matter of course, and disappears in two or three days when the secretion of milk has been fully established. This breaking up of the bag may be greatly hastened by the sucking of a hungry calf, and the kneading it gives the udder with its nose, by stripping the glands clean thrice daily, and by active rubbing at each milking with the palm of the hand, with or without lard, or, better, with camphorated ointment.

The congestion may be at times aggravated by standing in a draft of cold air, or by neglect to milk for an entire day or more (overstocking, hefting) with the view of making a great show of udder for purposes of sale. In such cases the surface of the bag pits on pressure, and the milk has a reddish tinge or even streaks of blood, or it is partially or fully clotted and is drawn with difficulty, mixed, it may be, with a yellowish serum (whey) which has separated from the casein. This should be treated like the above, though it may sometimes demand fomentations with warm water to ward off inflammation, and it may be a week before the natural condition of the gland is restored.

INFLAMMATION OF THE UDDER—SIMPLE MAMMITIS.

Congestion may merge into active inflammation, or it may arise direct, in connection with exposure to cold or wet, with standing in a cold draft, with blows on the udder with clubs, stones, horns, or feet, with injury from a sharp or cold stone, or the projecting edge of a board or end of a nail in the floor, with sudden and extreme changes of weather, with overfeeding on rich albuminous food like cotton-seed, beans, or peas, with indigestions, with sores on the teats, or with insufficient stripping of the udder in milking. In the period of full milk the organ is so susceptible that any serious disturbance of the general health is liable to fall upon the udder.

The *symptoms* and mode of onset vary in different cases. When following exposure there is usually a violent shivering fit, with cold horns, ears, tail, and limbs, and general erection of the hair. This is succeeded by a flush of heat (reaction) in which the horns, ears, and limbs become unnaturally warm, and the gland swells up and becomes firm and solid in one, two, three, or all four quarters. There is hot, dry muzzle, elevated temperature, full, accelerated pulse, and excited breathing, impaired or suspended appetite, and rumination with more or less costiveness, suppression of urine, and a lessened yield of milk, which may be entirely suppressed in the affected quarter.

In other cases the shivering escapes notice, the general disorder of the system is little marked or comes on late, and the first observed sign of illness is the firm swelling, heat, and tenderness of the bag. As the inflammation increases and extends the hot, tender udder causes the animal to straddle with its hind limbs, and when walking to halt on the limb on that side. If the cow lies down it is on the unaffected side. With the increase in intensity and the extension of the inflammation the general fever manifests itself more prominently. In some instances the connective tissue beneath the skin and between the lobules of the gland is affected, and then the swelling is uniformly rounded and of nearly the same consistency, pitting everywhere on pressure. In other cases it primarily attacks the secreting tissue of the gland, and then the swelling is more localized, and appears as hard, nodular masses in the interior of the gland. This last is the usual form of inflammation occurring from infection entering by the teats.

In all cases, but especially in the last-named form, the milk is suppressed and replaced by a watery fluid colored with blood (sometimes deeply), and mingled with masses of clotted casein. Later it becomes white and purulent, and in many cases of an offensive odor.

The course of the disease is sometimes so rapid and at others so slow that no definite rule can be laid down. In two or three days, or from that to the end of the week, the bag may soften, lose its heat and tenderness, and subside into the healthy condition, even resuming the secretion of milk. The longer the inflammatory hardness continues the greater the probability that its complete restoration will not be effected. When a portion of the gland fails to be restored in this way, and has its secretion arrested, it usually shrinks to a smaller size. More commonly a greater amount of the inflammatory product remains in the gland and develops into a solid fibrous mass, causing permanent hardening (induration). In other cases, in place of the product of inflammation developing into a fibrous mass, it softens and breaks down into the white creamy liquid pus (abscess). This abscess may make its way to the surface and escape externally, or it may burst into a milk duct and discharge through the teat. It may break into both and establish a channel for the escape of milk (fistula). In the worst types of the disease gangrene may ensue, a quarter or half, or even the whole udder, losing its vitality and sloughing off, if the cow can bear up against the depressing influence. These gangrenous cases are probably always the result of infection and sometimes run a very rapidly fatal course. I recall one to which I was called as soon as the owner noticed it, yet I found one quarter dark blue, cold, and showing a tendency to the formation of blebs containing a bloody secretion. The cow, which had waded through a depth of semiliquid manure to reach her stall, died within twenty-four hours.

Treatment will vary with the type and the stage of the disease. If the case is seen in the shivering fit, every effort should be made to cut that short, as the inflammation may be thereby greatly moderated if not checked. Copious drinks of warm water thrown in from horn or bottle; equally copious warm injections; the application of heat in some form to the surface of the body (by a rug wrung out of hot water; by hanging over the back and loins bags loosely filled with bran, sand, salt, chaff, or other agent previously heated in a stove; by the use of a flatiron or the warming of the surface by a hot-air bath), or by active friction with straw wisps by two or more persons; the administration of a pint of strong alcoholic liquor, or of 1 ounce of ground ginger, may serve to cut short the attack. After half an hour's sweat, rub dry and cover with a dry blanket.

If, on the other hand, there is little or no fever, and only a slight inflammation, rub well with camphorated ointment or a weak iodine ointment, and milk three, four, or six times a day, rubbing the bag thoroughly each time. Milking must be done with great gentleness, squeezing the teat in place of pulling and stripping it, and if this causes too much pain, the teat tube (Plate XXIV, Fig. 4), or the spring teat-dilator (Plate XXIV, Fig. 3) may be employed.

In cases in which the fever has set in and the inflammation is more advanced, a dose of laxative medicine is desirable (Epsom salts, 1 to 2 pounds, ginger, 1 ounce), which may be followed after the purging has ceased by daily doses of saltpeter, 1 ounce. Many rely on cooling and astringent applications to the inflamed quarter (vinegar, sugar of lead lotion, cold water, ice, etc.), but a safer and better resort is continued fomentation with warm water. A bucket of warm water replenished as it cools, may be set beneath the udder and two persons can raise a rug out of this and hold it against the udder, dipping it anew whenever the heat is somewhat lost. Or a sheet may be passed around the body with four holes cut for the teats and soft rags packed between it and the udder and kept warm by pouring on water as warm as the hands can bear, every ten or fifteen minutes. When this has been kept up for an hour or two the bag may be dried, well rubbed with soap and left thus with a soapy coating. If the pain is great, extract of belladonna may be applied along with the soap, and a dry suspensory bandage with holes for the teats may be applied. Strong mercurial ointment is very useful in relieving pain and softening the bag. This is especially valuable when the disease is protracted and induration threatens. It may be mixed with an equal amount of soap and half the amount of extract of belladonna. In cases of threatened induration excellent results are sometimes obtained from a weak induction current of electricity sent through the gland daily for ten minutes.

If *abscess* threatens it may be favored by fomentation and opened as soon as fluctuation from finger to finger shows the formation of matter at a point formerly hard. The wound may bleed freely, and there is a risk of opening a milk duct, yet relief will be secured, and a dressing twice daily with a lotion of carbolic acid, 1 part, water, 20 parts, and glycerin, 1 part, will suffice to keep the wound clean and healthy.

Gangrene of the affected part is often fatal. It demands antiseptics (chloride of zinc, 1 dram to 1 quart water) applied frequently to the part, or if the case can not be attended smear the affected quarter with melted Venice turpentine, or even wood tar. Antiseptic tonics (tincture of muriate of iron, 4 drams) may also be given four times daily in a quart of water.

CONTAGIOUS MAMMITIS—CONTAGIOUS INFLAMMATION OF THE UDDER.

As stated in the last article, that form of inflammation of the udder which attacks the gland ducts and follicles, causing deep-seated, hard, nodular swellings, is often contagious. Franck has demonstrated this by injecting into the milk ducts in different cows (milking and dry), the pus from the bags of cows affected with mammitis, or the liquids of putrid flesh, or putrid blood, and in every case he produced acute inflammation of the gland tissue within twenty-four hours. He thinks that in ordinary conditions the septic germ gains access by propagating itself through the milk, filling the milk canal and oozing from the external orifice. He points to this as a reason why dry cows escape the malady, though mingling freely with the sufferers, and why such dry cows do not suffer from inflammation of the gland tissue when attacked with foot-and-mouth disease. In this last case it is evident that it is not simply the inoculation with the milker's hand that is lacking, for the skin of the bag is attacked, but not its secreting glandular parts. Now that in any case of abscess we look for the cause in the chain forms of globular bacteria (*Streptococcus pyogenes*), in the cluster form of white globular bacteria (*Staphylococcus pyogenes albus*), and in the golden and citron yellow forms of clustered globular bacteria (*Staphylococcus pyogenes aureus* and *Staphylococcus pyogenes citreus*), the formation of pus gives presumptive evidence of the action of one or more of these germs. So in cases of mortification of the bag; in the very occurrence there is fair circumstantial evidence of the presence of erysipelas micrococcus or other germ which kills the local tissues. Again, in tuberculosis affecting the bag (a not uncommon condition), the active local cause is without doubt the tubercle bacillus.

It is now well established that the milk ducts and gland tissue, as well as any sore on the exterior of the teat or bag, may become the seat of diphtheritic inflammation and the formation of the skin-like pellicles that characterize that disease. Here again there is a definite germ causing the disease. The liability of cattle to diphtheria was noticed by Damman in connection with the epizoötic outbreak in calves and children in Pomerania in 1875, and, among others, Roux and Yersin have since inoculated the disease from man upon animals.* Dr. Klein, of London, in 1889, inoculated two cows, respectively three and four weeks after calving, with the products from a case of diphtheria in man, and in three days found a serous exudating sore and hard swelling in the seat of inoculation in the right shoulder, followed by vesicles (blisters) on the teats and udder, appearing from the fourth to the eighth day. He found the diphtheria bacillus in these, in the shoulder sore, in the milk (in which it increased enormously if left to stand at 68° F.), in the eruption produced in calves by inoculation with the scrapings, in cats that died with diphtheria after lapping the milk, and other cats that died of diphtheria after living with the former.†

It has been claimed that scarlet fever has been transmitted from the cow to man, and it can not be denied that in many cases the infection has been disseminated through the milk. The facts, however, when brought out fully, have shown that in almost every case the milk had first come in contact with a person suffering or recovering from scarlet fever, so that the milk was infected after it left the cow. The alleged exceptional cases at Hendon and Dover, England, are not conclusive. In the Hendon outbreak inoculations were made on calves from the slight eruption on the cow's teats, and they had a slight eruption on the lips and a form of inflammation of the kidneys, which Dr. Klein thought resembled that of scarlatina. The cows that had brought the disease to the Hendon dairies were traced back to Wiltshire, and cows were found there suffering from a similar malady, but there was no sign of scarlet fever resulting. In the Dover outbreak, the dairyman first denied any disease in his cows, and brought the certificate of a veterinarian to prove that they were sound at the time of the investigation; then later he confessed that the cows had had foot-and-mouth disease, and consequent eruption on the teats some time before. So

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* The diphtheria bacillus of calves, according to Löffler, is not the same as the human diphtheria bacillus. There is as yet no positive evidence to prove that human diphtheria may be communicated to animals, excepting perhaps the cat, unless this is done by direct inoculation. [Ed.]

† Nineteenth annual report of the local government board, 1889–'90.

the question remains whether the man who denied sickness in the cows to begin with, and adduced professional evidence of this, did not later acknowledge the foot-and-mouth disease as a blind to hide the real source of the trouble in scarlatina in his own family or the family of an employé. Dr. Stickler's corroborative proof from the three children inoculated with imported virus of foot-and-mouth disease is equally inconclusive, as the results were certainly not those of the foot-and-mouth disease as it appears in man, and the fact that the children did not contract scarlatina when exposed to it later proves only that they were at the time naturally insusceptible, or that Dr. Stickler had in some way infected his virus or the lancet used to insert it, so as to give them scarlatina. Certain it is that foot-and-mouth disease does not produce scarlet fever in man, and that scarlet fever so constantly prevalent on the American continent does not produce foot-and-mouth disease, from which this continent is happily free. Foot-and-mouth disease does, however, produce in man an eruption of blisters on the mouth and fingers and other symptoms which Dr. Stickler's cases failed to show. Whether the swollen glands of the neck in the one case and the sore throat in the other resulted from scarlatinal germs introduced from another source, or whether these were merely the result of septic inoculation with the impure and overkept matter imported from England, does not appear. We are left, therefore, without positive proof of the existence of scarlatina in the cow. That the milk may be contaminated, however, after leaving the cow is certain, and it has been suggested that on the open sore of the cow a scarlatina germ may be temporarily grafted, which, though harmless to the cow, may escape into the pail during milking and infect the person using the milk. Too great care can not be exercised in keeping the infection of scarlet fever apart from dairy cows or their milk products.

Among other contagious forms of mammitis I may name one which I have encountered in large dairies, starting as a sore and slight swelling at the opening of the teat and extending up along the milk duct to the gland structure in the bag, all of which become indurated, nodular, and painful. The milk is entirely suppressed in that quarter of the bag, and from that it may extend to the others as it does from cow to cow through the milker's hands.

Another form almost universally prevalent in this district of central New York in 1889 broke out over the teats and udder as blisters strongly resembling cow-pox, but which were not propagated when inoculated on calves. It was only exceptionally that this extended through the teat to the gland tissue, yet in some instances the bag was lost from this cause. Scarlatina in man was very prevalent at the time (many schools were closed in consequence), but no definite connection seemed to exist between this and the cow disease, and on different dairy farms there were families of young children that had never had scarlet fever and who did not at that time contract it.

It will be seen that contagious mammitis is not a single affection, but a group of diseases which have this in common, that they attack the udder.

Prevention is to be especially sought in all such cases. In purchasing new cows see that they come from a herd where the teats and udder are sound. If a new cow comes from a public market with unknown antecedents, let her be milked for a week by a person who does not milk any other cows. Keep her in a separate stall from others, so that there may be no infection from litter or flooring. Wash the udder with soap and water, and wet with a solution of two teaspoonsful carbolic acid in a pint of water before letting the regular milker of the other cows take her. If any cow in the herd shows the indurated end of the teat, or the inflammation and nodular tender character of the gland, separate her at once and give her a separate milker. If another cow is to be put into the stall she occupied, first clean and scrape it, and wet it with a strong solution of bluestone, 5 ounces in a gallon of water. The milk may be drawn off with a teat tube, or spring teat dilator (Plate XXIV, figs. 3 and 4), and the milk ducts injected frequently with a solution of peroxide of hydrogen. I have had little success in checking the upward progress of the disease through the teat with carbolic acid, or boracic acid solutions. Used on the outside of the other teats, however, these may serve to prevent them from becoming infected. In the absence of peroxide of hydrogen the affected teat may be injected with a solution of 1 grain corrosive sublimate in a pint of water, and the same may be used on the other teats, provided it is washed off every time before milking.

As additional precautions, no cow with a retained afterbirth or unhealthy discharge from the womb should be left with the other cows. Such cows doubtless infect their own udders and those of the cows next them by lashing with the soiled tail. If milkers handle retained afterbirth or vaginal discharge, or unhealthy wounds, or assist in a difficult and protracted parturition, they should wash the hands and arms thoroughly with soap and warm water and then rub them with the corrosive sublimate solution, or if not, at least with one of carbolic acid. Clothes stained with such offensive products should be washed.

The general treatment of contagious mammitis does not differ from that of the simple form, except that antiseptics should be given by the mouth as well as applied locally (hyposulphite of soda, one-half ounce daily).

COWPOX.

This is another form of contagious inflammation of the udder which does not spread readily from animal to animal except by the hands of the milker. It is held to occur spontaneously in the cow, but this is altogether improbable, and so-called spontaneous cases are rather to be looked on as instances in which the germs have been preserved dry in the buildings or introduced in some unknown manner. It is not uncommon in the horse, attacking the heels, the lips, or some other inoculated part of the body, and is then easily transferred to the cow, if the same man grooms and dresses the horse and milks the cow. It may also appear in the cow by infection, more or less direct, from a person who has been successfully vaccinated. Many believe that it is only a form of the smallpox of man modified by passing through the system of cow or horse. It is, however, unreasonable to suppose that this alleged modified smallpox could have been transmitted from child to child (the most susceptible of the human race) for ninety years, under all possible conditions, without once reverting to its original type of smallpox. Chauveau's experiments on both cattle and horses with the virus of smallpox, and its inoculation back on the human subject, go far to show that in the climate of western Europe, at least, no such transformation takes place. Smallpox remains smallpox and cowpox cowpox. Again, smallpox is communicable to a person who visits the patient in his room but avoids touching him, while cowpox is never thus transferred through the air unless deliberately diffused in the form of spray.

The disease in the cow is ushered in by a slight fever, which, however, is usually overlooked, and the first sign is tenderness of the teats. Examined, these may be redder and hotter than normal, and at the end of two days there appear little nodules, like small peas, of a pale red color, and increasing so that they may measure three-fourths of an inch to 1 inch in diameter by the seventh day. The yield of milk diminishes, and when heated it coagulates slightly. From the seventh to the tenth day the eruption forms into a blister with a depression in the center and raised margins, and from which the whole of the liquid can not be drawn out by a single puncture. The blister, in other words, is chambered, and each chamber must be opened to evacuate the whole of the contents. If the pock forms on a surface where there is thick hair it does not rise as a blister, but oozes out a straw-colored fluid which concretes on the hairs in an amber-colored mass. In one or two days after the pock is full it becomes yellow from contained pus, and then dries into a brownish yellow scab, which finally falls, leaving one or more distinct pits in the skin. Upon the teats, however, this regular course is rarely seen; the vesicles are burst by the hands of the milker as soon as liquid is formed, and as they continue to suffer at each milking they form raw, angry sores, scabbing more or less with intervals, but slow to undergo healing.

The only treatment required is to heal the sores, and as milking is the main cause of their persistence that must be done as gently as possible, or even with the teat tube or dilator (Plate XXIV, Figs. 3 and 4). It is essential to check the propagation of the germ, and for this purpose the sore teats may be washed frequently with a solution of half an ounce hyposulphite of soda in a pint of water. This will usually check the inflammation and cut short the malady.

SUPPRESSION OF MILK.

The absence of milk in the udder may result from ill health, debility, emaciation, chronic disease of the bag, wasting of the gland from previous disease, or insufficient food, but sometimes it will occur suddenly without any appreciable cause. The *treatment* will consist in removing the cause of the disease, to feed well on rich albuminoid food made into warm mashes, and to give ounce doses of aromatic carminatives, like anise-seed, fennel-seed, etc. Rubbing and stripping the udder are useful; and the application of oil of lavender or of turpentine, or even a blister of Spanish flies, will sometimes succeed.

BLOODY MILK.

Blood may escape with the milk when the udder has been injured by blows, also when it is congested or inflamed, when the circulation through it has been suddenly increased by richer and more abundant food, or when the cow is under the excitement of heat. The milk frothing up and assuming a pink tinge is often the first sign of red-water, and it may result from eating acrid or irritant plants, like the ranunculaceæ, resinous plants, etc. Deposits of tubercle or tumors in the udder, or induration of the gland, may be efficient causes, the irritation caused by milking contributing to draw the blood. Finally there may be a reddish tinge or sediment when madder or logwood has been eaten.

In milk which becomes red after it is drawn it may be due to the presence in it of the micrococcus prodigiosus. This also grows on bread, and is the explanation of the supposed miracle of the "bleeding host."

The treatment will vary with the cause. In congested glands give 1 pound of epsom salts, and daily thereafter ½ ounce saltpeter, with a dram of chlorate of potash; bathe the bag with hot or cold water, and rub with camphorated lard. If the food is too rich or abundant it must be reduced. If from acrid plants these must be removed from pasture or fodder. Induration of the udder may be met by rubbing with a combination of iodine ointment 1 part, soft soap 2 parts; or mercurial ointment and soap may be used. Careful milking is imperative.

BLUE MILK.

Watery milk is blue, but the presence of a germ (*Bacillus cyanogenus*) causes a distinct blue shade even in rich milk and cream. It may reach the milk after it has been drawn, or it may find its way into the opening of the milk ducts and enter the milk as it is drawn. In the latter case, frequent milking and the injection into the teats of a solution of 2 drams of hyposulphite of soda in a pint of water will serve to destroy them.

STRINGY MILK.

This may be caused by fungi developing in the liquid, and that the spores are present in the system of the cow may be safely inferred from the fact that in a large herd two or three cows only will yield such milk at a time, and that after a run of ten days or a fortnight they will recover and others will be attacked. I have found that such affected cows had the temperature raised one or two degrees above the others. Like most other fungi, this does not grow out into filaments within the body of the cow, but in five or six hours after milking the surface layers are found to be one dense network of filaments. If a needle is dipped in this and lifted, the liquid is drawn out into a long thread. In one case which I investigated near Ithaca, N. Y., the contamination was manifestly due to a spring which oozed out of a bank of black muck soil and stood in pools mixed with the dejections of the animals. Inoculation of pure milk with the water as it flowed out of this bank developed in it the fungus and the string characters. By fencing in this spring and giving the affected cows each 2 drams bisulphite of soda daily the trouble was arrested promptly and permanently.

CHAPPED TEATS.

These may be caused by anything which irritates them. The powerful sucking of the calf, the sudden chilling of the teat in winter after the calf has just let it go, or after the completion of milking with a wet hand; contact with cold water, or stagnant putrid water, or with filth or irritants when lying down; slight congestions of the skin in connection with overstocking, and, indeed, any source of local irritation may cause chapping. This may be slight or extend into great gaping sores and induce retention of milk or even mammitis. Soothing applications of vaseline, or a combination of equal parts of spermaceti and oil of sweet almonds, may be applied. If healing is tardy add 10 grains balsam of Peru to the ounce of ointment. If the irritation is very great, wash first with a solution of 1 dram sugar of lead in 1 pint of water, and then apply benzoated oxide of zinc ointment.

WARTS ON THE TEATS.

These are often very troublesome, yet they may be greatly benefited or entirely removed by smearing them thickly after each milking with pure olive oil. If they persist they may be cut off with a sharp pair of scissors and the sore touched with a stick of lunar caustic. They may now be oiled and the caustic repeated as demanded to prevent their renewed growth.

Scabby teats may be smeared with vaseline containing enough carbolic acid to give it an odor.

TEAT BLOCKED BY CONCRETION OF CASEIN.

Under unhealthy conditions of the gland or milk ducts, clots of casein form, and these, pressed clear of most of their liquid and rolled into rounded masses, may block the passage. They can be moved up and down by manipulation of the teat, and if they can not be pressed out they may be extracted by using the spring teat dilator (Plate XXIV, Fig. 3) being held surrounded by its three limbs. Before extraction is attempted an ounce of almond oil previously boiled should be injected into the teat.

TEAT BLOCKED BY CALCULUS.

When the calcareous matter of the milk has been precipitated in the form of a smooth, rounded stone, a rough conglomerated concretion, or a fine sand-like débris, it may cause obstruction and irritation. These bodies are felt to be much harder than those formed by casein, and the milk usually contains gritty particles. Extraction may be attempted by simple milking in the case of the finely divided gritty matter, or with the spring dilator (Plate XXIV, Fig. 3) in the case of the larger masses. Should this fail the teat may be laid open with the knife and sewed up again or closed with collodion, but such an operation is best deferred until the cow is dry.

TEAT BLOCKED BY A WARTY OR OTHER GROWTH INSIDE.

In this case the obstruction may be near the orifice of the teat or higher up, and the solid mass is not movable up and down with the same freedom as are concretions and calculi. The movement is limited by the elasticity of the inner membrane of the teat from which it grows, and is somewhat freer in certain cases because the growth has become loose and hangs by a narrow neck. In the case of the looser growths they may be snared by a fine spring passed as a loop through a fine tube (like a teat tube open at each end), and introduced into the teat. When this can not be done, the only resort is to cut in and excise it while the cow is dry.

THICKENING OF THE MUCOUS MEMBRANE AND CLOSURE OF THE MILK-DUCT.

As a result of inflammation extending from without inward, a gradual narrowing of the milk-duct may occur from thickening and narrowing of its lining membrane. This may be limited to a small area near the lower end, or it may extend through the whole length of the teat. The stream of milk becomes finer and finer until it finally ceases altogether, and a firm cord is felt running through the teat. If the constriction is only at the outlet the teat may be seized and distended by pressing the milk down into it from above, and an incision may be made with a sharp penknife in two directions at right angles to each other, and directly in the original opening. The knife should be first cleansed in boiling water. The opening may be kept from closing by a dumb-bell shaped bougie of gutta-percha (Plate XXIV, Fig. 5) or by the spring dilator. If the obstruction is more extended it may be perforated by Lüthi's perforating sound. (Plate XXIV, Fig. 1*a* and 1*b*.) This is a steel wire with a ring at one end, and at the other is screwed on to the wire a conical cap with sharp cutting edges at the base, which scrapes away the thickened masses of cells as it is drawn back. This may be passed again and again to sufficiently enlarge the passage, and then the passage may be kept open by wearing a long dumb-bell bougie, a thick piece of carbolized catgut, or a spring dilator. If the passage can not be sufficiently opened with the sound it may be incised by the hidden bistoury. (Plate XXIV, Fig. 2.) This is a knife lying alongside a flattened protector with smooth rounded edges, but which can be projected to any required distance by a lever on the handle. The incisions are made in four directions and as deep as may be necessary, and the walls can then be held apart by the spring dilator until they heal. In case the constriction and thickening of the canal extend the whole length of the teat, it is practically beyond remedy, as the gland is usually involved so as to render it useless.

CLOSURE OF THE MILK-DUCT BY A MEMBRANE.

In this form the duct of the teat is closed by the constriction of its lining membrane at one point, usually without thickening. The closure usually takes place while the cow is dry, otherwise its progress is gradual and for a time the milk may still be pressed through slowly. In such a case, if left at rest, the lower part of the teat fills up and the milk flows in a full stream at the first pressure, but after this it will not fill up again without sufficient time for it to filter through. This is to be cut open by the hidden bistoury (Plate XXIV, Fig. 2), which may be first passed through the opening of the membrane, if such exists. If not it may be bored through, or it may be pressed up against the membrane at one side of the teat and opened toward the center, so as to cut its way through. Incisions should be made in at least two opposite directions, and the edges may be then held apart by wearing the spring dilator until healing has been completed.

In all cases of operations on the teats the instruments must be thoroughly disinfected with hot water, or by dipping in carbolic acid, and then in water that has been boiled.

OPENING IN THE SIDE OF THE TEAT—MILK FISTULA.

This may occur from wounds penetrating the milk duct and failing to close, or it may be congenital, and then very often it leads to a distinct milk duct and an independent portion of the gland. In the first form it is only necessary to dissect away the skin leading into the opening for some distance down, to close the orifice with stitches, and to cover the whole with collodion. A teat tube or spring dilator may be worn to drain off the milk and prevent distension and reopening of the orifice. In case of an independent milk-duct and gland one of two courses may be selected: to open the one duct into the other by incision and then close the offending opening, or to inject the superfluous gland through its duct with a caustic solution so as to destroy its secreting power. In both cases it is desirable to wait until the cow goes dry.

DISEASES FOLLOWING PARTURITION.

DESCRIPTION OF PLATES.

PLATES XXII, XXIII:

Illustrate various appliances used in prolapse or inversion of the uterus. The uterus should first be returned to its proper situation and then some apparatus applied to prevent a recurrence of the inversion or protrusion.

PLATE XXII:

Fig. 1. Crupper, strap truss—taken from Hill's Bovine Medicine and Surgery.

Fig. 2. Renault's rope truss. The rope for this truss should be from 25 to 30 feet long, and about the thickness of the little finger.

PLATE XXIII:

Fig. 1. Cow to which Delwart's rope truss has been applied.

Fig. 1*a*. Shows the loop of Delwart's truss.

Fig. 2. Zundel's labial sutures. These consist of two wires passed through the lips of the vulva in a horizontal direction, and two additional wires passed through the loops at the ends of the horizontal wires in order to hold them in place.

Fig. 3. Iron truss for holding the vagina or uterus in place after calving. The cords are passed through the eyes at the corners of the triangular iron; the base of the triangle fits under the tail. The truss is from 5 to 7 inches long, and about 2½ inches wide.

PLATE XXIV:

Fig. 1. Lüthi's perforating sound, for opening the milk canal through the teat when this has become occluded. A, the sound one-half the natural size; B, section of head of sound, natural size, showing cutting edge.

Fig. 2. Bistouri caché. A blade hidden in its sheath which by pressure of the finger may be made to protrude a certain distance. This distance is regulated by the screw near the handle. The instrument is used to open the milk canal when closed up. It is introduced into the milk canal with its blade in the sheath and withdrawn with the blade protruding.

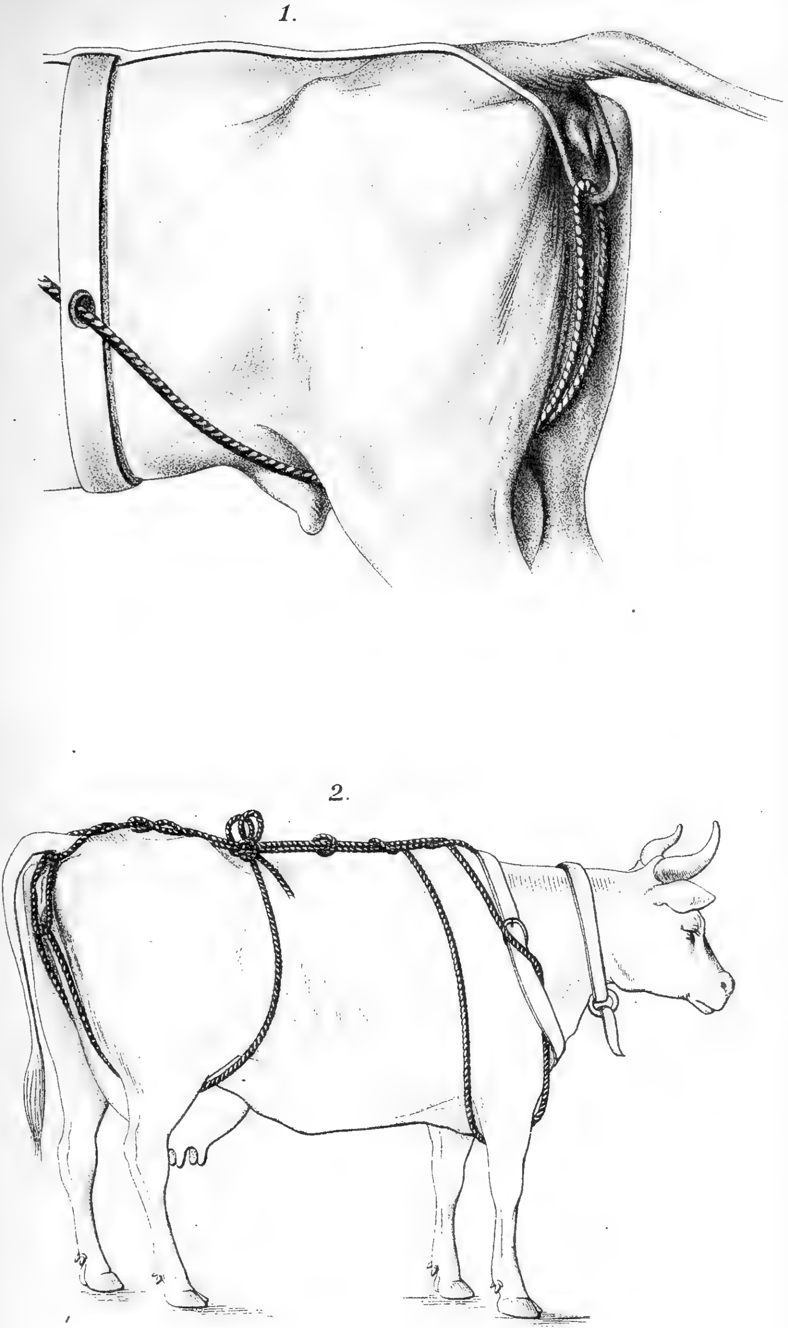
Fig. 3. Spring teat dilator, about ½ natural size, for dilating the milk canal.

Fig. 4. Ring teat syphon, for withdrawing milk when the teat is sore or injured.

Fig. 5. Gutta-percha bougie, for dilating the opening of the teat.

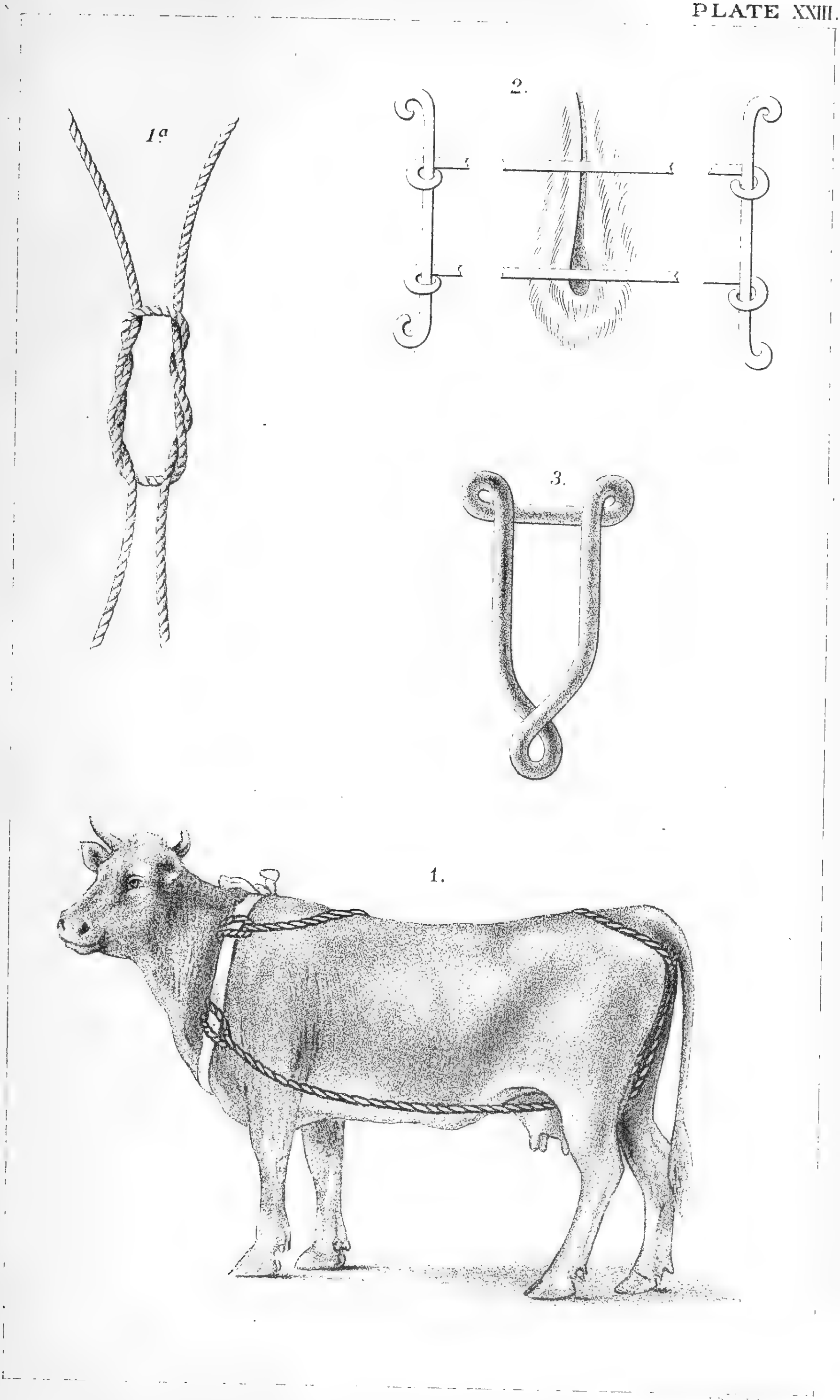
Fig. 6. Truss applied to calf for umbilical or navel hernia. From Fleming's Veterinary Obstetrics.

Fig. 7. Armatage's iron clam for umbilical or navel hernia. When this clam is applied care must be taken not to include a portion of the bowel.



HELIOTYPE PRINTING CO. BOSTON.

SUPPORTS FOR PROLAPSED UTERUS.



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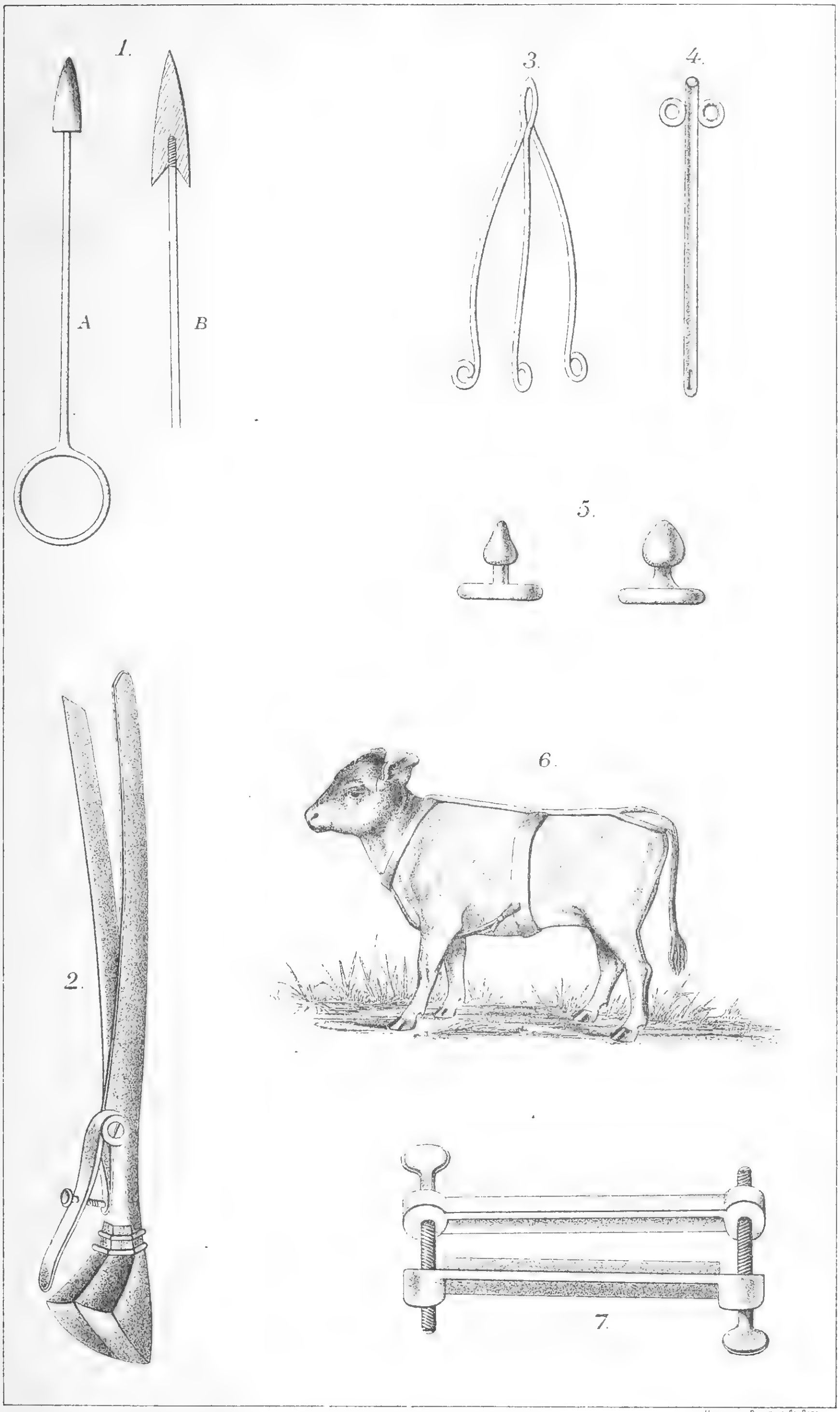

HELIOTYPE PRINTING CO. BOSTON.

DISEASES OF YOUNG CALVES.

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SUSPENDED BREATHING.

The moment the circulation through the navel string is stopped the blood of the calf begins to get overcharged with carbon dioxide (CO_2), and unless breathing is speedily established death promptly follows. Fortunately the desire to breathe, roused by the circulation of the venous blood and the reflex action from the wet and chilling skin, usually at once starts the contractions of the diaphragm and life is insured. Among the obstacles to breathing may be named suffocation before or during birth from compression of the navel cord and the arrest of its circulation; the detachment of the fetal membranes from the womb before the calf is born; a too free communication between the two auricles of the heart (foramen ovale) by which the nonaërated blood has mixed too abundantly with the aërated and induced debility and profound weakness; a condition of ill health and debility of the calf as a result of semi-starvation, overwork, or disease of the cow; fainting in such debilitated calf when calving has been difficult and prolonged; the birth of the calf with its head enveloped in the fetal membranes so that it has been unable to breathe; and the presence of tenacious phlegm in the mouth and nose, acting in the same manner.

Beside the importance of proper care and feeding of the cow as a preventive measure, attention should be given at once to relieve the new-born calf of its investing membrane and of any mucus that has collected in mouth or nostrils. Wiping out the nose deeply with a finger or feather excites to sneezing, hence to breathing. Blowing into the nose has a similar effect. Sucking the nostril through a tube applied to it is even more effective. Slapping the chest with the palm of the hand or with a towel dipped in cold water, compression and relaxation alternately of the walls of the chest, may start the action, and ammonia or even tobacco smoke blown into the nose may suffice. Every second is precious, however, and if possible the lungs should be dilated by forcibly introducing air from a bellows or from the human lungs. As the air is blown in through bellows or a tube the upper end of the windpipe must be pressed back against the gullet, as otherwise the air will go to the stomach. In a large dairy a piece of elastic tubing one-third of an inch in bore should be kept at hand for sucking and blowing in such cases.

BLEEDING FROM THE NAVEL.

This may occur in two conditions, when the cord is cut off too close to the navel and left untied, and when it tears off at the navel (Plate XIV). It may also bleed when torn across naturally, if it is sucked by the dam or another calf. In an animal with little plasticity to its blood it will flow under almost any circumstances. Where any cord is left it is always safe to tie it, and it is only when it is swollen and may possibly contain a loop of the bowel that there is danger in doing so. By pressing upward any bulky contents such danger is avoided. If torn, or cut too close to be tied, the bleeding may be checked by applying alum, copperas, or for a fraction of a second the end of an iron rod at a dull-red heat. If much blood has been lost it may be requisite to transfuse several ounces of blood, or of a weak common-salt solution, into the open umbilical vein.

URINE DISCHARGED THROUGH THE NAVEL—PERSISTENT URACHUS.

Before birth the urine passes from the bladder by a special tube through the navel and navel-string into the outer water-bag (allantois) (Plate XII). This closes at birth, and in the calf the tube is drawn in toward the bladder. It is only in the bull calf that it is likely to remain open, doubtless because of the long narrow channel through which the urine must otherwise escape. The urethra, too, is sometimes abnormally narrow, or even closed in the male. If part of the cord remains, tie it and allow the whole to wither up naturally. If the cord has been removed and the tube (urachus) protrudes, discharging the urine, that alone must be tied. If there is nothing pendent the urachus must be seized, covered by the skin, and a curved needle being passed through the skin and above the duct it may be tied along with this skin. A blister of Spanish flies, causing swelling of the skin, will often close the orifice. So with the hot iron. If the urethra of the male is impervious it can rarely be remedied.

INFLAMMATION OF THE URACHUS (NAVEL URINE-DUCT).

This may originate in direct mechanical injury to the navel in calving, or shortly after, with or without the lodgment of irritant and septic matter on its lacerated or cut end. The mere contact with healthy urine, hitherto harmless, can not be looked on as becoming suddenly irritating. The affection is usually marked by the presence of redness and swelling at the posterior part of the navel and the escape of urine and a few drops of whitish serous pus from the orifice of the urachus.

In those cases in which urine is not discharged a tender swelling, like a thick cord extending upward and backward from the navel into the abdomen, may be identified. The navel enlargement may be considerable, but it is solid, does not gurgle on handling, and can not be done away with by pressing it back into the abdomen as in a case of hernia.

In cases at first closed the pus may burst out later, coming from the back part of the navel and the swelling extending backward. In other cases whitish pus may pass with the urine by the ordinary channel, showing that it has opened back into the bladder. In other cases the umbilical veins become involved, in which case the swelling extends forward as well as backward. Thus the disease may result in destructive disorders of the liver, lungs, and, above all, of the joints.

The disease may usually be warded off or rendered simple and comparatively harmless by applying antiseptics to the navel-string at birth (carbolic acid 1 part, water and glycerine 5 parts each, or wood tar). Later, antiseptics may be freely used (hyposulphite of soda 4 drams, water 1 quart) as an application to the surface and as an injection into the urachus, or even into the bladder if the two still communicate. If they no longer communicate, a stronger injection may be used (tincture of perchloride of iron 60 drops, alcohol 1 ounce). Several weeks will be required for complete recovery.

ABSCESS OF THE NAVEL.

As the result of irritation at calving or by the withered cord, or by licking with the rough tongue of the cow, inflammation may attack the loose connective tissue of the navel to the exclusion of the urachus and veins, and go on to the formation of matter. In this case a firm swelling appears as large as the fist, which softens in the center and may finally burst and discharge. The opening, however, is usually small and may close prematurely, so that abscess after abscess is formed. It is distinguished from hernia by the fact that it can not be returned into the abdomen, and from inflammations of the veins and urachus by the absence of swellings forward and backward along the lines of these canals.

Treatment consists in an early opening of the abscess by a free incision and the injection twice a day of an astringent antiseptic (chloride of zinc ½ dram, water 1 pint).

INFLAMMATION OF THE NAVEL VEINS—UMBILICAL PHLEBITIS.

In this affection of the navel the inflammation may start directly from mechanical injury, as in either of the two forms just described, but on this are inoculated infective microbes, derived from a retained and putrefying afterbirth, an abortion, a metritis, a fetid discharge from the womb, an unhealthy open sore, a case of erysipelas, from overcrowding, from filthy floor or bedding, or from an offensive accumulation of manure, solid or liquid. As the microbes vary in different cases, given outbreaks will differ materially in their nature. One is erysipelas; another purulent infection with the tendency to secondary abscesses in the joints, liver, lungs, etc.; another is due to a septic germ and is associated with fetid discharge from the navel and general putrid blood poisoning. In estimating the causes of the disease we must not omit debility of the calf when the mother has been underfed or badly housed, or when either she or the fetus has been diseased.

The *symptoms* will vary. With the chain-form germs (streptococci) of erysipelas the navel becomes intensely red, with a very firm, painful swelling ending abruptly at the edges in sound skin, and extending forward along the umbilical veins. The secondary diseases are circumscribed black engorgements (infarctions) or abscesses of the liver, lungs, kidneys, or other internal organs, and sometimes disease of the joints.

With the ordinary pus-producing germs (*Staphylococcus pyogenes aureus* and *Streptococcus pyogenes*), the local inflammation in the navel causes a hot, painful swelling, which rapidly advances to the formation of matter (pus), and the raw exposed surface, at first bright red, becomes dark red or black, soft, friable, and pultaceous. If the pus is white, creamy, and comparatively inoffensive in odor, the secondary formations in internal organs and joints are mainly of the same purulent character (secondary abscesses).

If, on the other hand, the discharge is very offensive and the pus more serous or watery or bloody, there is reason to suspect the presence of some of the septic bacteria, and the results on the general system are a high fever and softening of the liver and spleen, and no tendency to abscesses of the internal organs. Diarrhea is a common symptom, and death ensues early, the blood after death being found unclotted.

Complicated cases are common, and in all alike the umbilical veins usually remain open and can be explored by a probe passed at first upward and then forward towards the liver.

Prevention is sought by applying a lotion of carbolic acid to the navel string at birth, or it may be smeared with common wood tar, which is at once antiseptic and a protective covering against germs. In the absence of either a strong solution of oak bark may be used.

Local treatment consists in the application of antiseptics to the surface and their injection into the vein. As a lotion use carbolic acid, 1 ounce in a quart of strong decoction of oak bark, or salicylic acid or salol may be sprinkled on the surface. The interior of the vein should be swabbed out with a probe wrapped around with cottonwool and dipped in boracic or salicylic acid.

If complications have extended to the liver or other internal organs, or the joints, other treatment will be demanded. In acute cases of general infection an early fatal result is to be expected.

PYÆMIC AND SEPTICÆMIC INFLAMMATION OF JOINTS IN CALVES.—JOINT-ILL.

This occurs in young calves within the first months after birth; it persists in the joints when once attacked, and is usually connected with disease of the navel. Rheumatism, on the other hand, rarely occurs in a calf under a month old. It tends to shift from joint to joint and is independent of any navel disease. Rheumatism, again, affects the fibrous structures of the joints, and rarely results in the formation of white matter, while the affection before named attacks the structures outside as well as inside the joints and above all the ends of the bones, and tends to the destruction and crumbling of their tissue, and even to the formation of open sores through which the fragile bones are exposed. The microbes from the unhealthy and infected wound in the navel pass into the system through the veins, or, in the case of the erysipelas germ, through the lymphatics, and form colonies and local inflammations and abscesses in and around the joints.

The *symptoms* are swelling of one or more joints, which are very hot and tender. The calf is stiff and lame, lies down constantly, and cares not to suck. There is very high fever and accelerated breathing and pulse, and there is swelling and purulent discharge (often fetid) from the navel. There may be added symptoms of disease of the liver, lungs, heart, or bowels, on which we need not here delay. The important point is to determine the condition of the navel in all such cases of diseased and swollen joints beginning in the first month of life, and in all cases of general stiffness, for beside the diseases of the internal organs there may be abscesses formed among the muscles of the trunk, though the joints appear sound. Cases of this kind, if they do not speedily die, tend to become emaciated and perish later in a state of weakness and exhaustion.

Prevention must begin with the purity of the buildings and the navel, as noted in the last article.

Treatment is in the main antiseptic. The slighter forms may be painted daily with tincture of iodine; or an ointment of biniodide of mercury (1 dram) and lard (2 ounces) may be rubbed on the affected joints daily until they are blistered. In case of swellings containing matter this may be drawn off through the nozzle of a hypodermic syringe and the following solution injected: Compound tincture of iodine, 1 dram; distilled (or boiled) water, 2 ounces. Internally the calf may take 5 grains quinia twice daily and 15 grains hyposulphite of soda, or 20 grains salicylate of soda three times a day.

UMBILICAL HERNIA—BREACH AT THE NAVEL.

This may exist at birth from imperfect closure of the muscles around the opening; it may even extend backward for a distance from two sides failing to come together. Apart from this the trouble rarely appears after the calf has been some time on solid food, as the paunch then extends down to the right over the navel, and thus forms an internal pad preventing the protrusion of intestine.

The *symptoms* of umbilical hernia are a soft swelling at the navel, with contents that usually gurgle on handling, and can be entirely returned into the abdomen by pressure. The diseases of the navel hitherto considered have not gurgling contents, and can not be completely returned into the abdomen. The only exception in the case of the hernia is when the walls of the sack have become greatly thickened; these will, of course, remain as a swelling after the bowel has been returned; and when the protruding bowel has contracted permanent adhesions to the sac it is impossible to return it fully without first severing that connection.

Treatment is not always necessary. A small hernia, like an egg, in a new-born calf, will usually recover of itself as the animal changes its diet to solid food and has the paunch fully developed as an internal pad.

In other cases apply a leather pad of 8 inches square attached around the body by two elastic bands connected with its four corners, and an elastic band passing fom its front border to a collar encircling the neck, and two other elastic bands from the neck collar along the two sides of the body to the two bands passing up over the back. (Plate XXIV, Fig. 6.)

For small hernias nitric acid may be used to destroy the skin and cause such swelling as to close the orifice before the skin is separated. For a mass like a large goose-egg one-half ounce of the acid may be rubbed in for three minutes. No more must be applied for fifteen days. For large masses this is inapplicable, and with too much loss of skin the orifice may fail to close and the bowels may escape.

The application of a clamp like those used in castration is a most effective method, but great care must be taken to see that all the contents of the sack are returned so that none may be inclosed in the clamp. (Plate XXIV, Fig. 7.)

Another most effective resort is to make a saturated solution of common salt, filter and boil it, and when cool inject under the skin (not into the sack) on each side of the hernia a dram of the fluid. A bandage may then be put around the body. In ten hours an enormous swelling will have taken place, pressing back the bowel into the abdomen. When this subsides the wound will have closed.

DROPSY OF THE NAVEL.

A sack formed at the navel, by contained liquid accumulated by reason of sucking by other calves, is unsightly and sometimes injurious. After making sure that it is simply a dropsical collection it may be deeply punctured at various points with a large-sized lancet or knife, fomented with hot water and then daily treated with a strong decoction of white-oak bark.

THE BLUE DISEASE—CYANOSIS.

This appearing in the calf at birth is due to the orifice between the two auricles of the heart (foramen ovale) remaining too open, allowing the nonaërated (venous) blood to mix with the aërated (arterial) blood, and it is beyond the reach of treatment. It is recognized by the blueness of the eyes, nose, mouth and other mucous membranes, the coldness of the surface, and the extreme sensitiveness to cold.

CONSTIPATION.

At birth the bowels of the calf contain the *meconium*, a tenacious, gluey, brownish-yellow material largely derived from the liver, which must be expelled before they can start their functions normally. The first milk of the cow (colostrum, beestings), rich in albumen and salts, is nature's laxative to expel this now offensive material, and should never be withheld from the calf. If, for lack of this, from the dry feeding of the cow, or from any other cause, the calf is costive, straining violently without passage, lying down and rising as in colic, and failing in appetite, no time should be lost in giving relief by an ounce dose of castor oil, assisting its action by injections of soapsuds or oil. Whatever meconium is within reach of the finger should be carefully removed. It is also important to give the cow a sloppy laxative diet.

INDIGESTION.

This may occur from many different causes, as costiveness, a too liberal supply of milk; too rich milk; the furnishing of the milk of a cow long after calving to a very young calf; allowing a calf to suck the first milk of a cow that has been hunted, driven by road, shipped by rail or otherwise violently excited; allowing the calf too long time between meals so that impelled by hunger it quickly overloads and clogs the stomach; feeding from the pail milk that has been held over in unwashed (unscalded) buckets, so that it is fermented and spoiled; feeding the milk of cows kept on unwholesome food; keeping the calves in cold, damp, dark, filthy or bad smelling pens; feeding the calves on artificial mixtures containing too much starchy matters; or overfeeding the calves on artificial food that may be appropriate enough in smaller amount. The licking of hair from themselves or others, and their formation into balls in the stomach will cause obstinate indigestion in the calf.

The *symptoms* are dullness, indisposition to move, uneasiness, eructations of gas from the stomach, sour breath, entire loss of appetite, lying down and rising as if in pain, fullness of the abdomen, which gives out a drumlike sound when tapped with the fingers. The costiveness may be marked at first, but soon it gives place to diarrhea, by which the offensive matters may be carried off and health restored. In other cases it becomes aggravated, merges into inflammation of the bowels, fever sets in and the calf gradually sinks.

Prevention consists in avoiding the causes above enumerated, or any others that may be detected.

Treatment consists in first clearing away the irritant present in the bowels. For this purpose one or two ounces of castor oil with 20 drops of laudanum may be given, and if the sour eructations are marked a tablespoonful of lime-water or one-fourth ounce calcined magnesia may be given and repeated two or three times a day. If the disorder continues after the removal of the irritant a large tablespoonful of rennet, or 30 grains of pepsin, may be given at each meal along with a teaspoonful of tincture of gentian. Any return of constipation must be treated by injections of warm water and soap, while the persistence of diarrhea must be met as advised under the article following this. In case of the formation of loose hair-balls inclosing milk undergoing putrid fermentation temporary benefit may be obtained by giving a tablespoonful of vegetable charcoal three or four times a day, but the only real remedy for these is to cut open the paunch and extract them. At this early age they may be found in the third or even the fourth stomach; in the adult they are confined to the first two, and are comparatively harmless.

DIARRHEA (SCOURING) IN CALVES—SIMPLE AND CONTAGIOUS.

As stated in the last article, scouring is a common result of indigestion, and at first may be nothing more than an attempt of nature to relieve the stomach and bowels of offensive and irritating contents. As the indigestion persists, however, the fermentations going on in the undigested masses become steadily more complex and active, and what was at first the mere result of irritation or suspended digestion comes to be a genuine contagious disease, in which the organized ferments (bacteria) propagate the affection from animal to animal and from herd to herd. More than once I have seen such epizoötic diarrhea starting on the head waters of a creek, and traveling along that stream follow the watershed and attacking the herds supplied with water from the contaminated channel. In the same way, the disease once started in a cow stable, is liable to persist for years, or until the building has been thoroughly cleansed and disinfected. It may be carried into a healthy stable by the introduction of a cow brought from an infected stable when she is closely approaching calving. Another method of its introduction is by the purchase of a calf from a herd where the infection exists.

In enumerating the other causes of this disease we may refer to those noted above as inducing indigestion. As a primary consideration any condition which lowers the vitality or vigor of the calf must be accorded a prominent place among factors which, apart from contagion, contribute to start the disease *de novo*. Other things being equal, the strong, vigorous races are the least predisposed to the malady, and in this respect the compact form, the healthy coat, the clear eye, and the bold, active carriage, are desirable. Even the color of the hair is not unimportant, as in the same herd I have found a far greater number of victims among the light colors (light yellow, light brown) than among those of a darker tint. This constitutional predisposition to indigestion and diarrhea is sometimes fostered by too close breeding, without tak ing due account of the maintenance of a robust constitution, and hence animals that are very much inbred need to be especially observed and cared for unless their inherent vigor has been thoroughly attested.

The surroundings of the calf are powerful influences. Calves kept indoors suffer to a greater extent than those running in the open air and having the invigorating influences of sunshine, pure air, and exercise. But close, crowded, filthy, bad-smelling buildings are especially causative of the complaint. The presence in the air of carbon-dioxide, the product of breathing, and of the fetid gaseous products of decomposing dung and urine diminish by about one-fourth of their volume the life-giving oxygen, and in the same ratio hinder the aëration of the blood and the maintenance of vigorous health. Worse than this, such fetid gases are usually direct poisons to the animal breathing them, for example, sulphuretted hydrogen (hydrogen sulphide 2 SH_2), and various alkaloids (ptomaines) and toxins (neutral poisonous principles) produced in the filth fermentations. These lower the general health and stamina, impair digestion, and by leading to the accumulation in stomach and bowels of undigested materials they lay the foundation for offensive fermentations within these organs, and consequent irritation, poisoning, and diarrhea. They further weaken the system so that it can no longer resist and overcome the trouble.

The condition of the nursing cow and her milk is another potent cause of trouble. The food of the cow is important. The influence of this is shown in the following tables:

Becquerel and Vernois.

Character of feed.	Water.	Casein and extractive matter.	Milk sugar.	Butter.	Salts.
	Parts in 1,000.	*Parts in 1,000.*	*Parts in 1,000.*	*Parts in 1,000.*	*Parts in 1,000.*
Cows on winter feed:					
Trefoil or lucerne, 12–13 pounds; oat straw, 9–10 pounds; beets, 7 pounds; water, 2 buckets	871.26	47.81	33.47	42.07	5.34
Cows on summer feed:					
Green trefoil, lucerne, maize, barley, grass, 2 buckets water	859.56	54.7	36.38	42.76	6.80
Goat's milk on different feed:					
On straw and trefoil	858.68	47.38	35.47	52.54	5.93
On beets	888.77	33.81	38.02	33.68	5.72
Normal mean	844.90	35.14	36.90	56.87	6.18

In these examples the deterioration of the milk in casein on the less nutritious winter feeding is very marked, although the relative amount of butter remains almost unchanged. In the case of the goat the result is even more striking, the beet diet giving a very large decrease of both casein and butter and an increase of milk sugar.

The following table, condensed from the Iowa Agricultural Experiment Station Bulletin, gives the results in butter and total solids when the same cows were fed on different rations in succession. Each cow was fed a daily ration of 12 pounds corn fodder and 4 pounds clover hay, beside the test diet of (1) $12\frac{1}{4}$ pounds corn and cobmeal, and (2) 10 pounds sugar meal—a product of the glucose manufacture. This special feed was given seven days before the commencement of each test period to obviate the effects of transition. The analyses of the special rations are given below:

Constituents.	Corn and cob meal.	Sugar meal.
	Per cent.	*Per cent.*
Moisture	13.37	6.10
Salts	1.43	1.17
Fat	2.81	11.16
Carbo-hydrates (heat-formers)	65.99	52.66
Woody fiber	8.03	8.64
Proteids (flesh-formers)	8.37	20.27

The great excess of fat and nitrogenous or flesh-forming principles in the sugar meal is very evident.

Animal.	Milk.	Fat.	Solids.	Fat.	Solids.	Ratio of fat to solids not fat.
	Pounds.	*P. ct.*	*Per ct.*	*Pounds.*	*Pounds.*	
Grade Shorthorn cow:						
First period, 21 days, corn and cob meal	631.25	3.43	11.57	21.67	73.02	422 : 1,000
Second period, 21 days, sugar meal	641.50	4.04	12.53	25.93	83.38	476.2 : 1,000
Third period, 21 days, corn and cob meal	559.00	3.22	11.86	17.97	66.32	371.7 : 1,000
Grade Shorthorn cow:						
First period, 21 days, corn and cob meal	604.75	3.57	11.95	21.56	72.28	425.1 : 1,000
Second period, 21 days, sugar meal	582.00	3.91	12.37	22.74	72.57	456.3 : 1,000
Third period, 21 days, corn and cob meal	527.00	3.37	12.05	17.78	63.48	389.1 : 1,000
Grade Shorthorn cow:						
First period, 21 days, sugar meal	753.50	3.97	12.43	29.94	93.67	469.8 : 1,000
Second period, 21 days, corn and cob meal	601.50	3.15	11.45	18.97	68.89	380.0 : 1,000
Third period, 21 days, sugar meal	560.50	3.85	12.16	21.58	68.16	463.3 : 1,000
Grade Holstein cow:						
First period, 21 days, sugar meal	487.50	4.15	13.27	20.25	64.69	455.6 : 1,000
Second period, 21 days, corn and cob meal	379.00	3.51	12.69	13.30	48.09	382.3 : 1,000
Third period, 21 days, sugar meal	374.50	3.72	13.01	13.95	48.74	401.0 : 1,000

Here we see in every instance a marked relative increase of the butter, and to a less extent of the other milk solids whenever the sugar meal—rich in fat and albuminoids—was furnished. The opposite theory having been largely taught it becomes needful to thus sustain the old and well-founded belief of the dairymen.

Not only does the richness of the milk vary with the nature of the food, but it varies also according to the time of the day when it is drawn, the morning milk giving $7\frac{1}{2}$ per cent of cream and the evening milk $9\frac{1}{2}$ per cent (Hassall). Boedecker found that the morning milk had 10 per cent of solids, while the evening milk had 13 per cent. Again, the milk first drawn at any milking is always poorer than the last drawn. The first may have only one-half, or in extreme cases one-fourth, the cream of the last. Once more, when the cow is in heat the milk becomes richer in solids (casein and butter), and contains granular and white blood-cells like the colostrum, and often disagrees with the young animal living on it. Now, while these various modifications in the amount of solid matters may prove harmless to a strong and vigorous calf, they can easily be the occasion of intestinal disorder in a weaker one, or in one with health already somewhat impaired by sickness, exposure, or unwholesome buildings. The casein of the cow's milk coagulates in one solid mass, and is much less easily penetrated by the digesting fluids than the fine flaky coagula of woman's or mare's milk. An excess of casein, therefore, thrown on an already overtaxed stomach can all the more readily induce disorder. So with butter fat. While a most important element in nutrition, it may be present in the stomach in such amount as to interfere with the action of the gastric juice on the casein, and with the interruption of the natural stomach digestion the fats themselves undergo decomposition with the production of offensive and irritating fatty acids.

The milk of the very young cow is usually more watery than that of the mature animal, and that of the old cow has a greater liability to become acid. It varies much with the breed, the Channel Island cattle being notorious for the relatively large amount of cream, while the Holsteins, Ayrshires, and Shorthorns are remarkable rather for the amount of casein. The milk of cows fed on potatoes and grass is very poor and watery; that from cows fed on cabbage or Swedish turnips has a disagreeable taste and odor (from the former an offensive liquid has been distilled).

Cows fed on overkept, fermented, and soured rations have acid milk which readily turns and coagulates. Thus old, long-kept brewers' grains, swill, the refuse of glucose factories, and ensilage which has been put up too green, all act in this way. The same may come from disease in the cow's udder, or any general disease of the cow with attendant fever, and in all such cases the tendency is to rapid change and unwholesomeness. If the milk is drawn and fed from a pail there is the added danger of all sorts of poisonous ferments getting into it and multiplying; it may be from the imperfect cleansing and scalding of the pail; from rinsing the pails with water that is impure; from the entrance of bacterial ferments floating in the filthy atmosphere of the stable, or from the entrance of the volatile chemical products of fermentation.

In addition to the dangers coming through the milk, the calf suffers in its digestive powers from any temporary illness, and among others from the excitement attendant on the cutting of teeth, and impaired digestion means fermentations in the undigested masses and the excessive production of poisonous ptomaines and toxins.

Whatever may be the starting or predisposing cause of this malady, when once established it is liable to perpetuate itself by contagion and to prove a veritable plague in a herd or a district.

The *symptoms* of diarrhea may appear so promptly after birth as to lead to the idea that the cause already existed in the body of the calf, and it usually shows itself before the end of the second week. It may be preceded by constipation, as in retained meconium or by fetid eructations and colicky pains, as in acute indigestion. The tail is stained by the liquid dejections, which are at first simply soft and mixed with mucus with a sour odor, accompanied by a peculiar and characteristic fetor (suggesting rotten cheese), which continually grows worse. The amount of water and mucus steadily increases, the normal predominance of fatty matters becoming modified by the presence of a considerable amount of undigested casein, which is not present in the healthy feces, and in acute cases death may result in one or two days from the combined drain on the system and the poisoning by the absorbed products of the decomposition in the stomach and bowels. When the case is prolonged the passages, at first five or six per day, increase to fifteen or twenty, and pass with more and more straining, so that they are projected from the animal in a liquid stream. The color of the feces, at first yellow, becomes a lighter grayish yellow or of a dirty white (hence the name white scour), and the fetor becomes intolerable. At first the calf retains its appetite, but as the severity of the disease increases the animal shows less and less disposition to suck, and has lost all vivacity, lying dull and listless, and when raised walking weakly and unsteadily. Flesh is lost rapidly, the hair stands erect, the skin gets dry and scurfy, the nose is dry and hot, or this condition alternates with a moist and cool one. By this time the mouth and skin, as well as the breath and dung, exhale the peculiar penetrating, sour, offensive odor, and the poor calf has become an object of disgust to all that approach it. At first, and unless inflammation of the stomach and bowels supervene (and unless the affection has started in indigestion and colic), the belly is not bloated nor painful on pressure, symptoms of acute colicky pains are absent, and the bowels do not rumble, nor are bubbles of gas mingled with the feces. The irritant products of the intestinal fermentations may, however, irritate and excoriate the skin around the anus, which becomes red, raw, and broken out in sores for some distance. Similarly the rectum, exposed by reason of the relaxed condition of the anus, or temporarily in straining to pass the liquid dejection, is of a more or less deep red, and it may be ulcerated. Fever, with rapid pulse and increased breathing and temperature, usually comes on with the very fetid character of the feces and is more pronounced as the bowels become inflamed, the abdomen sore to the touch and tucked up, and the feces more watery, and even mixed with blood.

The *prevention* of these cases is the prevention of constipation and indigestion with all their varied causes as above enumerated, the selection of a strong, vigorous stock, and above all the combating of contagion, especially in the separation of the sick from the healthy, and in the thorough purification and disinfection of the buildings. The cleansing and sweetening of all drains, the removal of dung heaps, and the washing and scraping of floors and walls, followed by a liberal application of chloride of lime (bleaching powder), 4 ounces to the gallon, are indicated. Great care must be exercised in the feeding of the cow to have sound and wholesome food and water, so apportioned as to make the milk neither too rich nor too poor, and to her health so that the calf may be saved from the evil consequences of poisonous principles that may be produced in the body of the cow. The calves should be carefully kept apart from all calving cows and their discharges. Similarly each calf must have special attention to see that its nurse gives milk which agrees with it, and that this is furnished at suitable times. If allowed to suck it should either be left with the cow or it may be fed three times a day. If it comes hungry twice a day it is more likely to overload and derange the stomach, and if left too long hungry it is tempted to take in unsuitable and unwholesome food, for which its stomach is as yet unprepared. So if fed from the pail it is safer to do so three times daily than twice. The utmost cleanliness of feeding-dishes should be secured and the feeder must be ever on the alert to prevent the strong and hungry from drinking the milk of the weaker in addition to their own. In case the cow nurse has been subjected to any great excitement by reason of travel, hunting, or carrying, the first milk she yields thereafter should be used for some other purpose and only the second allowed to the calf. Indeed, one and all of the conditions above indicated as causes should be judiciously guarded against.

Treatment will vary according to the nature and stage of the disease. When the disease is not widespread, but isolated cases only occur, it may be assumed to be a simple diarrhea and is easily dealt with. The first object is to remove the irritant matter from stomach and bowels, and for this 1 or 2 ounces of castor oil may be given according to the size of the calf. If the stools smell particularly sour, it may be replaced by 1 ounce calcined magnesia, and in any case a tablespoonful or two of lime-water must be given with each meal. Great harm is often done by giving opium and astringents at the outset. These merely serve to bind up the bowels and retain the irritant source of the trouble; literally "to shut up the wolf in the sheepfold." When the offending agents have been expelled in this way carminatives and demulcent agents may be given: One dram anise water, 1 dram nitrate of bismuth, and 1 dram gum arabic, three times a day. Under such a course the consistency of the stools should increase until in a day or two they become natural.

If, however, the outbreak is more general and evidently the result of contagion, the first consideration is to remove all sources of such contamination. Test the milk of the cow with blue litmus paper, and if it reddens reject the milk of that cow until by sound dry feeding, with perhaps a course of hyposulphite of soda and gentian root, her milk shall have been made alkaline. The castor oil or magnesia will still be demanded to clear away the (now infecting) irritants, but they should be combined with antiseptics, and, while the lime-water and the carminative mixture may still be used, a most valuable addition will be found in the following: Calomel 10 grains, prepared chalk 1 ounce, creosote 1 teaspoonful; mix, divide into 10 parts, and give one four times a day. Or the following may be given four times a day: One dram Dover's powder, 6 grains powdered ipecacuanha; mix, divide into 10 equal parts. Injections of solutions of gum arabic are often useful, and if the anus is red and excoriated, ½ dram of copperas may be added to each pint of the gummy solution. All the milk given must be boiled, and if that does not agree, eggs made into an emulsion with barley-water, may be substituted. Small doses (tablespoonful) of port wine are often useful from the first, and as the feces lose their watery character and become more consistent, tincture of gentian in doses of two teaspoonfuls may be given three or four times a day. Counterirritants, such as mustard, ammonia, or oil of turpentine, may be rubbed on the abdomen when that becomes tender to the touch.

OTHER AILMENTS OF THE CALF.

Among these may be named several congenital imperfections, such as imperforate anus, vulva, or prepuce, which are to be recognized by the inability to pass dung or urine, in spite of straining, and the formation of swellings in the anus, vulva, or sheath. Each must be carefully incised with the knife, taking care not to injure the muscles which circumscribe the respective openings. Also tongue-tie, in which the thin flaccid mucous membrane passing from the median line of the lower surface of the tongue binds the latter too closely to the floor of the mouth and renders the tongue unfit for gathering in the food in after life. This must be cut with knife or scissors so as to give the tongue a reasonable amount of liberty.

Aphtha or Thrush is another trouble of the sucking calf, showing itself as a white curdy elevation on the tongue, lips, cheeks, or gums, and when detached leaving a raw, red, angry surface. It is due to the growth of a vegetable parasite long recognized as the *Oïdium albicans*, but which Grawitz identifies as the *Mycoderma vini*. It is easily removed by rubbing with powdered borax, but inasmuch as other colonies are likely to start either in the mouth or lower down in the pharynx, gullet, or stomach, it is well to give a dose of one-half dram of hyposulphite of soda in water day by day for several days.

Rickets is not a common disease in calves, and comes on, if at all, later than those we have been considering. It consists in softening and friability of the bones from a deficiency of lime salts, and appears to be mainly connected with an inherited weakness of constitution, unsuitable feeding, cold, close, damp buildings, and other conditions inimical to health. The prevention and treatment of rickets consists essentially in the improvement of the digestion and general health; hence sunshine, open air, exercise, nourishing food, and tonics are indicated.

BONES—DISEASES AND ACCIDENTS.

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To facilitate the study of diseases of bones and the accidental injuries to which they are exposed, some knowledge of the skeleton is advisable. The skeleton of the adult ox is made up of the following number of bones:

Spinal column	43
Of the head	28
Of the chest	27
Of the shoulder	2—1 on each side.
Of the arm	2—1 on each side.
Of the fore arm	4—2 on each side.
Of the fore foot	40—20 on each side.
Of the pelvis	2—1 on each side.
Of the thigh	2—1 on each side.
Of the leg	6—3 on each side.
Of the hind foot	38—19 on each side.

Without attempting to burden the reader with the technical names and a scientific classification of each, I deem it desirable to describe some of the characteristics of forms in general, and of a few classes into which they may be divided, leaving the special study of individual bones to the illustrations of the skeleton (Plate XXV), which will serve better than any amount of writing to fix in the mind of the reader the location, relation, and function of each one. In early fetal life the place of bone is supplied by temporary cartilage, which gradually changes to bone. For convenience of study, bones may be said to be composed of two elementary constituents—the organic or animal and the inorganic or earthy. In young animals the former predominates; with increasing years the relative proportions of the two change, so that when advanced age is reached the proportion of inorganic far exceeds the organic. The gradual change with advancing years from organic to inorganic has the effect of rendering the bone harder and more brittle, and though it is stronger the reparatory process is slower when injury does occur.

The bones are nourished in two ways: first, from the outside through their covering, called the periosteum—the thin strong membrane that covers every part of the bone except at the joints—and, second, from within through the minute branches of blood-vessels, which pass into the bones through holes (*foramen*) on their surface and are distributed in the soft structure (*medulla*) of the inside. The structure of the bone is divided into two parts: the compact or hard material of the outside, which gives strength and is more abundant in the shafts of long bones; and the cancellated softer tissue of the inside, which affords accommodation to the blood vessels necessary for the nourishment of that part of the structure.

In shape bones are divided into three classes: long, flat, and irregular. The long bones are the ribs and those mostly found in the limbs, the flat bones in the head, the shoulder and the pelvis, and the irregular in the spinal column and the bones of the head.

DISEASES OF BONES.

The diseased conditions found in bones are classified briefly as follows: Inflammation of the structure of the bones (*ostitis*), which may be either acute or chronic, and may involve the whole extent of the bone affected, or may be confined to only a portion of it; inflammation of the covering of the bone (*periostitis*); formation of tumor or enlargement on the surface of a bone (*exostosis*), which is liable to occur in any part of the bone covered with periosteum, and is a common result of inflammation of that membrane, which, when it occurs in the neighborhood of a joint and involves two or more bones, is likely to result in their union (*anchylosis*). The inflammatory condition sometimes assumes an ulcerated form (*caries*), which from interrupted nutrition of the part deprived of the blood necessary to its nourishment occasionally dies, and becoming separated from the main portion of the bone, acts as a foreign body (*necrosis*). Soft bones (*mollities ossium*) is the condition found in young animals in which the proportion of inorganic or earthy matter is too small to give the necessary stability, so that the bones, particularly of the limbs, bend. Rickets or bending of the bones arises from this condition. In some cases the long bones of the limb are too weak at birth to support the weight of the animal, and temporary splints carefully padded and wrapped on with soft bandages become necessary. Hard bones (*fragilitas ossium*) is the condition opposite to that last described, and occurs in old animals, where through deficiency of animal or organic matter the bones become unduly hard and brittle, rendering them more liable to fracture and more difficult to unite when such an accident occurs. With this little introduction, which seems almost indispensable, we will proceed at once to the consideration of accidents.

SPRAINS.

The most common accident occurring to bones and joints is a sprain of the ligaments uniting the bones, or the tendons uniting the muscles and bones. A sprain is the result of a sudden forcing of a joint in an unnatural direction; or, if in a natural direction, beyond the power of the ligament or tendon to properly restrain it, so that part of the fibers of either are ruptured. When such an accident occurs pain is immediately inflicted, varying in degree with the extent of the injury, which is soon followed by swelling, with more or less heat and tenderness. If the seat of the injury be in any of the limbs lameness is likely to be the result. Of the causes of sprain, slipping on ice or a wet floor, playing or fighting with another animal are the most common.

Sprain of the shoulder joint.—This is likely to occur from any of the causes mentioned above or from the animal slipping suddenly in a rut or hole. When such an accident occurs sudden lameness will attract attention. The animal will be noticed to drag the leg when walking, at each step carrying it in a circular direction, outward and forward. The leg should be carefully examined, pressure over the joint causing the animal to evince pain. If the person making the examination is in doubt it is well to make a comparison between the shoulders by pressing first on one and then the other. After such an accident the animal should be tied up so as to limit as far as possible the use of the injured joint. Soft food should be given with a view to keeping the bowels acting freely. The first part of the treatment may consist of an application of extract of witch-hazel twice a day, freely applied around the injury. Should the lameness continue after the tenth day good results will be obtained from the application of a blister, which should be done by carefully clipping the hair off over the joint, including a surface of 4 or 5 inches in circumference, and rubbing in the following preparation:

Powdered cantharides	½ ounce.
Spirits of turpentine	2 drams.
Vaseline	1½ ounce.

The animal's head should be carefully tied to prevent licking the blister until the third day. The blistered surface should then be smeared with lard or vaseline every other day until the scabs fall off. Gentle exercise should be allowed after the fourth or fifth day from the application of the blister. If the lameness still remains the blister may be repeated in three weeks or a month.

Sprain of the Fetlock.—This may occur from misstep when the animal is moving rapidly and the twisting or wrenching of the foot is sufficient to partially rupture the ligaments which bind the bones together at that part. Such an accident also frequently occurs from the foot becoming fastened in a hole in the floor, and the wrenching is the result of the animal's attempt to liberate it. Lameness, followed by swelling of the joint and pain when it is handled, or when the animal moves the joint, and heat, are the more noticeable symptoms. If the sprain be very severe the animal occasionally does not bear its weight on the limb. Careful bathing with cold water, followed by the application of extract of witch-hazel or tincture of arnica and careful bandaging should be the immediate treatment. If the lameness has not disappeared by the fourth day, the blister advised for the sprain of the shoulder should be applied, and the same precautions observed as to tying the animal's head and subsequent smearing with vaseline. When a blister is applied in this locality the back part of the heel should be first filled with lard or vaseline, and care taken to prevent any of the blistering preparation from coming in contact with the skin of that part. If this precaution is not observed scratches may ensue and prove troublesome.

Sprain of the hip.—This is likely to result from the animal slipping in such a way as to spread the hind feet wide apart. The patient goes stiff with the hind legs, or lame with one hind leg, walking with a straddling gait, and swinging the leg outward as it is carried forward. Tenderness may occasionally be detected on pressure, but owing to the heavy covering of muscles outside of the joint this test is not always reliable. During the early stages medical treatment is not likely to be of much service. After the fourth or fifth day the blister mentioned in "Sprain of the Shoulder" may be applied with advantage.

Sprain of the back.—Sprain of the back, particularly in the region of the loins, is not an uncommon accident among cattle. It is likely to occur from the animal slipping with both hind feet sideways so as to twist the back; or the feet slipping violently backward so that great stress is thrown on the loins. The patient moves with difficulty, using the hind parts in a guarded manner as if afraid of causing severe pain. Occasionally if the sprain is severe the animal will rise with difficulty. Pressure on the back in the immediate region of the loins causes pain. Such cases may be mistaken for paralysis, and in fact in severe cases although the nerve supply is not interfered with, the injury to the muscles and resulting pain is so great that the condition is almost equal to paralysis during the early stages of the injury, although likely to be attended with more favorable results. Hot applications, as blankets wrung out of hot water and changed at short intervals, will be likely to afford relief during the earlier stages. Afterwards the cantharides blister mentioned in sprain of shoulder may be applied with advantage.

FRACTURES—BROKEN BONES.

Bones may be accidentally broken in many ways and from different causes. Fractures in general are likely to be produced by external force suddenly and violently applied, either directly to the part or at a distance, the force being transmitted through the stronger bones until it expends itself by breaking a weaker one remote from the seat of the injury. Occasionally violent contraction of muscles is sufficient to break a bone. Certain bones are more liable to fracture than others, those of the limbs in particular, owing to their exposed position. The bones of some animals are more easily fractured than those of others, owing to certain predisposing causes, such as age, habit, or hereditary constitutional weakness. The bones of an animal advanced in years are more subject to fracture because of the preponderance of inorganic matter rendering them more brittle. They are also occasionally rendered liable to fracture by a previously existing diseased condition. Fractures are divided into four classes: Partial, simple, compound, and comminuted.

Partial fractures are those which are likely to occur in a young animal in which the preponderance of animal matter or the semi-cartilaginous condition of the bone renders it tough, so that considerable force must be applied before fragments of the bone are dissolved, and even then the bone bends, breaking on the side opposite that to which the force was applied, after the manner in which a green stick would bend and break.

Simple fracture is one in which the bone is severed in two parts, either in a line directly through the bone, or obliquely, without serious injury to the adjoining structures.

Compound fracture is one in which there is an open wound communicating with the ends of the broken bones.

Comminuted fracture is one in which the bone is shattered or divided into a number of fragments.

General symptoms of fracture.—When a fracture of one or more of the large bones of a limb occurs, symptoms are sure to be well marked. After the accident the animal refuses to touch the foot to the ground, and if compelled to move does so with great pain and reluctance. There is more or less shortening of the limb, with trembling of the muscles in the vicinity of the injury, deformity, and increased mobility, so that instead of the natural joints of the limb and the natural muscular control of their motion a new joint is formed where the fracture occurred, over which the animal has no control. As the leg hangs dependent from the body, shortened by the ends of the bones being forced past one another from the muscular contraction which invariably takes place, it swings in an awkward and unnatural manner, permitting the toe and foot to assume positions in their relations to other parts of the body which otherwise would be impossible. If the fractured bone is so situated that the parts may be moved one upon another, a grating sound, known as crepitus, will be observed.

General treatment of fractures.—When a fracture occurs the advisability of attempting treatment must first be determined. If the animal be young, valuable, and of reasonably quiet temperament, and the fracture not too great in extent, the chances of recovery are fair. On the other hand, if the animal should be of little value, irritable, advanced in years, and the fracture a serious compound or comminuted one, the wiser course would generally be to put the creature out of its misery. Having determined to attempt treatment no time should be lost in restoring the parts as nearly as possible to their natural position and retaining them there. If the ends of the bones have been drawn past one another, they should by firm and continuous tension be drawn out until they again assume the position in which they were before the accident. All this can better be done before the swelling—which is sure to result—takes place. If the swelling has occurred before the injury is noticed do not attempt to treat it, but proceed at once to treat the fracture as though the swelling were not present, for no step can be taken toward recovery until the ends of the bone have been restored to proper position. When that is done and proper appliances have been used to prevent them from being again misplaced, the swelling, which is the result of irritation, will be relieved. In selecting the appliances to be used in the treatment of fracture, the judgment and ingenuity of the operator are of much importance. Splints, made of wood shaped to fit the limb, and padded with soft material where they come in contact with bony prominences, and held in position by means of bandages, are the oldest method, and with some are still the most popular. The fracture-pads used in human surgery, and for sale in surgical depots, are very convenient. After being dipped in water they may be molded to fit the limb and be retained by means of bandages. Heavy sole leather is also used after being soaked in warm water and molded to the shape of the limb and holes cut in it to fit over any sharp irregularities in the natural shape of the bones. Gutta-percha sheets are also used and answer well. They are prepared and used in the same way as the leather.

Another, and perhaps the simplest of all methods, is the application of a plaster of Paris bandage, which is made as follows: Strips of thin cheese-cloth, 3 inches wide and 8 or 9 feet long, are laid flat on a board and on them is spread a layer of plaster of Paris about one-eighth of an inch thick, then starting at one end rolling carefully so as to gather the plaster in between the layers of the bandage. It is, of course, important that the cloth be thin and the plaster of Paris fresh and active. After preparing four or five of such bandages the operator is ready to dress the fracture, which, after the parts have been brought into position, should be done by covering all that part of the limb to which the plaster of Paris bandage is to be applied with a single layer of the dry bandage, letting it extend both above and below the part to which the plaster of Paris bandage is to be applied and including under the folds of the dry bandage at each end a layer of absorbent cotton, which is intended to form a pad to prevent the ends of the plaster of Paris bandage from chafing the skin beneath. When this is done one of the plaster of Paris bandages should be placed in a vessel of water and allowed to remain till the air-bubbles have ceased to arise from it, which will generally indicate that it is soaked through. Then taking it in the hand wind it carefully around and around the limb, unrolling the bandage as it is wound around the limb, occasionally smoothing down the plaster of Paris. Should it form roughly or in ridges the hand may be dipped in water to impart increased moisture while doing so. When about finished with one bandage place another one in the water so that the winding operation may be continued without delay. The bandages should be applied till the cast is from one-half to three-quarters of an inch thick; then gently restraining the animal for one-half or three-quarters of an hour till the plaster is hardened. Any of the appliances used should be so applied as to absolutely prevent any motion of the detached parts. If the fracture is near a joint it is generally best to include the joint in the appliance. The part of the limb below the bandage should be carefully and firmly wrapped with an ordinary cotton bandage all the way from the plaster bandage down to the hoof. This last bandage will tend to prevent swelling, which is likely to occur; the result of the dependent position in which the animal is forced by nature to keep the injured limb. When plaster of Paris bandages are applied to a compound fracture the injured part may be previously dressed with a small thick pad of cotton immediately over the wound. In applying the bandage the operator may with a little care so arrange it as to keep the folds of the bandages off the cotton, or have only a thin layer over it, which may be easily cut out and the cotton removed, leaving a convenient opening through which to dress the wound without removing the bandage. The ends of the bandage or other appliance should be carefully watched to see that the skin does not become chafed, particularly at the lower end. If the bandage should become weak or broken at any part it may be strengthened without removal by applying other bandages immediately over it. If swelling has taken place before the bandage has been applied there is likely to be some loosening as it disappears, and even without the swelling there is likely to be a tendency of the bandage to slide downward. This may be overcome by fastening it to a suspender attached to a surcingle or passed over the body and attached to the opposite leg. If the looseness can not be overcome in this way the space may be filled by pouring in a thin paste of plaster of Paris. A better method, however, is to remove the bandage and apply another. Owing to the hardness of the bandage it will be removed with some difficulty. A deep groove should be cut down completely through it on the opposite sides. This may be done with a chisel and a small hammer, if the bandage is carefully held by an assistant so that the concussion of the blows is not transmitted to the injured bones. The patient should have a roomy stall and should be tied by the head to prevent any attempts to move around. In some cases slings have been used. Ordinarily, however, they are not satisfactory in cattle practice, and if applied should only be for a few days at a time and with a view to lessen the animal's disposition to lie down, rather than to prevent it. When they are used continuously the pressure on the abdomen is likely to interfere with digestion and the general health of the animal.

Modes of union.—The animal should be kept as quiet as possible and given such food as will have a tendency to keep the bowels slightly relaxed. The success of the operation will depend chiefly on the skill of the operator, but not alone in the selecting and use of the appliances; for as much attention must be given to subsequent management. The patients are unreasonable, and a single awkward motion may undo the work of weeks so far as the union of the parts of the bone is concerned. It takes place after the same process and, if the conditions are favorable, with greater rapidity than in the human being. The injury that caused the fracture is almost sure to have extended to some of the adjacent tissues, and even though the fracture may be of the simplest type there is almost sure to be considerable hemorrhage around the ends of the broken bone. This, however, is unimportant if the skin remains intact, unless a very large vessel should be injured, or the fracture should open some of the important cavities of the body, in which case a fatal hemorrhage might result. If, on the other hand, the fracture be a compound one, the external opening furnishes a fertile field for the lodgment of disease-producing germs. Unless great care is exercised in such cases a suppurative process is likely to be established which will seriously interfere with if not entirely arrest the process of union between the bones; or it may become so serious as to endanger the general health of the animal and even be attended with fatal results. This last danger is greater where the injury has occurred to the bones of the arm or thigh. In such cases, owing to the dense covering of fascia which ensheathes the muscular covering, pus is likely to be imprisoned, and burrowing downward saturate the whole structure, not only endangering the limb, but, being likely to be reabsorbed, may set up blood-poisoning and seriously interfere with the general health of the patient, even to causing death. In order as far as possible to prevent such an unfortunate complication the wound should be carefully cleansed with a mild solution of carbolic acid, then dusted over with iodoform before the bandages are applied, and cleansed and dressed daily in the same way. After dressing always cover with absorbent cotton. In the early process of union an exudation of lymph takes place, which is at first fluid, gradually becoming thicker and firmer till it forms a callus in the shape of a ring or ferrule surrounding the detached portions of the bone, known as the external or ensheathing callus. It occasionally happens that this callus only forms at the ends of the bones, filling the spaces that exist between them, when it is known as the intermediate callus. The process of union may be divided into five stages: In the first stage, including the first eight days, the detached portions of the bone and the sharp projections that are not sufficiently nourished are absorbed; the blood which escaped into the surrounding tissues, the result of the injury, is gradually absorbed and the effused lymph which is ultimately to constitute the temporary cartilage takes its place. In the second stage, from the tenth to the twentieth day, the tumor or callus is formed and fibro-cartilage is developed inside and around the exposed end of the bone. In the third stage, extending from the twentieth to the fortieth or fiftieth day, according to age and strength of the animal, the fibro-cartilaginous structure undergoes a change and is gradually converted into bone, forming a ferule on the outside and a plug on the inside, which serve to hold the part in position. In the fourth stage, extending to about the sixth month, the whole of the new structure is converted into bone. The fifth stage, extending up to the end of the first year, the callus is absorbed, being no longer necessary, and the connection between the cavities of the two bones is again established.

Common complications.—The process of union just described is healthy and normal. Diseased conditions may at any time supervene during the treatment and render the operation unsuccessful. In the case of compound fracture, the open wound communicating with the ends of the bones, a septic condition is apt to arise which may become so serious as to endanger the animal's life and bring about conditions which in human surgery would indicate amputation. Although that operation is not a general one in veterinary practice, there is no reason why it should not be attempted as a last resort, particularly if the animal be valuable, or one whose existence is necessary in order to perpetuate some valuable strain. Even in the simplest form of fracture, if the splints or bandages are improperly applied and the fractured bone left so loosely guarded that the broken ends move one upon another, the formation of the calluses previously described is likely to be interfered with, and in place of a strong, rigid, and healthy union a formation of elastic cartilage is the result. This false structure unites the broken ends of the bones in such a way that they move one upon another, depriving the bone of its stability and usefulness. When once the healthy process of union is interrupted in the manner just described, it is with great difficulty that it can be again established. It no longer does any good to continue the restraining power; in fact, the change of the temporary cartilage into bone is more likely to be reëstablished if the parts move violently upon one another for a short time so as to set up and renew the process of inflammation. Then if the restraint be again applied there is some chance of union. In order as far as possible to avoid this danger, care should be exercised that the bandage fits closely and that it is kept on till there is no longer any danger but that a perfect union has taken place. It is impossible to say at just what time the splints or bandages can safely be removed. In a young and healthy animal of quiet temperament, where the parts have been firmly held in position throughout the whole time, from thirty to forty days may be regarded as reasonably safe. Under more unfavorable conditions as to age, vitality, and restraint, the period had better be extended up to sixty days if the general condition of the animal is such as to permit of so long a continuance. After the appliance has been removed the animal should be allowed to stand quiet for a few days, then given very gentle exercise, gradually increased over a period of a week or ten days, by which time the patient will be so far recovered as to be placed in pasture. It should, however, be alone for a time, so as not to take any chance of injury from fighting or other accidents that associations with other animals might involve.

Special fractures.—Of the special fractures liable to occur that of the horn is perhaps the most common. It is always the result of violent mechanical means, such as blows, injury occurring while fighting, or from the animal getting its head locked in some manner while feeding from a rack. When it occurs there are two ways in which the injury is likely to affect the animal. First and most common, the horny crust is likely to be stripped from the bony projection which it covers. Second, the crust and bone may both be broken or bent down, the fracture occurring in that case at the root of the horn and involving part of the bones of the head in the immediate vicinity. In the first case, where the horny covering is knocked off, little attention is necessary. The animal may be relieved from suffering by smearing the stump with pine tar and wrapping it in cloth. If the core is much lacerated perhaps it would be better to amputate. The necessity for such an operation must be determined by the condition of the injury, influenced to some extent by the ideas of the owner on the subject. When the operation is performed it should be done with a sharp, fine-toothed saw, and by sawing the horn off close enough to include a little of the skin and hair around its base. The practice of dehorning has grown popular in many parts of the country. It is a simple operation, and, although attended with considerable immediate suffering, does not produce serious constitutional disturbance. The advisability of performing the operation on all cattle is a question of expediency and must be justified by the expectation of benefit on the part of the feeder. If the horn should be broken so that the core and crust are bent out of shape without the detachment of one from the other, it may be restored to its normal position and retained there by means of a splint made to fit across the back of the head, so as to be laced to both horns, the sound horn serving to hold the broken one in position. Such a splint may be fastened on by means of either wire or cord and allowed to remain six weeks or two months.

Fractures of the bones of the face.—These occasionally occur, and when over the cavities of the nose produce depression, disfigurement, and impeded respiration, owing to the lessening of the caliber of the nasal passages. When such an accident occurs the depressed bone should be gently forced back to place by introducing the finger in the nostril, or if the fracture be too far up for this, a probe may be passed and the parts retained by placing a plaster of thin leather or strong canvas smeared with tar immediately over it, extending out to the sound surroundings, taking care to imbed the hair over the fractured portion in the tar of the plaster so it will be firmly held and prevented from again becoming depressed. If only one nostril should be involved the depressed portion may be held in position by packing the nostril on that side with absorbent cotton. This practice, however, has the objection of giving the animal great discomfort, and in some cases a disposition to aggravate the injury.

Fracture of the skull or cranium.—Fractures of the bones forming the cavity in which the brain is situated are, owing to their strength, comparatively rare among cattle. Such an accident can only be the result of external violence, and it is hardly possible that it could occur without some fragment of the broken bone pressing upon the brain so as to cause coma, other severe nervous derangement, or even death. If the animal survives the first shock the efforts should be directed toward relieving the pressure, which may be done by making an opening in the bone (trephining) and with a hook drawing the depressed part outward. Interference is not so likely to be attended with good results as to be warranted in all cases. The effects of a very severe shock which may not have produced a fracture, although the symptoms were alarming, will in many cases pass off, leaving the animal in a better condition than if an operation had been performed.

Fracture of the lower jaw.—This occasionally occurs, and is more likely to result from the kick of a horse than from any other cause. The front part of the jaw is likely to be split or shattered in any direction in which the force may have been applied. Bloody discharges from the mouth and failure to eat or ruminate are symptoms most likely to attract attention. The treatment is simple, and consists of first removing detached pieces of bone, then drawing the parts together and retaining them by means of pieces of copper wire fastened around the teeth, and feeding the animal on sloppy food until recovery takes place. The wound should be dressed once or twice a day with a 3 per cent solution of carbolic acid, forced gently in with a syringe so as to remove any food which may have become impacted and interfere with the healing process.

Fracture of the vertebræ or spinal column.—This is not so common among cattle as other animals. If the fracture should be through the body of the bone there is likely to be pressure on or laceration of the spinal cord, causing paralysis of all parts posterior to the seat of injury. Fractures of the prominences on the vertebræ occasionally occur without interfering with the canal in which the spinal cord is located. Such accidents are likely to pass unnoticed, for although the animal may suffer considerable pain, it is not likely to be manifested in such a way as to attract attention, and the deep covering of muscles serves to effectually conceal the injury. When the fracture occurs in the upper part of the neck, paralysis of the muscles used in respiration must result, and death from asphyxia very shortly ensues. The more common accident is to the loins, and when a fracture of the body of the vertebræ occurs in this region so as to produce pressure on the spinal cord, paralysis of the hind legs and quarters is the result. Diagnosis of such an accident is more difficult than in the case of any other fracture. The parts can not be moved one upon another so that crepitus is noticeable. The heavy coating of muscles conceals irregularities of shape, which would otherwise be likely to attract attention. About the only reliable symptom is paralysis or loss of use and sensation of the parts posterior to the injury; careful examination may reveal the seat of the injury. If it was the result of a blow there is likely to be some abrasion of the skin. The diagnosis is only important as an aid in determining the proper course to pursue. If paralysis is present and a depression or irregularity of the spinal column is so apparent as to leave no doubt of the existence of a fracture, the only alternative is to destroy the animal, for of recovery there can be no hope. If, on the other hand, the paralysis is incomplete, and there is no depression or irregularity of the spinal column or other evidence of fracture, the patient should be made as comfortable as possible by being placed in a well-bedded box stall and a few days permitted to elapse before the case is abandoned. The symptoms last described might possibly be the result of a severe strain of the muscles of the loins, in which case an improvement will soon be noticeable.

Fractures of the pelvis.—The pelvis or bony framework which gives shape to the posterior part of the body is liable to fracture in many ways. A common one is by a separation of the two bones which constitute the whole pelvis along the bottom and center line (*symphysis pubis*). In early life the two bones are separate and distinct. The union between them which is at first cartilaginous undergoes a change and is converted into bone; so that in adult life the whole pelvis is practically one bone. The point on which the two bones are united is weaker than the adjoining parts of the bone. When an animal slips violently, spreading the legs wide apart, the weaker materials give way and the bones are divided. If the accident is noticed when it occurs it is likely to throw light on the nature of the injury. The animal will be immediately noticed going stiff behind, the legs being spread apart. Further examination may be made by introducing the hand, previously carefully oiled, into the rectum or vagina and pressing down along the central line, which will cause the patient to evince acute pain. In this case no appliance can be used to advantage. The animal should be tied in a stall until the parts become reunited and the lameness disappears.

Fracture of the posterior part of the bone (*ischium*) which forms the point of the buttocks occasionally occurs. The buttock on the injured side will be less prominent than the other. Careful manipulation will generally move the parts so that crepitus may be recognized. If the fracture is through the posterior part of the bone it is unimportant and deserving of no more attention than placing the animal in such a position as to insure it against subsequent injury until the bones are united. Some distortion is likely to result, but not sufficient to warrant interference.

Fracture through the body of the bone on a line with the hip joint (*acetabulum*) occasionally though rarely occurs, and is nearly always associated with dislocation of the hip joint and the forcing of the head of the upper bone of the leg (*femur*) upward, far out of its place. The violent contraction of powerful muscles of the hip renders it impossible to reduce the dislocation, and even if it were possible the fractured pelvis could not be held in position, so that the case becomes at once a hopeless one. It may be recognized by the animal standing on three legs, the leg on the injured side seeming shorter than its fellow and hanging pendulous, the muscles of the hip violently contracted and hard to the touch. The animal evinces great pain when the limb is moved. There is likely to be some apparent distortion in the relations between the point of the hip and the point of the buttock. This will be more readily noticed by comparing the injured side with the other. The parts may be moved so as to produce crepitus. The examination may be completed by introducing the oiled hand into the vagina or rectum, when the two sides of the pelvis will reveal well marked differences.

Fracture of the point of the hip.—The anterior and external part of the pelvis (*ilium*), commonly known as the point of the hip, is liable to fracture which stock owners describe as "hipping," or being "hipped." This accident is likely to be the result of crowding while passing through a narrow door, of falling violently on the point of the hip, or from a violent blow directed downward and forward against it. The lesion generally extends across the flat surface of the bone from its outer and posterior edge forward and inward. Distortion is likely to be the only noticeable symptom. The detached portion varies in size in different cases and with it the resulting deformity. The animal is noticed to be slightly lame, but this symptom soon disappears. The detached portion of the bone is drawn downward and away from the main part by the action of the muscles below, which are so powerful as to render return impossible. Bony union between the two parts does not again take place, but a cartilaginous hinge, previously described as a false joint, supplies the deficiency. The animal suffers very little inconvenience, and for practical use may be serviceable as before the accident, though the distorted appearance depreciates its value.

Fracture of the ribs.—Such an occurrence can take place only as the result of a direct injury, as from blows or crowding. The posterior ribs, being more exposed, are more liable to fracture. Pain in moving, slight swelling over the seat of injury, and difficult breathing are obvious symptoms. If the fracture be complete, crepitation may be occasionally noticed by placing the hand flat over the injured part, observing carefully the motion as the chest contracts and expands during respiration. This symptom is more noticeable when the animal coughs. Unless the point of the broken bone penetrates the cavity of the chest the fracture is usually unimportant and calls for no treatment other than quiet. If the breathing is very labored and attended with much pain, motion may be limited by applying a wide bandage firmly around the chest. The animal should be restricted in the amount of food and water for a few days, the stomach being kept as nearly empty as possible. Sloppy food should be given to encourage, as much as possible, free action of the diaphragm in breathing.

Fractures of bones of the limbs.—On this subject much has been said in the preceding remarks on general fractures. As a rule fracture through one of the large bones of the shoulder (scapula) or thigh (femur) is very difficult to manage. The powerful contraction of the muscles and the changing shape of the limb resulting from their action renders it impossible to retain the detached parts of the bone in proper position. Therefore, though the union should take place, there is almost sure to be considerable deformity and more or less lameness. Fracture of the arm (humerus) or leg (tibia) is likely to be attended with better results. The muscular covering is not so thick, the sheath in which they are held is more tense, and the change in the shape of the limb from muscular action not so noticeable, the muscular force not so great, all of which facilitate replacing in position the dislodged ends and retaining them.

Fracture of the knee (carpus) and hock (tarsus).—Unless it is the result of a very violent injury this seldom occurs, and is generally associated with other injury and serious complications. Displacement does not generally occur to any considerable extent. The treatment, of course, will consist in holding the limb perfectly quiet in a natural position, which may be done by the application of long wooden splints retained by bandages, or a plaster of Paris bandage.

Fractures below the knee.—Fracture of the long bone below the knee (metacarpus) and hock (metatarsus) is more common. In young animals of quiet temperament the treatment of simple fractures here is likely to be attended with good results. On the other hand a compound fracture in this region becomes a serious matter. The structures which surround the bones are so thin that a very small degree of sloughing will expose parts of the bones and be likely to lead to serious complications and probably fatal results.

Fractures of bones below the fetlock.—These fractures are comparatively unimportant unless associated with other serious injury. The parts can generally be held in position without much difficulty, and union generally takes place quite rapidly.

Appliances.—Of the appliances used in the treatment of the fracture of limbs above the knee, splints made of wood or strong leather and bandages are likely to serve best. Below the knee plaster of Paris bandages are preferable. The writer is well aware that many of the standard authors deprecate the use of the latter, but an extensive experience leads me to believe that they have many advantages over any of the other appliances when used alone, and they may in many ways be used with advantage in combination with others.

Dislocations.—Luxation or displacement of the bones forming a joint, without fracture, is comparatively rare among cattle. It most frequently occurs in the stifle joint, where dislocation of the knee-pan (patella) takes place. A glance at the skeleton (Plate xxv) will show the relations better than they can be described. It will be observed that the small irregularly shaped bone (patella) plays on the anterior rounded part of the lower end of the hip bone (femur) and between it and the upper end of the thigh bone (tibia). The outer ridge on the lower end of the thigh bone is less prominent than the inner one, so that displacement, when it does take place, is by slipping outward. Such an accident may occur from direct injury or external force, as a blow, or from slipping. When it does occur the symptoms produced are somewhat alarming. The animal is unable to draw the leg forward, and either stands with it thrown back with the toe pointing downward, or, if it should succeed in getting its weight upon it, holds it firmly on the ground, fearing to move it. Examination of the outside of the joint will disclose the situation of the patella outside of its proper place. If the operator is not familiar with the normal appearance of the joint it is well to make a comparison between the injured and the sound one. If compelled to move the animal does so with great difficulty, jerking the leg which it is unable to bring forward, hopping with the other and partially dragging the injured one. The treatment is simple. A rope should be applied around the fetlock, the leg drawn forcibly forward by an assistant, while the operator carefully manipulates the dislocated bone, shoving it inward and forward as the leg is brought forward. If successful it slips into its place with a sharp click and the animal steps off as though nothing had happened. Unless some precaution is taken the accident is liable to recur, as the ligaments have been stretched by the dislocation till they no longer hold the bone with that firmness necessary to retain it. The animal should be tied and the foot fastened forward, so that the animal can just stand on it comfortably, by means of a rope or strap around the fetlock, carried forward between the front legs around the neck and tied on the breast. Should this accident occur more than once it is a good practice to apply a blister around the joint, as in the formula recommended in sprain of shoulder, and observe the precautions as to restraint and subsequent treatment there recommended. With this one exception dislocations in the ox occurring independently of other complications are rare. Dislocation with fracture may occur in any of the joints, and where one is suspected or discovered, before treatment is applied, examination should always be made for the other. When a fracture occurs in the vicinity of a joint the force sufficient to rend the bone is likely to be partly exerted on the immediate tissues, and when the bone gives way the structures of the joints are likely to be seriously injured. It occasionally happens that the injury to the joint becomes the most important complication in the treatment of a fracture. In order to clearly understand the reason for this a few words are necessary in relation to the structure of joints.

The different pieces constituting the skeleton of the animal body are united in such a manner as to admit of more or less motion one upon another. In some of the more simple joints the bones fitting one into another are held together by the dense structures around them, admitting of very little or no movement at all, as the bones of the head. In other joints the bones are bound together by dense cartilaginous structures, admitting of only limited motion, such as the union of the small bones at the back part of the knee and hock (metacarpal and metatarsal). In the more perfect form of joint, the power of motion becomes complete and the structures are more complex. The substance of the bone on its articular surface is not covered with periosteum, but is sheathed in a dense thin layer of cartilage, shaped to fit the other surfaces with which it comes in contact (articular). This layer is thickest towards its center when covering bony eminences, and is elastic, of a pearly whiteness and resisting, though soft enough to be easily cut. The bones forming an articulation are bound together by numerous ligaments attached to bony prominences. The whole joint is sealed in by a band or ribbon-like ligament (capsular ligament) extending around the joint and attached at the outer edge of the articular surface, uniting the bones and hermetically sealing the cavities of the articulation. This structure and the articular surface of the bone is covered by a thin, delicate membrane, known as the synovial membrane, which secretes the joint-oil (*synovia*). This fluid is viscid and colorless, or slightly yellow, and although it does not possess a large amount of fat, its character somewhat resembles oil, and it serves the same purpose in lubricating the joints that oil does to the joints of an engine. Although the tissues of the joint when used in a natural way are able to withstand the effect of great exertion, when unnaturally used, as they are very delicate and complex, they are liable to inflammatory and other changes of a very serious nature. The synovial membrane, and in fact the whole structure of the joint, is susceptible to injury and serious inflammatory derangement, and the capsular ligament is liable to be distended from excessive secretion of synovia. The latter process may be almost noninflammatory, and attended with little inconvenience or importance other than a blemish to the animal, which in cattle is not serious. It may occur on the back part of the leg above the fetlock or on the inner and fore part of the hock, corresponding in its location to windgalls and bog spavin of the horse. Continuous support by bandages will generally force reabsorption, and as the limb is not subjected to violent action, as in the case of the horse, the affection is not so liable to recur.

Spavin.—Occasionally working oxen that are used in the lumber woods and made to pull heavily, with bad footing, are afflicted with this. When it occurs lameness is the first symptom. During the early stages of the disease the lameness is most severe in the morning and disappears after the animal is exercised; it gradually becomes more severe as the disease advances, so that when the disease is well established the animal is lame continuously. Shortly after the lameness appears a bunch (*exostosis*) will be noticed on the inner and fore part of the affected joint. This bunch differs from bog spavin in that it is hard, while bog spavin is soft. It increases in size as the disease advances, till the animal is too lame to be used for labor. As the disease is always attended with considerable pain there is more or less loss of flesh. In the most advanced stage the animal will step with difficulty, frequently holding the foot from the ground, or if forced to take a few steps, stands with it elevated, twitching with pain. In the earlier stage of the disease only a small portion of the fore part of the lower or second articulation is involved, but the inflammatory process gradually extends over the whole surface of the lower joints of the hock. The structures of the joint are broken down and the bones are united (*anchylosis*). This process may include any or all of the three lower joints of the hock. The joint of motion which is situated on the lower end of the leg bone is seldom involved. Treatment of spavin in the ox, as in the horse, is likely to be tedious, and not always resulting in perfect cure. Usually it is best to fatten the animal for slaughter. If, however, treatment is decided upon, it would be by the application of the following blister:

Powdered cantharides	3 drams.
Biniodide of mercury	2 drams.
Vaseline	1½ ounces.

Clip the hair off and apply over the inner and fore part of the joint, covering the surface an inch and a half in every direction from the enlargement, or over an area 3 to 4 inches across. Fasten the animal's head so that it can not reach the part to lick it; after the third day grease with lard every other day until the scabs come off. This blister may be repeated every month or six weeks. The lameness will generally begin to disappear about the third or fourth month and a more or less perfect cure be effected by the sixth or seventh.

In a case of spavin the cure is not effected by restoring the diseased parts to their natural condition, but by uniting the bones and obliterating the joints. If this union extends over the whole articular surface of the joints affected and is sufficiently strong to prevent any motion of the bones, the animal will again go sound. The joints that are obliterated not being those of motion are not important, so that the animal suffers no inconvenience in their loss.

RHEUMATISM.

Cattle exposed to severe cold or damp weather are likely to suffer from this disease, or it may appear as a sequel to some diseases of the lungs or skin. Some animals seem to be naturally predisposed to it. In its nature it is inflammatory and is more likely to involve the organs of locomotion than any other, though the heart and other internal organs are occasionally involved as a secondary result. Primarily it appears as an inflammation of joints, ligaments, tendons, or the covering of muscles. It is due to a specific condition of the blood in which certain irritant properties are developed and lodged and in the fibrous tissues of the structures named.

There is some dispute as to what the true nature of the irritant property peculiar to this disease really is. The acid condition of the urine has led to the supposition that it is possibly due to lactic acid. In the herbivora the acid found is hippuric. As it is likely to be caused by impaired action of the skin, there is reason to suppose that it is due to the presence in the system of some of the natural constituents of perspiration, either in excessive quantity or in perverted condition.

It generally appears as a sudden lameness, with noticeable swelling around some of the joints of the affected limb, though it is quite likely that the swelling will not bear any proportionate relation to the amount of pain evinced.

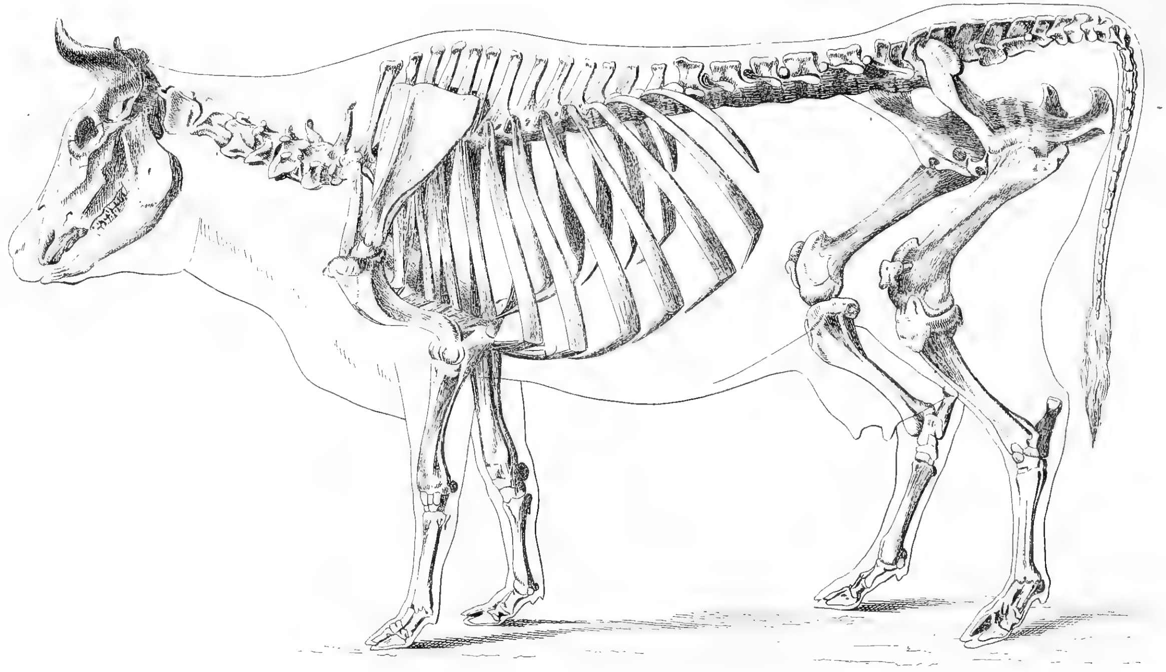
The disease may be confined to one limb, or more than one may be affected. It may appear simultaneously in different parts of the body, or after involving one or more parts suddenly disappear and reappear in another place, which may be remote from or near to the part first affected, which, if the disease is not arrested, is likely to suffer from subsequent attacks. The local symptoms are always accompanied with constitutional disturbance of a feverish nature, which usually precedes the appearance of the more painful symptoms. The temperature is likely to run up from 104° F. to 108° F. In an acute attack the mouth will be found hot and dry, the pulse hard, the secretion of urine lessened, the urine acid in its character and charged with impurities. The bowels are less active, and there is frequently a marked disposition to lie down continuously.

A chronic type of the disease, which may supervene on the acute or occur independently, is characterized by the symptoms already mentioned, except that the constitutional disturbance is not likely to be present, or, if so, not so marked, nor do the acute local conditions show the same tendency to shift from one part to another.

This inclination to remain fixed in one place has a tendency to bring about structural derangement and permanent injury to the parts involved in the shape of thickening and enlargement of the soft structures, or in extreme cases in the formation of bony tumors and the obliteration of a joint.

Treatment.—At the outset a purgative dose of Epsom salts should be given, which may be from 1 to 1½ pounds for an ordinary-sized cow. If the pain is very acute it may be relieved by occasional doses of laudanum or opium, not more than an ounce of the former or a dram of the latter, three times a day. When the opium is used care must be taken to keep the bowels acting regularly. For this purpose it may be necessary to give occasional small doses of Epsom salts. In conjunction with the above, or alone if it is not deemed necessary to give the opium, half-ounce doses of the nitrate or bicarbonate of potash should be given three times a day. Great care should be exercised to keep the patient comfortable. If unable to stand, a liberal supply of bedding should be used to prevent possible injury from bruising and bed-sores. The stall should be roomy, so that the patient may move with ease and be perfectly free from moisture, drafts, and sudden changes of temperature. The food should be such as will be easily digested—bran mashes, green food when it can be procured, and clean hay. Locally the pain may be relieved and the disease checked by the application around the affected joint of stimulating liniments or blisters. (See blister recommended for use in treatment of spavin.)

PLATE XXV.



Naines after Chauveau.

HELIOTYPE PRINTING CO. BOSTON.

SKELETON OF THE COW.

SURGICAL OPERATIONS.

By the late Dr. WILLIAM DICKSON, *Veterinarian to the State Farmers' Institute of Minnesota;* revised and completed by Dr. WM. HERBERT LOWE, *Superintendent of the United States Quarantine for the port of New York, Garfield, N. J.*

There are fewer surgical operations performed on the cow than on the horse. Various causes conduce to this result. Naturally plethoric, slow in their motions, and even when at liberty, save under occasional exceptional circumstances, singularly averse to active exertion of any kind, animals of the ox tribe consequently enjoy a practical immunity from a proportion of accidents which in animals of a more buoyant and active temperament so frequently entail results demanding surgical intervention. Oxen are seldom used nowadays for purposes of draft or burden, and even when put to either of these uses the risk of anything like serious injury is greatly diminished by their deliberate movement. The nature of their food and their usual environments all tend to operate more or less in the same direction.

There is, however, another and a very material reason. A cow, an ox, or any individual of the species, represents to the ordinary owner just so much capital—not usually a very large amount—and in the event of accident or ailment monetary or utilitarian considerations have an important bearing on the question of recourse to professional assistance. An ox is but an ox anyhow, and, although the interest of his owner sometimes requires to have a sick one treated, the animal itself, I fear, is but seldom regarded as possessing much if any claim to moral protection, still less to sentimental consideration. If he is injured he has got to be mended, but, like a piece of torn currency, how does not so much matter. Surely humanity demands kind treatment for all animals, and even when compassion and self-interest do not join hands the sick or wounded bovine has quite as much claim to all possible relief from pain and suffering as the most valuable or highly endowed of living creatures.

The primary object of a work of this kind, therefore, is to treat of the best means known to practical science in a style and language so plain that an owner will himself be able to come to the assistance of his suffering dumb dependents, and, in many of the emergencies which occur on the farm or the ranch, be able, with the help of the knowledge thus attained, to perform many of the minor operations which may become necessary without having to weigh the question of possible cost against the economical results to be attained by professional treatment.

The intention is not by any means to supplant the veterinary practitioner. It is, on the contrary, the matured result of a deep and earnest desire to benefit the farmer and stock-owner by directing aright his well meaning but ofttimes mistaken efforts and those of his employés in ministering to the necessities of their suffering charges in those emergencies which are constantly liable to occur where competent assistance is beyond reach. It is to enable him to perform in a rational and effective manner minor operations which would in any case be undertaken with less intelligence and success than would be likely were the owner armed with a certain knowledge of the correct principles on which they ought to be conducted. If this work fulfills its mission, as who can doubt it will, the efforts at self-help of its readers will be free from bungling and simple guesswork, while the animals in their charge will be material gainers by the change.

There are, moreover, sundry operations hardly, perhaps, entitled to rank as surgical, which are usually performed not always by any means in the best possible manner, nor with invariable success by the animal's owner or his servants. It will be the writer's endeavor to attempt to show how some of them can be performed in such a way as to obtain the most favorable results while abridging the animal's pain and peril and diverting danger and consequent loss.

In the performance of any operation upon an animal of the size and strength of the ox the first consideration is to secure it in such a manner as to preclude the possibility of its injuring either itself or those taking any part in the operation, for two or more are invariably necessary. The nature and time likely to be occupied by an operation must of course largely determine the method to be adopted.

The majority of operations with which the present chapter is concerned are usually performed on the ox in a standing position. To secure the animal in this position lay hold of one horn and with the disengaged hand grasp the nose, the finger and thumb being introduced into the nostrils, and press against the cartilage which makes a division between them. If this is insufficient the animal should be secured to a tree or a post. A very excellent method of restraint is to tie a long rope in a slip noose over the horns, pass it around the chest just behind the fore legs, taking a half hitch on itself, taking another half hitch in front of the hind limbs, passing the free end under the tail, bringing it forward and making it fast either to the head or one of the hitches. The head should be raised to the level of the back before the final knot is tied, so as to render it too serious and painful a matter for him to repeat the first attempt he makes to lower it. Should the nature or extent of the operation be likely to take up a considerable length of time it is invariably the best plan to throw the animal. In the case of the ox this is very easily done, either by use of horse hobbles should they be at hand, or by the application of a simple rope. If the horse hobbles are used they should be fastened on the leg just above the fetlocks (ankle joints), as they are in that position less liable to come off than if placed around the pastern.

Of the many ways of applying the rope for this purpose I will only describe two, which I consider the best and simplest. First: Take a long, strong rope (one which has been used a few times is more flexible), double it, and at two or three feet from the doubled end, according to the size of the animal, make a knot and pass the collar thus formed over the animal's head, allowing it to rest on what would be the collar place in a horse. Now pass the ends of the rope between the fore legs, carry one around each hind leg just above the fetlock joint, from outside in, under itself once, and bring the free ends forward, passing each through the collar loop on its own side and bringing the slack back toward and beyond the hind quarters. (Plate XXVI, Fig. 2.)

Two or three stout men should then take hold of each rope and at a given signal pull. The animal's hind legs being drawn forward, the balance is lost, and if the animal does not fall or lie down he can be readily pushed over on his side and secured in the desired position. Second: The three half hitches. Take a rope 30 or more feet long, make a slip noose at the end, and pass it over the animal's horns, leaving the knot in the loop between the horns; then pass the rope backward along the neck to the withers, just in front of which take a half hitch on it, passing it along the back, take one half hitch just behind the forelegs and a second in front of the hind limbs round the flank. (Plate XXVI, Fig. 1.) The free end of the rope is taken hold of by one or two assistants while another holds the animal's head. By pulling firmly on the rope, or inducing the animal to make a step or two forward while steady traction is made on the rope, the beast will quietly lie down, when his feet can be secured in the way most convenient for the operator.

There are numerous other methods, involving more or less complete restraint, which may be equally efficacious, but one or other of the ways indicated will doubtless be found to fully meet all ordinary cases.

RINGING THE BULL.

This is usually and ought always to be done before the calf has attained sufficient weight or strength to make his restraint a matter of serious difficulty. An ordinary halter is usually all that is required, the strap being secured to a tree or post. A jointed steel or copper ring is ordinarily used. Those made of the latter metal are preferable.

The common method of punching a round piece out of the nasal septum for the introduction of the ring is, I think, open to objection, as portions of the fine nervous filaments are destroyed. The sensibility of the parts is thus lessened and the object of ringing to some extent defeated. The insertion of the ring by means of a trocar and canula is preferable, as the method is not open to this objection.

For some years I have used a little instrument devised by myself which can be made by any worker in metal, consisting of a steel point riveted into a short canula made to fit on one end of the ring while open. (Plate XXVIII, Fig. 11.) When attached to the ring it is easily and quickly passed through the septum, the half of the ring following as a matter of course. It can then be removed, and the ends of the ring brought together and fastened by means of the screw for that purpose. By this means any animal can readily be ringed by anyone in less time than it takes to describe the process; whereas, by any other method which necessitates first puncturing or piercing the septum and subsequently introducing the ring, the operation is, even when the animal's struggles do not complicate matters, necessarily rendered tedious and uncertain by the fact that the openings through the skin and cartilage are not in apposition.

DEHORNING.

In this and other countries for some years past a heated controversy has from time to time been carried on not only as to the advisability of dehorning, but also as to the propriety of the proceeding. The advocates of wholesale removal of horns in many cases exaggerate alike the necessity and the advantages accruing from the practice; on the other hand, their opponents are backed by the ultra humanitarian who stigmatizes the operation as barbarous, or worse. In some countries these views are upheld even by courts of law whose legal acumen is able to detect in the procedure grave cruelty to animals.

In this country owners are left to decide matters of this sort for themselves, but a work of this kind would hardly be complete without some expression of an opinion on the subject which might be helpful to the dubious when the matter comes up for decision. Justly, then, does the operation amount to cruelty?

I answer distinctly, it does not. Cruelty to animals is defined as the infliction of *unnecessary* pain. Now, the operation of dehorning causes pain certainly, as all surgical operations necessarily do, but it is not by any means more painful than many other operations (notably castration), to which we regularly subject individual animals without a second thought. Moreover, the pain is transient as well as slight, and as a matter of fact pales into insignificance before the severe and lasting torture inflicted as a matter of every-day occurrence by animals upon each other when left to wear in confinement their weapons of offense, which, although doubtless of utility in a wild state are in a state of domesticity a menace to their companions and a dangerous encumbrance to themselves.

The matter has acquired enhanced importance from the fact that, owing to the strenuous efforts made by the U. S. Department of Agriculture, the invidious discrimination which barred the entrance to Europe of American stockers is likely to be removed, and our cattle are liable in the near future to make lengthened journeys by land and sea. The removal of their horns will then not only lessen the owner's risk, but will also add materially to the comfort and safety of the animals themselves.

But there is fortunately within the reach of all an open avenue of escape from that portion of the operation which supplies the only cogent argument against the practice under discussion.

The owner of the 2 or 3 day's old calf, if he wishes it to all intents and purposes a "moolly," can dehorn it, or, more correctly speaking, prevent horns ever being developed, by means of a chemical preparation which reduces the pain to a minimum, while it is even more effectual than either the saw or forceps. There are several chemical dehorners advertised in the open market, most or all of them effective, but the cheapest and simplest consists of a stick of caustic potash.

The operation is performed as follows, and is uniformly successful, if performed before the calf is 3 days old: The little animal is caught and gently laid over on its side, in which position it is easily held by one assistant while the operator clips the hair off the trifling prominence on the frontal bone, which marks the spot on the uppermost side of the head where the horn would be developed if not interfered with. He then takes his stick of potash, dips it in cold water, and carefully rubs it over the part just clipped for the space of, say, ten seconds. The calf is now turned over, the corresponding portion of the frontal bone on that side clipped and thoroughly rubbed with the moistened potash the same way as the first.

By this time the side first treated is dry and ready for a second application of the caustic, which should conform exactly to the first. Follow the same procedure on the remaining side, where the matrix of the embryo horn has been located, and if the caustic has been properly applied no horns will ever make their appearance.

For animals intended to be kept either for steers or dairy cows nothing can be more effectual, but it were well to discriminate between these and the head of the herd, the bull, and for this reason: We dehorn our cows and steers chiefly to protect them from each other, whereas our main object in dehorning the bull is to protect ourselves. For this reason our end in the case of the latter is more effectually accomplished if we leave him in possession of his horns until he has learned to rely upon them as his weapons of offense and defense, and then deprive him of his armament. If we employ in his case chemical dehorning at the early age recommended for the steer and cow, necessity becomes a second nature, and the animal intuitively adopts the catapult-like tactics of the "moolly." These, although, comparatively speaking, less harmful as between the animals themselves, are equally dangerous when directed against their owner; for captious, indeed, would be the critic who discriminated between being butted to death or hooked to death.

Instances have been cited to prove that the effects of the deprivation of his horns are only temporary in the case of the animal that has once become dangerous or unruly, but a lengthened and varied experience convinces me that such is not the general fact. The moral effect of throwing the animal and depriving it of its natural weapons is both great and lasting, and with proper treatment the advantages thus obtained need neither be lost nor lessened. The animal, shorn of its weapons, dreads the very approach of man, and its impulse is to go from him instead of for him. Animals are of more retentive memory than they are generally credited with. May we venture on a case in point:

In Iowa a certain hog went daily to the railroad depot to gratify his appetite with the grains of corn dropped from the trains in passing. One day, when familiarity had assuaged his fear of cars and engines, his fastidious taste induced him to endeavor to secure an unusually tempting morsel that lay between the rails underneath a train then standing at the station. At this moment the train happened to start, taking with it the porker's tail, which had become imprisoned between the wheel and the shoe of the brake, leaving the unfortunate epicure to go through the rest of his career without a steering apparatus. One would have supposed the warning would have proved deterrent, but those who took an interest in the venturesome porcine observed that while he adhered to his daily foraging expeditions on the track, whenever he heard the rattle of the cars or the whistle of the locomotive he gravely backed up against an adjacent water-tank to insure the safety of his already diminished ornament. The animal had had sufficient railroading experience to be able to appreciate to the full extent the awful seriousness of the loss of terminal facilities. He did not want any more tail taken off; and it is exactly so with the bull deprived of his horns. Let him keep them until he has learned to depend on them, then take them off, and if rationally treated he will ever after be quiet and tractable.

The operation is in itself simple, and can under ordinary circumstances be performed by the owner. The precaution of the greatest importance is to see that the animal is secured so that it can not struggle enough to hurt itself. The animal may be thrown by any of the methods already indicated. The only additional accessories for the above purpose is a strong halter and a long rope, fastened around its girth before it is cast. The free end of this is then passed through the ring on the halter and the head pulled back against the ribs. A hitch underneath the tail should bring the rope forward to the halter, where it may be fastened so as to be readily loosed when the first horn has been removed. To remove the second horn loose the head, turn the animal over, and refasten the head as before.

The exponents of dehorning have attempted to envelop the operation in a mist of a technical absurdities, and insist on the necessity of an apparatus as intricate as a self-binder and about as easy to move round as the average elevator. But the above method will answer all practical purposes. The only instrument needed is an ordinary jointing saw, which should be used as quietly and quickly as possible.

Animals may be dehorned any time except in flytime, or when the mercury is liable to drop to the neighborhood of zero, and cold water is the only dressing needed. It is a good practice to deprive the animal of food for twelve hours before operating.

BLEEDING OR BLOOD-LETTING.

Although nowadays this operation has fortunately become less frequent than when it was generally considered the panacea for all ills, there are beyond doubt some cases in which the operation is admittedly the quickest and surest means of affording relief.

In the ox the operation is usually performed on the left jugular vein, which is large and is easily rendered so prominent as to prevent the possibility of mistake, by tying a cord around the neck below the place where the incision is to be made. (Plate XXVII, Fig. 4.) The rope should be tied in a slip knot, so as to admit of its being easily undone, or a rope used with a loop at one end and a series of good-sized knots at the other, the loop and knots to be used as buttons and button holes. The best instrument to use is a large-bladed fleam. (Plate XXVII, Fig. 3.) After the animal is secured the operator stands by the shoulder, holds the fleam in his left hand, the blade just short of touching the skin and parallel to the direction of the vein, and the stick or mallet with which to strike it in his right; one quick sharp blow should be sufficient. If the hair is long it is a wise precaution to moisten and smooth it down.

When sufficient blood has been withdrawn the rope is removed and the orifice closed by means of a pin inserted through the lips of the incision *in the skin only*, and a piece of fine string or tow wound either over or under it in the shape of a figure 8, or in a circle between the skin and the pin (Plate XXVIII, Fig. 10), the point of which should be clipped off. To prevent the animal from rubbing the part and tearing or dislodging the pin, it is advisable to tie the head up for a couple of days, providing the animal's health will admit of it, after which the pin may be removed and the wound left to heal in the usual manner.

Before leaving the subject it may be well to add that as the good effects derived from bleeding depends more on the quickness with which the blood is drawn than on the quantity extracted, it is of importance that a liberal opening should be made into the blood-vessel and the blood allowed to flow until a perceptible impression has been made on the pulse.

As has already been said, the best instrument in the hands of an owner is the fleam, as owing to the toughness and thickness of the skin of the ox the edge of a lancet is apt to turn and inflict a gash in a direction other than the operator intended. I need hardly add that the instrument used should be sharp and scrupulously clean. A neglect of the latter precaution is apt to lead to very serious consequences.

SETONING.

Setons are used in case of the ox tribe for various purposes, of which perhaps the most common is as a preventive in anthrax or blackleg, when a seton is usually inserted in the dewlap. This is not done to afford exit to any poisonous discharge from the system, as is generally supposed, but to cause a sufficient amount of inflammation to increase the coagulating properties of the blood, which in these diseases becomes altered (as described elsewhere), notably losing its viscidity and in consequence oozing through the walls of the blood vessels. For this purpose the seton should be deeply inserted and should be dressed daily with turpentine or common blister.

The ordinary use of a seton is for a different object, as, for instance, to keep up constant drainage from a cavity containing matter, or to act as a stimulant or counterirritant. To insert a seton, the place of entrance and exit having been decided on, with the finger and thumb make a small fold of the skin transverse to the direction the seton is to be inserted, and cut it through, either with a sharp knife or a pair of scissors (this should be done at both the entrance and exit); then with a steady pressure and slight lateral movement insert the seton by means of a seton needle. (Plate XVIII, Figs. 1 and 2.) The seton should consist of a piece of strong tape, varying in breadth according to circumstances, and should be kept in place either by a knot on each end or by tying the ends together.

Setons should be gently moved once a day after suppuration is set up, and they should not be allowed to remain in over three weeks, or a month at the outside.

TRACHEOTOMY.

This operation consists of making an opening in the trachea or windpipe. It is indicated whenever there is an obstruction from any cause in the upper part of the respiratory tract which threatens the death of the animal by asphyxia (suffocation). The mode of procedure is as follows: Have an assistant extend the animal's head as far as possible to make the trachea tense and prominent; make a longitudinal incision about 2 or 2½ inches long through the skin and deeper tissues at the most prominent part of the trachea, which is about the middle or upper third; the edges of the skin should be held apart to allow the introduction of the tenaculum or curved needle through the rings of the trachea, and a circular piece of the trachea removed, large enough to allow of the introduction of the tracheotomy tube. (Plate XXVII, Figs. 1 and 2.) The latter should be removed once or twice daily and cleansed, and the wound dressed antiseptically. To ascertain when it is time to discontinue the use of the tube and to allow the wound to close, the hand should be held over the opening, which will necessitate the animal to use its natural passages in breathing. Observe if it is performed in a natural manner, and if so remove the tube and allow the wound to close. This is the general mode of procedure where the surgeon has all the necessary instruments and a moderate amount of time at his disposal. Often it has to be performed in great haste without the proper instruments and under great disadvantages, the operator having to quickly cut down and open the trachea and spread the parts, using some instrument improvised by him at the time. This operation only gives the animal relief in breathing, and therefore the proper remedial treatment should be adopted at the onset of the attack and continued until the cause (the disease) has been overcome.

CHOKING.

Choking, or the lodging of foreign bodies in the gullet is divided into pharyngeal, cervical, and thoracic, according to location of the obstruction. The symptoms in general are uneasiness on the part of the patient, involuntary movement of the jaws, grinding of the teeth, a profuse escape of saliva and tympanitis of the rumen. If the obstruction is in the pharynx the mouth speculum should be introduced and the hand and arm of the operator oiled and inserted and an effort made to remove the obstruction. If this should be unsuccessful it will probably be necessary to have recourse to the probang, (Plate III, Fig. 2), which should be carefully introduced and the obstruction slowly pushed downwards toward the rumen, care being taken not to lacerate the coats of the œsophagus. An operation known as œsophagotomy may be performed in case the above efforts have failed. I will briefly describe the steps to be taken in such an emergency.

ŒSOPHAGOTOMY.

This operation is easily performed, but, as above stated, should not be resorted to unless all other methods have failed, as wounds of the œsophagus are difficult to manage, and tend to produce a stricture of the tube.

To perform the operation have a strong assistant elevate the animal's head so as to stretch and render tense the inferior muscles of the neck. With a sharp convex bistoury make a longitudinal incision through the skin, muscles, and coats of the œsophagus directly down upon the obstacle, care being taken not to make the incision any longer than necessary. After the obstruction is removed the wound in the œsophagus is closed and sutured with carbolized catgut, then the divided muscle and skin brought in apposition and secured. The animal should be fed on gruels for a few days and the wound dressed daily upon the same general principles as an ordinary wound.

PUNCTURING THE RUMEN.

This is an operation that when indicated has to be performed at once or the animal may be lost. It is indicated in severe cases of acute tympanites in cattle, commonly known as hoven, which is due to the generation of gas resulting from fermentation. To relieve this distension an ordinary cattle trocar and canula (Plate III, Figs. 5 *a* and 5 *b*) are inserted into the rumen, the most distended portion of the left side of the animal being the part selected. The trocar is withdrawn and the canula left in until the gas has fully escaped.

Puncturing is not a serious operation in cattle, and in cases of great distension should be performed without hesitancy or delay. Relief is almost instantaneous in many cases. Of course the proper remedial agents should be administered to arrest further fermentation. (See Tympanites, p. 29.)

RUMENOTOMY.

The opening of the paunch or rumen in cattle and the removal of a part or the whole of the ingesta through said opening is termed rumenotomy. The operation should only be performed in severe cases where the rumen is excessively overloaded and distended. The animal is placed with its right side against a wall and firmly held in position by strong assistants. The incision is made in the same place that the trocar is inserted for puncturing that organ in cases of hoven. The opening is increased in size until the operator's hand can be inserted into the rumen. Before any of the contents are removed from that organ a linen cloth should be placed from the outer wound into the rumen in order to prevent any of the ingesta from getting into the abdominal cavity. After removing a portion of the contents of the rumen some practitioners introduce such medicine as may be indicated before closing the wound. Clean the wound and close the opening in the rumen with uninterrupted (Plate XXVIII, Fig. 8) carbolized catgut sutures. Next close the external wound, consisting of the integument, muscle, and peritoneum, with stout interrupted (Plate XXVIII, Fig. 6) metallic sutures. No food should be given for several hours after the operation, and then only gruels. (See Distension of Rumen with Food, p. 31.)

TREATMENT OF ABSCESSES.

Abscesses are of frequent occurrence and demand prompt treatment. An abscess may be detected, if situated externally, by heat, pain, redness, and swelling in the early stages, and if further developed by the fluctuation which will be present. When any of these symptoms are absent, the suppuration should be encouraged by the means of hot fomentations and poultices. Care must be taken that the abscess is not opened too soon, or it may to some extent cause it to scatter and the escape of pus will be lessened. The time to open an abscess is just before it is ready to break, and should be done with a sharp lance, a crucial incision sometimes being necessary. The cavity should be syringed out with tepid water, which is better if mildly antiseptic. Care should be taken not to allow the wound to close too rapidly, and to prevent this a tent of lint or oakum should be introduced.

WOUNDS.

It is probably not going too far to say that as a general rule wounds of the bovine species, unless sufficiently serious to endanger the animal's life, are left uncared for. The poor suffering creatures are too often, even in fly-time, left to endure untold torture from wounds not at first of much importance, but which, from the constant irritation caused by flies, dirt, etc., often develop into hideous, unhealthy sores, which can not fail, even when they do heal, to leave extensive and lasting blemishes as silent records of the owner's thriftlessness and inhumanity.

The comparatively low market value of all but the full-blood and pedigreed animal precludes an owner (save in a few exceptional cases, inspired by a higher than ordinary sense of humanity) from entertaining professional assistance. It is more than doubtful whether the suffering creature does not go from bad to worse when its case is made over to the tender mercies of the ignorant local cow-leech, to whom "wolf in the tail" is a terrifying living presence, and "hollow horn" a solid fact, and whose sole claim to erudition in such matters consists of a generally conceited ability to manufacture on scientific prescriptions an artificial substitute for the cud supposed to be "lost."

There is yet another class of owners who entertain an infinite and blind belief in liniments and patent nostrums, which are not only an unnecessary expense, but sometimes by their very action retard rather than expedite the process by which nature in her unerring wisdom repairs the injured tissues, tendons, and bony structure.

It should always be borne in mind that although some applications are stimulating, and therefore serve as a useful ally in the process of restoration, it is after all to nature we must look to renovate the injured parts, and all that the most skillful can do is to intelligently aid her by combating those conditions which are calculated to interfere with her beneficent endeavors. All that the most suitable applications can accomplish in the case of wounds is in the first place to prevent the access of those poisonous germs which exist in the surroundings of the animal, such as the soil and the manure, and in the second when the process of repair is for some reason temporarily inactive or altogether arrested to incite that curative inflammation which is the invariable method by which the cure is effected.

Some owners may urge that it has always been their practice to use some shotgun prescription that has earned for itself a reputation, because it was supposed to have routed a rash on the youngest baby, and proved equally efficacious on a wire-cut on the last dropped calf, without even pausing to think that either case might have done equally well or even better if confided unanointed to the healing hands of nature.

For the purposes of the present work wounds may be divided into three classes: (1) Incised; (2) punctured; (3) lacerated or contused.

An incised wound is one with clean-cut edges, and may be either superficial or deep. In wounds of all descriptions there is necessarily more or less bleeding, and this is especially liable to be the case in incised wounds, particularly when they penetrate to a considerable depth, or when inflicted on a part where arteries of any size approach the surface. To arrest the hemorrhage must, therefore, be the first consideration. If slight, a generous use of cold water will be all that is necessary, but if one or more vessels of any size have been wounded or entirely severed they should be taken up and ligated. If the blood flows continuously and is dark in color it proceeds from a vein, but if bright colored and jerky in its flow it is arterial.

There is nothing very formidable or difficult in taking up an artery. It simply means tying up the bleeding vessel, which should be accomplished as follows: To discover the bleeding artery take a sponge, dip it in cold water, and by gentle pressure on the wound clear it of the accumulated blood. The jet of fresh blood reveals the end of the vessel, which is readily recognized by its whitish yellow or buff color. It should be seized with a forceps or pincers and slightly drawn clear of the surrounding tissues. Now take the thread and place the middle of it under the artery, fetch up the ends, tie one simple knot tightly, pressing down the thread with the forefinger so as not to include the forceps, then a second one over it, cut off the ends, and the thing is done. The bleeding being arrested, the operator can now carefully clean and inspect the wound, taking care to remove all blood and foreign matters and clip the hair around the edges before proceeding to stitch it up. If the wound is superficial the lips may be brought together by a series of independent stitches (Plate XXVIII, Fig. 6), about three-fourths of an inch to an inch apart. The stitches should not be drawn tightly; it is sufficient to bring the edges of the wound in apposition.

If the wound is deep the needle should be introduced perpendicularly at as great a distance from the lip of the wound as the depth it is to be inserted, so as to give the thread sufficient hold. All the stitches should be as nearly as possible at equal distances from the border of the wound to prevent unequal strain, and the knots should be made at the side, not over the wound. (Plate XXVIII, Fig. 6.) When the wound is large and deep, care should be taken to have an opening in the lowest part to allow for the escape of the discharges.

In deep wounds which run crosswise of a limb or muscle it will often be advisable to use what is technically known as the "quilled suture," which is most readily described by Fig. 7, Plate XXVIII. To accomplish this method a curved needle with an eye in the point and a strong double thread should be used. The needle thus threaded is introduced perpendicularly at least an inch from the wound on one side, carried across below and brought out the same distance from the border of the cut on the opposite side, the thread being seized and held in position while the needle is withdrawn, leaving a loop of thread protruding on one side and two loose ends on the other of each stitch. When a sufficient number of stitches have been made, take a light piece of wood about the size of a lead pencil, corresponding in length to the size of the wound or slightly longer, and insert it through each of the loops, drawing up the free ends of the threads, which should in turn be tied securely on a similar piece of wood on that side.

Punctured wounds.—Owing to the uncertainty of their depth and the structures they may involve, punctured wounds are by far the most dangerous and difficult to treat. Not only is the extent of the damage hidden from view, but the very character of the injury, as can be readily understood, implies at least the possibility of deep-seated inflammation and consequent discharge of pus (matter), which, when formed, is kept pent up until it has accumulated to such an extent that it burrows by simple gravity, as no other exit is possible. In this way foreign matters, such as a broken piece of the stake or snag, or whatever caused the wound, may be carried to an indefinite depth, or the cavity of a joint may be invaded and very serious, if not fatal, consequences supervene.

The danger is especially marked when the injury is inflicted on parts liable to frequent and extensive motion, but all cases of punctured wounds should receive unusual care, as no judgment can be accurately formed from the external appearance of the wound. While a probe can ascertain the depth, it throws but little light on the extent or exact nature of the internal injury. For this reason all punctured wounds should invariably be carefully searched by means of a probe or some substitute devised for the occasion, such as a piece of wire with a smooth blunt end, or a piece of hard wood shaped for the purpose. Stitching is not admissible in the case of punctured wounds.

In the event of a punctured wound not being very deep, when the bruising and laceration are slight, it is possible for healing to take place by adhesion, and this should always be encouraged, as the process of repair by this method is far superior to that by granulation, which will be referred to later. With this object in view the animal should be kept as quiet as possible. A dose of physic, such as a pound of Glauber or Epsom salts, should be administered, and warm fomentations or poultices, when this is practicable, applied, the surface of the wound being dressed twice a day with the ordinary white lotion, which is made as follows:

Acetate of lead	1 ounce.
Sulphate of zinc	6 drams.
Water	1 quart.

The lead and zinc should be put in a quart bottle with a pint of rain water and well shaken, when the balance of the water may be added.

In wounds of this description the process of repair may be complicated by the appearance of exuberant granulations, popularly known as "proud" or "dead flesh," but these should not be interfered with unless they should continue after the acute stage of inflammation has been subdued. If, after this, they persist, they may be treated with a solution of sulphate of copper (bluestone) or nitrate of silver (lunar caustic) and water. Irritation, caused by an overinterference with the process of repair, and injudicious bandaging are potent factors in bringing about this condition, and the discontinuance of either or both, will often leave no necessity for special treatment.

Contused or lacerated wounds.—These are usually caused by a blow with some blunt instrument, the breaking of the flooring, or an animal getting one of its limbs through or over the partition between the stalls. The seriousness depends largely on the depth of the injury, and treatment should be directed to allaying the inflammation and preventing the consequent tendency to sloughing. To this end soothing applications, such as fomentations and poultices, are plainly indicated.

Methods of healing.—These may technically be divided into a number of distinct processes, but practically we may speak of them as two only, viz., by primary union or adhesion, and by granulation. As suppuration is not so liable to occur in the ox as in the horse, healing by the former and more speedy process is much more common in the first named species, more particularly in clean cut or incised wounds, provided they have been stitched within twelve hours from the time the injury which caused them was inflicted; that they have been kept clean and that the patient has by some means been kept fairly still. This latter stipulation is probably hardest to comply with. Quiet is an important factor in the process of repair among the lower animals as well as their masters, and the rule is none the less good because unfortunately it is more frequently honored in the breach than in the observance. Healing by this method is in some cases extraordinarily quick, union between the divided parts having been known to take place as soon as twenty-four hours after their adjustment by the surgeon.

The second method of healing, namely, by granulation, which is, however, the manner in which most wounds in animals heal, takes much longer time. In punctured wounds of any depth healing necessarily takes place in this way only, and the treatment should be directed largely to alleviating pain and moderating inflammation. The former can be accomplished by opium applied locally in the form of the diluted tincture, or given internally in repeated small doses, and the latter by aconite or fluid extract of gelsemium. Twenty-five to thirty drops of either are given at intervals depending on the severity of the fever in the drinking water or dropped on the tongue.

After treatment and dressing of wounds.—The dressing of wounds, whether they have been attended to by a veterinarian or not, is a matter which, in case of animals of the ox tribe, invariably devolves upon the owner or his employés. It must not, however, be inferred from this that the matter is of secondary importance. The dressing of wounds is one of the most important branches of veterinary surgery, and one of the most constant difficulties that the practicing veterinarian has to contend with lies in the want of appreciation on the part of owners in the absolute importance of care and attention in the after treatment of wounds. It is for this reason that the writer is averse to closing this portion of his task without pointedly calling attention to the fact that it is very largely to skillful, patient, and careful dressing that satisfactory recovery from most serious accidents is due, and this unswerving vigilance and solicitude I would bespeak not only for the injured parts, but for the general care of the animal and its surroundings.

The first and foremost consideration in the dressing of a wound is the observance of scrupulous cleanliness. The most subtle medicaments are worse than wasted if dirt claims a 50 per cent interest in the business, as is too often the case upon the farm where the care of an animal is relegated to the ignorant and thoughtless hired help. Unless an animal is in slings, straw and other foreign bodies as well as blood and necessary discharges usually adhere to a wound when it comes to be dressed. These should be carefully freed from the wound by means of a sponge dipped in a 2 per cent solution of carbolic acid. The sponge should not be brought into actual contact, but should be wrung out just above it, the water being allowed to trickle over the injured part. When the wound and the parts surrounding it have been thoroughly cleansed it may be dressed either with the "white lotion," the formula for which has already been given, or with a solution of chloride of zinc, one ounce to a quart of pure cold water. In cold weather the parts may be dressed with the following: Oxide of zinc ointment, 4 ounces; compound tincture of benzoin, 2 drams; mix, and keep the box covered.

A single fold of ordinary cotton batting, gently pressed over the ointment, will cause it to remain adherent to the wounded part. In superficial excoriated wounds in cattle a very excellent first dressing (after thoroughly cleansing the wound) consists of iodoform (a compound of iodine and chloroform) blown on to the wound through a quill or a folded piece of stiff paper. This should be followed by a second dressing of pulverized aloes applied in the same way, which not only forms an artificial scab, but possesses the additional advantage of keeping off flies.

There are many other applications equally simple and efficacious, such as perchloride of mercury, one part to eight hundred of water; boracic acid, one part to twenty parts of water; carbolic acid one part to water thirty parts, but the foregoing will be found as good as any.

No good purpose can be served by applying to healthy wounds irritating mixtures of oils and acids, and an owner may safely make up his mind to the fact that whatever mixture he may use, no matter how successful it may have been, he is pretty sure to have a neighbor who will want to know the reason why he did not use something else. Whatever antiseptic is used always recollect that cleanliness, rest, and attention constitute 50 per cent of the contest, and that the other half may safely be left to the restoring touch of nature.

Barbed-wire cuts.—I have specified these simply because there exists in some sections of the country a fixed idea that there is a specific poison in barbed wire, causing injuries which require treatment differing from that which is applicable to ordinary wounds. Barbed-wire cuts differ from ordinary wounds only in the parts being often lacerated and torn, and the treatment already indicated for wounds of that description is applicable to them.

CASTRATION.

Castration consists of the removal of the essential organs of generation. It is performed upon both the male and the female. In the male the organs removed are the testicles and in the female the ovaries.

Castration in the male is performed for several different purposes. It may be necessary, as is the case in certain diseased conditions of the testicles and in strangulated hernia, but the usual object of the operation is to enhance the general value of the animal. For example, if the animal is intended for burden the operation will better fit him for his work by so modifying his temperament and physical condition that he may be easily controlled by his master. Again, if he is merely to be used for beef purposes the operation will improve the quality of the flesh.

The operation upon the female may be performed on account of diseased conditions, but I may say that the chief object of the operation is to make the animal one of more profit to its owner by altering the lacteal secretion and also the physical condition. Advocates of this operation claim that a spayed cow will milk under favorable conditions for a number of years continuously, and that the milk is greatly increased in richness. Careful tests, however, indicate that the value of this operation with dairy cows has been exaggerated. When the cow is spayed it does away with all trouble attending œstrum or heat, gestation and parturition with its accidents and ailments. The flesh of the spayed cow is more tender and juicy than that of the entire animal.

The operation upon the male may be either the uncovered or the covered. In the former the incision is made down to the testicle proper, and in the latter you cut through the scrotum or the outside covering and through the dartos or the next coat, being careful to cut no deeper tissues or coats. The age at which the operation is performed varies, but usually it is performed between the second and third month. If done in early life there is less danger of complications, the organs not being fully developed and in a latent condition. There are many different methods of operating, the principal ones of which I will mention. In the uncovered operation a good free incision should be made, exposing the testicle completely. Now it may be removed by simply cutting it off. The only danger of doing this is the hemorrhage which is likely to follow. To obviate this before the division of the spermatic cord it should be twisted several times in the following manner: Take hold of the spermatic cord with the left hand, having the cord between the thumb and the index finger. Now twist the free portion several times with the right hand, all the time being careful to push with the left hand towards the body of the animal. In this way the danger of injury to the cord during the animal's struggles will be overcome. The hemorrhage will be none, or very little, if it has been done properly. This is the most simple manner of torsion. There are forceps and other instruments made to perform the operation in this manner. Instead of practicing torsion in any of its ways to prevent hemorrhage, we may apply a ligature either directly to the spermatic artery from which the hemorrhage comes, or to the entire cord. You may either use a silk or a catgut ligature. The actual cautery is an old method, but I will not describe it, as I consider that we have better methods now. The next method with the clamps, although extensively used upon the horse, is not practiced to any great extent upon the bovine at the present time. It is a very old method, and is considered very safe. Clamps are used in the covered and uncovered operations.

But more simple and better methods are now known for the castration of the bull. A more modern method is by the ecraseur. The chain of the instrument is placed around the spermatic cord and tightened so as to crush the tissues and thus prevent hemorrhage. The clamp and ligature are the methods principally employed in the covered operation, and in order to thoroughly understand this procedure it will be necessary for the reader to have at least a crude anatomical knowledge of the parts. The former, or the uncovered, is the usual mode of operating, except in certain abnormal conditions.

The operation of "mulling" or crushing the spermatic cord is an unscientific and barbarous procedure, causing unnecessary pain and suffering.

The above methods apply only to the animal in a normal condition. Before operating always examine and be sure that everything is as it should be. If otherwise, a special operative procedure will be necessary. Whichever mode of operation be adopted from a practical standpoint, the principal precautions to be taken in order to attain success are as follows: First, thorough cleanliness under strict aseptic and antiseptic precautions; second, a free and boldly made incision; third, the avoidance of undue pulling or tension upon the spermatic cord; fourth, free drainage, which can be maintained, provided the original incision has been properly made.

CASTRATION OF THE FEMALE.

Ovariotomy or spaying.—The operation should be performed when the cow is in her prime and giving her greatest flow of milk, care being taken that she is in good health and moderate condition, not too plethoric; or, on the other hand, she must not be at all anæmic, and also that she be not in heat or pregnant. This operation may be performed in one of two ways, namely, by the flank or by the vagina, each operation having its special advantages. In the flank operation the animal may be operated upon either while standing or while in the recumbent position. If standing she should be placed against a wall or a partition, and her head held by a strong assistant. The legs also must be secured to prevent the animal from kicking. A vertical incision should be made in the left flank about the middle of the upper portion, care being taken not to make the opening too far down, in order to avoid the division of the circumflex artery which traverses that region. The operator should now make an opening through the peritoneum, which is best done with the fingers. Next introduce the hand and arm into the abdominal cavity and direct the hand backward toward the pelvis, searching for the horns of the uterus. Follow them up and the ovaries will easily be found. They should then be drawn outward and may be removed either by the ecraseur or by torsion. The closing and suturing the wound will complete the operation. An adhesive plaster bandage can be beneficially applied.

The operation by the vagina is more complicated and requires special and expensive instruments. The mode of procedure in brief is as follows: A speculum is introduced into the vagina and an incision is made into the superior wall of that passage about 2 inches from the neck of the uterus, cutting from below upward and from before backward. Make an incision which should not exceed 3½ inches in length. The next step is to get possession of the ovaries. They are situated in a fold of the broad ligament and should be drawn carefully into the vagina through the incision. Now take the long-handled scissors specially made for this purpose, with which the thick border of the broad ligament is divided. The torsion forceps are introduced and applied to the broad ligament above the ovary. The left hand is then introduced and the thumb and the index finger grasp hold of the broad ligament above the forceps. Now commence with your right hand to apply torsion and thus remove the ovary. The other ovary may be removed in the same manner.

The operation of castration is by no means a serious one, and when properly performed there is little danger from complications. Although the danger is trifling the complications which may arise are sometimes of a serious nature. Hemorrhage, either primary or secondary, tetanus or lockjaw, abcesses, hernia or rupture, gangrene, and peritonitis are the most serious complications that follow castration. Whichever complication arises will require its own special treatment, which I will not go into here, as it will be fully dealt with under another heading. I might add, however, that, generally speaking, the animal, after being castrated, should either be regularly exercised or be allowed freedom, so that it can exercise itself. Drafts of cold air or sudden changes of the temperature are dangerous. The animal should be fed moderately, but of a diet easily digestible.

SURGICAL OPERATIONS.

DESCRIPTION OF PLATES.

PLATE XXVI:

Fig. 1. Reuff's method of throwing or casting the ox. From Fleming's Operative Veterinary Surgery.

Fig. 2. Miles' method of throwing or casting the ox. From Fleming's Operative Veterinary Surgery.

PLATE XXVII:

Fig. 1*a* front and Fig. 1 *b* side view of a simple tracheotomy tube. After Armatage, from Hill's Bovine Medicine and Surgery. This tube is inserted in the trachea or windpipe in cases of threatened suffocation from obstructions in the upper portion of the air passage.

Fig. 2. Shows the tracheotomy tube applied and held in position by straps around the neck. After Armatage, from Hill's Bovine Medicine and Surgery.

Fig. 3. Represents an ordinary fleam with blades of different sizes.

Fig. 4. Cow prepared for bleeding. A cord is tied firmly about the lower portion of the neck, causing the jugular vein to become distended with blood and swell out.

PLATE XXVIII:

Fig. 1 and 2. Seton needles. These may be either long or short, straight or curved, according to the locality in which a seton is to be inserted.

Fig. 3. Various forms of surgical needles.

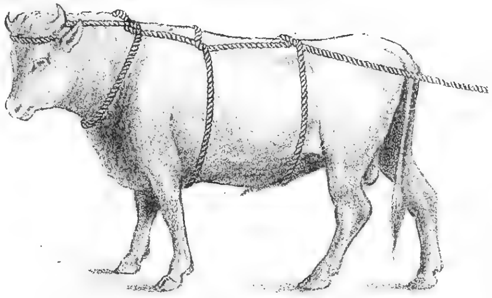
Fig. 4. Suture forceps or needle-holder, for passing needles through thick and dense tissues.

Fig. 5. Knot properly tied.

Figs. 6, 7, 8, 9, 10. Various forms of sutures. Fig. 6, interrupted suture; 7, quilled suture; 8, uninterrupted suture; 9, twisted suture, made by passing suture pins through the parts to be held together and winding the thread about them so as to represent the figure 8; 10, single-pin suture.

Fig. 11. Appliance for ringing the bull, one-fourth natural size.

Fig. 12. Nose clamp, with spring and keeper.



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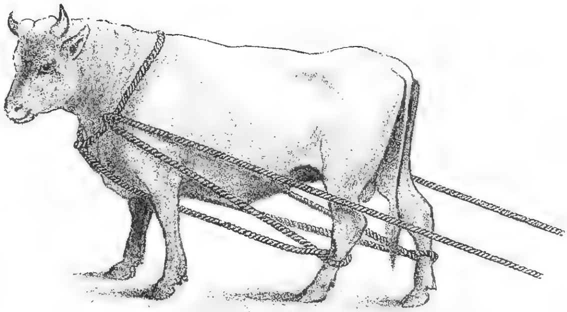

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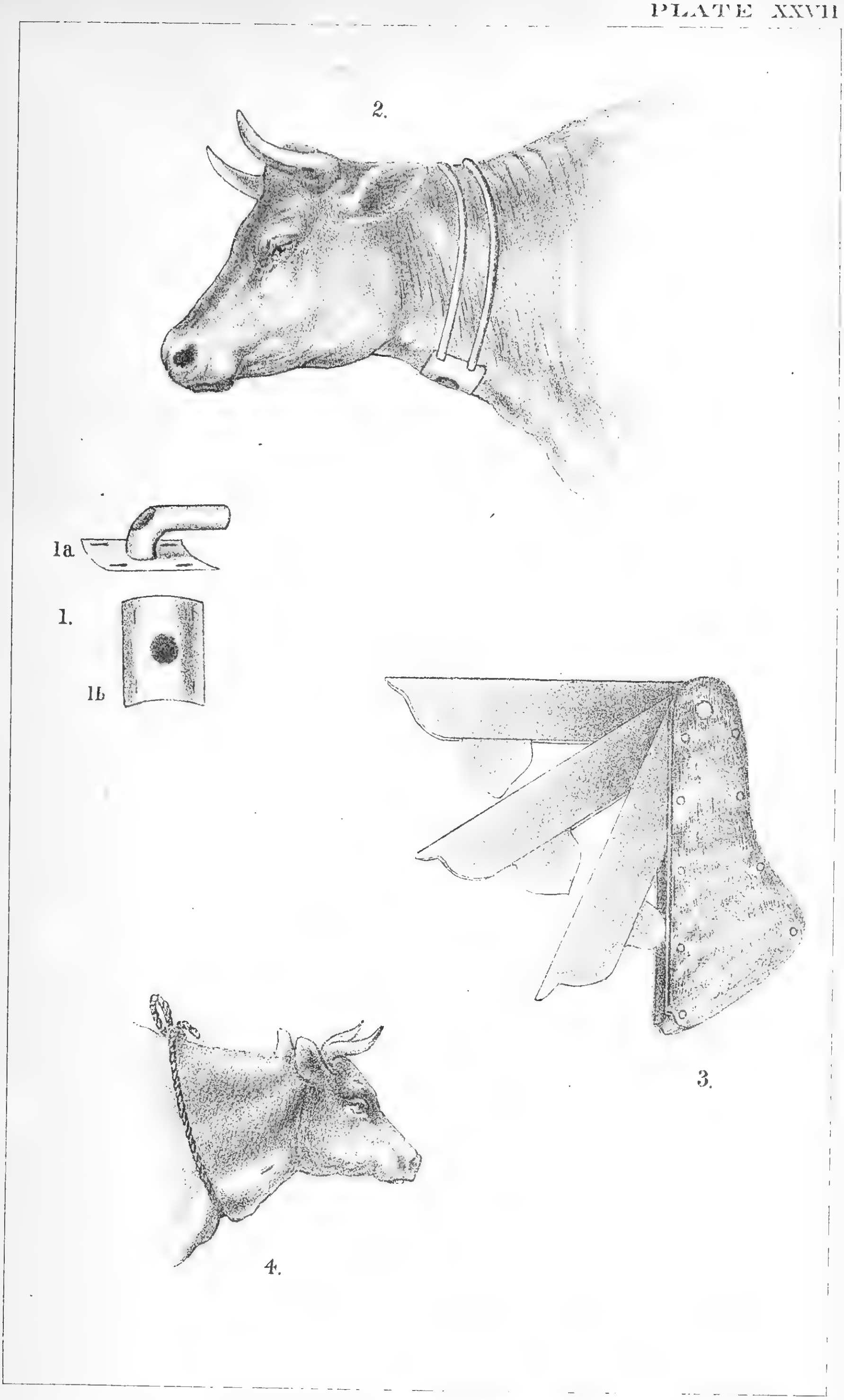
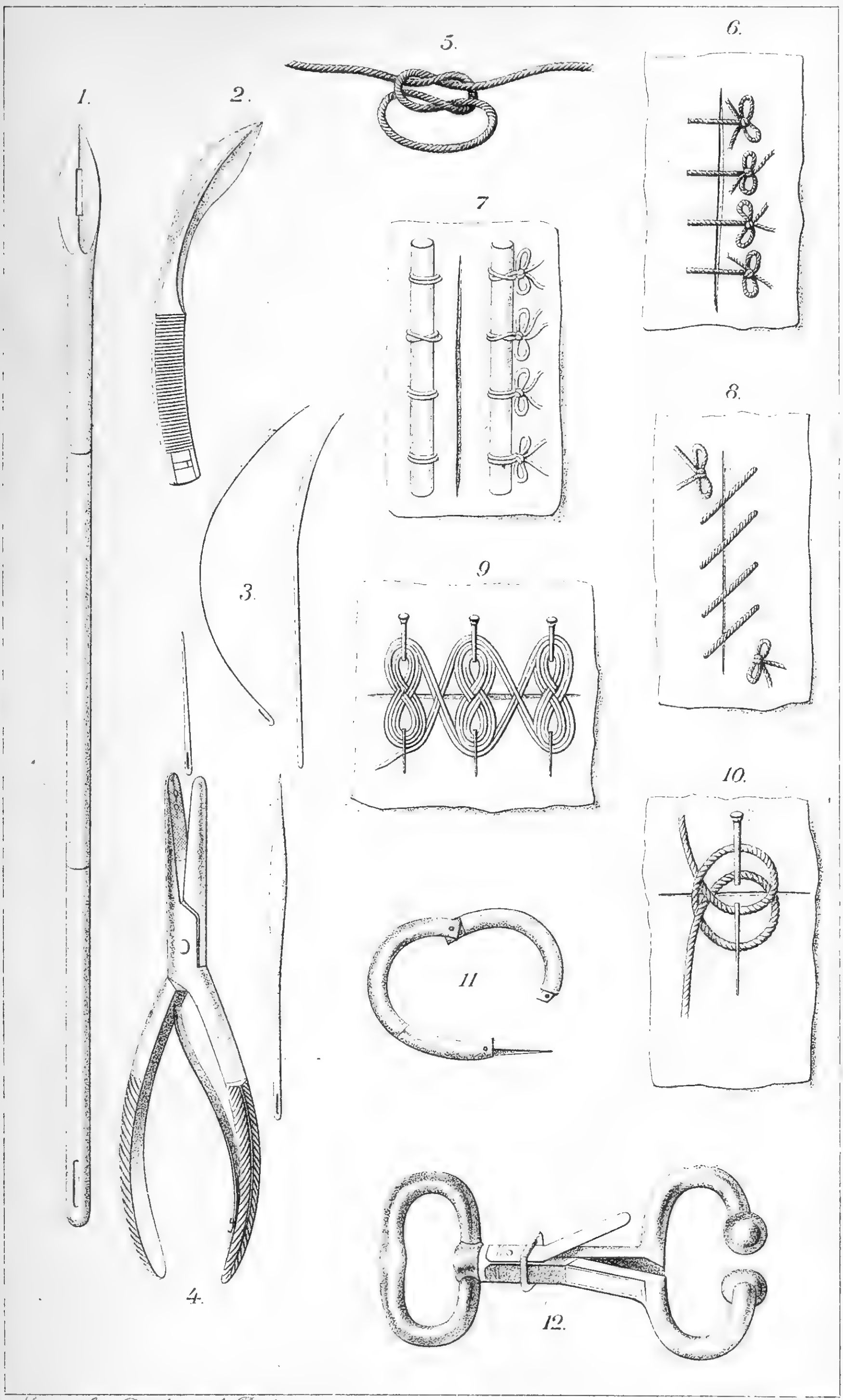


TRACHEOTOMY AND VENESECTION.



Nevins after Reynders and Fleming

SURGICAL INSTRUMENTS AND SUTURES.

TUMORS.

By DR. WILLIAM HERBERT LOWE,

Superintendent of the United States Neat Cattle quarantine Station for the port of New York, Garfield, N. J.

Tumors are noninflammatory new growths due to increased nutrition. They may be superficial or deep seated, external or internal. From a pathological point of view there is a great variety of tumors, both benign and malignant, but in this chapter it is my purpose to describe only the more common ones that affect animals of the bovine species. One of the most frequent and troublesome tumors of the nonmalignant class in cattle is the epidermic, commonly known as the wart. Warts consist of a thickening of the epidermis, or outer skin, produced by accumulation of its scales, with hypertrophy of the papillæ of the true skin. These growths generally occur in young animals and are frequently seen upon the under surface of the abdomen, the mammary glands, the genitals, lips, and eyelids. Their removal is not attended with danger; their seat should be cauterized immediately after removal, to prevent their return. They may be removed with caustic, by excision, by torsion, or by the ligature, the method being determined by their size, conformation, and location upon the animal.

The *fibroma or fibrous tumor* is nonmalignant, and is principally composed of developed connective tissue. It is usual to see tumors of this class in parts where there is much fibrous tissue. They vary greatly in size; sometimes they are as small as an ordinary wart, and on the other hand fibrous tumors have been removed that were many pounds in weight. A fibrous tumor develops slowly and no pain or tenderness is likely to be detected unless the tumor should be accidentally bruised or otherwise injured. The tumor is generally hard and has a rounded form and may be contained in a wall of areolar tissue, but occasionally it is soft. This variation is principally due to the age of the tumor and the time in which it has been developing. The fibroma is not by any means a dangerous tumor; it acts mainly as an inconvenience, the degree of which depends upon its size and location. However, they often become very large, but they have few vessels and little hemorrhage is likely to follow their removal with a knife. Fibrous tumors are often due to imprisonment of pus in the deep-seated muscular structures, which may arise from undue pressure of some kind, or from bruises. Intelligent and prompt treatment will in the majority of cases be followed by gratifying results. In the early stages iodine may be applied externally or injected into the substance of the tumor. Good results are often obtained by the application of stimulating embrocations and by suitable blisters. Setons are sometimes inserted with excellent results; caustics and the actual cautery are also occasionally used. It is my experience that in most cases where the growth is hard and of long standing by far the best treatment is by extirpation with the knife. Although this tumor in itself, as I have already said, contains only a few blood-vessels, yet it may be located upon or in close proximity to a large artery or important nerve. Injury to the latter might cause loss of either sensation or motion to a part, and therefore I would impress upon the operator the importance of familiarity with the anatomy of the part. If the operator knows the course of the large blood-vessels and the nerves in the vicinity of the tumor there is little or no risk, provided, of course, that the knife is handled with dexterity. The sensibility of the tissues may be lessened by injecting a solution of cocaine with the hypodermic needle into the substance of the tumor and surrounding tissues a few minutes before commencing the operation. The form and extent of the incision through the skin must depend upon the size, base, and relation of the tumor. A straight incision prolonged beyond the base of the tumor, in order to allow greater freedom in dissection and more complete extirpation, will suffice in some cases, but an elliptical incision should be resorted to when the enveloping skin is in excess and a portion has to be removed. If all the skin is to be saved and the tumor is large, a crucial T or Y incision should be made. The enucleation of large tumors, especially those with a wide base, requires time and care. The flaps of the wound may be kept apart by an assistant or tenaculi. The tumor itself may be seized by the hand, forceps, or tenaculum, or if voluminous, a piece of tape or strong ligature thread may be passed through it, by which it can be better held and moved about while the dissection is made. Hemorrhage from small vessels can be readily suppressed by compression or by torsion with the artery forceps. Hemorrhage from larger vessels should be controlled by the ligature, which is the safest method with vessels of any size. After the tumor is removed the wound is closed and treated as any ordinary wound, unless the extirpation has not been completely made, in which case caustics of varying strength are sometimes introduced before the wound is allowed to heal.

Polypi belong to the fibrous tumors, and may be defined as tumors attached by means of a narrow pedicle. A polypus not infrequently occurs in the nasal passages, often bleeding readily and sometimes interfering with respiration. A polypus also sometimes develops in the vagina and the uterus of cows. The treatment of polypus is removal when possible. The ecraseur will be found a useful instrument for this purpose. After removal the parts should be frequently syringed with an antiseptic wash.

The *lipomata or fatty tumor*, consisting of fat cells, is another of the nonmalignant tumors which sometimes develops upon the bovine animal. They should be removed when possible, whether found externally, within the passage of the vagina, or any other part of the animal. In most cases it is necessary to cauterize the seat of the tumor immediately after removal.

Cystic tumors.—In horned cattle immense cystic tumors form in front of the knees, caused by the animal being compelled to lie on a hard floor. The cause should be removed before any treatment is attempted. The simplest operation in the vicinity of a joint must be performed with extreme care, in order to prevent injury and traumatic inflammation and its results. In the cystic tumors of the knee a seton can with safety be inserted through their substance, after which a bandage should be applied to prevent the animal from bruising the parts whilst lying down. These cystic tumors are often removed in this way. Serous cysts form in different parts of the animal's body, including the thyroid body and the facial sinuses. In the cow small ovarian cysts are sometimes a cause of nymphomania. There are various other kinds of cysts, including cutaneous and hair-bearing cysts, the complete treatment of which the limits of this chapter will not allow.

Osseous tumors develop in the neighborhood of joints in rheumatic affections. They result from the ossification of exudate which has been formed in consequence of some inflammation. Little can be done in the way of treatment beyond the actual cautery or counter-irritation.

Osteo-sarcoma is a tumor composed partly of flesh and partly of bone. The upper and lower jaws of cattle appear to be peculiarly susceptible to this form of disease, the growth having an irregularly protuberant surface. (See Actinomycosis, p. 409.)

Carcinoma, or cancer.—The most malignant tumors in the bovine, as in the human being, are beyond doubt the carcinomata, or cancer and its varieties, which are the encephaloid, scirrhous, colloid, cystic, and epithelial. The various forms of encephaloid cancer are known as villous, melanotic, and fungus hæmatodes. The favorite seat of cancer in the ox seems to be the maxilla, although the tongue is not infrequently its seat. When the heart is affected it is almost always secondarily.

In the early stages of cancer the general health is not perceptibly affected, but as the disease advances the lymphatics and glands become involved. If discovered in the early stages excision of the tumor may be performed, but if the disease has progressed to any extent this is not likely to be followed by beneficial results, owing to its malignity and tendency to recur. Numerous caustics have been employed. Such measures in the ox, however, have not been at all satisfactory, and from the tendency of the disease to recur, and owing to its nature, the affected animals should not only be destroyed, but the flesh condemned as human food.

DISEASES OF THE SKIN.

By M. R. TRUMBOWER, D. V. S., Sterling, Ill.

The *skin* consists of two parts, the epidermis or cuticle, and the dermis, cutis vera or corium.

The *epidermis*, cuticle, or scarf skin, is an epithelial structure, forming a protective covering to the corium. It varies in thickness, is quite insensible and nonvascular, and consists of agglutinated cells; these cells vary in form, the deep layers being columnar, those above rounded, flat on the free surface, finally dry, desquamating membranous or horny scales.

The epidermis is divided into a firm and transparent superficial and a deep soft layer. The latter is the *rete mucosum*, in whose cells the pigment exists which gives color to the skin. The deep surface of the epidermis is accurately molded on the papillary layer of the true skin, and, when removed by maceration, presents depressions which correspond to the elevations on the dermis. From the cuticle tubular prolongations pass into the sebaceous and sudorific glands; thus the entire surface of the body is inclosed by the cuticle.

The *dermis*, or true skin, is vascular and highly sensitive, being the seat of touch. It is covered by epidermis, and attached to the underlying parts by a layer of areolar tissue, which usually contains fat, hence called *panniculus adiposus*. The cutis consists of fibro-areolar tissue and vessels of supply. It is divided into two layers, the deep or true corium and the upper or papillary. The corium consists of strong interlacing fibrous bands, chiefly white; its meshes are larger and more open towards the attached surface, giving lodgment to the sweat glands and fat. The papillary or superficial layer is formed of a series of small conical eminences or papillæ, which are highly sensitive, and consist of a homogenous transparent tissue. The blood vessels form dense capillary plexuses in the corium, terminating by loops in the papillæ. The papillary nerves run in a waving manner, usually terminating in loops.

Hair is an appendage of the skin and forms its external covering. It is a special modification of epidermis, having the same essential structure. It consists of a root, shaft, and point. The root has a bulbous extremity, is lighter and softer than the stem, and lodged in a recess or hair follicle, which may either be in the corium or subcutaneous areolæ. The follicle is dilated at the bottom to correspond with the root-bulb, and the ducts of one or more sebaceous glands open into it. At the bottom of each follicle is a conical vascular papilla, similar in every respect to those on the surface of the skin; this papilla fits into a corresponding depression in the root of the hair. The shaft consists of a center or medulla, a surrounding fibrous portion, and an external coating or cortex. The medulla consists of cells containing pigment or fat, is opaque, and deeply colored. All hair has not this medulla. The fibrous portion occupies the bulk of the stem, and the cortex is merely a single layer of thin, flat, imbricated scales.

The *sebaceous glands*, lodged in the corium, are most abundant in parts exposed to friction. They generally open into the hair follicles, occasionally on the surface of the body. Each gland consists of a small duct, which terminates in a lobulated recess. These lobules vary, and are, as is the duct, lined with epithelium. They are filled with sebaceous matter, which, as it is secreted, is detached into the sacs. They are very plentiful between the claws of cattle.

The *sudorific glands*, or sweat glands, are situated in the subcutaneous areolar tissue, surrounded by a quantity of fat. They are small, round, reddish bodies, each of which consists of one or more fine tubes coiled into a ball, the free end of the tube being continued up through the true skin and cuticle, and opening on the surface. Each sweat-gland is supplied with a cluster of capillary blood-vessels which vary in size, being very large when perspiration is excessive. The contents of the smaller ones are fluid, and the larger semifluid.

The skin may be regarded as an organ supplementary in its action to the lungs and kidneys, since the skin by its secretion is capable of removing a considerable quantity of water from the blood, small amounts of carbon dioxide, and small amounts of salts, and in certain instances during suppression of the renal secretions a small amount of urea. The skin is also the chief organ for the regulation of animal heat, by or through conduction, radiation, and evaporation of water, permitting of loss of heat, while it also, through other mechanisms, is able to regulate the amount of heat lost. The hair furnishes protection against extreme and sudden variations of temperature by the fact that hairs are poor conductors of heat, and inclose between them a still layer of air, itself a nonconductor of heat. The hairs are also furnished with an apparatus by which the loss of heat may be regulated; thus, in cold weather, through the contraction of unstriped muscular fibers of the skin, the hairs become erect and the external coat becomes thicker. Cold, too, acts as a stimulus to the growth of hair, and we find in consequence a thicker coat in winter than in summer. The hairs also furnish protection against wet, as they are always more or less oily from the secretion of sebaceous glands, and thus shed water. The hairs, through their elasticity, furnish mechanical protection, and through the thickness of the coat, to a certain degree, resist the attacks of insects. Finally, the hairs assist the sense of touch.

The sweat-glands are constantly discharging a watery secretion in the form of insensible perspiration, and by their influence act as regulators of the temperature of the body. Hence, in warm weather, the secretion of the skin is increased, which tends to prevent the overheating of the body. Sweating, in addition to regulating heat, is also an active agent in removing effete material from the blood; therefore this secretion can not be checked without danger to the animal. If the skin be covered with an impermeable coating of grease or tar, death results from blood poisoning, due to the retention of materials destined to be excreted by the skin.

The total amount of secretion poured out by the skin is not only modified by the condition of the atmosphere, but also by the character and quantity of the food, by the amount of exercise, and especially by the quantity of fluid taken.

The sebaceous secretion is intended to lubricate the skin and hairs. It consists of soft, fatty material suspended in water, and is characterized by a special odor peculiar to the animal by which it is secreted.

I will not attempt to classify the various diseases of the skin, for in a work of this kind it would only serve to confuse the reader.

We will first consider a class of diseases which are of an inflammatory type; next, those due to faulty secretion and abnormal growth; then, diseases of parasitic origin; and, lastly, local injuries of the skin.

PRURITIS—ITCHING.

We will consider pruritis first as a distinct subject. It is not a disease, only a sensation, and therefore a symptom. It is one of the symptoms accompanying the majority of the diseases which we will consider in this work. It may truly be considered a neurosis, or increased sensibility of the skin—*hyperæsthesia*, dependent upon nervous excitability. It is, then, a functional affection, nerve disturbance, unaccompanied by primary structural changes in the skin. Nothing is seen except the secondary lesions, produced mechanically by scratching or rubbing.

There are various forms of itching, the result of specific skin diseases, where the pruritis is a secondary symptom. In such cases it should not be regarded as an affection.

Causes.—Many causes may induce the condition which we recognize here as pruritis. The most common one is gastro-intestinal irritation. This condition is often witnessed in cattle suffering from impaction or inflammation of the third stomach, and has been called "mad itch," from the fact that the affected animal manifested a mad fury in rubbing certain portions of the body, even to lacerating the skin on the sides of the body and legs with the teeth. In attacks of dysentery I have seen cattle rub the root of the tail and buttocks until the flesh was worn off down to the bones.

Another cause is found in affections of the liver and of the kidneys, when an increase of effete material has to be thrown off by the skin. Morbid materials circulating in the blood may produce a tickling or smarting sensation of the skin in their passage from the blood to the free surface of the skin. Certain irritating substances when eaten may be excreted by the skin, and coming thus in direct contact with the sensory nerves produce itching. In another class of cases the pruritis may be due to an atrophy, contraction, or hardening of the skin, when the nerves become irritated by the pressure. These conditions may be so slightly marked in a thick skin like that of the ox that they can not be recognized. It is frequently noticed that cattle will rub themselves as soon as they pass from the stable into the open air—changing from a warm to a cold atmosphere. Again, we may find an animal which does all its rubbing in the stall. We may look for lice, but fail to find them. These conditions are generally attributable to high feeding and to too close confinement. They may be associated with inflammatory irritation or not—certainly we fail to discover any morbid changes in the skin. There is to some extent a delightful sensation produced by rubbing, and it may partly become a habit of pleasure.

Treatment.—We must place our chief reliance upon a change of food, plenty of exercise, and in most cases the administration of an active cathartic—1 to 1½ pounds of Epsom salts, a handful of common salt, a tablespoonful of ginger or pepper, mixed with 2 quarts of water, all of which is to be given at one dose. Afterward half an ounce of hyposulphite of soda may be given twice a day for a week, mixed with the feed. For an external application, when the skin is abraded or thickened from rubbing, a solution of borax, 4 ounces to the quart of water, may be used. Carbolic acid, ½ ounce to a quart of water, will give relief in some cases.

INFLAMMATORY DISEASES OF THE SKIN.

ERYTHEMA.

This is the simplest form of inflammation of the skin. It consists of an increased redness, which may occur in patches or involve considerable surface. The red coloration disappears when pressed upon by the finger, but soon returns again after the pressure is removed. There is seldom much swelling of the affected part, though often a glutinous discharge may be noticed, which dries and mats the hair or forms a thin scale upon the skin. In simple erythema the epidermis alone is affected; when it becomes chronic, fissures form, which extend into the corium or true skin.

Erythema is divided into *Erythema simplex*, *E. chronicum*, and *E. intertrigo.*

Causes.—Erythema simplex, consisting of an inflammatory irritation, is witnessed in very young calves, in which the navel leaks. The discharge being urine, it causes an irritation of the surrounding skin. Erythema intertrigo is that condition known as chafing, and is occasionally seen on the udder of cows from chafing by the legs; chafing between the legs is not uncommon among fat steers. Erythema chronicum, or mammillarum, is found in the form of chapped teats of cows and chapped lips in suckling calves. It frequently occurs in cows when they are turned out in winter directly after milking, and in others from chafing by the calf in sucking. Some cows are peculiarly subject to sore teats. The fissures when neglected in the early stage of formation become deep, very painful, often bleeding at the slightest touch, and cause the animal to become a kicker when milked in that condition. Occasionally the lower portions of the legs become irritated and chapped when cattle are fed in a muddy or wet yard in winter, or if they are compelled to wade through water in frosty weather.

Treatment.—In ordinary cases of erythema, the removal of the cause and the application of benzoated oxide of zinc ointment, carbolized cosmoline, or a mixture of creolin, 1 ounce to a pint of water, applied a few times, will restore the skin to a healthy condition.

When there are fissures the zinc ointment is the best. If at the teats, a milk syphon (Plate XXIV, Fig. 4) should be used instead of milking by hand, and the calf, if there is one suckled, should be taken away. When the calf's mouth is affected it should be fed by hand. When the legs are irritated or chapped, dry stabling for a few days and the application of tar ointment will soon heal them.

URTICARIA—NETTLE RASH—SURFEIT.

This is a mild inflammatory affection of the skin, characterized by sudden development of patches of various sizes, from that of a nickel to as large as the hand. The patches of raised skin are marked by an abrupt border, and are irregular in form. All the swelling may disappear in a few hours, or it may go away in one place and reappear on another part of the body. It is always accompanied by a great desire to rub the affected part. In its simplest type, as just described, it is never followed by any serous exudation, or eruptions, unless the surface of the skin becomes abraded from scratching or rubbing. Another type of urticaria, known as *lichen urticatus*, by some writers designated *prurigo vernalis* or spring itch, is manifested by the eruption of small vesicles upon the swollen parts of the skin. These disappear more slowly and are followed by loss of the hair of the affected areas. This form of the disease is more apt than the former to become scattered over the whole body. Its duration greatly depends upon the presence or the removal of the exciting cause. Occasionally the relapses are so frequent that it finally becomes a chronic disorder.

Causes.—Derangements of the digestive organs are the most common causes, such as overloading the stomach when the animal is turned out to graze in the spring, certain constituents of food and high feeding among fattening stock. When the kidneys are functionally deranged urticaria may appear. Spinal irritation and other nervous affections may cause it.

Treatment.—Administer a full dose of Epsom salts. Give soft, easily digested food, and wash the affected parts with a solution of bicarbonate of soda—common baking soda—8 ounces to the gallon of water twice a day. If it assumes a persistent tendency, give a tablespoonful of the following powder in the feed three times a day: Cream of tartar, sulphur, and nitrate of potash, equal parts by weight, mix. A tablespoonful of Fowler's solution of arsenic may be given in drinking water once a day, if the case has assumed a chronic or recurrent character.

ECZEMA.

Eczema is a noncontagious inflammation of the skin, characterized by any or all of the results of inflammation at once or in succession, such as erythema, vesicles, or pustules, accompanied by more or less infiltration and itching, terminating in a watery discharge, with the formation of crusts or in scaling off. The disease may run an acute course and then disappear, or it may become chronic; therefore, two varieties are recognized, *vesicular* or *pustular*, and *chronic eczema.*

Causes.—Eczema is not so common among cattle as in horses and in dogs, in which it is the most common of all skin diseases. Among cattle it is occasionally observed under systems of bad hygiene, filthiness, lousiness, overcrowding, overfeeding, excessively damp or too warm stables. It is found to develop now and then in cattle that are fed upon sour substances, distillery swill, house or garden garbage, etc. Localized eczema may be caused by irritant substances applied to the skin—turpentine, ammonia, the essential oils, mustard, Spanish fly ointment, etc. Occasionally an eruption with vesiculation of the skin has been induced by the excessive use of mercurial preparations for the destruction of lice.

Symptoms.—In accordance with the variety of symptoms during the progress of the disease we may divide it into different stages or periods. (1) Swelling and increased heat of the skin; the formation of vesicles, which are circumscribed, rounded elevations of the epidermis, varying in size from a pin head to a split pea, containing a clear, watery fluid; (2) exudation of a watery, glutinous fluid, formation of crusts, and sometimes suppuration, or the formation of vesicles containing pus (pustules); (3) scaling off (desquamation), with redness, and thickening of the skin. From the very beginning of the disease the animal will commence to rub the affected parts, hence the various stages may not always be easily recognized, as the rubbing will produce more or less abrasion, thus leaving the skin raw—sometimes bleeding. Neither do these symptoms always occur in regular succession, for in some cases the exudation will be most prominent, being very profuse, and serve to spread the disorder over a large surface. In other cases the formation of incrustations, or rawness of the skin, will be the most striking feature. The disease may be limited to certain small areas, or it may be diffused over the greater part of the body; the vesicles or pustules may be scattered in small clusters, or a large number run together. The chronic form is really only a prolongation of the disease, successive crops of pustules appearing on various portions of the body, frequently invading fresh sections of the skin, while the older surfaces form scabs or crusts upon the raw, indurated skin.

In old standing cases the skin will break, forming fissures, especially on portions of the body that bend—the neck and limbs. Thus the disease may be prolonged indefinitely. When eczema reaches its latest period, either acute or chronic, desquamation of the affected parts is the most prominent feature. The formation and shedding of these successive crops of scales constitute the character of the disease frequently denominated *psoriasis*.

Treatment.—The treatment of eczema is often anything but a pleasant task. There is no one method of treatment which will always prove successful, no matter how early it is begun, or how small an area is involved. We must endeavor to remove the cause by giving attention to the general health of the animal and its environment. Feeding should be moderate in quantity and not too stimulating in character—green feed, bran mashes, ground oats, clean hay, plenty of salt. If the animal has been fed too high, give an active purgative—Epsom salts preferred—once a week, if necessary, and half an ounce of acetate or nitrate of potash may be given in the feed twice a day. If the animal is in poor condition and debilitated, give a tablespoonful of the following mixture in feed twice a day: Powdered copperas, gentian, sulphur, and sassafras bark, equal parts by weight. If the animal is lousy the parasites must be destroyed before the eczema can be cured. The external treatment must vary with the character of the lesions; no irritating application is to be made while the disease is in its acute, vesicular, or pustular stage, and, in the chronic stage, active stimulants must be used. Much washing is harmful, yet crusts and scales must be removed in order to obtain satisfactory results from the external applications. Both objects, however, can be attained by judiciously combining the curative agents with such substances as will at the same time cleanse the parts.

In the vesicular stage, when the skin is feverish and the epidermis peeling off, exposing the exuding skin, an application of boracic acid solution, 2 drams of the acid to 8 ounces of water, will often relieve the smarting or itching, and also serve to check the exudation and dry the surface. If this fails to have the desired effect use creolin, 1 ounce to a quart of water as a wash, or the black wash, composed of 1 dram of calomel to 10 ounces of lime-water. Any of these three washes may be used several times a day until incrustation is well established. Then use creolin, 1 ounce to a pint of sweet oil, or the benzoated oxide of zinc ointment, giving the affected surfaces a thorough application once a day. When the eczema is not the result of an external irritant it takes usually from one to two weeks before the healing is completed.

In chronic eczema, where there is a succession of scabs or scales, indolent sores or fissures, the white precipitate ointment, nitrate of mercury ointment, or blue ointment, mixed with equal parts of cosmoline or fresh lard, may be applied every second day, taking care to protect the parts so anointed that the animal can not lick it off.

In some cases the use of the following mixture will do well: Oil of tar one-half ounce, glycerine 1 ounce, alcohol 1 pint. Rub this in after cleansing the parts with warm water and soap. The internal administration of arsenic often yields excellent results in chronic eczema. Take 1 dram of arsenic, 1 dram of carbonate of potash, 1 pint of boiling water, and give 1 ounce of this twice a day in water, after feeding.

IMPETIGO LARVALIS AND LABIALIS.

Impetigo is an inflammatory disease of the skin, characterized by the formation of distinct pustules, about the size of a pea or bean, unattended by itching. The pustules develop from the papular layer of the skin, and contain a yellowish white pus. After reaching maturity they remain stationary for a few days, then they disappear by absorption and dry up into crusts. Later the crusts drop off, leaving upon the skin a red spot which soon disappears. Occasionally the crusts remain firmly adherent for a long time, or they may be raised up and loosened by the formation of matter underneath. The dry crusts usually have a brown or black appearance.

Causes.—Impetigo larvalis generally affects sucking calves only, in which the disease appears upon the lips, nostrils, and face. It is attributed to some irritant substance contained in the mother's milk. Impetigo labialis et facialis generally is witnessed among grazing animals, regardless of age, and it especially attacks animals with white hair and skin. The mouth, face, and limbs become covered with pustules, which may rupture in a few hours, followed by rapid and successive incrustations; the scabs frequently coalesce, covering a large surface; pus may form under them, and the whole thickness of the skin become involved in the morbid process. This form of the disease is attributed to the local irritant properties of plants growing in the pasture, such as St. John's wort *(Hypericum perforatum)*, smartweed *(Polygonum hydropiper)*, vetches, honeydew, etc. Buckwheat, at the time the seeds become ripe, is said to have caused it, also bedding with buckwheat straw.

Treatment.—Sucking calves should be removed from the mother, and the latter should have a purgative to divert the poisonous substance secreted with the milk. When the more formidable disease among grazing cattle appears the pasturage should be changed, and the affected parts of the animal thoroughly anointed once a day with sweet oil, containing 2 drams of carbolic acid to the pint. This should be continued until the crusts soften and begin to drop off, then the parts may be thoroughly cleansed with warm water and soap. Subsequently apply the white precipitate ointment or carbolized cosmoline daily until the parts are healed.

ECTHYMA.

This is an affection characterized by the formation of one or more large, isolated, flat pustules, situated upon an inflamed base. They occur mostly where the skin is thin and unprotected by hair on the udder, inside of thighs, and on or about the external genital organs.

Causes.—Disorder of the blood in debilitated conditions of the system; occasionally as the result of septic infection, by discharges following imperfect or tedious cleansing after calving.

Symptoms.—Large round or oval flattened pustules form, from the size of a pea to that of a chestnut. They are yellowish in color, surrounded by a red sensitive margin. Afterwards the pustules become reddish from admixture with blood, and soon dry into brown, flat crusts. The duration of each pustule may extend over a period of two weeks; meanwhile new ones form, until the cause is removed.

Ecthyma differs from impetigo in the size of the pustules and crust, and differs from boils in not having a core in the center.

Treatment.—General tonic treatment internally. Removal of offending discharges and disinfection of the affected region, by frequent bathing with creolin, 1 ounce to a pint of water. Open each pustule as soon as it forms and cauterize the bottom with nitrate of silver, or dilute liquor nitrate of mercury. If crusts are present they must be soaked loose by frequent applications of oil or lard, and then treated with carbolized cosmoline until the skin is restored to health.

PEMPHIGUS—WATER BLISTERS.

This is an inflammatory disease of the skin, characterized by successive formations of rounded, irregularly-shaped water blisters, varying in size from a pea to a hen's egg.

Causes.—Obscure.

Symptoms.—The formation of a blister is preceded by a congestion or swelling of the skin. Yellowish-colored water collects beneath the cuticle, which raises the latter from its bed in the form of a blister. The blisters appear in a succession of crops; as soon as one crop disappears another forms. They usually occur in clusters, each one being distinct, or they may coalesce. Each crop usually runs its course in a week. Itching or burning sensations attend this disease, which cause the animal to rub, thereby frequently producing excoriations and formation of crust on the affected region.

Treatment.—Give a tablespoonful of the following mixture in feed twice a day: Saltpeter, cream of tartar, and sulphur, equal parts by weight. The blisters should be opened as soon as formed, to allow the escape of the serum, then apply a wash composed of chloride of zinc, 1 dram to 15 ounces of water. When there is any formation of crusts apply carbolized cosmoline.

FURUNCULUS—BOILS.

This is an acute affection of the skin, usually involving its whole thickness, characterized by the formation of one or more abscesses, originating generally in a sebaceous gland, sweat-gland, or hair follicle. They usually terminate by absorption, or by the formation of a central core, which sloughs out, leaving a deep round cavity that soon heals.

Causes.—Impoverished state of the blood, the result of kidney diseases, or of local friction, or contusions.

Symptoms.—Boils in cattle usually appear singly, not in clusters; they may attain the size of a hen's egg. The abscess begins as a small round nodule, painful to pressure, gradually increases in size until death of the central portion takes place, then the surface of the skin gives way to internal pressure, and the core is released and expelled. Constitutional symptoms are generally absent, unless the boils occur in considerable numbers, or by their size involve a great amount of tissue.

Treatment.—Poulticing to ripen the abscess. If this can not be done, apply comphorated oil two or three times a day until the core is formed. As soon as the central or most prominent part becomes soft, the abscess should be opened to release the core. Then use carbolized cosmoline once a day until the healing is completed. If the animal is in poor condition give tonics—copperas, gentian, ginger, and sulphur, equal parts by weight, one tablespoonful twice a day. If the animal manifests a feverish condition of the system, administer half an ounce of saltpeter twice a day, continuing it several days or a week.

FAULTY SECRETIONS AND ABNORMAL GROWTHS OF THE SKIN.

PITYRIASIS—SEBORRHŒA—DANDRUFF—SCURF.

This is a condition characterized by an excessive secretion of sebaceous matter, forming upon the skin in small crusts or scales.

Causes.—It is due to a functional derangement of the sebaceous glands, usually accompanied by dryness and loss of pliancy of the skin. The animal is hidebound, as it is commonly termed, thin in flesh, inclined to rub, and very frequently lousy. The condition is observed most often towards the spring of the year. Animals that are continually housed, the skins of which receive no cleaning, generally present a coat filled with fine scales, composed of epithelium from the epidermis and dried sebaceous matter. This, however, is a physiological condition, and compatible with perfect health.

Symptoms.—Pityriasis may affect the greater portion of the body, though usually only certain parts are affected—the ears, neck, rump, etc. The skin becomes scurfy, the hairy coat filled with bran-like, gray, or whitish scales.

Treatment.—Nutritious food, such as oil-cake meal, bran, ground oats, and clean hay. In the spring it generally disappears after the animal is turned out to pasture. When lice are present they should be destroyed.

ELEPHANTIASIS—SCLERODERMA.

This condition consists in a chronic thickening of the skin, which may affect one or more limbs, or involve the whole integument. It is characterized by recurrent attacks of swelling of the skin and subcutaneous areolar tissue. After each attack the affected parts remain infiltrated to a larger extent than before, until finally the skin may attain a thickness of an inch, become wrinkled and fissured. This disease is confined to hot climates. The predisposing cause is unknown.

ŒDEMA—ANASARCA OF THE SKIN.

This is a dropsical condition of the skin and subcutaneous areolar tissue, characterized by pitting under pressure, the fingers leaving a dent which remains a short time.

Causes.—Œdema generally results from a weakened state of the system, arising from previous disease. It may also be dependent upon a functional derangement of the kidneys. Occasionally I have seen very large œdematous swellings beneath the lower jaw without being able to discover the cause.

Symptoms.—Sudden painless swelling of a limb, udder, lower surface of abdomen, or lower jaw becomes apparent. This may increase in dimensions for several days, or may attain its maximum in less than twenty-four hours. Unless complicated with some acute disease of a specific character, there is not much if any constitutional disturbance. The deep layer of the skin is infiltrated with serum, which gives it the characteristic condition of pitting under pressure.

Treatment.—When the cause can be ascertained and removed, we will have a reasonable expectation of seeing the œdema disappear. When no direct specific cause can be discovered, and the animal is debilitated, give general tonics. If, on the contrary, it is in good flesh, give a purgative, followed by half an ounce of acetate of potash twice a day. External applications are useless.

Œdema may be distinguished from erysipelas or anthrax by the absence of pain and fever.

DERMAPILOUS AND SEBACEOUS CYSTS—WENS.

A dermapilous cyst is formed by an involution of the skin, with a growth of hair on the inner wall of the sac. It may become imbedded deeply in the tissues subcutaneously, or may just penetrate the thickness of the skin, where it is movable and painless. They are generally found within the ear or at its base, although they may form on any part of the body. Usually they have a small opening, from which a thick, cheesy matter can be squeezed out. The rational treatment is to dissect them out.

Sebaceous cysts appear not unlike the former. They are formed by a dilatation of the hair follicle and sebaceous duct within the skin, and contain a gray or yellowish sebaceous mass. The tumor may attain the size of a cherry-stone or a walnut. Generally they are round, movable, and painless, soft or doughy in consistency, and covered with skin and hair. They develop slowly. The best treatment is to dissect out the sac with contents entire.

VERRUCA—WARTS.

Cattle are affected with two varieties of warts. One, the *verruca vulgaris*, is composed of a cluster of enlarged papillæ, covered with a thickened epidermis, the number of papillæ determining the breadth and their length its height. They are generally circular in figure, slightly roughened on the surface, and spring from the skin by a broad base. Occasionally large numbers of very thin, long, pedunculated warts grow from the skin of the ear, lips, about the eyes, and vulva. Another variety, the *verruca acuminata*, sometimes erroneously denominated epithelial cancers, are irregularly shaped elevations, tufted, or club-shaped, occasionally existing as thick, short, fleshy excrescences, giving the growth the appearance of granulation tissue. Their color is red or purplish, and oftentimes by friction they become raw and bleeding, emitting then a very offensive odor. They usually grow in clusters and their development is rapid. I once treated a two-year-old steer in which the back part of both forelegs were covered with these excrescences, some as large as a goose-egg. Many of them presented a raw, bleeding surface; others had a perfectly smooth surface, devoid of hair.

Causes.—An abnormal nutrition of the skin, determined by increased energy of growth operating upon a healthy skin; at other times upon a weak or impoverished skin.

Treatment.—When they are small and pedunculated they may be snipped off with shears, and the stump touched with nitrate of silver. When they are broad and flattened they can be dissected out, and the wound cauterized, if necessary. If they are large and very vascular they may be ligated, one by one, by taking a strong cord and tying it as firmly around the base as possible. They will then shrivel, die, and drop off. If there is a tendency to grow again apply a red-hot iron, or nitric acid with a glass rod.

KELIS.

Kelis is an irregularly-shaped flat tumor of the skin, resulting from hypertrophy—increased growth of the fibrous tissue of the corium, producing absorption of the papillary layer.

Causes.—It may arise spontaneously, or follow a scar after an injury.

Symptoms.—Kelis generally appears below the knee or hock. It may occur singly or in numbers. There are no constitutional symptoms. Its growth is very slow, and seldom causes any inconvenience. It appears as a flattened, irregular or spreading growth within the substance of the skin, is hard to the touch, and is especially characterized by divergent branches or roots; hence the name is derived from its resemblance to a crab. Occasionally some part of it may soften and result in an abscess. It may grow several inches in length, and encircle the whole limb.

Treatment.—So long as no inconvenience is manifested by the animal it is best not to meddle with it; when it does, the animal ought to be fattened for beef, the meat being perfectly harmless to the consumer.

PARASITIC DISEASES OF THE SKIN.

SCABIES—ACARIASIS—MANGE—ITCH.

Mange is a disease of a local nature, due to a mite, which induces irritation and incrustation on the surface of the body generally. It is always contagious, requiring for its development the transplantation of the parasites or their eggs from the diseased to the healthy animal. This disease is not very common among cattle in this country, while in some countries it prevails as an epizoötic. Poor hygiene appears to favor the extension of the disease, and it is claimed that weakened cattle are more predisposed to harbor the parasite than strong, healthy ones. It is also more prevalent in winter than in summer, and in the latter season sometimes entirely disappears.

Cattle are afflicted with two varieties of these parasites. They belong to the class *Arachnidæ*; genera, *Psoroptes* (*Dermatodectes*) which simply bite, and hold on to the skin; and *Chorioptes* (*symbiotes*) living together in large families, and not piercing further than the cuticle in search of food.

Psoroptes communis var. *bovis* (Syn. Dermatodectes commŭnis, Dermatocoptes commŭnis).—This is the most frequent one met in cattle. It lives on the surface of the epidermis, and gives rise to much irritation by biting. It generally chooses the regions of the top of the shoulder and root of the tail for its habitation. From these localities it gradually extends by increase in numbers, causing intense itching and great distress in the affected animal. From the irritation of the skin papular nodules appear, which develop into vesicles filled with fluid and rupture. The drying of the exuding fluid forms crusts, and these are liable to be followed by ulceration. The hairs may project up through the crust or fall out. In chronic cases the skin becomes thickened and almost insensible, dry, and wrinkled. As it is easy to confound this disease with eczema, our sole dependence for a correct diagnosis rests upon the discovery of the parasite, or, at least, upon positive evidence of contagion. The acari can be detected upon the hair and surface of the epidermis by the aid of an ordinary magnifying glass, or they may be seen with the naked eye as minute white points moving about when the infested animal stands in the full glare of the sun on a warm day.

Chorioptes symbiotes var. *bovis* (Symbiotes bovis).—This variety of the acari rarely affect cattle. They generally live at the base of the tail; through neglect they may extend along the back or down upon the thighs. This type of mange is not nearly so contagious as the former variety, though in all other respects it produces similar effects. This variety is best seen by picking off a scab and laying it on a piece of white paper, which is then placed in the sun. The next day the parasites may be found in clusters.

Treatment.—It is of the utmost importance to cleanse the skin, removing crusts, etc., before the parasites can be effectually eradicated. For this purpose use soft soap and warm water, and give the animal a thorough scrubbing, especially in regions where the skin has been rubbed. If the crusts are not all removed by the first washing, apply sweet oil to soften them. They may then be washed off the following day. To kill the mites apply thoroughly, with a brush, the following mixture: Creolin, 1 ounce; oil of tar, 1 ounce; soft soap, ½ pint; sulphur, ½ pound; alcohol, 1 pint. Wash it off in two days with soap and water. Three or four days later a second application should be made to destroy all remaining acari. It is essential that the stable or stalls where affected cattle have been should be cleansed and whitewashed, or saturated with sulphuric acid 1 pint to 3 gallons of water.

PHTHIRIASIS—LOUSINESS.

The lice of cattle are of two kinds, the suctorial lice, belonging to the family Pediculidæ of the order Hemiptera (sub-order Parasita), which are found only upon mammals. The other variety—biting lice—belong to the family Philopteridæ of the order Pseudoneuroptera (sub-order Mallophaga), which attack mammals and fowls. Those belonging to the first variety are the short-nosed ox-louse—*Hæmatopinus eurysternus*—and the long-nosed ox-louse—*Hæmatopinus vituli* (Syn. H. tennirostris). The short-nosed ox-louse is the larger and the harder to exterminate. It infests almost exclusively the neck and shoulders, and those parts are frequently worn bare by the animal in its efforts to rid itself of these tormentors. The full-grown females of the short-nosed ox-louse are from one-eighth to one-fifth of an inch long, and fully half that in width, while the males are slightly smaller. The males have a broad, black stripe running forward from the end of the body to near the middle of the abdomen; the females have no indication of this stripe. The true pumping organ, as in all the Pediculidæ, consists of a slender piercing tube which may be greatly extended in order to reach the blood of the infested animal.

The females deposit their eggs on the hair, attaching them very near the skin by means of an adhesive substance. The long-nosed ox louse is the most familiar to cattlemen. The body is about an eighth of an inch long, and not more than one-third of that in width. The head is very long and slender, and no eyes are visible. In color there is little difference in the two species.

There is but one species of biting lice known to occur on cattle, the *Trichodectes scalaris.* This is very common on cattle. It is very distinct from the suctorial species in appearance, and this is readily recognized by all observers, for it is generally called "the little red louse," in contrast with the blue louse. They are also less injurious than the former.

The biting louse possesses a mandibulate mouth, or a mouth provided with cutting and biting jaws. They attack the animal along the spine, hips, rump, and sometimes the neck and head.

Symptoms.—Lousiness generally becomes manifest in winter and toward spring, when the animal is found to rub the infested portions of the body, occasionally to such an extent as to produce excoriations of the skin. It becomes thin in flesh and debilitated. A close examination will reveal the true state, and prompt attention is advisable.

Treatment.—The treatment does not vary for the three species, although the short-nosed louse is the most difficult to destroy. I have been most successful with a decoction of Cocculus Indicus—fish berries. Take a half pound for each animal, pound fine, then add two quarts of vinegar, and set it on the stove to simmer for an hour. Apply this thoroughly by rubbing it well into the hair over the infested region. This will not injure the skin or sicken the animal, and it remains effective long enough to kill all the young lice as they are hatched from the nits. Prof. Riley's kerosene emulsion is also very effective, and is made as follows: Kerosene, 2 gallons; common or whale oil soap, one-quarter pound; water, 1 gallon. Heat the solution of soap and add it boiling hot to the kerosene; churn the mixture for five or ten minutes. Dilute the emulsion with eight parts of water, and apply it to the animal by a thorough rubbing. Fifty animals can be treated with 10 gallons of the liquid.

ŒSTRIASIS—WARBLES—GRUB IN THE SKIN.

Warbles are characterized by tumors in the skin along the back and loins of cattle, which contain a grub deposited by the *Hypoderma bovis,* or gadfly. When the cattle are attacked by this fly it is easily known by the terror and agitation of the whole herd. The unfortunate object of the attack runs bellowing from among the herd to some distant part of the field or the nearest water. The tail, from the severity of the pain, is held with a tremulous motion straight from the body, and the head and neck are stretched out to the utmost. The remainder, from fear generally, follow to the water or run off to different parts of the field.

The larva of this fly, when young, is smooth, white, and transparent; as it enlarges it becomes browner, and about the time it is full grown it is of a deep brown color. The larva, having attained its full growth and size, effects its escape from the abscess in the back of the affected animal, and falls to the ground; it then seeks a retreat in which to pupate. The puparium is of a dark brown color, narrower at one end than at the other, flat on one side, and very round and convex on the other. They may remain in this state for about six weeks, when the fly appears. The grubs usually escape during the months of May and June; occasionally as late as September. Sometimes these warbles are very numerous, and cause a great deal of pain and uneasiness in the animal, which becomes thin in flesh, hidebound, and feverish; more frequently, however, they do no harm, except to the hides. I am under the impression that the so-called heel-fly of our southwestern States and the gadfly are identical. I have never had an opportunity of learning the true history of the former, therefore I can not be explicit.

Treatment.—Whenever cattle have these tumors along the back in the winter, it is advisable to enlarge the opening which already exists and press out the grub, or it may be caught with the point of a shoemaker's awl and extracted.

Since writing the foregoing history of the development of the grub, I have seen an article written by Dr. Cooper Curtice, published in the Journal of Comparative Medicine and Veterinary Archives, Vol. XII, No. 6, in which he details quite a different history concerning the ox-warble, viz: He discovered that the *Hypoderma bovis* is *not* the common species of gadfly that we have in this country, but that it is the *Hypoderma lineata* Villers, which is common with us. He says:

The adult fly lays its eggs somewhere on cattle, presumably the back, by attaching them to the hairs. This attachment is admirably outlined by the structure of the egg, which is similar to that of the horse botfly, *Gastrophilus equi*, and by the structure of the ovipositor, which is not adapted for boring. While some authors have contended that the egg is laid in the skin others have conclusively shown that this is not the case. * * * Development takes place within the egg while yet attached to the hair. * * * From this point on my version of the life history varies from that of others until the larva has arrived at its destination in the cysts, under the skin, which open to the air through the hide. * * * It has been stated by various authorities that the young grub emerging from the shell bored its way through the skin until it reached the subcutaneous tissue, and thus made its channel. From circumstantial evidence I believe that the embryos are licked by the cattle and swallowed, or lodged in the back of the mouth or œsophagus. This theory is based on the appearance of the cattle grubs in the walls of the œsophagus in November, long before they are found in the backs of cattle in this locality. Later, about Christmas time, the grubs appear suddenly, and in full force under the skin of the back. At their first appearance under the skin they are as large as those found in the œsophagus at that time, and differ in nowise from them. By the latter part of January or early in February all have disappeared from the œsophagus, together with all traces of inflammatory action in that organ so observable in January. The earliest grub holes that I have been able to find are very uniform in size, corresponding with the caliber of the grubs contained in them, and had no appearance of the sac which forms later. The walls were rough as if gnawed, and the hole was cylindrical to near the epidermis, when it suddenly contracted. Now the freshness of the wound and the absence of inflammatory action is a very good index of the recent date of the wound, for when the wound is exposed to the air germs are sure to enter, a sac grows and secretes pus. Were the wound of a more remote date it would be of quite another character, as every pathologist will admit. Just preceding the time when one is able to find the young warbles in the skin, that condition known to butchers as "lick" appears. The "lick" is nothing more than an effusion of serum into the connective tissue membrane, and is produced by the inflammation set up by the wanderings of the young grubs. This effusion can also be found in the walls of the œsophagus, just prior to the final disappearance of the grubs. The disappearance of the "licks" from the tissues underlying that portion of the hide most infested, the saddle, is followed by finding the grubs in sacs in the first and second cutaneous stages. When the sacs are well formed the "licks" have disappeared. These "licks" are said by farmers and butchers to be caused by cattle licking themselves. It is easy to understand, however, that the cattle lick themselves at this time on account of the irritation produced by the grubs in piercing through the sensitive skin. The appearance of "lick" in those parts where the force of the tongue could not reach, as in the œsophagus, an appearance which has been my guide to the grub and its vicinity, is quite good proof that the grubs cause "lick."

BUFFALO GNAT—SIMULIUM PECUARUM.

This is a small fly inhabiting the lower Mississippi Valley, and proves a great scourge to cattle in that region. The term buffalo gnat is derived from their supposed resemblance to that animal. It has a large hump-backed thorax, with a head supplied with two antennæ-like small horns. It belongs to the order *diptera*, family *simulidæ*. The perfect fly varies in length from 3^{mm} to 4.5^{mm}, the females being usually the larger. They are characterized by their peculiar short and thick shape; the head is bent under, and is nearly as wide as the very large and humped thorax. The thick antennæ are composed of twelve stout joints; the four-jointed palpi terminate in long and fine joints; the posterior shanks and the first joint of the hind tarsi are somewhat dilated. The free labrum is as sharp as a dagger, and the very prominent proboscis is well adapted for drawing blood. The insects possess no ocelli, but their eyes are large. In the male they join at the forehead, but in the female they are farther apart. The mouth organs of the male are not so well developed as in the female, being soft and unable to draw blood. The bodies of these gnats are quite hard and can resist considerable pressure. The color of the southern buffalo gnat is black, but covered with grayish-brown, short, and silken hairs, which are arranged upon the thorax in such a manner as to show three parallel longitudinal black stripes. The abdomen is more densely covered with similar hairs, and shows, furthermore, a dorsal broad, whitish stripe, which widens towards the posterior end. The legs are more reddish, but also covered with hairs of the same color as elsewhere. The balancers are yellowish-white and the wings ample. These pests are migratory, or are driven in swarms by the wind, hence they appear in localities remote from their breeding place. They have been seen as far north as Jackson County, Ill., and Daviess County, Ind. As a rule, however, they are restricted to the counties bordering on the Mississippi River, from St. Louis, Mo., to Red River in Louisiana. Arkansas appears to be their great breeding place, and nearly the whole State is more or less afflicted with them, especially along the streams and valleys. Occasionally they extend their flight into southeastern Kansas. Overflows of the Mississippi, occurring in March, April and May, are generally soon followed by dense swarms.

This pest has been known as far back as the earliest settlements of Kentucky and Tennessee. The appearance of the buffalo gnats occurs each year with the continuous warm weather of spring, when they may be seen to gather in swarms on the vegetation along the confluent streams of the Mississippi, and from thence are drifted about by the winds, and carried sometimes for long distances. At first the members of a swarm are very blood-thirsty, but they soon begin to die off until all have disappeared. The duration of an invasion of the infested region varies from a few days to five or six weeks. Cold weather renders them dormant, until the warmth of the sun revivifies them again, while very hot weather kills them. When these gnats have filled themselves with blood from an animal they soon die. The females alone leave their breeding place, the males always remain. In their migration they select certain places, generally low and wet ground; exposed sunny spots are shunned. Some years they prove very disastrous to the stockowners in the infested regions, and as they do not appear each year in the same place they often swarm in upon a wooded pasture, or attack cattle passing along the road, which become worn out from the attack before they can be brought to a safe place. They are most active in the early morning and evening, exceedingly quick in their movements, and almost noiseless. When they are very numerous they cover the whole animal without regard to position; thus when cattle are weakened from exposure during winter, and by scarcity of feed, they succumb easily. When cattle are attacked they attempt to run away from them, and generally aim to reach brushwood or thickets in order to rub off their tormentors. If near water they plunge into that, and remain in it until the gnats leave the place, or the animal becomes pinched with hunger. Animals which have a smooth, short coat are not so badly punished as those with long hair. The bites of a few gnats will not affect the animal seriously, but when attacked by swarms they rapidly weaken from loss of blood and shock, and may die subsequently from exhaustion or blood poisoning. The fatality is much greater among mules than cattle. Their mode of attack is to follow the hair to the skin, plunge their stout beaks into it, and fill themselves with blood; they then drop off, and die within twenty-four hours. The place of puncture on the animal is marked by a drop of blood which oozes from the wound. Their breeding places are the tributaries to large rivers or streams; they select places where the water runs slowly. The eggs are deposited by the females just above the water's edge, upon any object projecting above the water; they are mostly deposited in the forenoon, hatched out in a few hours and the larvæ fall into the stream. These larvæ congregate in swift water, where they live for nearly a year. Then they spin a tough brown cocoon, with the upper end open, within which they become transformed into pupæ, and in about ten days emerge as adult gnats.

Treatment.—When an animal has been weakened by an attack of these gnats, give from 1 to 2 drams of carbonate of ammonia in 4 ounces of whisky every four hours. Keep the animal in a cool, dark place. Occasional immersion in cold water has been beneficial.

Prevention.—Smoke from fires built of wet wood, burning leather, tar, rags, etc., has proved the most practical for the purpose of keeping them at a distance. As soon as the gnats appear build a fire, make as much smoke as you can, and drive the cattle close up to it, where they will remain as long as the pest is about. Whenever it can be done, stabling the cattle during the day and turning them out from late in the evening until early morning will be a reasonably safe measure to adopt. Cotton-seed oil mixed with tar, fish oil, kerosene, or carbolic acid, applied to the cattle twice a day will protect them to a very great extent.

HÆMATOBIA SERRATA—HORN-FLY.

This is a small black fly, which first appeared in sufficient numbers to attract attention in this country in the year 1887. In that year they appeared in the counties adjoining Philadelphia, Pa. In the following year they extended into Maryland, and a year later reached the District of Columbia and Virginia. They attack cattle in the fields by piercing their skin and sucking the blood. When they are present in large numbers they collect upon the roots of the horns, along the top of the neck, or under the belly, thus proving a veritable pest among cattle in the infested regions. From the fact that they congregate upon the bases of the horns when they are at rest they have received the popular name of "horn-fly." They appear with the warm weather of spring—the early part of May—and disappear after the first severe frost in the fall. The flies are observed in the greatest numbers during July. The characteristic habit of clustering about the base of the horn seems to exist only when the flies are quite abundant. When they average only a hundred or so to a single animal comparatively few will be found on the horns. Moreover, as a general thing, the horn-clustering habit seems to be more predominant earlier in the season than later, although the flies may seem to be nearly as numerous. The clustering upon the horns, although it has excited considerable alarm, is not productive of the slightest harm to the animal. The flies assume two characteristic positions, one while feeding and the other while resting. It is the resting position in which they are always found when upon the horns. In this position the wings are held nearly flat down the back, overlapping at base and diverging only moderately at tip; the beak is held in a nearly horizontal position, and the legs are not widely spread. In the active sucking position, however, the wings are slightly elevated and are held out from the body, not at right angles, but approaching it. The legs are spread out widely, and the beak, inserted in the skin of the animal, is held in nearly a perpendicular position. The fly, before inserting its beak, has worked its way through the hairs close to the skin. While feeding, however, the hair, which can be seen over its body, does not seem to interfere with its speedy flight when alarmed, for a fling of the tail or an impatient turn of the head will cause the flies to rise instantly in a cloud for a foot or two, returning as quickly again and resuming their former positions. The horns are not the only resting places, for with the horns covered by them for two inches above their base, toward nightfall vast numbers will also settle upon the neck where they can not be reached by the head or tail. When feeding they are found over the back and flanks and on the legs. During a rain storm they flock beneath the belly. When the animal is lying down a favorite place of attack seems to be under the thigh, and belly around the bag. With certain animals the dewlap becomes badly attacked, while in others this portion of the body is about exempt. Certain cattle, again, will be covered with flies and will lose condition rapidly, while others are but slightly affected.

The amount of injury done by this pest is not so very great; it is stated that the flies alone will never cause the death of an animal. They reduce the condition of stock considerably, and in the case of milch cows the yield of milk is reduced from one-fourth to one-half. Their bites seldom produce sores by themselves, but large sores have been made by the cattle in rubbing themselves against trees, fences, etc., in an endeavor to allay the irritation caused by the bites, or in spots where they could not rub by licking constantly with the tongue, as about the udder and on the inside of the thighs. These sores are usually difficult to heal, as from the continued irritation by the flies and the repeated licking by the animal, the sore is maintained.

Treatment.—Almost any greasy substance applied to the skin and horns of the animal will keep the flies off for several days. For this purpose common axle-grease, whale oil, carbolized oil, etc., may be used.

Prevention.—The flies are propagated from eggs laid in the droppings of cattle by the female flies. Thus a new generation of flies is produced about every two weeks. It is recommended by Prof. C. V. Riley, entomologist for the U. S. Department of Agriculture, that a spadeful of lime should be placed upon each dropping of the cattle in the field, to destroy the larvæ after they leave the egg, and previous to their transformation into the fly. By doing this twice a week the number of subsequent flies could be materially lessened, possibly the pest altogether eradicated.

TICKS—IXODES.

There are several species of ticks that attach themselves to cattle. The most common in this country is the *Boöphilus bovis*. (Plates XLIV.) They are most numerous on uncultivated land, prairies, and woodland. They attach themselves to cattle on the thighs, flank, and neck, where they fill themselves with blood and then drop to the ground. They bore into the skin and cause considerable irritation of the parts. They may be destroyed by the application of oil or grease which kills them by occluding their breathing pores. When they are carelessly pulled off by hand the head sometimes breaks off and remains in the skin, causing a suppurating sore and possibly septic infection of the animal.

FLEAS—PULEX IRRITANS AND SARCOPSYLLA PENETRANS.

The *Pulex irritans*, the common flea, penetrates the cuticle with a pair of very fine sharp lancets attached to its head, and draws blood from the animal. They become annoying to cattle when they are present in great numbers, and cause a diminution of milk.

The *Sarcopsylla penetrans*, the chigre, met with in some of the western States, burrows beneath or within the skin, and deposits its eggs, causing the animal to rub the parts. A small vesicle may form, succeeded occasionally by the formation of a small ulcer.

Treatment.—When fleas or chigres cause much annoyance to cattle it can be prevented by moistening their skin every morning with tobacco juice or carbolic-acid water—1 ounce of the acid to 2 quarts of water.

FLIES AND MOSQUITOS.

These may become dangerous to cattle in sections where malignant anthrax prevails, as they may be the carriers of poison from the diseased or dead animal to the healthy one.

The tsetse fly *(Glossina morsitans)* of Africa is very destructive to cattle, their sting causing death in many cases. Maggots hatched from the eggs deposited by flies upon wounds frequently are very annoying to the animal, and retard the healing process. The maggots from the screw-worm fly *(Lucillia macellaria)* burrow in wounds and cause increased inflammation, and have been known to cause the death of cattle. When maggots or screw worms appear on wounds of the skin, be they deep or superficial, no time should be lost in getting rid of them. The application of turpentine or carbolized water—1 ounce to a pint—should be used to destroy the vermin, and the wound afterward covered with tar to keep the flies away.

RINGWORM—TINEA TONSURANS AND TINEA FAVOSA.

Ringworm is an affection of the skin, due to a vegetable parasite. *Tinea tonsurans* is due to the presence of a minute or microscopic fungus—the *Trichophyton tonsurans*. It affects the hair and the epidermic layer of the skin, and is highly contagious, being readily transmitted from one animal to another. This fungus consists of spores and filaments. The spores being the most numerous are round, nucleated, and seldom vary much in size. They are very abundant in the hair follicle. The filaments are articulated, waving, and contain granules. This disease is productive of changes in the root and shaft of the hair, rendering them brittle and easily broken off.

Symptoms.—This disease becomes manifested by the formation of circular patches on the skin, which soon become denuded of hair. The cuticular layer of the skin is slightly inflamed, and vesication with exudation occurs, followed by the formation of scaly, brittle crusts. The patches appear silvery gray when incrusted, and are mostly confined to the head and neck. It is a common disease among young cattle in the winter and spring. Very early in the development of the patches the hairs split, twist, and break off close to the skin. This disease is attended with more or less itching. It is communicable to man.

Tinea favosa is due to another fungus, the *Achorion Schönleinii.* This enters the hair follicle and involves the cuticle surrounding it, small crusts from which increase in diameter and thickness and then become elevated at their margin, forming a cup-shaped scab, the *favus cup*, which gives the disease its distinctive character. The number of these cups varies from a few to many hundreds. The hairs involved become brittle and broken, fall off with the crusts, leaving small bald patches. The crusts are of a pale or sulphur yellow color at first; as they grow older they turn darker, or to a brown color. This form of ringworm has a peculiar odor, resembling that of mice or musty straw. It is occasionally communicated to cattle by man, mice, cats, etc., all being subject to this disease.

Treatment.—Remove all crusts by washing with soap and water, then apply acetic acid, sulphur ointment, or nitrate of mercury ointment once a day. Cleanse the stable and whitewash it to destroy the spores scattered by the crusts.

WOUNDS OF THE SKIN.

SNAKE-BITES.

Three varieties of snakes are poisonous in this country—the *Crotalus* or rattlesnake, *Trigonocephalus* or cotton-mouth, and the *Elaps fulvius*, a small snake of the South. Snake bites on cattle generally occur about the head, feet, or limbs. A close inspection will reveal the marks where the fangs of the reptile entered the skin. When the poison has been freely ejected in the wound excessive pain is soon manifested, quickly followed by swelling, which diffuses itself extensively over the surrounding surface. The tumefaction is doughy to the touch and of a purple color. Extreme prostration sets in and the animal may soon become partly unconscious; the body becomes cold, and the pulse-beats almost imperceptible; finally the heart fails completely and the animal dies. Generally, however, the poison is not sufficiently active to cause death, but the recovery from its effects will be slow. Large abscesses and sloughs may form, which will require a long time to heal, or end in the exhaustion and death of the victim.

Treatment.—Powerful diffusible stimulants are indicated to maintain life until the first impression or shock of the poison has passed away. For this purpose whisky is given in pint doses every fifteen or twenty minutes, until it arouses the sinking vitality. Aqua ammonia in 1 ounce doses, diluted with 2 quarts of water, may be substituted for the whisky. External treatment should consist in cauterization of the wound by plunging a red-hot pointed iron into it as deeply as the situation of the wound will permit. Gashes an inch long should be cut into the skin over the swollen part, for the purpose of draining the blood away and lessening the danger of extensive subsequent sloughing. Afterwards keep the parts well painted with tincture of iodine.

VENOMOUS STINGS.

These may be inflicted by scorpions, tarantulas, wasps, bees, hornets, etc. Occasionally an animal may be stung by a wasp or bumble-bee and owing to some peculiar state of the blood of the animal the injured skin will swell and form a painful enlargement. If stung by a swarm of bees the animal may become very sick and prostrated. The external application of sugar of lead water, 1 ounce to the pint, will usually relieve the pain and swelling. When the animal suffers constitutionally, 2 drams of carbonate of ammonia or 4 ounces of whisky should be administered every 2 hours until the animal rallies from the shock.

BURNS AND SCALDS.

This is a rare accident among cattle, yet in cases of fire it may occur. The application of heat, whether dry or moist, unless sufficient instantly to destroy the life of a part, is always followed by the development of vesicles or blisters, which contain a thin, watery fluid. The blisters may be isolated and not very large, or one blister may cover a very large surface. When the burn is very severe the skin may be wholly devitalized, or the injury may extend into the deeper structures beneath the skin. Then sloughs will occur, followed by a contraction of the parts in healing; if on a limb this may render the animal stiff. When the burn or scald has been a severe one the resulting pain is great and the constitutional disturbance very marked.

Treatment.—For a superficial burn use a mixture of equal parts of limewater and linseed oil, or common white paint—white lead ground in oil. This will exclude the atmosphere and protect the inflamed skin. If it is not convenient to obtain this, chimney soot, flour, or starch may be spread on the wound (dry), and covered with cotton batting and light bandage if possible. The blisters should be opened to let the contained fluid escape, but do not pull off the thin cuticle which has been raised by the blister. When the burn is extensive and deep sloughing occurs, the parts should be treated like other deep wounds, by poulticing, astringent washes, etc. When the system has sustained much shock, stimulants may be required internally, such as 4 ounces of whisky or 2 drams of carbonate of ammonia, every hour until the animal rallies. When the pain is very great, hypodermic injections of 6 grains of morphia may be administered every six hours.

Frostbite on any portion of the body may be treated as recommended in the article on diseases of the ears.

EMPHYSEMA—WIND UNDER THE SKIN.

Emphysema of the skin is not a true disease of the skin, but we will mention it as a pathological condition. It is characterized by a distension of the skin with air contained in the subcutaneous areolar tissue. It may depend upon a septic condition of the blood, as in anthrax or blackleg; or air may be forced under the skin about the head, neck, and shoulders, as a result of rupture of the windpipe. It occurs in the region of the chest and shoulders from penetrating wounds of the chest and lung, and occasionally follows puncture of the rumen, when the escaping gas becomes retained under the skin.

Symptoms.—The skin is enormously distended over a greater or less portion of the body; thus any region of the body may lose its natural contour and appear like a monstrosity. There is a peculiar crackling beneath the skin when the hand is passed over it, and on tapping it with the fingers a resonant drum-like sound is elicited.

Treatment.—Puncture the distended skin with a broad-bladed pocket knife and press out the contained air. Further treatment must be directed with a view to the removal of the cause.

DISEASES OF THE FOOT.

By M. R. TRUMBOWER, D. V. S., Sterling, Ill.

LAMINITIS—FOUNDER.

Laminitis denotes an active inflammation of the sensitive structures within the wall of the hoof, which may in severe cases result in suppuration, and the loss of one or more claws. Owing to the simplicity of the structure of the foot of the ox, compared with that of the horse, this disease is rarely seen in an acute form, but a mild form, commonly called soreness, is not of infrequent occurrence.

Causes.—Laminitis in cattle may be caused by overfeeding, overheating, or by driving long distances over rough or stony soil.

Symptoms.—An unwillingness to maintain the standing position; the animal persists in lying down. The feet will be found unnaturally hot, and frequently some swelling may be noticed above the hoof; the general body temperature is increased, and the breathing accelerated. Ordinarily the animal eats and drinks. When it is made to move excessive tenderness of the feet becomes manifest; it affects the hind as well as the fore feet, usually all four.

Treatment.—Cold packs to the feet, or if the animal can be made to stand in a running stream of water, having a soft bottom, this will often relieve the inflammation without the necessity of any additional treatment. It may be well, however, to give a full dose of Epsom salts, 1 to $1\frac{1}{2}$ pounds, followed by half-ounce doses of saltpeter two or three times a day.

SORENESS—FOOT SORENESS.

Cattle that are driven over stony roads, especially such as have been stabled or pastured on soft ground, soon wear down the soles of their feet and become lame from foot-soreness. Draft oxen, for this reason, require to be shod. When the soreness is excessive it may develop into an active inflammation of all the sensitive structures of the foot—laminitis.

Treatment.—Rest, poulticing the feet with moistened clay, followed by astringent washes—strong white-oak bark or alum water.

LOSS OF HOOF.

Cattle sometimes become fastened between planks or otherwise, and pull off the wall of one or both claws in the effort to extricate themselves. The claws of one or more feet may be shed as the result of acute laminitis.

Treatment.—Apply a thick coating of pine tar over the bleeding surface, then cover with a layer of oakum or absorbent cotton; apply another coat of tar over this, and then bandage closely and firmly. This may remain without disturbance until the new growing wall becomes sufficiently strong to sustain the pressure and weight of the animal. If, however, at any time it becomes manifest that pus is forming under this dressing, by oozing or bad smell, the bandage should be removed and as much of the suppurating surface freshly dressed as may indicate any unhealthy condition. Before applying tar to this second dressing the foot should be soaked in a solution of chloride of zinc, 1 dram to a pint of water. This may have to be repeated every few days, and should be continued so long as there is any pus formation. If the loss of hoof is due to suppurative laminitis, the parts denuded of the horny covering must be thoroughly cleansed and disinfected with the zinc solution. Then apply a moderately thick layer of absorbent cotton, and apply the tar and bandage over this. After this the zinc solution may be poured in at the top of the dressing daily. It will thus soak in and saturate the dressing and inflamed tissue. It may become necessary to remove the whole of the dressing once a week to give the parts a fresh cleansing, and then to reapply it. In all cases where it can be avoided, the first dressing should never be removed entirely, but holes may be made through it for the escape of pus.

FOUL IN FOOT—FOOT-ROT.

A variety of causes may produce inflammation of the foot between the claws or toes; sometimes the inflammation will extend entirely around the bulb of the heels. It may be due to an overgrowth of the claws and inward pressure, as in ingrowing nail of man, or it may be caused by the irritation of stable filth, to impaction and hardening of soil between the claws, or to other foreign substances becoming wedged in and causing inflammation and softening or ulceration of the skin in the interdigital space. Tuberculous cattle are subject to foul feet. This disease is most frequently seen in the hind feet, though all four feet may become affected. It is never contagious among cattle like the foot-rot among sheep.

Symptoms.—The animal is observed to limp in walking. On examination of the foot we discover fever, swelling above the hoof, and of the soft parts between the claws, which frequently spreads the foot apart to a considerable extent, or the inflammation may have advanced to softening and sloughing of the interdigital membrane. If the disease is neglected at this stage deep abscesses may form and the pus burrow under the horny wall, or the joint within the hoof may become inflamed and the articular attachments destroyed, in which case the treatment will become difficult and recovery very tedious.

Treatment.—In the earlier stages of the disease, before pus burrows beneath the horn, a thorough cleansing and an application of a carbolic acid solution—1 ounce to a pint of water—clean stabling, and laxative food will soon remedy the evil. If deep sloughing has taken place the carbolic solution should be used, and a wad of oakum or cotton smeared with pine tar should be secured firmly in the cleft. This can be done by taking a strip of strong cloth, two inches wide, passing the middle between the claws, then tying the ends after winding them in opposite directions above the hoof. Sometimes warm poulticing, with oil-cake meal, boiled carrots, or boiled mashed potatoes, becomes necessary to relieve excessive fever and pain. If the pus burrows under the horn its channel must be followed by paring away the horn until the bottom is reached. The after treatment will be the same as that already recommended. If the joint becomes diseased an amputation of that toe will be the quickest and surest method to relieve the suffering of the animal, and offers the best chance for an early recovery.

ULCERATION OF THE HEEL.

Occasionally we find ulcers at the junction of the hair with the hoof at the heel, which present an elevated, raw, or ragged surface, and cause considerable lameness. This is generally due to a bruise of the fibrous cushion of the back part of the foot. Subsequent sloughing or necrosis may occur, or pus may form deep down within the wall and gain an exit at the margin of the heel.

Treatment.—If there is a deep opening inject the carbolic solution once a day until it closes. If the ulcer is only superficial apply, twice a week, a mixture of equal parts of blue vitriol and alum in dry powder.

FISSURE OF THE WALL—SPLIT HOOF.

This is rarely seen among cattle. It may occur in weak walls, in heavy-bodied cattle, by stepping on an uneven surface, especially when the point of the toe is grown out long. I have seen the point of the toe broken and the wall split almost up to the hair.

Treatment.—The divided sections may be brought into approximation and held in place by drilling a small hole from one side into and through the other, commencing half an inch back of the fissure on each side, then drive a light horseshoe nail through the hole and clinch it. Pare the injured claw as short as it will bear.

INTERDIGITAL FIBROMA.

Hard, nodular, fibrous tumors sometimes grow in the cleft of the foot, and cause inconvenience, lameness, absorption, or ulceration of the contiguous parts.

Treatment.—They should be dissected out, and the wound dressed with carbolized cosmoline once a day until healing is completed.

DEFORMITIES.

Deformities in the feet of cattle usually consist in overgrowth of horn, generally due to want of wear in animals which are stabled. The hoof may turn inward, outward, or upward, and may give rise to lameness, inability to walk, foul foot, etc. Bulls which are continually stabled, dairy cows also, very frequently have misshapen feet for want of an occasional trimming, which may eventually lead to permanent injury.

Treatment.—Cut the superabundant growth of horn down with saw, knife, or rasp, until the foot assumes its natural form.

PRICKS AND WOUNDS.

If an animal suffers with a penetrating wound from prick of fork or nail, the orifice of the wound should be enlarged to permit a free discharge of pus; then apply a flaxseed poultice, changing it three times a day until the fever has abated. Keep the animal on a clean floor until all lameness has disappeared.

If an animal is cut in the foot with barbed wire, piece of glass, or any other substance, dress the wound, after proper cleansing, with carbolic acid solution, 1 ounce to 20 of water. If any uneven edges of horn or skin or lacerated flesh project, trim them off, and in all cases when it can be done a tarred bandage should be applied. This will serve to sustain the cut surfaces in their place, exclude dirt, and protect against flies, maggots, etc.

When the wound has extended into a joint, surgical treatment may become necessary, which will require the services of an educated veterinarian.

Occasionally an animal becomes fastened by the foot in some crevice and sustains severe bruising, wrenching, or fracture of some part of the foot. In such cases cold water packs to the injured member will be of service until the fever and swelling disappear. Afterwards allow the animal rest until the usefulness of the foot is restored. This will be all that is required, unless complications arise.

DISEASES OF THE EYE AND ITS APPENDAGES.

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For the sake of gaining a clear comprehension of the diseases of the eye it becomes necessary to review the anatomy of this important organ. The essential organ of vision or globe of the eye will be first described, then the receptacle of this globe or orbital cavity, the muscles that move it, the protective membranes or eyelids, the membrana nictitans or accessory eyelids, and, lastly, the lachrymal apparatus.

The *globe* or *ball* of the eye approaches the spherical in form. On closer inspection, however, it will appear to be made up of two combined portions from spheres of different sizes. The posterior portion, forming about five-sixths of the ball, is a sphere of comparatively large size with a small segment cut off it in front, and at this point there is applied to it the anterior portion, which, being a segment of a smaller sphere, projects at the front of the ball with a greater convexity than the posterior portion.

The eyeball consists of concentrically arranged coats, and of refracting media inclosed within these coats. The coats are three in number, viz, (1) an external protective tunic made up of the *sclerotic* and *cornea*; (2) a middle vascular and pigmentary tunic, the *choroid;* (3) an internal nervous layer, the *retina*. The sclerotic is the white opaque part of the outer tunic, of which it forms about the posterior five-sixths, being coextensive with the larger sphere already mentioned. The cornea forms the remaining one-sixth of the outer tunic, being coextensive with the segment of the smaller sphere. It is distinguished from the sclerotic by being colorless and transparent. The choriod coat will be recognized as the black layer lying subjacent to the sclerotic. It does not line the cornea, but terminates behind the line of junction of that coat with the sclerotic by a thickened edge—the ciliary processes. At the line of junction of the sclerotic and cornea the iris passes across the interior of the eye. This, which may be viewed as a dependency of the choroid, is a muscular curtain perforated by an aperture termed the pupil. The retina will be recognized as a delicate glassy layer, lining the greater part of the choroid.

The refracting media of the eye are three in number, viz, (1) the aqueous humor, a watery fluid inclosed in a chamber behind the cornea; (2) the crystalline lens and its capsule, a transparent soft solid of a biconvex form, and placed behind the iris; (3) the vitreous humor, a transparent material with a consistence like thin jelly, and occupying as much of the interior of the eye as is subjacent to the choroid.

The *sclerotic* is a strong, opaque, fibrous membrane, which, in a great measure, maintains the form of the eyeball, and protects the more delicate structures within it. Its anterior portion, which is covered by the ocular conjunctiva, is commonly known as the "white of the eye." In form it is bell-shaped, and the optic nerve pierces it behind like a handle, the perforation being a little to its inner side. In front the rim of the bell becomes continuous with the cornea. The outer surface of the membrane receives the insertion of the muscles of the eyeball. The coat is thickest over the posterior part of the eyeball, and is thinnest a little behind its junction with the cornea.

The *cornea* is the anterior transparent portion of the outer coat of the eyeball. It may be viewed as a part of the sclerotic specially modified to permit the passage of light into the interior of the eye. Its outline is elliptical, approaching the circular, and its greatest diameter is transverse. At its periphery it joins the sclerotic by continuity of tissue, and as the edge of the cornea is slightly beveled and has the fibrous sclerotic carried for a little distance forward on its outward surface, the cornea is generally said to be fitted into the sclerotic like a watch-glass into its rim. The venous canal of Schlemm runs circularly around the eyeball at the line of junction of the sclerotic and cornea. The anterior surface of the cornea is exquisitely smooth, and is kept moist by the lachrymal secretion. Its posterior surface forms the anterior boundary of the chamber in which the aqueous humor is contained. The cornea is of uniform thickness, and is of a dense, almost horny, consistence. Save a few capillary loops of blood-vessels at its margin, the cornea is without vessels. Its structure is comprised of five distinct layers.

The *aqueous humor* occupies a chamber which is bounded in front by the posterior surface of the cornea, and behind by the capsule and suspensory ligament of the lens, and by the ends of the ciliary processes. It is across this chamber that the iris extends. The aqueous humor is composed of water, with a small proportion of common salt in solution.

The *iris* is a muscular pigmented curtain extending across the interior of the eye and having about its center an aperture termed the pupil. By variations in the size of this aperture the amount of light transmitted to the retina is regulated. It varies somewhat in color, but is most frequently of a yellowish-brown tint. Its anterior face is bathed by the aqueous humor. The greater part of the posterior surface is in contact with the capsule of the lens and glides on it during the movements of the curtain. The circumferential border is attached within the junction of the sclerotic and cornea. The inner border circumscribes the pupil, which varies in outline according to its size. When much contracted the pupil is a very elongated ellipse, the long axis of which is in the line joining the nasal and temporal angles of the eyelids. It contains muscular tissue, which by contracting or relaxing lessens or dilates the pupillary opening.

The *choroid coat* is a bell-shaped, dark membrane which lines the sclerotic. Its outer surface has a shaggy appearance, due to the tunica fusca, which unites the two coats. Between the two the ciliary vessels and nerves pass forward. Behind it is pierced by the optic nerve; in front it is continued as the ciliary processes, which form, as it were, the rim of the bell. The ciliary processes form a fringe around the slightly inverted rim of the choroid.

The *retina* is the most delicate of the coats of the eyeball. It is formed by the expansion of the optic nerve on the inner surface of the choroid, and like that coat, it is bell-shaped. Its inner surface is molded on the vitreous humor. The nervous structures of the retina terminate at a wavy line, the ora serrata, behind the ciliary processes. Ten distinct layers are described as composing the thickness of the retina.

The *lens* is situated behind the pupil, and is contained within a capsule of its own.

The *capsule* is a close-fitting, firm, transparent membrane. The anterior surface forms the posterior boundary of the cavity in which the aqueous humor is contained, and the iris in its movement glides on it. The posterior surface is in contact with the vitreous humor.

The *vitreous humor* occupies four-fifths of the interior of the eyeball. It is globular in form, with a depression in front for the lodgment of the lens. It is colorless, transparent, and of a consistency like thin jelly. It is enveloped by a delicate capsule—the hyaloid membrane, which is connected in front with the suspensory ligament of the lens, and ends by joining the capsule behind the lens.

The *orbital cavity*, situated at the side of the head, is circumscribed by a bony margin; posteriorly, however, there are no bony walls, and the cavity is confounded with the depression above and behind the orbit—the temporal fossa. A fibrous membrane completes this cavity and keeps it distinct from the temporal fossa. This membrane—the ocular sheath or periorbita—is attached posteriorly around the opening in the back part of the orbital cavity (the orbital hiatus) and anteriorly to its inner face; then it becomes prolonged beyond the margin to form the fibrous membrane of the eyelids. The orbital cavity has the form when complete of a regular hollow cone, open at its base and closed at the apex. The opening of this cone is directed forward, downward and outward. Independently of the globe of the eye, this cavity lodges the muscles that move it, the membrana nictitans, and the lachrymal gland.

The *muscles of the eye* are seven in number—one retractor, four straight, and two oblique. The retractor oculi envelops the optic nerve between the brain and the ball of the eye, and becomes attached upon the external face of the sclerotic tunic. When this muscle contracts, it draws the globe back into the orbit, away from the light. The superior, inferior, external, and internal recti or straight muscles are attached to the back part of the orbital sheath, and spread forward in four bundles over the globe of the eye, where they become inserted by a fibrous expansion into the sclerotic at the margin of the cornea. When they act singly they turn the globe either upward, downward, inward, or outward. The great oblique, by its action, pivots the eye inward and upward in the orbit. The small oblique turns the eye outward and downward.

The *eyelids* are two moveable curtains, superior and inferior, which cover and protect the eye in front. They are attached to the circumference of the orbit, and have a convex external face formed by the skin, and a concave internal face molded on the anterior surface of the eye, and are lined by the conjunctiva, which is reflected above and below on the eyeball. The border of each lid is slightly beveled on the inner side, and shows the openings of the Meibomian glands. These glands secrete an unctuous fluid, which is thrown out on the border of the lids, the function of which is to facilitate their movements and enable them to retain the tears in the ocular cavity. The eyelid is composed of a fibrous inner membrane ending in a stiff arch near the border, a muscle to close the lid, another to open it, the skin externally, and the conjunctival mucous membrane internally. The border of each lid is covered and protected by long hairs, to prevent floating particles of matter in the atmosphere gaining entrance to the eye.

The *membrana nictitans*, which is also named the third eyelid, winking eyelid, haw, etc., is placed at the inner angle of the eye, whence it extends over the eyeball to relieve it from foreign bodies which may fall upon it. It has for its framework a fibro-cartilage, irregular in shape, thick, and nearly prismatic at its base, and thin anteriorly where it is covered by the conjunctiva; behind, it is loosely attached to a fatty cushion.

The *lachrymal gland* is situated between the orbital process and the upper part of the eyeball. It secretes the tears destined to lubricate the anterior surface of the eye. This fluid escapes upon the organ at at the outer angle of the lids, and is carried between them and the eyeball towards the inner angle.

The *caruncula lachrymalis* is a small round body, frequently entirely or partially black, situated in the inner angle of the eye, and is designed to direct the tears towards the puncta lachrymalia.

The *puncta lachrymalia* are two little openings, situated one in each eyelid, a short distance from the inner corner, which admit the tears into the lachrymal ducts leading to the lacrymal canal, from whence they are emptied into the nasal passages.

CONJUNCTIVITIS—SIMPLE OPHTHALMIA.

This is an inflammation of the conjunctival mucous membrane of the eyeball and lids; in severe cases the deeper coats of the eye become involved, seriously complicating the attack.

Causes.—It may result from a bruise of the eyelid; from the introduction of foreign matters into the eye, such as chaff, hayseed, dust, gnats, etc.; from exposure to cold; poisonous or irritating vapors arising from filthiness of stable. Dust, cinders, or sand blown into the eyes during transportation frequently induce conjunctivitis.

Symptoms.—A profuse flow of tears, closure of the eyelids from intolerance to light, retraction of the eyeball and corresponding protrusion of the haw, disinclination to move, diminution of milk secretion, etc. On parting the lids the lining membrane is found injected with an excess of blood, giving to it a red and swollen appearance; the sclerotic or white of the eye is bloodshot and the cornea may be cloudy. If the disease advances keratitis results, with its train of unfavorable symptoms.

Treatment.—Careful examination should be made to discover particles of chaff, etc., which may have lodged in the eye, and upon the discovery of such a cause prompt removal is indicated. This may be accomplished by flushing the eye with warm water by means of a syringe, or if the foreign substance is adherent to the eyeball or lid it may be scooped out with the handle of a teaspoon or some other blunt instrument. To relieve the congestion and local irritation, a wash composed of acetate of zinc, 5 grains to the ounce of pure soft water, may be used, to which may be added twenty drops of laudanum. A few drops of this should be placed in the eye with a camel's-hair pencil or soft feather three or four times daily. The animal should be placed in a cool, darkened stable, and then a cloth folded into several thicknesses should be fastened to the horns in such a manner as to reach below the eyes. This should be kept wet with cold water during the day and removed at night. If there is much fever and constitutional disturbance it becomes advisable to administer 1 pound of Epsom salts dissolved in 1 quart of water.

CATARRHAL CONJUNCTIVITIS—SPECIFIC OPHTHALMIA.

This generally appears in an enzoötic form, and affects quite a number in the herd. It is usually attributed to some irritant material carried in the atmosphere or emanating from the soil. It is most prevalent on low grounds, and is seldom seen in the winter months. It affects old and young animals alike, but I have never witnessed a second attack in the same animal, although it appeared among freshly-introduced animals for several successive years.

Symptoms.—Catarrhal conjunctivitis is characterized chiefly by a mucopurulent discharge of the eyes, an intense degree of inflammation of the mucous membrane, accompanied by swelling of the eyelids and an early opacity of the cornea. The flow of tears is mixed with pus, sometimes streaked with blood, which gathers in large masses on the cheek. The eyes are kept continually closed. The implication of the cornea in the disease frequently blinds the animal for a time, and occasionally suppurative keratitis, ulcers of the cornea, or staphyloma supervene. The attack is marked from the onset by a high fever, loss of appetite, partial loss of milk, suspended rumination, and separation from the herd.

Treatment.—The animal should be housed in a cool, dark stable, supplied with plenty of fresh water to drink and soft succulent food. Administer 1 pound of Epsom salts—if a very large animal 1½ pounds—dissolved in 2 or 3 pints of water. Give tincture of veratrum viride every two hours in 30-drop doses and half an ounce of saltpeter three times a day. For an eyewash take boracic acid, 1 dram, and pour 4 ounces of boiling water over it. Use this wash as often as convenient, applying it directly to the eye. In the majority of cases improvement becomes manifest in a few days, and the eye will become clear and free from inflammation in ten days or two weeks. Where the disease develops ulceration of the cornea, or well-marked deep-seated keratitis, the treatment recommended for those conditions should be adopted.

Prevention.—Whenever this affection appears in a herd all the unaffected animals should be moved to another locality; that is, to fields which possess a different character of soil and feed. The water should also be changed, especially if they have been obtaining their drinking water from a running stream or stagnant pond.

KERATITIS—CORNEITIS.

This is an inflammation of the cornea proper, although the sclerotica at the corneal border becomes involved to some extent. It may be divided into diffuse and suppurative.

Causes.—The cornea constitutes the most prominent portion of the eyeball, hence it is subject to a variety of injuries—scratches, pricks, contusions, lacerations, etc. Inflammation of the cornea may also be due to the extension of catarrhal conjunctivitis or intraocular disease, and it may occasionally occur without any perceptible cause.

Symptoms.—Diffuse keratitis is characterized by an exudation into and an opacity of the cornea. The swelling of the anterior part of the eyeball may be of an irregular form, in points resembling small bladders, or it may commence at the periphery of the cornea by an abrupt thickening, which gradually diminishes as it approaches the center. If the whole cornea is affected it has a uniform gray or grayish white appearance. The flow of tears is not so marked as in conjunctivitis, nor is the suffering so acute. Both eyes usually become affected, unless it is due to an external injury.

In favorable cases the exudate within the cornea begins to disappear within a week or ten days, the eye becomes clearer, regains its transparency, until it eventually is fully restored. In unfavorable cases blood vessels form and are seen to traverse the affected part from periphery to center, vision becomes entirely lost, and permanent opacity (*albugo* or *leucoma*) remains. When it arises from constitutional causes recurrence is frequent, leaving the corneal membrane more cloudy after each attack, until the sight is permanently lost.

Suppurative keratitis may be a sequel of diffuse keratitis; more commonly, however, it abruptly becomes manifest by a raised swelling on or near the center of the cornea that very soon assumes a yellow turbid color, while the periphery of the swelling fades into an opaque ring. Suppurative keratitis is seldom noticed for the first day or two—not until distinct pus formation has occurred. When it is the result of diffuse keratitis, ulceration and the escape of the contained pus is inevitable; otherwise the pus may be absorbed. When the deeper membranes covering the anterior chamber of the eye become involved the contents of this chamber may be evacuated and the sight permanently lost.

Treatment.—Place the animal in a darkened stable, give green or sloppy food, and administer 4 ounces of Glauber's salt—sulphate of soda—dissolved in a quart of water once a day. If the animal is debilitated a tablespoonful of tonic powder should be mixed with the feed three times a day. This may be composed of equal parts by weight of powdered copperas (sulphate of iron), gentian, and ginger. As an application for the eye nitrate of silver, 3 grains to the ounce of soft water, with the addition of 1 grain sulphate of morphia, may be used several times a day. If ulceration occurs a solution of blue vitriol (sulphate of copper) or nitrate of silver, 5 grains to the ounce of water, should be used. (See Ulcer of Cornea.)

To remove opacity, after the inflammation has subsided, apply a few drops of the following solution twice a day: Iodide of potassium, 15 grains; tincture sanguinaria, 20 drops; distilled water, 2 ounces; mix.

ULCERS OF THE CORNEA.

An ulcer is the common consequence of the bursting of a small abscess, which not unfrequently forms beneath the delicate layer of the conjunctiva, continued over the cornea; or, in the very substance of the cornea itself, after violent keratitis, or catarrhal conjunctivitis. At other times the ulcer is produced by bruises, scratches, and other direct injury of the cornea.

Symptoms.—The ulcer is generally at first of a pale gray color, with its edges high and irregular, and discharges instead of pus an acrid watery substance, with a tendency to spread widely and deeply. If it spreads superficially upon the cornea, the transparency of this membrane is lost; if it proceeds deeply and penetrates the anterior chamber of the aqueous humor, this fluid escapes, the iris may prolapse, and the lens and the vitreous humor become expelled, thus producing a destruction of the whole organ.

Treatment.—It is of the greatest importance, as soon as an ulcer appears upon the cornea, to prevent its growing larger. The corroding process must be converted into a healthy one. For this purpose nothing is more reliable than the use of solid nitrate of silver. A stick of nitrate of silver should be scraped to a point; the animal's head should be firmly secured; an assistant should part the lids; if necessary the haw must be secured within the corner of the eye and then all parts of the ulcer should be lightly touched with the silver. After waiting a few minutes the eye should be thoroughly washed out with warm milk. This operation generally has to be repeated once more at the end of three or four days. If healthy action succeeds, the ulcer assumes a delicate fleshy tint, and the former redness around the ulcer disappears in proportion as the ulcer heals.

In superficial abrasions of the cornea, where there is no distinct excavation, this caustic treatment is not needed. The eye should be bathed with sulphate of zinc, 30 grains to half a pint of soft water, several times a day, and protected against exposure to cold air and sunlight. Excessive ulceration sometimes assumes the form of fungous excrescence upon the cornea, appearing to derive its nourishment from loops of blood-vessels of the conjunctiva. Under these circumstances the fungoid mass must be cut away, and the wound cauterized with the nitrate of silver, or else the eye will soon be destroyed. When ulcers of the cornea appear indolent, with a tendency to slough, in addition to the treatment already prescribed, tonic powders should be given twice a day mixed with the feed; powdered copperas, gentian, and ginger, equal parts by weight. Dose, one tablespoonful.

STAPHYLOMA.

This is a disease of the eyeball, in which the cornea loses its transparency, rises above the level of the eye, and even projects beyond the eyelids, in the form of an elongated, whitish, or pearl-colored tumor, which is sometimes smooth, at other times uneven.

Causes.—Inflammation is the only known cause, although it may not occur immediately; it frequently follows catarrhal conjunctivitis and keratitis as a sequela.

Treatment.—In a few cases restoration of sight may be effected by puncturing the projecting tumor, and treating it afterwards with nitrate of silver in the same manner as prescribed for ulceration of the cornea. I have known a few cases where spontaneous rupture occurred, and healing without any treatment at all.

CATARACT.

In cataract the crystalline lens becomes opaque and loses its transparency, the power of refraction is lost—the animal can not see.

Causes.—Cataract generally arises from a diminution—atrophy—or other change in the nutrition of the lens; it may occur as a result of inflammation of the deep structures of the eye. Cataract may be simple, or complicated with amaurosis, adhesions, etc.

Symptoms.—It is known by the whiteness or loss of transparency of the lens, although the pupil dilates and contracts. Sight may be totally lost; however, evidence is usually manifested that the animal distinguishes light when brought out of a darkened stable. For the most part the formation of cataract takes place slowly, the cases in which it originates very quickly being but few.

Treatment.—There is only one method for the treatment of cataract—a surgical operation for the removal of the lens; but this is not advisable, for the sight can not be perfectly restored, and objects would be seen imperfectly without the aid of glasses.

AMAUROSIS.

A paralysis of the nerve of sight or the expansion of the retina.

Causes.—This is the result of concussion from a blow upon the forehead, fracture of bone over the eye, causing downward pressure, rheumatic inflammation of the optic nerve, or from extension of deep inflammation of the eye involving the retina. It sometimes occurs as the result of excessive loss of blood, or of great debility.

Symptoms.—In this disease seldom any observation is made until the animal in its gait and by its action indicates blindness. Generally both eyes are affected. The eyeball remains clear, and the pupil permanently dilated. No response to light is manifested.

Treatment—If due to debility, loss of blood, or associated with rheumatism, general blood tonics may be given in the feed, viz, powdered sulphate of iron, 1 dram; gentian, 2 drams; nux vomica, one-half dram; to be given twice a day. In cases of rheumatism, one-half ounce of saltpeter may be added.

FILARIA OCULI—WORM IN THE EYE.

Filaria oculi (*provisionally taken as the larva of F. cervina*).—This is a small white worm, and is found in the eye, swimming in the aqueous fluid in the anterior chamber. It may be apparently harmless for a long time, but will eventually induce keratitis with inflammatory exudations.

Treatment.—The cornea may be punctured at its upper and outer margin, and the worm squeezed out with the aqueous humor. The latter will be formed again.

CORNEAL DERMATOMA—HAIRY TUMOR ON THE EYEBALL.

In a few instances this has been seen as a congenital growth. The tumor arises from the cornea or the sclerotic, covered by its respective membrane, with a growth of hair upon its surface. These tumors may be quite prominent or flattened, and are dark in color; the hair may protrude out between the eyelids, giving the animal the appearance of having a double eyelid.

Treatment.—A surgical operation becomes necessary for their removal, one requiring a skilled operator.

STRABISMUS—SQUINTING.

This is a very rare affection among cattle. Strabismus may be either single or double—affecting one eye or both. It is due to a paralysis, or a weakening of one of the straight muscles of the eyeball. Generally it is a congenital defect, and the squinting is towards the nose—strabismus convergens. It is best not to attempt to remedy the defect, as the risk in an operation is greater than the chances of success warrant.

PTERYGIUM.

This term is applied to a fleshy-colored membrane, triangular in form, which most frequently grows from the inner angle of the eye and extends over the cornea, thus interfering with vision. It may grow from the outer angle, or even from the superior or inferior hemisphere of the eyeball. The figure is invariably that of a triangle, with its base on the white of the eye, and its apex more or less advanced over the cornea toward its center.

The distinguishing characteristics are the constancy of the triangular form, and the facility with which the whole of it may be taken hold of with a pair of forceps and raised into a fold on the cornea. Every other kind of excrescence attached to this membrane continues firmly adherent to it, and can not be folded and raised from the surface of the cornea in any manner whatever.

Treatment.—Raise the fold and dissect it away from all points of attachment.

TRICHIASIS—INVERSION OF THE EYELASHES.

In the simplest form the eyelashes bend inwardly, touching the eyeball, causing irritation and simple conjunctivitis. It may be also associated with entropion.

Treatment.—The offending eyelashes should be cut off or pulled out. In cases where the natural growth of the eyelashes is directed inward an operation similar to that for entropion becomes necessary.

ENTROPION—INVERSION OF THE EYELID.

In inversion of the eyelid the eyelashes soon irritate the anterior face of the cornea, and produce more or less inflammation and opacity. The inversion may be due to the growth of a tumor within or without the lid, to abscess, laceration, or injury, causing the lid to lose its natural conformity to the eyeball, ulcerations, etc. Surgical interference, in either case, becomes necessary to restore the lid to its natural direction.

ECTROPION—EVERSION OF THE EYELID.

This serves to injure the eye by permitting dust and other foreign substances to gain admission to the eye, and interferes with the natural removal of such substances. A delicate surgical operation—the removal of an elliptic section of the palpæbral conjunctiva—may remedy the defect.

TUMORS OF THE EYELIDS.

Occasionally tumors form upon or within the substance of the eyelid. These may be of a fibroid nature, and arise from the follicles of the hair as sebaceous tumors, or may be in the form of an abscess. In debilitating diseases the lids sometimes become swollen and puffy, a condition which might possibly be taken for the growth of a tumor. This generally disappears with the improvement of the health of the animal. Warts not uncommonly appear on or about the eyelids of cattle.

Treatment.—The removal of a tumor in the vicinity of so delicate an organ as the eye should not be attempted by any one not qualified for the operation.

LACERATION OF THE EYELID.

This accident is not uncommon where cattle are fenced in by barbed wire; an animal may be caught under the eyelid by the horn of another; it may occur in the stable by means of a projecting nail or splinter of wood.

Treatment.—The edges of the wound should be brought together closely and correctly, by means of pins pushed through very nearly the whole thickness of the lid, extending through each lip of the torn part; then a waxed silk or linen thread must be wound over each end of the pin crossing the torn line in the form of the figure 8 (Plate XXVIII, Fig. 9); the pins should be placed about $\frac{3}{8}$ of an inch apart. The projecting ends of the pins should be cut off close to the ligature, and the parts kept anointed with vaseline to which has been added 5 per cent of creolin. In place of a pin suture, silver wire, catgut, or strong linen thread may be used in the way of an ordinary suture.

FOREIGN BODIES IN THE EYE.

Splinters of wood, hedge thorns, pieces of cornstalk or leaves, stems of hay or straw, twigs of trees, or weeds may penetrate into the eye, break off and remain, causing inflammation, blindness, abscess, etc. These substances may penetrate the eyeball, but more frequently they glide off and enter between the eye and the ocular sheath.

Treatment.—Their removal becomes often a very difficult task, from the fact that the organ is so extremely sensitive, and the retracting power so strong as to necessitate casting the animal, or even the administration of sufficient chloroform to render it completely insensible. The removal, however, is of paramount importance, and the after treatment depends upon the extent and location of the injury—cold water compress over the injured eye, the application of mild astringent and cooling washes, such as acetate or sulphate of zinc, 5 grains to the ounce of water. When there is extreme suffering from pain a 5 per cent solution of atropia or morphia, 5 grains to the ounce of water, may be dropped into the eye, alternating with the cooling wash several times a day. When abscesses form within the orbit a free opening must be maintained for the discharge of pus. In deep penetrating wounds of the eye there is a great tendency to the formation of a fungus growth, which often necessitates the enucleation of the whole eyeball.

ORBITAL AND PERIORBITAL ABSCESS.

Orbital abscess may form outside of the globe and within the orbital sheath, as the result of a previous wound of the parts, or from fracture of the bony orbit, etc. Periorbital abscess commences outside of the ocular sheath, beneath the periosteal membrane covering the bone, and is usually the result of a diseased or fractured bone which enters into the formation of the orbital cavity.

Symptoms.—Orbital abscess is manifested by a pushing forward of the eyeball (exophthalmos), a swelling of the conjunctiva and eyelids. The bulging out of the eye is in proportion to the size of the abscess; the movement of the eye is fixed, due to the painfulness of any voluntary movement of the eyeball. Periorbital abscess generally pushes the eye to one side; otherwise the symptoms are similar to the foregoing. The pain generally is very great; paralysis of the nerve of sight may occur, and death may be caused by the abscess extending to the brain.

Treatment.—The treatment for either orbital or periorbital abscess is the same as that for abscess occurring in any other part of the body—a free opening for the escape of imprisoned pus. This should be made as soon as the true nature of the disease is recognized. Afterwards antiseptic injections may be needed to stimulate healthy granulation and to prevent septic infection of the ocular membranes. For this purpose a saturated solution of boracic acid may be used, or listerine one part to ten of water. When the fever runs high, Glauber salts—sulphate of soda—may be given in 4-ounce doses once a day. The animal should be kept in a darkened stable, on soft or green feed.

FRACTURE OF THE ORBIT.

This accident occasionally occurs among belligerent animals, or as the result of blows delivered by brutal attendants. The orbital process above the eye may be entirely crushed in, pressing down upon the eyeball. In such an event the depressed bone should be elevated into its proper place, and if it fails to unite it may have to be removed with saw or chisel. The margin of the orbit may be crushed at any point and cause periorbital abscess, or necrosis may result from the presence of a splinter of bone or the excessive destruction of bone. In all cases of fracture the animal should be taken out of the herd and kept by itself until the injured part has had time to heal.

NECROSIS OF THE BONY ORBIT.

As the result of fracture of the margin of the orbit a part of the injured bone may become necrosed (dead), and periostitis and periorbital abscess will follow as a consequence. The discovery of this disease will at first resemble abscess, but on making an examination with a probe after the abscess is open we will find the bone rough and brittle at the point of disease. The discharge will have a peculiar fetid odor, and is often mixed with blood.

Treatment.—The affected bone must be laid bare and all diseased portions removed by scraping, or if necessary with saw or chisel, disregarding the extent of the injury or the size of the wound necessary to be inflicted. A large portion of the bony orbit may be removed without serious danger to the eye, provided the eyeball itself has not been previously affected by the disease or involved in the original injury.

TUMORS OF THE ORBIT.

A fungus tumor of the eyeball or orbit occasionally appears, which is designated *fungus hæmatodes.* This may arise without any appreciable cause, or as the result of a wound. It frequently commences within the eyeball as a small red mass, eventually bursts through, and pushes its way outside of the orbit as a large dark red mass, bleeding at the slightest touch. It has a peculiar fetid odor, and early in its appearance destroys sight, involving all the contents of the orbit, not infrequently the bony wall itself.

Unless the tumor is totally removed in its early stage of growth, together with the eyeball, the disease will eventually cause emaciation and death of the animal. The enucleation of the eyeball should not be undertaken by any one unacquainted with the anatomical structures involved in such an operation. When the operation is performed early enough the result is generally satisfactory.

Bony tumors of the orbit are occasionally present in cattle, the result of bruises, fractures, etc. They may encroach upon the contents of the orbit, causing paralysis of the optic nerve—the condition known as amaurosis—or by pressure upon the posterior surface of the eyeball force it forward, or produce atrophy (shrinking). They may displace the eye in any direction, with or without disturbing vision.

Fibrous tumors growing within the orbit will produce symptoms similar to those of bony tumors.

Treatment.—When the outlines of the tumor, whether fungoid, bony, or fibrous, can be detected, an operation for its removal should be undertaken as soon as the sight of the eye is in any manner disturbed.

DISLOCATION OF THE EYEBALL.

The eyeball may be torn out of its socket by the horns of another animal in a fight, or it may be crowded out with the blunt end of a club, cane, or probe in the hands of a human brute.

Treatment.—When the optic nerve is not lacerated and the retractor muscles at the back of the eye are intact, an attempt at reduction is advisable. This, however, must follow very soon after the injury—before swelling takes place. Divide the outer corner of the eyelid to enlarge the orifice, then by pressure with the fingers of both hands placed upon the sides of the eye the ball may be put back into its place. Apply a firm compress over the injured eye and keep it constantly wet with cold water, containing one dram of sugar of lead to each quart.

If the attempt at reduction proves unsuccessful the artery at the back of the eye should be ligated, and then the whole mass cut off as deep within the orbit as possible. The orbital cavity should be packed daily with fresh absorbent cotton after washing it out with a 3 per cent solution of carbolic acid or 10 per cent dilution of creolin.

INFLAMMATION AND ENLARGEMENT OF THE HAW.

The haw or membrana nictitans is subject to inflammation and swelling from the extension of conjunctivitis, or direct injury by foreign substances. It presents a red, swollen appearance, accompanied by considerable pain and a profuse flow of tears. A slight scarification with a sharp knife and the application of a cooling lotion, such as recommended for conjunctivitis, will soon reduce the swelling and restore it to its normal function.

There is, however, a tendency for an inflammation of this membrane to take on a chronic character, which may eventually result in a permanent enlargement, resembling a tumor. When it attains sufficient size to protrude itself permanently over the eye, or project between the lids so as to obstruct the sight, its removal may become necessary. A threaded needle is passed through the body of the enlarged mass by which the membrane is drawn out as far as possible, then with a blunt pair of scissors it may be dissected away from its attachments. The eye is afterwards treated with simple cooling lotions.

DISEASES OF THE EAR.

By M. R. TRUMBOWER, D. V. S., Sterling, Ill.

Diseases of the ears of cattle are not very common, for the reason, probably, that they are not subjected to the brutality of drivers so much as horses, and that the horns to a great extent protect them against external violence.

OTITIS—INFLAMMATION OF THE INTERNAL EAR.

Inflammation of the deep part of the ear is often difficult to recognize in cattle. It may be caused by disease of bone in that region, from blows inflicted by drivers or from injury by other cattle. Occasionally the ear becomes involved in actinomycosis, or the inflammation may be the result of a tuberculous affection.

Symptoms.—The animal will hold its head to one side, or shake it, while the ear itself is held immovable. The movement of the jaws in eating usually gives rise to a manifestation of pain; the base of the ear may be feverish and swollen, and very sensitive to the touch. If the inflammation has advanced to a suppurative stage matter will flow from the ear, which generally emits a very offensive odor.

Treatment.—At first hot fomentations to reduce pain and fever, followed by a sharp blister below the ear. Laudanum, one part to ten parts of sweet oil, may be injected into the ear to relieve pain and to soften the secretions. If there is a discharge from the ear it should be thoroughly washed out by injecting warm soapsuds until all the matter has been washed away, then inject the following mixture twice a day: Sulphate of morphia, 20 grains; water, 1 pint; glycerine, 4 ounces.

ABSCESS.

Abscesses sometimes form about the base of the ear, either inside or outside, caused by contusions. A serous cyst is found occasionally between the cartilage and the skin on the base of the ear, which may be due to a similar cause.

Treatment.—Make a free incision with the knife into the most prominent part of the abscess or cyst, then wash out the sac with carbolized water, using a syringe for the purpose. If the abscess recurs, open it again, wash it out, and inject tincture of iodine, or fill it with iodoform.

FUNGOID GROWTHS.

As a result of laceration, or wound of any kind, fungous growths may develop on the ear, characterized by a raw, bleeding, granulating surface, with a tendency to become pendulous.

Treatment.—The whole tumor or diseased structure should be cut away, and the wound treated daily with a dressing of carbolized cosmoline, or turpentine and sweet oil, one part of the former to four of the latter.

FOREIGN BODIES IN THE EAR.

Bugs have been known to gain entrance into the ear of an animal. I once removed an acorn from the ear of a cow that had been roaming in the woods. Accidentally, pieces of wood from a stanchion may become lodged in the ear.

Symptoms.—A continuous uneasiness or frequent shaking of the head, occasionally the manifestations of exceeding great pain. The animal may rub the head and ear against trees or other objects in an endeavor to dislodge the offending body.

Treatment.—A careful examination will reveal the offending cause, which may be removed with a pair of forceps, or scraped out with a hair-pin or piece of wire bent at one end. If much inflammation exists the ear may be swollen so that the foreign substance will be hidden from sight, then a probe may be inserted to feel for the object, which, when located, should be removed, even if it becomes necessary to split the ear at the base to do so. Afterward treat the ear with frequent warm water fomentations and the injection of soapy water, or oil and water.

SCURFY EARS.

Cattle are subject to scurfy ears, which may be due to a general morbid condition of the skin, or may be confined to the ears alone. The affected animal shows an inclination to rub the ear; thick scales of scurf collect on it, which sometimes have the appearance of hard, dry, horny scales. I believe this condition is chiefly due to a faulty secretion of the sebaceous glands of the ear, and would recommend a thorough cleansing with a stiff brush, then anoint the ear as far as affected with vaseline four parts to one part of white precipitate ointment. If the scurfy ears are only a part of a general scurfiness of the skin, the condition of the animal needs attention. (See "Pityriasis.")

FROSTBITE—GELATIO.

It is not uncommon among young cattle which are poorly nourished and exposed outdoors to storms and extreme cold to suffer frostbite of the ear, which may constitute actual freezing of the part.

Symptoms.—Gelatio presents naturally every degree of severity from the mere chilling of the tip of the ear to positive freezing and death of a portion. In a day or two after the freezing has occurred the ear will become swollen and very painful; the dead part will remain cold and begin to shrivel; a line of separation then forms between the inflamed and the dead or dying portion, and finally the piece destroyed drops off, leaving a raw healing surface. When the ear is only slightly affected by the cold an excoriation or peeling off of superficial skin takes place, accompanied by some pain and itching.

Treatment.—A good liniment for frozen ears will be found in a mixture of turpentine, ammonia, and chloroform, of each one part, added to six parts of sweet oil. Rub this on the ear several times a day. It will relieve pain and stimulate the circulation, thus favoring a recovery of the injured structures.

LACERATIONS OF THE EAR.

Aggressive dogs are the most frequent cause of lacerated ear, generally leaving a torn, ragged edge and bruised cartilage.

Treatment.—If the wound is extensive a trimming of the ragged edges becomes necessary; then fasten the edges together with silver wire, catgut, or strong thick linen thread, taking a deep hold. Apply pine tar.

DISEASE OF THE CARTILAGE AND NECROSIS.

Occasionally the cartilages of the ear become affected, usually the result of a deep bruise; pus forms, which burrows under the skin, and may find a discharge at any part of the ear more or less distant from the seat of the disease. When the cartilage has been extensively injured, pieces of it may become dead—necrosed—and dissolve, to be carried away with the pus, or it may lead to extensive sloughing and the formation of numerous running sores. In the disease of the cartilage there is seldom much swelling or great pain. The discharge is usually very offensive, and occasionally streaked with blood. Whenever there is a long-continued persistent discharge from one or more openings in the ear, disease of the cartilage may be suspected.

Treatment.—The sinus formed by the passage of matter should be probed and searched to the bottom for the presence of a foreign substance or the evidence of decaying cartilage. When the probe touches necrosed cartilage it will feel like the presence of a piece of dry leather or partially softened wood. A counter-opening must then be made at this place, and all diseased cartilage cut away with the knife. The subsequent treatment consists in keeping the artificial wound open for the discharge of pus, and the injection of chloride of zinc, 5 grains to the ounce of water, once or twice a day, until the wound is healed.

ENCHONDROMA OF THE EAR.

This is an excessive growth of cartilage, found at the base of the ear in the form of a hard, painless tumor, firmly attached to the movable ear. The only recourse for its removal is the knife in the hands of one acquainted with the anatomy of the part involved in the operation.

INFECTIOUS DISEASES OF CATTLE.

By Drs. D. E. SALMON and THEOBALD SMITH.

GENERAL INTRODUCTION.

The importance to the farmer and stock raiser of a general knowledge of the nature of infectious diseases need not be insisted on, as it must be evident to all who have charge of farm animals. The growing facilities for intercourse between one section of a country and another and between different countries cause a wide distribution of the infectious diseases once restricted to a definite locality. Not only the animals themselves, but the cars, vessels, or other conveyances in which they are carried may become agents for the dissemination of disease. The growing tendency of specialization in agriculture which leads to the maintenance of large herds of cattle, sheep, and swine makes infectious diseases both more common and more dangerous. Fresh animals are being continually introduced which may be the carriers of disease from other herds, and when this is once introduced into a large herd the losses become very high, because it is difficult, if not impossible, to check a disease after it has once obtained a foothold.

These considerations make it plain that only by the most careful supervision by intelligent men who understand the nature of infectious diseases and their causes in a general way can these be kept away. We must likewise consider how incomplete our knowledge concerning many diseases is, and probably will be for some time to come. The suggestions and recommendations offered by investigators may, therefore, not always be correct, and may require frequent modification as our information grows more comprehensive and exact.

An infectious disease may be defined as any malady caused by the introduction into the body of minute organisms of a vegetable or animal nature which have the power of indefinite multiplication and of setting free certain peculiar poisons which are chiefly responsible for the morbid changes.

This definition might include diseases due to certain animal parasites, such as trichinæ, for example, which multiply in the digestive tract, but whose progeny is limited to a single generation. By common consent the term infectious is restricted to those diseases caused by the invasion and multiplication of certain very minute unicellular organisms included under the general classes of bacteria and protozoa. Nearly all the diseases of cattle, for which a definite cause has been traced, are due to bacteria. Among these are tuberculosis, anthrax, black quarter, and tetanus (or lockjaw). Only one, Texas fever, is traceable to protozoa, and one, actinomycosis, to a fungus. Those diseases, of which the cause is unknown or imperfectly worked out, are pleuro-pneumonia, rinderpest, foot-and-mouth disease, rabies, cowpox, malignant catarrh, and dysentery.

Bacteria may be defined as very minute, unicellular organisms of a plant-like character. Their form is very simple, as may be seen from an inspection of the various species depicted on Plate XXIX. The description of these figures will be found at the end of this article. The magnification there given will furnish the reader some idea of their very minute size. They multiply in two ways. The bacterium elongates and then divides in the middle to form two daughter cells. These go through the same process at once and thus four cells are produced. The division of these leads to 8, the division of 8 to 16, and so on indefinitely. The rapidity with which this multiplication takes place depends upon the nature of the bacterium. The bacillus of tuberculosis multiplies very slowly, while that of anthrax multiplies with great rapidity, provided both are in the most favorable condition. Another mode of reproduction, limited to certain classes of bacteria, consists in the formation of a spore within the body of the bacterium. Spore formation usually takes place when the conditions pertaining to the growth of the bacteria become unfavorable. The spores are much more resistant to destructive agents than the bacteria which produced them. The anthrax spore may live several years in a dried state, but the anthrax bacillus perishes in a few days under like conditions. This matter will be referred to again when we come to discuss the subject of disinfection.

Of the protozoa which cause disease very little is at present known. The one which produces Texas fever is pictured on Plate XLIII, in Figs. 4 and 5. These parasites have a more complex life history than bacteria, and as they can not be grown in artificial media their thorough investigation is at present hampered with great difficulties.

The differences in the symptoms and lesions of the various infectious diseases are due to differences in the respective organisms causing them. Similarly the great differences observed in the sources from which animals become infected and the manner in which infection takes place are due to differences in the life history of these minute organisms. Much discussion has taken place of late years concerning the precise meaning of the words infection and contagion. But these words are now wholly inadequate to express the complex processes of infection, and it may be said that each species of bacterium or protozoön has its own peculiar way of invading the animal body, differing more or less from all the rest. There are, however, a few broad distinctions which may be expressed with the help of these old terms. Infection, as laid down above, refers at present in a comprehensive way to all microörganisms capable of setting up disease in the body. Some microörganisms are transmitted directly from one animal to another, and the diseases produced may be called contagious. Among these are included pleuro-pneumonia, rinderpest, foot-and-mouth disease, rabies, cowpox, and tuberculosis. Again, certain organisms are perhaps never transmitted from one animal to another, but may come from the soil. Among these are tetanus, black quarter, anthrax, to a large extent, and perhaps actinomycosis in part. These diseases according to some authorities may be called miasmatic. There is a third class of infectious diseases of which the specific bacteria are transmitted from one animal to another, as with the contagious diseases, but the bacteria may, under certain favorable conditions, find enough food in the soil and the surroundings of animals to multiply to some extent after they have left the sick before they gain entrance into a healthy animal.

This general classification is subject to change if we take into consideration other characteristics. Thus tuberculosis would not by many be considered contagious in the sense that foot-and-mouth disease is, because of the insidious beginning and slow course of the disease. Yet the bacillus must come from preëxisting disease in either case. The disease of rabies or hydrophobia is not contagious in the sense that rinderpest is, because the virus of rabies must be inoculated into a wound before it can take effect. Yet, in both cases, the virus passes without modification from one animal to another, though in different ways.

Again, all the diseases under the second group, which seem to come from the soil and from pastures, are in one sense contagious in that the virus may be taken from a sick animal and inoculated directly into a healthy animal with positive result. Other illustrations may be cited which show that these old terms are not in themselves satisfactory. There are so many conditions which enter into the process of infection that no single classification will give a sufficiently correct or comprehensive idea of it. These statements will be easily understood if the different infectious diseases in the following pages be studied with reference to the way or ways in which each disease may be contracted. Enough has been said, therefore, to show that if we wish to make ourselves acquainted with the dangers of any given disease we must study that disease and not rely upon any single word to tell the whole story.

Infectious diseases have, as a general rule, a period of incubation which comprises the time elapsing between the infection and the actual appearance of the disease. This period varies with the malady. The most common symptom of this class of diseases is fever. The severity of the fever is measured by the temperature of the animal and this is readily and accurately ascertainable by the clinical thermometer. (See Plate III, Fig. 1.) The other symptoms are variable and depend upon the particular organ or organs most implicated. Loss of appetite, cessation of rumination and milk secretion, and general dullness are symptoms quite invariably present in most infectious diseases.

Secondary diseases or complications may arise during the course of infectious diseases which are largely due to bacteria other than those producing the original malady. These complications are often so severe as to become fatal. In general it may be stated that they are due to filthy surroundings, and hence cleanliness may become an important aid to recovery.

The treatment of infectious diseases is given under each malady so far as this is allowable or advisable. These diseases are not, as a rule, amenable to treatment. When the symptoms have once appeared the disease is apt to run its course in spite of treatment, and if it is one from which animals usually recover, all that can be done is to put them into the most favorable surroundings. Many infectious diseases lead sooner or later to death, and treatment is useless so far as the sick are concerned. But it may be worse than useless for those not yet infected. All animals suffering with infectious diseases are a menace to all others more or less directly. They represent for the time being manufactories of disease germs, and they are giving them off more or less abundantly during the period of disease. They may infect others directly or they may scatter the virus about, and the surroundings may become a future source of infection for healthy animals. This leads us to the subject of prevention, as the most important of all which claim our attention. In this place only a few general remarks will suffice to bring the subject before the reader.

The most important thing is to keep disease away from a herd or farm. To do this all sick or suspicious animals should be avoided. A grave form of disease may be introduced by apparently mild or trivial cases brought in from without. It is generally conceded that continual change and movement of animals are the most potent means by which infectious diseases are disseminated.

With some cattle diseases, such as anthrax, black quarter, and pleuro-pneumonia, preventive inoculation is resorted to in some countries. This may be desirable when certain diseases have become stationary in any locality so that eradication is impossible. It should not be practiced in territories where a given disease may still be extirpated by ordinary precautions. Preventive inoculation is applicable to only a few maladies, and therefore its aid in the control of diseases is a limited one.

When an infectious disease has gained foothold in a herd the course to be pursued in getting rid of it will depend upon the nature of the malady. A good rule is to kill diseased animals, especially when the disease is likely to run a chronic course, as in tuberculosis. The next important step is to separate the well from the sick by placing the former on fresh ground. This is rarely possible, hence the destruction or removal of the sick, with thorough disinfection of the infected locality, is the next thing to be done. As to the disinfectants to be used, special directions are given under the various diseases, to which the reader is referred. Here we will simply call attention briefly to the general subject.

Disinfection consists in the use of certain substances in solution which destroy bacteria or their spores, or both. Those which are cheapest and most available for animal diseases are ordinary freshly slaked lime or unslaked in powder, chloride of lime, crude carbolic acid, and mercuric chloride or corrosive sublimate.

(1) Slaked lime is perhaps the most easily procured, but its disinfecting power is limited. While it is capable of destroying all bacteria in their vegetative state, it is unable to destroy spores such as those of anthrax and black quarter. It is probable, however, that in incrusting spores it may destroy their vitality sooner or later. It is regarded as safe practice to use only spore-destroying substances for the virus of those diseases of which we have no definite knowledge. Nevertheless in the absence of other disinfectants lime is very useful. It may be employed as a whitewash on wood and stone and sprinkled as a dilute wash or in powder over yards, manure heaps, and over carcasses before they are buried and over the ground on which they have lain, to prevent other animals from carrying the infection away.

(2) Chloride of lime is more efficient than simple slaked or unslaked lime, since it destroys spores. It is the ordinary bleaching powder of commerce, and is quite unstable, hence old preparations, unless sealed, are of little value. A 5 per cent solution is sufficiently strong for all spore-bearing bacteria (3 ounces in 2 quarts of water).

(3) Crude carbolic acid. The ordinary purified carbolic acid is too expensive to be used on a large scale, and the crude product is a very good substitute. This is made more powerful by mixing with it an equal volume of commercial sulphuric acid. While the sulphuric acid is being added to the crude carbolic acid much heat is evolved, and if the glass jar in which the two are mixed together is placed in cold water the resulting product is said to have a higher disinfecting power. The mixture is added to enough water to make a 5 per cent solution (about 3 ounces to 2 quarts of water). This is strong enough for all purposes. It may be kept in wood or glass but not in metal, owing to the corroding action of the acid. It should be applied freely on woodwork and on infected floors. It must be borne in mind that it may be injurious to the hands, and to the feet of animals which are compelled to walk in it. In most cases where its application becomes desirable—and this rule should apply to all disinfections—the disinfected stables, stalls, etc., should remain vacant as long as possible before cattle are again put in.

(4) Mercuric chloride or corrosive sublimate is a powerful disinfec-

tant but it is likewise very poisonous, hence its uses are limited. A solution of one-tenth per cent is usually sufficient (1 ounce to 15 gallons water). It is corrosive, and hence metal pails and dishes are to be avoided. All solutions should be labeled "poison," and to avoid accidents none should be kept on hand. In general the three first mentioned are safer, and Nos. 2 and 3 equally powerful in the solutions recommended.

In addition to these artificial substances there are several natural sanitary agents of great importance as destroyers of virus. These are cleanliness, ventilation, drying, and sunshine. All virus excepting such as may live in the soil is killed sooner or later by drying and sunshine, and the importance of these factors in the daily life of animals need not be insisted on here. Finally, all sanitary measures which contribute to the healthfulness of animal surroundings are directly or indirectly inimical to disease germs, and all carelessness in the keeping of animals may be regarded as an ally of these destructive organisms.

CONTAGIOUS DISEASES.

(Description of Plate XXIX.)

The bacteria on this plate are partly from tissues, partly from cultures, and stained artificially with aniline colors (fuchsin or methylene blue). Figs. 6 and 7 are copied from Fränkel and Pfeiffer's atlas. All but Fig. 7 are magnified 1,000 times; Fig. 7, 500 times.

Fig. 1. Bacteria from pneumonia in cattle. These are also the cause of Wildseuche and Rinderseuche in Europe, and are closely related to swine-plague bacteria. These bacteria were drawn from a piece of spleen-pulp (rabbit).

Fig. 2. Micrococci (staphylococcus) which produce inflammation and suppuration, also pyæmia.

Fig. 3. Micrococci (streptococcus) which produce inflammation of the lining membranes of the abdomen, thorax, heart, brain, and joints. Frequently associated with the preceding bacteria in abscesses.

Fig. 4. Bacilli of black quarter. The pale oval bodies as well as the light spots in one end of the bacilli represent spores.

Fig. 5. Bacilli which produce tetanus or lockjaw. The light spot in the enlarged ends of the rods represent a spore.

Fig. 6. Bacilli of tuberculosis. Microscopic sections of a pearly nodule from the lining membrane of the chest cavity. The bacilli are stained red and appear as small straight rods within the cells of the nodule or tubercle.

Fig. 7. Bacilli of anthrax. Bacilli from the spleen of a mouse inoculated with a culture. The bacilli were obtained from the blood of a cow which died of anthrax in Mississippi. The bacilli appear as rods stained blue. The round bodies are blood corpuscles, also stained artificially.

CONTAGIOUS PLEURO-PNEUMONIA.

Definition and history.—This disease has been eradicated from the United States, and it is not probable that it will ever be seen in this country again. As, however, much interest has been manifested in regard to it for a number of years, and as our cattle are still prohibited from some foreign markets on account of its recent existence here, the subject is treated at greater length than would otherwise be necessary.

Fig. 1

Fig. 2

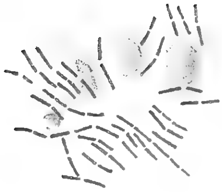
Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7



The Orcutt Co. Litho. Chicago.

VARIOUS BACTERIA WHICH PRODUCE DISEASE IN CATTLE.

The contagious pleuro-pneumonia of cattle is a specific epizoötic disease which affects bovine animals, and from which other species are exempt. It is characterized, when the disease results from exposure in the usual manner, by an inflammation of the lungs and pleuræ, which is generally extensive, and which has a tendency to invade portions of these organs not primarily affected, and to cause death of the diseased portion of the lung. This disease is frequently called *the lung plague*, which corresponds with its German name of *Lungenseuche.* In French it is spoken of as the *péripneumonie contagieuse.*

The history of the contagious pleuro-pneumonia of cattle can not be traced with any certainty to a period earlier than the beginning of the eighteenth century. No doubt it existed and ravaged the herds of Europe for many years and perhaps centuries before that time, but veterinary knowledge was so limited that the descriptions of the symptoms and post-mortem appearances are too vague and too limited to admit of the identification of the maladies to which they refer. It has been supposed by some writers that certain passages in the writings of Aristotle, Livy, and Virgil show the existence of pleuro-pneumonia at the time that their works were composed, but their references are too indefinite to be seriously accepted as indicating this rather than some other disease.

As early as 1713 and 1714 it seems quite plain that pleuro-pneumonia existed in Suabia and several cantons of Switzerland. Even clearer accounts are in existence of its prevalence in Switzerland in 1732, 1743, and 1765. In 1769 a disease of cattle was investigated in Franche-Comté by Bourgelat which was called *murie*, but which undoubtedly was identical with the pleuro-pneumonia of to-day. From that period we have frequent and well-authenticated accounts of its existence in various parts of Europe. During the period from 1790 to 1812 it was spread throughout a large portion of the continent of Europe by the cattle driven for the subsistence of the armies, which marched and countermarched in all directions. It was generally prevalent in Italy in 1800. It appears to have been unknown, however, in the department of the Nord, France, until 1826, but during the years from 1820 to 1840 it penetrated into most parts of that country. During the same period it was introduced into and allowed to spread over Belgium and Holland.

This contagion is said to have been carried to Ireland from Holland in 1839, and is reported as existing in England in 1842. The disease was brought to the United States at several different times. Probably the first introduction of the contagion was with a diseased cow sold in Brooklyn, N. Y., in 1843. It came to New Jersey by importing affected animals in 1847. Massachusetts was infected in the same way in 1859.

South Africa was infected by a bull brought from Holland in 1854, and Australia likewise received the contagion with an English cow in 1858. It is also reported as existing in various parts of the continent of Asia, but the time of its first appearance and the extent of its distribution are very uncertain.

Some countries, which had only been infected for a short time, such as Norway, Sweden, and Denmark, have succeeded in eradicating the disease without much difficulty by slaughtering all affected and exposed animals. Other countries long infected, and in which the contagion was thoroughly established, like Australia, South Africa, Italy, France, Belgium, and parts of Germany, have labored long, in some cases making no progress, and in others being only partially successful. Holland was one of the first of the thoroughly infected countries to free itself from the contagion.

In the United States, Massachusetts eradicated pleuro-pneumonia during the period from 1860 to 1866. New York and New Jersey made an attempt to eradicate it in 1879, but were not successful. Late in 1883 the contagion was carried to Ohio, probably by Jersey cattle purchasedin the vicinity of Baltimore, Md., to which place it had extended previous to 1868. From the herd then infected it was spread by the sale of cattle during 1884 to a limited number of herds in Illinois, to one herd in Missouri, and to two herds in Kentucky. The alarm caused among the stock-owners of the United States by this widespread dissemination of a disease so much dreaded led to the adoption of active measures for its control and eradication. By coöperation between the United States Department of Agriculture and the authorities of the affected States it was found possible to prevent the further spread of the contagion and to eradicate it after a few months' delay.

In 1886 pleuro-pneumonia was discovered in some of the large distillery stables of Chicago, and among cows on neighboring lots. This led to renewed efforts to secure the complete extirpation of this disease from the country. Congress, in 1887, enlarged the appropriation available for this purpose, and gave more extended authority. During the same year the disease was stamped out of Chicago, and has not since appeared in any district west of the Allegheny Mountains.

The work of eradication was at the same time commenced in all of the infected States. Before the end of the year 1889 Pennsylvania, Delaware, Maryland, the District of Columbia, and Virginia had been freed from the disease. More difficulties, however, were encountered in the States of New York and New Jersey, on account of the larger territory infected and the density of the population. The long struggle was crowned with success, however, and the last animal in which the disease appeared in the State of New York was slaughtered early in 1891, and the last one affected in New Jersey met the same fate early in the spring of 1892.

During these same years a supreme effort has been made to stamp out this lung plague from Great Britain. From the official reports it appears that the number of infected districts and of diseased animals have rapidly diminished, and there is good reason to believe that if the work is continued for a sufficient time it will meet with success. The chief obstacle appears to be in connection with Ireland, where the contagion is believed to be widely disseminated and where the activity of the authorities is not so manifest as in England and Scotland. If the contagion is allowed to linger in Ireland it is very plain that Great Britain can never long remain free from it.

The other infected European countries, though they maintain a veterinary sanitary service, are not making satisfactory progress in eradicating the disease. This is due partly to delays in carrying out the provisions of the laws and partly to mistaken ideas as to the measures which are necessary to accomplish the object. The United States was the last of the countries, having old infected districts, which undertook to stamp out this contagion, and, excepting Holland, it is the first to reach success.

The cause (etiology) of pleuro-pneumonia.—This is a contagious disease, and on the American continent, at least, it only arises by contagion from a previously affected animal. It is, consequently, never seen here except as the result of importing affected animals from the Old World. When thoroughly stamped out it does not reappear, and if imported animals continue to be properly inspected and quarantined we have every reason to believe that pleuro-pneumonia will never again be seen affecting the cattle of this country.

The exact nature of the virus or contagion of lung plague has never been determined. Efforts have been made by the methods now common in bacteriology to cultivate and isolate the pathogenic germs, but up to the present these have not been successful. Various investigators have from time to time claimed the discovery of the specific germs of the disease, but in every case these claims have proved to be unfounded. The methods now in use for such investigations do not appear proper for the discovery of these germs. They do not multiply in any of the substances which are used to cultivate other disease germs, and they are not revealed by the most advanced methods of microscopical research. That this disease is caused by microörganisms of some kind appears certain from our knowledge of the cause of other contagious diseases, and these no doubt will be discovered when our methods of research are sufficiently advanced.

As the specific cause of the disease is not known, we are, of course, uncertain in regard to many of the characters of the virus and of the conditions necessary for it to retain its virulence when outside of the animal body. Some investigators and writers are of the opinion that the disease can only be contracted by an animal coming near enough to a living diseased animal to receive the contagion directly from it. They hold that the contagion is expired with the air from the affected lungs, and that it must be almost immediately inspired by another animal in order to produce the disease. Some experimental attempts to infect animals by placing them in stables where diseased animals have been, and by placing the diseased lungs of slaughtered animals in their feeding troughs have failed, and, consequently, apparently confirm this view.

On the other hand, it is known that the serum from affected lungs retains its virulence and may be used successfully for inoculation weeks or months after the death of the animal from which it was taken. This is particularly the case when this liquid is hermetically sealed in glass tubes. Other investigators state that they have successfully infected cattle by placing in the nostrils sponges or pledgets of cotton saturated with such serum. Cattle have also, according to the best evidence attainable, been infected from the clothing of attendants, from horns used in drenching, and from smelling about wagons which have been used to transport carcasses of animals affected with this disease. In the work of eradicating pleuro-pneumonia from the United States many stables have been found in which the disease would appear and reappear after the slaughter of affected herds, and in spite of any precautions which could be adopted. These were always old stables, with woodwork in a decaying condition and with floors underlaid with filth which could not be thoroughly removed or disinfected. In every one of these cases the destruction of the stable, the burning of the lumber of which it was constructed, the removal of the accumulations beneath the floors, and the thorough disinfection prevented the recurrence of the plague in new stables built upon the same premises. This experience conclusively shows that under certain conditions, at least, stables may retain the infection for a considerable time, and that when restocked the disease may break out again from such infection.

As a rule, however, the disease is acquired by a healthy animal being near to an affected one and receiving the contagion direct. Affected animals may give off the contagion in the early stages of the disease before the symptoms are apparent to the observer, and they may retain this infectious character, if they survive the attack, for six months and probably for a year after all symptoms of the disease have disappeared.

Incubation.—The time which elapses between exposure to the contagion of pleuro-pneumonia and the first appearance of the symptoms of this disease varies greatly with different individuals and with different outbreaks of the disease. Ordinarily the symptoms of disease make their appearance within from three to six weeks after exposure; but they may be observed within two weeks or they may not become apparent until nearly or quite three months. It is this long period of incubation, and the great length of time that an animal may disseminate the contagion after apparent recovery, which give the plague that insidious character so often spoken of, and which greatly increases the difficulties of eradication.

Symptoms.—The symptoms are such as would be expected with inflammation of the lungs and pleuræ, but they vary considerably according to the type which the disease manifests. If the attack is an acute one, as is frequently seen in hot weather, the symptoms appear suddenly, the breathing becomes rapid and difficult, the animal grunts or moans with each expiration, the shoulders stand out from the chest, the head is extended on the neck, the back is arched, the temperature is 104° to 107°, the milk secretion is suspended, there is no appetite, rumination is stopped, the animal may bloat and later be affected with a severe diarrhea. Such cases are generally fatal in from seven to twenty days.

Very often the attack comes on slowly and the symptoms are much less clear. In the mildest cases there is a cough for a week or two, but no appreciable loss of appetite or elevation of temperature. The lungs are but slightly affected and recovery soon follows. Such animals may disseminate the contagion for a long time without being suspected, and for that reason are the most dangerous of all.

A more severe type of the plague is the most frequently seen. In these cases the cough is frequent, more or less painful, the back somewhat arched, and the milk secretion diminished. The prominence of these symptoms increases, the appetite is affected, the animal loses flesh, the breathing becomes more rapid, the cough more painful, pressure of the fingers between the ribs shows tenderness, the hair loses its gloss and stands erect, the skin becomes adherent, little if any milk is secreted, and the temperature rises to 103° or 105°. Animals thus affected may continue to grow worse and die in from three to eight weeks, or they may after a time begin to improve and make an apparent recovery. The inflammation of the lung does not, as a rule, subside and the organ return to its normal condition as is the case in ordinary pneumonia, but with this disease the life of the affected portion of the lung is destroyed, the tissue dies and a fibrous wall is formed around it to shut it away from the living parts of the body. The tissue, thus encysted, gradually softens, becomes disintegrated and breaks down into pus. The recovery, therefore, is not complete; it is only apparent and partial.

To those accustomed to examining the lungs of cattle, other and extremely important symptoms may be detected during the course of the disease. By applying the ear over the walls of the chest an area of a certain extent may be found where the natural breathing sound is diminished or entirely lost. This represents the diseased portion of the lungs. In other cases a loud blowing sound may be heard, quite different from any sound produced when the lung is in a healthy condition. In some cases crepitation is heard near the border line of the diseased area, and friction sounds produced by the roughened pleura; but these can only be appreciated by those whose ears have been trained to distinguish between the different sounds which reach the ear when applied to the chest wall. By percussion, that is, by pressing the fingers of the left hand firmly against the wall of the chest and tapping upon the middle finger with the ends of the fingers of the right hand, an area of dullness may be discovered corresponding to the portion where the respiratory murmur has disappeared. This loss of respiration detected by ausculation, and the dullness brought out by percussion, are the most important evidences of an inflamed or consolidated lung.

Seriously affected animals remain standing, if they have sufficient strength, but those which lie down always lie on the affected side.

The proportion of animals which become affected after being exposed varies according to the virulence of the outbreak, the susceptibility of the animals, and the length of time during which exposure is continued. Sometimes not over 15, 20, or 30 per cent will contract the disease when a large herd is exposed; but, on the other hand, 80 or 90 per cent may be affected. The proportion of cases in which the disease proves fatal also varies greatly—it may not exceed 10 per cent and it may reach 50 per cent. In general it may be said that about 40 per cent of the exposed animals will contract the disease and about one-half of these cases will prove fatal.

Post-mortem appearances.—Owing to the complexity of the structure of the lung tissue, its ramifications of bronchial tubes and blood-vessels and its abundant supply of lymphatics, the pathological changes in pleuro-pneumonia are but imperfectly understood and interpreted with great difficulty. Our ignorance as to the nature of the exciting cause adds to this difficulty. Furthermore there are certain kinds of pneumonia which present some resemblances to pleuro-pneumonia and which may therefore be confused with it in some of its phases.

If we kill an animal affected with acute pleuro-pneumonia and examine the cavity of the chest and lungs the following appearances will be noted:

The thorax may contain more or less serum, which may be clear or clouded. There may be firm adhesions of different parts of the lungs to the chest wall, the extent of which depends on the stage and severity of the disease. The diseased lobes are unusually large and exceedingly firm to the touch. The weight of a single large lobe may reach 40 pounds. Usually only one side is affected, often but a single lobe, and this most commonly the large or principal lobe. The pleura may be covered with one or more layers of a firm, elastic grayish membrane, which varies in thickness and which sometimes may be pulled away entirely. Sometimes it is absent. The pleura, however, is opaque and apparently very much thickened. This is due to the diseased condition of the connective tissue beneath the pleura, as will be explained further on. When an affected lobe is cut through at right angles to its long diameter the cut surface will present a variety of interesting changes. In the first place, the spaces between the small subdivisions of the lung (the lobules), which in the healthy lung are barely visible, are distended with a yellowish white, usually quite firm, substance, which is coagulated fibrin. The cut surface thus appears divided up into small fields by yellowish white bands of varying thickness running in various directions through the lung tissue and beneath the pleura. (Plate XXXII.) These bands may appear honeycombed and the spaces filled with yellowish fluid (serum) or they may be uniformly solid. It will also be noticed that the space immediately outside of and around the artery, vein, and air-tube is similarly broadened by fibrinous deposits. Some authorities look upon these bands as constituting the so-called marbling of pleuro-pneumonia.

In addition to these changes which have taken place in the connective tissue between the lobules, the lung tissue itself may be markedly altered. Certain areas of the cut surface may be very firm in texture and brownish red in color. The cut surface is granular or roughened, not smooth to the eye. Other areas equally firm may be more grayish yellow in color, still others may be blackish. (Plate XXXIII.) Besides these areas which represent solidified (hepatized) lung tissue there may be others which approach the normal lung tissue in color and which are soft and float in water. From these a milky purulent fluid may often be expressed. These different shades are represented in Plate XXXII, Fig. 2, within a small compass. Some authorities are inclined to consider these variations in color on the same cut surface as the so-called marbling of pleuro-pneumonia. It matters not whether we regard the bands between the lobules or the varying shades of the lobules themselves as the marbling, provided either or both are peculiar to contagious pleuro-pneumonia. If we examine the blood-vessels appearing on such a cut surface they will usually be found plugged within the firmly hepatized regions. The artery contains a dark, soft, removable clot, the vein a grayish pink, granular, fragile plug (thrombus) which adheres firmly to the wall of the vein, and if this be slit open, indications of a diseased condition of the inner coat will be readily detected. When large regions of the lung tissue are hepatized the main air-tube and its branches are usually filled with grayish, cylindrical branched masses of fibrin easily removed, as they do not adhere to the mucous membrane.

The views of pathologists differ as to the nature of the earliest changes in pleuro-pneumonia, and it is not within the scope of this work to present imperfectly developed or controverted theories. In the foregoing description we have taken as a type the acute pleuro-pneumonia in its fully developed phase, which can scarcely be mistaken for any other disease. We have seen that there is an inflammatory condition of the connective tissue between the lobules, resulting in the exudation of coagulable lymph. This inflammation is equally marked around the blood-vessels and air-tubes. It leads to inflammatory changes in the inner wall of the veins, and these cause the deposition of thrombi or plugs in the vessels, which prevent the return of the blood. The blood pumped into the lung tissue through the artery, but unable to get out by way of the vein, leaves the meshwork of capillaries around the air vesicles, enters the latter, and produces the firm hepatized condition so characteristic of this disease. It will be easily understood how the different shades of color from dark red to grayish or yellowish red are produced if we bear in mind that the veins in different parts of the lung tissue are plugged at different times, and that, therefore, the affected regions are in different stages of disease.

The complete plugging of the veins may lead to the death of circumscribed masses of lung tissue. A line of separation forms between the living and the dead tissue and a thick cyst wall of fibrous tissue forms around the latter. The dead tissue for a time preserves the appearance of lung tissue, then undergoes disintegration and liquefaction. The softened mass is finally absorbed and the walls of the cyst or capsule around it gradually collapse and form a cicatrix. This favorable termination takes place only when the dead mass is not too large. This may, however, involve over a half of one of the large lobes. Under such circumstances recovery is improbable. A more favorable termination is the abundant growth of fibrous tissue around and into the hepatized masses. The formation of fibrous tissue may extend to the pleura or lung covering and cause firm adhesion of the lungs to the chest wall and to the pericardium or heart-case.

The same peculiar inflammatory changes which take place between the lobules of the lung and around the bronchi and vessels may invade the pleural cavity, cause extensive membranous and spongy deposits on the pleura and firm deposits around the heart and large arteries, the gullet, and windpipe.

These are the main features of the lung disease caused by contagious pleuro-pneumonia. In the typical acute cases there are a sufficient number of peculiarities to enable us to make a positive diagnosis. There are, however, many cases in which the disease is restricted to small areas, or to the interlobular tissue, or in which the changes are as yet imperfectly developed, or else so far advanced that doubts may arise as to the true nature of the affection. In such cases all obtainable facts, including the history of the case, the symptoms during life, and the pathological changes observed on post-mortem examination must be taken into consideration. Only one who has made a careful study of the disease is fitted to decide in such cases.

Other kinds of lung disease may be confounded with pleuro-pneumonia because of certain features common to most lung diseases of cattle. The inflammation of the connective tissue between the lobules is not infrequently observed in so-called interstitial pneumonia and may lead to the formation of whitish bands intersecting the lung tissue in various directions. On the cut surface these bands may give rise to a decidedly "marbled" appearance. Again, in traumatic pneumonia, due as its name implies to the entrance of foreign bodies into the lung tissue, generally from the paunch, the connective tissue around the place of disease becomes inflamed and thickened and the disease itself may simulate pleuro-pneumonia in its retrogressive stages when it is confined to a small portion of lung tissue. The filling up of the interlobular spaces with fibrin and connective tissue of inflammatory origin is not thus limited to pleuro-pneumonia, but may appear in a marked degree in other lung diseases. It must not be inferred from this statement that these interlobular changes are necessarily the same as those in pleuro-pneumonia, although they may appear the same to the naked eye. We simply note their presence without discussing their nature.

In general the distinction between pleuro-pneumonia and broncho-pneumonia is not difficult to make. In the latter disease the pneumonia generally invades certain lobes as indicated by the dotted line on Plate XXX. The disease attacks the smaller lobes in their lowest portions first and gradually extends upward, *i. e.*, toward the root of the lung or the back of the animal and backward into the large principal lobes. Again both lungs, in advanced cases, are often symmetrically affected, as shown by the dotted line on both lungs in the plate referred to. In contagious pleuro-pneumonia the large principal lobe of one side is most frequently affected, and a symmetrical disease of both lungs is very rare, if, in fact, it has ever been observed. The lung tissue in broncho-pneumonia is not enlarged, but rather more contracted than the normal tissue around it. This is well illustrated in Plate XXXI. Normal air-containing lobules may be scattered among and around the hepatized portion in an irregular manner. In pleuro-pneumonia the diseased and healthy portions are either sharply divided off, one from the other, or else they shade into each other by intermediate stages.

The hepatized lung tissue in broncho-pneumonia when the cut surface is examined is usually of a more or less dark flesh color with paler grayish yellow dots regularly interspersed, giving it a peculiar mottled appearance. In the more advanced stages it becomes more firm, and may contain nodular and firmer masses disseminated through it. The air-tubes usually contain more or less soft creamy or cheesy pus or a turbid fluid quite different from the loose fibrinous casts of acute pleuro-pneumonia. The interlobular tissue may or may not be affected. It sometimes contains loose fibrinous plugs, or it may be greatly distended with air, especially in the still normal portions of the lung. The pleura is seldom seriously diseased. If we contrast with these features the firm, dark red hepatizations, the plugging of the veins, the extensive interlobular deposits and the well-marked pleuritis in pleuro-pneumonia, there is little chance for confusion between well-developed cases of these two lung diseases.

It should not be forgotten, however, that the lesions of the disease known as contagious pleuro-pneumonia may be confined to the serous membranes of the thorax, or they may be confined to the parenchyma of the lungs; they may affect a whole lobe, or only a small portion of the lobe; they may or may not cause the so-called marbled appearance. In the same way broncho-pneumonia may vary as to the parts of the lung affected, the extent of the lesions, the degree and kind of pathological changes in the interlobular tissue, the color of the lung on cross section and the amount of hepatization. In individual cases, therefore, it is often necessary in the present condition of science to take into account the history of the animal, the course of the disease, and the communicability of the affection before a diagnosis can be made between the two diseases.

Prevention and treatment.—The prevention of pleuro-pneumonia, as of other contagious diseases, consists in keeping animals so that they will not be exposed to the contagion. As the disease only arises by contagion; there is no possibility of an animal becoming affected with it unless it has been exposed. If, therefore, pleuro-pneumonia exists in a locality the owner of healthy cattle should make every effort to keep his animals from coming near those which are affected, or near any which have been exposed. He should be equally particular not to allow any person who has been on the infected premises to visit his own pastures, stables, or cattle.

If pleuro-pneumonia breaks out in a herd every animal in that herd should be slaughtered, the stables should be thoroughly cleaned and disinfected, and no other cattle should be allowed on the premises until a period of ninety days has elapsed.

Medical treatment of affected animals is unavailing and should not be attempted. No matter how valuable the diseased animals may have been before they contracted the disease, they should be at once destroyed and the contagion eradicated. This is the best policy for the individual as well as for the community.

The eradication of this disease by local or national governments can only be successful when the same principles are adopted and carried out as are here recommended for individual stables. It is then a difficult undertaking, simply because the contagion is generally widely disseminated before any measures are adopted, and because a great majority of cattle-owners will never report the existence of the disease. Regulations must therefore be enforced which will insure the prompt discovery of every herd in which the disease appears, as well as the destruction of all diseased and exposed animals and the thorough disinfection of the premises.

To discover pleuro-pneumonia sufficiently early for this purpose the district supposed to be infected should be clearly defined and a sufficient force of inspectors should be constantly employed to inspect every herd in that district at least once in two weeks, or better, once a week. No bovine animal should be allowed to go out of the defined district alive, and all which enter it should be carefully inspected to insure their freedom from disease. As an assistance to the discovery of diseased herds, every animal which dies in the infected district from any cause, and every animal which is slaughtered, even if apparently in good health, should be the subject of a careful post-mortem examination. Many affected herds will be found in this way.

In addition to these measures it is also necessary to guard against the removal of animals from one stable to another, and the mixing of herds upon common pastures or in the public highways. The object must be to isolate every individual's cattle as completely as possible, or otherwise a single affected animal may infect a dozen or more herds. To prevent surreptitious sale or trading of cattle, each animal must in some way be numbered and recorded in the books kept by the official in charge of the district. In the work of the U. S. Department of Agriculture a numbered metal tag has been fastened to every animal's ear, and index books have been so arranged that with a number given the owner could be at once ascertained, or from the owner's name the cattle for which he was responsible could be at once learned. In this way if an animal was missing from a stable the fact became apparent at once, or if one animal too many was found in a stable the number in its ear would indicate where it came from.

When pleuro-pneumonia is discovered by these means the entire herd should be slaughtered as soon as the formalities of appraisement can be arranged. In country districts the carcasses should be buried, as it is generally impracticable to dispose of them in any other way. In city districts the animals may be taken to a slaughter-house, with such precautions as are possible to prevent dissemination of the contagion. The animals should be slaughtered under the supervision of an inspector. The healthy carcasses may be utilized for food, but the blood, entrails, and all diseased carcasses should be heated to a temperature equal to or above boiling water, and then used for the manufacture of fertilizers.

The disinfection of premises should be thorough and should be carried out by a trained corps of men employed for that purpose. The floors of stables should be removed, the accumulations removed from beneath them, the contents of hay-lofts should be destroyed, and the woodwork and soil beneath the stables should be thoroughly drenched with a solution of bichloride of mercury, one part to two thousand of water. After the flooring is replaced the woodwork should be coated with lime wash, containing one-fourth pound of chloride of lime to the gallon of mixture.

Usually in these cases the owners are dependent upon their herd of cows for their living, and, consequently, it is difficult or impossible to hold the stables vacant for any considerable period. In a majority of instances cattle may be at once admitted to stables so disinfected, without the reappearance of the disease. Occasionally, however, it will reappear without apparent cause. For this reason the inspection and other measures must be maintained in the infected district for six months or a year after the last case of disease has been disposed of.

Many people have objected to the slaughter of diseased and exposed animals as an unscientific and expensive method of eradicating this disease. To these it may be answered that it is the only method which has ever proved successful, and that in the end it is much more economical than temporizing measures.

Inoculation has been adopted in many countries, and has undoubtedly lessened the death rate, but the disease is kept up and spreads where this practice is allowed. For this reason it should be prohibited wherever there is a possibility and disposition to eradicate the contagion.

PLEURO-PNEUMONIA.

[Description of plates.]

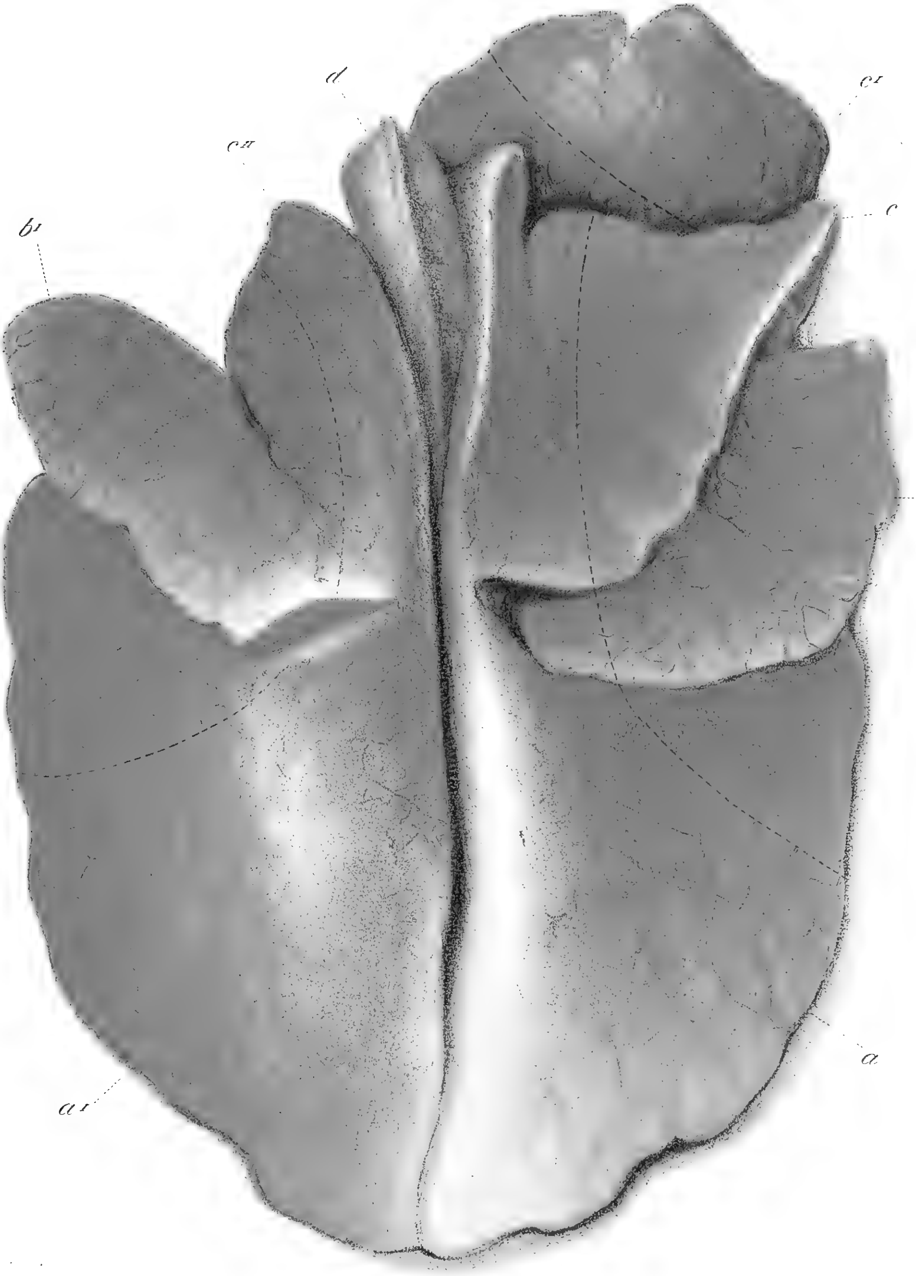
PLATE XXX. The dorsal or upper surface of the lungs of the ox reduced to one sixth of the natural size: *a*, *a′*, the right and the left principal lobe. These are the largest and are situated posteriorly, resting upon the diaphragm; *b*, *b′*, the ventral lobes, situated between the principal lobes, and *c*, *c′*, *c″*, the most anterior or cephalic lobes; *c*, *c′*, *c″*, anterior or cephalic lobes. The right anterior is divided into two lobes (*c*, *c′*), the left is single (*c″*); *d*, trachea or windpipe.

Those portions of the lung tissue lying outside of the dotted lines are the ones most commonly affected in the ordinary types of pneumonia. In the majority of the lungs examined in the laboratory of the Bureau, which were affected with contagious pleuro-pneumonia, the principal lobes (*a*, *a′*) were primarily affected.

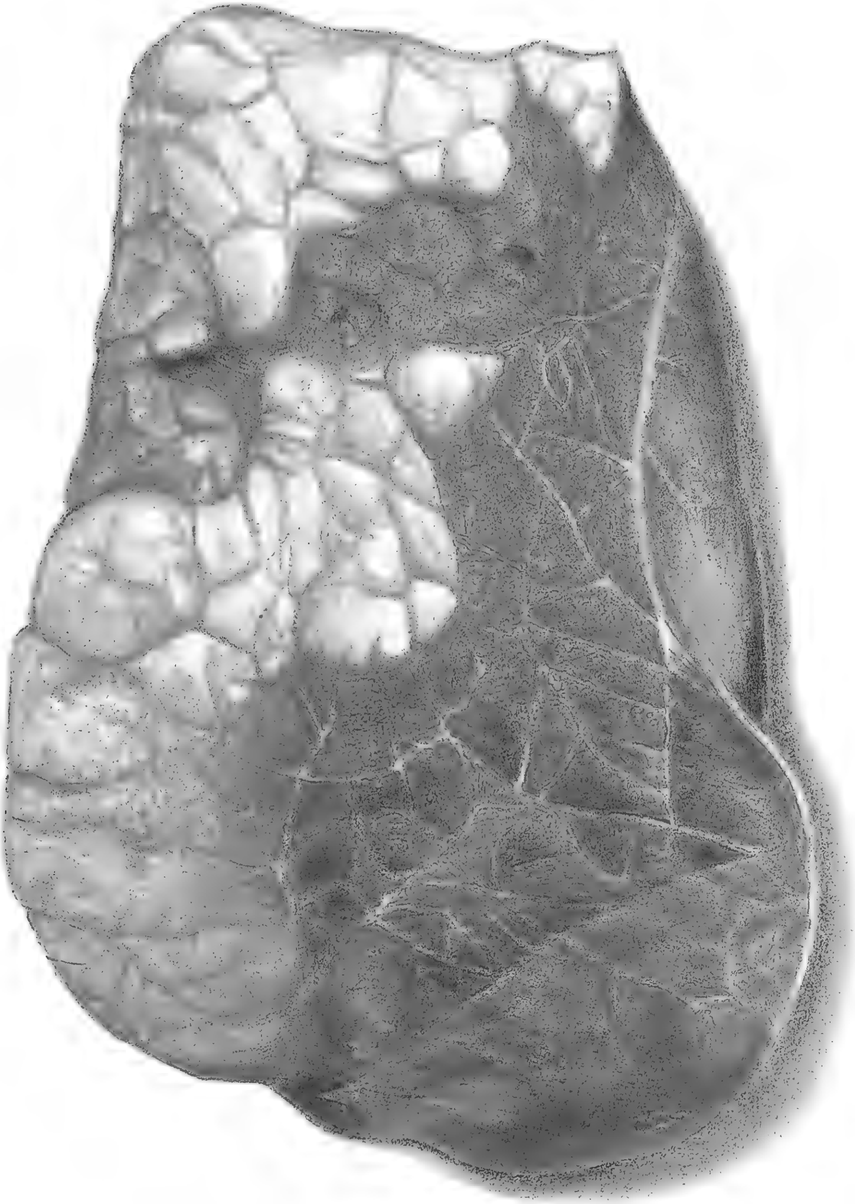
PLATE XXXI. The ventral or middle lobe of the right lung affected with collapse and beginning broncho-pneumonia. The light yellowish portions represent healthy lung tissue, the red represents the disease. It will be noticed that the lines between the lobules are quite faint, indicating little or no inflammation of the connective tissue between the lobules. The healthy lung tissue is seen to be raised above the level of the diseased portion. In contagious pleuro-pneumonia the exact reverse is the case, the diseased portions being very much larger than the healthy.

PLATE XXXII. Appearance of a cow's lung affected with contagious pleuro-pneumonia when sections or slices are made of it and cut surfaces examined. Fig. 1. Transverse section through the right principal lobe in a case of acute pleuro-pneumonia. The area drawn includes the air-tubes, veins, and arteries, and illustrates the great thickening of the interlobular connective tissue into broad whitish bands, and of the walls of the air-tubes, veins, and arteries: *a*, air-tube, cut obliquely; *a′*, air-tube cut directly across; *b*, arteries cut across; *c*, large vein completely occluded by a thrombus, or plug formed during life. The great thickening of the walls of the artery and vein in this disease is especially brought out by stating that in the healthy lung they are so thin as to be easily overlooked. Fig. 2. Transverse section of the principal lobe in a case of acute pleuro-pneumonia, illustrating the different kinds of hepatization or consolidation of the lung. These are indicated by the different colors from dark red to reddish yellow. This variation of color is regarded by some as the real marbling characteristic of pleuro-pneumonia, while the whitish bands penetrating the lung tissue in all directions constitute the true marbling according to other observers.

PLATE XXXIII. Illustrates what are called infarctions in pleuro-pneumonia. The right half of the figure shows nearly normal lung tissue. The left represents a blackish mass in which the lung tissue is filled with blood and solidified. This is caused by the plugging of the vein carrying away the blood from this portion. The heart forces the blood through the artery into the tissue at considerable pressure, but, owing to the fact that its return is prevented, the minute blood-vessels rupture and the air vesicles become distended with blood which coagulates and causes the firmness of the tissue.



UPPER OR DORSAL SURFACE OF THE LUNGS OF THE OX.
1/6 natural size.



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BRONCHO-PNEUMONIA.

PLATE XXXII

Fig. 1

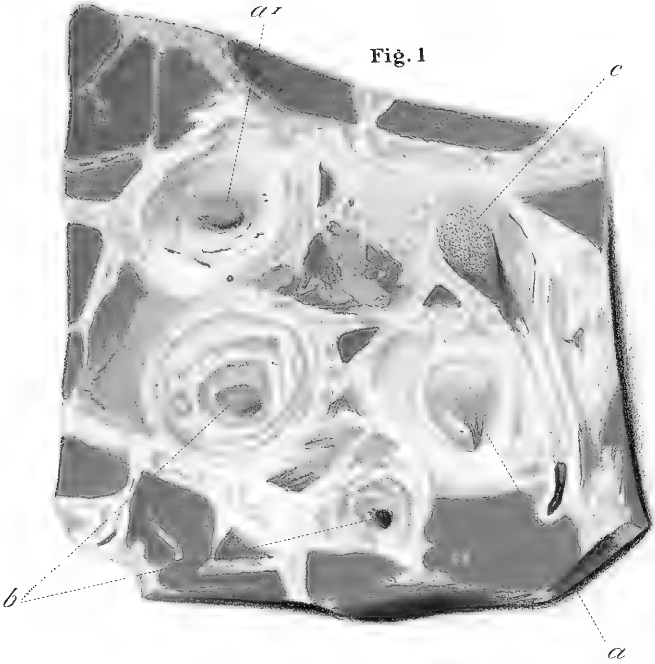
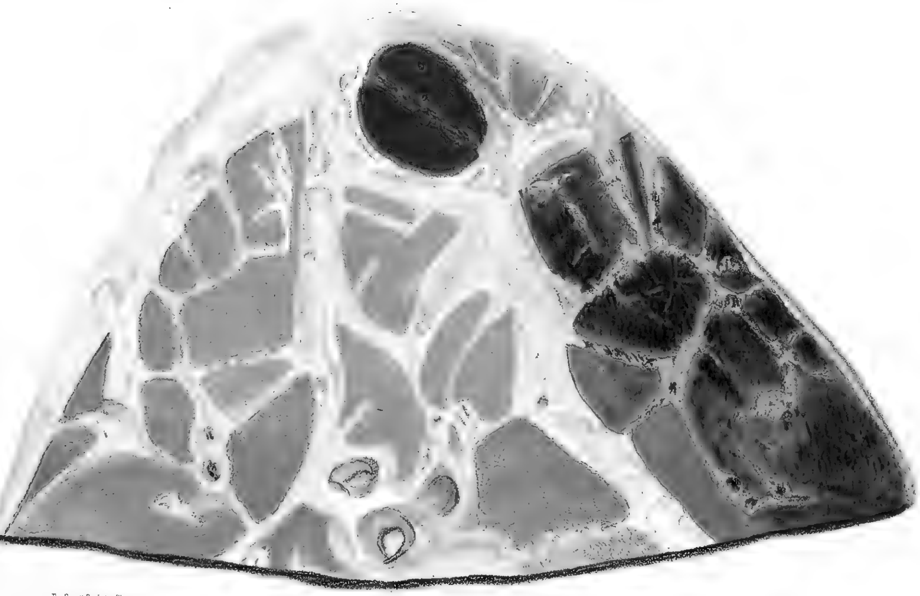


Fig. 2



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CONTAGIOUS PLEURO-PNEUMONIA.

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CONTAGIOUS PLEURO-PNEUMONIA.

RINDERPEST.

Rinderpest, also known as cattle plague, is an acute infectious disease of cattle in which the digestive organs are mainly involved. Though unknown in this country, the importance of having near at hand a few definite facts concerning this disease, should it ever reach our shores, will be at once appreciated. A knowledge of such facts may aid in an early recognition of the disease. It must not be forgotten, on the other hand, that a superficial knowledge of diseases, such as the layman may gain through reading, not infrequently leads to confounding comparatively harmless, noninfectious maladies with such as are truly dangerous (foot-and-mouth disease, rinderpest, etc.), and causes temporary panics among stock-owners.

Rinderpest has its home, according to some authorities, in the territory around the Black Sea and the Volga River in Russia, according to others, in Central Asia. Thence it has been conveyed at various times by cattle to the countries of western Europe, where it has proved a veritable bovine scourge. It probably visited Europe as early as the beginning of the Christian era, and the migrations of people from the far East have since then introduced the disease from time to time. Especially during the eighteenth century it was more or less prevalent in Europe, owing to the frequent wars, during which herds of cattle were brought from eastern Europe and Asia to supply the demands of the armies. As late as 1870 it prevailed in Europe during the Franco-Prussian war.

The virus is conveyed from one country to another chiefly by means of infected cattle. The railroad facilities of the present, which furnish the means of such rapid communications, are particularly liable to aid in the dissemination of the disease.

In the past rinderpest has been supposed identical with various human diseases, among them smallpox and typhoid fever. These suppositions are unfounded, and the view of authorities to-day is that it is a disease of a peculiar kind, not identical with any other known infectious disease.

The contagium of the rinderpest.—The cause of rinderpest must be looked for among microörganisms—most likely bacteria. The investigations made thus far hardly permit us to draw any positive conclusions. It was formerly supposed by various authorities that rinderpest virus appeared spontaneously under the influence of deteriorated food and long and exhausting drives, also during unusual meteorological conditions. This view, however, is no longer maintained. It is probable that the disease in its home in Asia is perpetuated by continual infection of fresh animals, and some authorities even go so far as to believe that the disease would be entirely stamped out, even in its native haunts, by a destruction of all sick and infected herds. However this may be, the success of such an undertaking would largely depend on the nature of the cause. If a strictly parasitic organism, like the contagium of pleuro-pneumonia, it might be completely extirpated in this way. If, however, the germs or bacteria may live and multiply outside of the bovine body, in the soil, water, or some other animal, extirpation would be impossible.

The virus may be transmitted from sick to healthy animals in a variety of ways, both direct and indirect. It is said to be present in the various excreta of the diseased, such as the discharges from the nose and the saliva, the urine, and the manure. It retains its vitality outside of the body in a moist state for months, even a year or more, according to some authorities. Hence manure and the fodder and bedding soiled with the discharges may convey the disease. When dried, however, its vitality is said to be lost in a few days. Persons may carry the virus on their shoes, clothing, and implements. Even small animals, such as cats and rats, which frequent barns and stables have been looked upon as carriers of the virus.

Cattle are very susceptible to the disease, and in its virulent type all those exposed are said to become infected. Buffaloes, sheep, and goats are likewise susceptible, but in a less degree.

It is also claimed that animals after having passed through one attack are able to resist successfully future attacks. Inoculation with virus is said to produce immunity, but the process of inoculation itself is followed by death in many cases.

Symptoms.—The symptoms of rinderpest are not very characteristic, and hence the diagnosis of a suspected case in the beginning of an invasion is attended with difficulties. Certain appearances which are characteristic of one epizoötic may be absent in another. Different observers are not quite agreed as to the most constant and important.

The period of incubation, *i. e.*, the time elapsing between the exposure to infection and the earliest outward symptoms, varies from 3 to 9 days. Then the first sign is a very high fever temperature, which may reach 107° F. The heat of the skin varies in different parts of the body, and may be felt at the base of the ears and horns. Repeated chills are frequently observed. The pulse reaches 50 to 60 beats per minute, and may rise to 90 or 100 in very severe attacks.

The animal manifests great debility. The head droops and rests on some object of support. One or both ears may droop. The coat is staring and the muzzle dry. The secretion of milk diminishes very rapidly. Within twelve to twenty hours the usual quantity may have become reduced one-half or two-thirds. The back is arched, and the four limbs brought together under the body.

As the disease progresses symptoms with reference to the digestive and respiratory organs become prominent. The mucous membrane of the mouth, the nose, as well as that of the rectum and vagina, becomes reddened either in patches or diffusely, and assumes a scarlet hue. The discharges, at first firm, become softer, and soon diarrhea sets in. This is said to be one of the most constant symptoms. The rectum may become everted and paralyzed, and the bowels move spontaneously. The discharges may be streaked with blood. Coughing is a common symptom, and by some considered characteristic. It is associated with discharges from the nose and vagina, and dribbling of saliva from the mouth. The eyes also are affected. There is an increased formation of a viscid secretion which flows down the face.

Another series of changes prominent in some epizoötics and mild or absent in others are the ulcers or so-called erosions in the mouth. These begin as red patches and streaks. The mucous membrane in such localities is converted into a grayish-white slough, which, when shed, leaves a small erosion or ulcer. At the same time similar changes may go on in the skin of the thighs, the udder, or the scrotum, and about the vagina, which lead to small sloughs.

In severe cases, which are the most common in the susceptible cattle of western Europe, death ensues four to seven days after the first appearance of the disease, and is preceded by great emaciation and debility, fetid, purulent discharges from nose and mouth, and the relaxed rectum and vagina.

After death, if the animal be opened and the organs carefully examined, the chief changes will be found in the digestive organs. The lining membrane of the mouth and pharynx is covered with mucus, is reddened in spots, and shows superficial yellowish gray, cheesy patches, which represent dead tissue and when removed expose ulcerated depressions. The same reddening in spots and the yellowish gray, cheesy deposits or patches are found in the fourth stomach, the small intestines, and more rarely in the cæcum, while the third stomach or manyplies is more or less impacted with dry, hard food. Similar changes may be found on the mucous membrane of the nasal cavity, the uterus, vagina, and rectum. In addition to these lesions are others with reference to the heart, liver, and other vital organs, which need not concern us here.

Neither treatment nor inoculation is permitted in European countries.

FOOT-AND-MOUTH DISEASE.

This disease is also known as epizoötic aphtha, aphthous fever, eczema epizoötica, and may be defined as an acute, highly contagious fever of a specific nature, characterized by the eruption of vesicles or blisters in the mouth, around the coronets of the feet, and between the toes. It is not restricted to cattle, but attacks swine with equal facility. Sheep and goats are less susceptible. Horses, dogs, cats, and fowls are rarely attacked. Human beings may become infected by drinking the unboiled milk from animals suffering with the disease. In such cases the symptoms resemble those observed in animals. There is fever and difficulty in swallowing, followed by an eruption of blisters in the mouth and very rarely by similar ones on the fingers. The disease is very seldom fatal, and chiefly restricted to children and to those adults who handle sick animals or drink large quantities of unboiled milk. Some veterinarians regard the human affection as by no means uncommon in countries where foot-and-mouth disease prevails, but that the disturbance of health is usually too slight to come to the notice of the family doctor.

The disease prevails in European countries and occasions great losses. Although the actual mortality is quite low, and not more than 1 to 3 per cent of the affected animals die, serious losses result from the diminution of the milk secretion and consequent interference with the business of the dairy. There is likewise more or less loss of flesh in animals.

According to the very accurate statistics collected by the German Empire, 431,235 head of cattle, 230,868 sheep and goats, and 153,808 swine were affected with the disease in that country in 1890. The infection, quite insignificant in 1886, had been gradually spreading until it reached the enormous figures given above in 1890. During this same year it prevailed in France, Italy, Belgium, Austria-Hungary, Switzerland, Roumania, and Bulgaria.

Contrary to most other infectious diseases, foot-and-mouth disease may attack the same animals repeatedly, provided the intervals between the attacks are longer than six to twelve months. The immunity or protection conferred is thus only of limited duration. Hence protective inoculation with the virus, in whatever manner it may be practiced, is not only of no use but decidedly dangerous, as it will introduce the disease. It is, however, not uncommon in European countries to practice inoculation after the disease has appeared in a herd in order to hasten its progress. This is highly recommended by some, since it not only hastens the infection, but the disease is apt to be milder and limited to the mouth. It consists in rubbing with the finger or a piece of cloth a little of the mucus from the mouth of a diseased animal upon the inner surface of the upper lip of those to be inoculated. From 50 to 75 per cent of the inoculated animals take the disease.

As with other communicable diseases, the source and origin of foot-and-mouth disease has given rise to much speculation. The disease had been known in Europe for centuries, but it was not until a comparatively recent date that the erroneous conceptions of its spontaneous origin as a result of climatic and metorological conditions, exhausting journeys, etc., were abandoned. It is now generally conceded that foot-and-mouth disease is propagated by a specific virus and that every outbreak starts from some preëxisting outbreak.

The infection is contained in the eruptions, and hence shed from the mouth and the feet. A wide distribution of the virus and a rapid infection of a herd is the result. Animals may be infected directly by coming in contact with the diseased, or they may be exposed to the virus in stables, in the field and along roads, in cars, and in all places shortly before frequented by diseased cattle. Human beings may carry the virus on their clothing and transmit it on their hands when milking, since the udder is occasionally the seat of the eruption. Milk in a raw state may also transmit the disease to animals fed with it.

The observations made by some veterinarians would lead us to suppose that the virus is quite readily destroyed. It is claimed that stables thoroughly cleaned become safe after drying for a short time. Hence litter of all kinds, such as manure, soiled hay, and straw, may remain infective for a longer time because they do not dry out. Other authorities maintain that the virus is quite tenacious and may live in stables even as long as a year. They also state that animals which have passed through the disease may be a source of infection for several months after recovery.

Symptoms.—After a period of incubation, lasting from three to five days and sometimes not longer than two days, the disease begins with a fever. The temperature does not as a rule rise above 104° F. The lining membrane of the mouth becomes reddened, the appetite is diminished, and rumination ceases. The mouth is usually kept closed and the quantity of saliva is increased. A smacking sound is not infrequently made by the animal. These symptoms are chiefly due to the pain accompanying the disease in the mouth. After two or three days the eruption appears. This consists of small yellowish-white vesicles or blisters, about as large as a hemp seed or a pea, on the gums and inner surface of lips, the inside of the cheeks, the border and under surface of the tongue. They may become half an inch or more in diameter. In some cases the back of the tongue near the tip may be the seat of large blisters.

These vesicles burst soon after their appearance, sometimes on the first day. More rarely they may persist two or three days if small. After they have ruptured the grayish white membrane forming the blister may remain attached for a day or more, or disappear speedily and leave deeply reddened spots or erosions, which are very painful. These exposed spots may soon become covered again with the normal epithelium, or else be converted into ulcers under unfavorable conditions. In this stage the saliva forms in large quantities and hangs in strings from the mouth. In eight to fourteen days the disease may have entirely disappeared.

In addition to the changes going on in the mouth, one or more feet may become diseased. The skin around the coronet and in the cleft between the toes becomes hot and tender and may swell. Blisters appear in the mouth, but they are speedily ruptured, and the inflamed, exposed spots covered with a viscid substance (exudate).

The disease may attack the udder in cows, or more particularly the teats. Some authorities regard the udder disease merely as the result of infection during milking. The vesicles are broken as they appear by the hands of the milker, and the teats become covered with reddened spots deprived of the superficial layer of skin, and are very tender. The healing, however, goes on quite rapidly. The milk is said to be somewhat changed in appearance. It becomes viscid and coagulates more quickly and is more or less unfit for making butter and cheese.

These are the main symptoms accompanying an uncomplicated case of foot-and-mouth disease. In all such recovery is rapid and complete; but occasionally complications arise which are not only very injurious but may be fatal. Thus the mouth lesions may be accompanied by nasal catarrh or pneumonia. The feet, especially, are liable to suffer when neglected. They may become very much swollen, and the inflammation and suppuration extend to the tendons and bones of the foot, or the hoof may be shed. In such cases the animals rarely recover.

As a result of the general affection young calves may succumb to a secondary inflammation of the stomach and bowels, and older animals may abort or suffer from inflammation of the udder.

Treatment.—As the disease is mild and tends to rapid recovery, no general treatment, excepting that which tends to put the animals in the best condition, is required. Since the secondary diseases and complications are the most injurious, and as they are largely the result of other bacteria, the greatest care should be exercised in keeping the animals and their surroundings clean. The bedding should be light and dry, and frequently changed to prevent further injury to the feet. The animals should not stand upon hard or rough floors.

To relieve the irritation in the mouth various solutions have been recommended. Among these are borax, 1 ounce in 3 pints of water; water containing vinegar and salt; alum 1 ounce in a quart of water. These may be applied with a syringe or poured in from a bottle, or else an irrigator may be improvised by attaching a funnel to a rubber tube. The funnel is elevated and the liquor poured into it. The pressure necessary may be increased or diminished by raising or lowering the funnel. The injections may be practiced once or twice a day, and about half a pint injected each time. The blisters should not be opened.

For the feet in mild cases, in addition to cleanliness and proper bedding, nothing is required. Some veterinarians, however, recommend antiseptic and astringent applications to prevent further mischief. For this purpose they may be gently bathed in water containing 1 ounce of alum to the pint, or in Burow's solution (powdered alum 1 ounce, powdered lead acetate 2 ounces, water 3 quarts). Carbolic acid, 1 ounce in 3 pints of water, or equal parts of wood tar and olive oil are recommended. At the same time some veterinarians state that these substances communicate unpleasant odors to the milk and therefore should only be used for oxen and young animals.

For the affection of the teats simple glycerine or glycerine containing one-fourth dram of boracic acid to the ounce may be applied several times a day, or zinc ointment containing preferably 30 drops of the tincture of opium to the ounce. Burow's solution given above may also be applied. Care should be taken to withdraw the milk at proper intervals.

VESICULAR ERUPTION OF THE GENITAL ORGANS.

This contagious disease is not known in our country, but it is more or less prevalent on the Continent. It is the subject of legislation in Germany, and governmental statistics are published annually concerning its distribution in the Empire. According to the latest reports 5,782 head of cattle were attacked during 1890, and there has been a constant increase in the number of cases since 1886.

A similar or perhaps identical disease of horses has the same distribution. Whether, however, such disease is transmissible from horses to cattle and *vice versa* has not been definitely determined.

The disease may be defined as a highly contagious eruption situated upon the external genital organs of both sexes, and accompanied with little or no general disturbance of health. The contagion is transmitted mainly during copulation. The bull may have the disease and convey it to all the cows with which he comes in contact. Or he may become infected by one cow, and, although not showing the disease, he may transmit it for several days after to all other cows during copulation. Simple contact between one cow and another may convey the disease, or the sponges used in cleaning the diseased may carry the virus to the healthy.

Symptoms.—The period elapsing between the infection and the appearance of symptoms is somewhat variable. It is usually given as three to six days. It may be briefer or much longer. In cows the mucous membrane of the vagina and the vulva become swollen, reddened, and very tender. The secretion is very abundant and consists at first largely of serum and mucus. Small vesicles then appear which rapidly burst and are converted into excoriations or deeper ulcerations. The secretion becomes more purulent, and is apt to dry in crusts about the root of the tail. The eruption is accompanied with much itching and difficulty in urinating. The walk may be stiff and awkward. In bulls the eruption is situated on the prepuce and the end of the penis, and is accompanied by a little purulent discharge from the prepuce, itching and difficulty in urinating. In severe cases the inflammation and swelling may extend backward to the scrotum and forward upon the abdomen.

The disease lasts from two to four weeks, and always terminates in recovery. The acute stage lasts only four or five days, while the complete healing of the inflammation is slow. The eruption is usually accompanied by very little general disturbance. If the pain and irritation are severe there may be some slight loss of appetite and diminished milk secretion.

Treatment need not be resorted to excepting in severe cases. The secretion and exudation should be washed off and a mild antiseptic applied, such as a 1 per cent solution of carbolic acid (1 ounce to 3 quarts of water). Care must be taken not to carry the disease from the sick to the well by sponges, etc., which have come in contact with the affected organs. These should be destroyed. To prevent the spread of the disease the infected animals should be kept isolated until they have recovered.

RABIES OR HYDROPHOBIA.

Rabies is a disease which seems to originate in the canine race and which may be transmitted to other species of animals and to man through bites. There are some writers who maintain that it may arise spontaneously in the dog without previous inoculation. The advances made in our knowledge by the researches of Pasteur and others do not favor this view, but lead directly to the inference that rabies is always communicated from a preceding case, and that it never originates spontaneously.

We must assume, therefore, that the disease is always transmitted by the bite of the rabid animal. The saliva contains the virus which is introduced into or under the skin on the tooth of the rabid animal.

By no means are all bites followed by rabies. According to some authorities only one-fourth of the inoculated cattle become diseased. This low percentage may be due to the kind of wound inflicted. When the bleeding is very profuse the virus may be washed out at once. As to the nature of this virus nothing is definitely known, although Pasteur and his co-workers have made prolonged efforts in this direction.

In general the virus behaves like bacterial poisons. It may be transmitted from one animal to another by simple inoculation, just as we may preserve the virus of other infectious diseases.

From these facts it becomes evident that the virus of rabies can only be transmitted directly from the sick to the healthy, and that for this transmission a wound is necessary. Since the virus is contained in the saliva, the disease may be artificially produced by inoculating an animal with the saliva of some rabid animal. Healthy animals, from the nature of the case, can not carry the virus. It is still a widely prevalent belief that if persons or animals are bitten by a dog, for instance, they are liable to become rabid when such a dog contracts rabies at any time in the future. There is no foundation for such belief, and it would be a great comfort to many people who are now and then bitten by animals if such belief were given up. There is no foundation for the theory that rabies may be caused by the bite of an animal which has been inoculated, but in which the disease has not yet appeared. All experience, both scientific and practical, goes to show that rabies is transmitted only by animals actually diseased.

Rabies is not a very uncommon disease in cattle in those regions where rabid dogs are occasionally found. Thus in the German Empire carefully compiled statistics have shown that next to dogs cattle are more frequently affected than any other of the domesticated animals.

In 1890 590 dogs, 98 head of cattle, 11 cats, and 9 pigs were found rabid. These figures are easily explained when we take into consideration the relation between dogs and cattle. The latter are very much exposed to the bites of the former on pastures. It is also well known that dogs are more or less trained and incited to worry cattle at all times. The latter receive bites most frequently on the hind legs and in the hips and about the lower jaw. These places are most accessible to dogs, owing to the habit of cattle to drive their tormentors away by lowering their head and using their horns.

The virus after being deposited in the wound by the bite of a rabid animal, remains latent for a time. This period of incubation is quite variable in duration. One veterinarian (Gerlach) collected the statistics of 133 cases, and found this period to vary from 14 to 285 days. The majority of cases, however, contract the disease in from one to three months after the bite has been inflicted.

Symptoms.—The disease may be divided into a preliminary stage, a stage of excitation or madness, and a paralytic stage. In all cases the termination is fatal and the entire course is from 5 to 6 days. The preliminary stage is indicated by loss of appetite and rumination, great restlessness, anxiety, and manifestation of fear. The second stage is characterized by increasing restlessness, loud roaring at times with changed voice, violent butting with the horns and pawing the ground with the feet. A constant symptom is the increased secretion of saliva which hangs from the mouth in strings, and which may be frothy. Constipation is marked, and there is manifested a continual effort to defecate, which is unsuccessful. Spasms of the muscles in different parts of the body are also present at intervals.

In the final stage symptons of paralysis appear, especially in the posterior limbs, and the walk becomes stiff, unsteady, and swaying. Complete paralysis of the posterior half of the body may appear before death. In this final stage the body is very much emaciated, in spite of the brief duration of the disease. It should also be stated that there is no fever or elevation of temperature during the disease. If cattle which have succumbed to rabies be opened very slight evidence of disease will be found anywhere. The blood is dark and imperfectly coagulated. The throat may be reddened and there may be small spots of extravasated blood in the intestines. The stomachs are usually empty. In the spleen there may be hemorrhagic enlargements (infarcts). The cadavers rapidly undergo decomposition.

It is not an easy matter to decide whether a given animal has rabies, since the symptons and the lesions given above belong in part to a variety of other diseases. The positive evidence that a rabid dog has been near cattle would greatly assist in making a decision in doubtful cases. The disease in dogs is pretty well recognized by most people, but in case a suspected dog is killed it is desirable to open the animal and examine the contents of the stomach. While food is absent a variety of odd things may be present which the abnormally changed appetite of the rabid dog has induced him to swallow. Among such things may be straws, sticks, glass, rags, earth, pieces of leather and whatever the animal may have encountered small enough to be swallowed. This miscellaneous collection in the stomach of dogs is regarded by authorities as a very valuable sign, and may be made use of by layman in case of doubt.

Treatment is out of the question after the symptoms have once appeared. When, however, soon after a bite has been inflicted by a rabid dog, the wound can be found it may be desirable to cauterize it with the hot iron or with strong acids, alkalies, or even to cut out the entire wound if such procedure is possible. Prevention which seeks to control effectively the disease by restricting it among dogs is most likely to prove successful. The measures which are adapted to this end can not be discussed in this place.

The method of preventive inoculation which Pasteur has originated and which seems to be so successful in the human subject is not applicable to animals for various reasons.

TUBERCULOSIS.*

(Plates XXIX, Fig. 6; XXXIV to XXXVIII, inclusive.)

Tuberculosis is an infectious disease characterized by the formation in various organs of the body of minute nodules or tubercles which contain the *bacillus tuberculosis*, the cause of the disease.

The disease, in its various manifestations, has been known for many centuries, and legislative enactments having reference to the destruction of affected animals and forbidding the use of the flesh date far back into the Middle Ages. The opinions entertained regarding the nature and the cause of the malady varied much in different periods, and very markedly influenced the laws and regulations in vogue. Thus, in the sixteenth century, the disease was considered identical with syphilis in man. In consequence of this belief very stringent laws were enacted, which made the destruction of tuberculous cattle compulsory. In the eighteenth century this erroneous conception of the nature of the disease was abandoned and all restrictions against the use of meat were removed. Since that time, however, the tide of opinion has again turned against this disease. The particular opinion held at any time concerning its nature usually furnished for it a name. There are in most languages, therefore, a large number of peculiar terms which have accumulated, but which do not concern us here.

Occurrence.—The statistics concerning tuberculosis show that it is a disease prevalent in all civilized countries. In some countries, such as the northern part of Norway and Sweden, on the steppes of eastern

* For a brief account of the disease in other animals, see the Report of the Secretary of Agriculture for 1889, p. 63.

Europe and Russia, in Sicily and Iceland, and in Algiers it is said to be quite rare. In most countries an effort is now being made to determine more accurately the prevalence of this disease. Some very valuable tables have been published by the German Government for the year extending from October, 1888, to October, 1889. We learn from this that of 1,270,604 animals killed for beef in public abattoirs 26,352, or about 2 per cent, were tuberculous.

In France, according to figures given by Arloing, there are, on the average, 5 animals tuberculous in every 1,000, or about one-half per cent. In the various cities of France the figures obtained by inspectors at the abattoirs vary from 1.43 to 14.5 per 1,000, the observation extending over a period of one to five years. In Belgium, according to Van Hertsen, the rate is 4 per cent. In Holland it varies from 4 to 19.6 per 1,000. In England, according to Cope, it varies from 1 to 26 per cent, according to the locality. At Copenhagen, according to Bang, during 1888, the rate was 6 per cent; for cows alone it rose to 16 per cent. In the Argentine Republic, according to Even, tuberculosis seems to attack the recently imported improved stock (10 to 15 per cent), while it is comparatively rare among natives (one-half per cent).

In our own country cattle (mostly milch cows) slaughtered at Baltimore under the auspices of this Bureau several years ago were found tuberculous to the extent of 2½ to 3½ per cent. Among 2,273,547 head of cattle, chiefly steers, slaughtered for beef in the various meat inspection districts of the United States from May 15, 1891, to March 1, 1892, only 492 or .02 per cent were found tuberculous. For the year ending December 31, 1889, there were found in the same districts among 54,158 cows 669 cases of tuberculosis, or 1.23 per cent.

It is not far from the truth to assume from these statistics that one of every fifty head of cattle in the more densely populated areas of Europe and America is tuberculous. When we consider the age and sex of the affected animals some striking differences are observed. According to the German report the statistics of a large number of abattoirs showed that 6.9 per cent of the cows, 3.6 per cent of the oxen, 2.6 per cent of the bulls, and not quite 1 per cent of the calves and yearlings were tuberculous. It has also been observed that tuberculosis increases in frequency with the age of the animals. If we take the number of cases of animals of a year and under affected with tuberculosis as the unit of comparison, animals from one to three years old furnish ten times, those three to six years old thirty times, and those over six years forty times the number of cases.

The cause of this disease may be considered as twofold, the tubercle bacillus first and foremost, without which this disease could never develop, and certain predisposing causes which prepare the way for it. First, as to the ways in which tubercle bacilli find their way into the body. These in the order of their importance may be considered under four heads: (1) By inhalation into the lungs; (2) into the digestive tract in the milk of tuberculous cows; (3) during coition when the sexual organs are tuberculous; (4) from the tuberculous mother to the fetus in the uterus. Inhalation is by far the most common mode of infection, since statistics show a large percentage of primary lung disease in cattle. Thus in the German report quoted the lungs were found 14½ times more frequently diseased than the digestive organs.

The bacilli can only get into the lungs when inhaled. They must, therefore, be thoroughly dried and pulverized before currents of air can carry them. It is well known that the bacilli withstand drying for months before they lose their power of producing disease. They leave the body of diseased animals in several ways. There may be a little discharge occasionally coughed up from the diseased lungs, or milk may be spilt, or there may be a discharge from the vagina when the genital organs are tuberculous. The bacilli from these sources may become dried and pulverized, and carried in the air of the stable and into the lungs of still healthy cattle where the disease then develops.

The disease of the stomach, intestines, and mesenteric glands is very probably the result of food infection. Tubercle bacilli may have been scattered upon the feed by diseased animals. But the most common source of such infection is the milk of tuberculous cows. Calves may become infected in this way. The disease may remain latent until the animal becomes older. The not infrequent occurrence of tuberculosis of the uterus and ovaries makes it probable that the disease may be transmitted by a diseased bull, or carried by a healthy bull from a diseased cow to a number of healthy cows.

The source of infection is always some previous case of the disease, for the latter can never arise spontaneously. Hence, in those stables in which there is frequent change of cattle, the introduction of tuberculosis by cattle coming from other infected stables is the most frequent source of infection. Since the bacilli, when dried, can be carried by the air it is not necessary that healthy animals should come in direct contact with cases of disease to become infected.

We will now briefly consider the various conditions which favor the bacilli in their attack. Unsanitary conditions, such as overcrowding in poorly-ventilated and poorly-lighted stables, and feeding of food which is not nutritious, are not insignificant in this respect. Conditions which injure the lungs are favorable to the development of tuberculosis. Among these are the inhalation of dust and smoke, and all conditions which may induce chronic inflammation of the bronchial tubes, with abundant secretion and subsequent pneumonia (bronchopneumonia). Among the other causes which are said to favor tuberculosis is the overproduction of milk, too many births, the improvement of stock by continual inbreeding, and the consequent inheritance of certain constitutional characters of a debilitating nature. Animals living in the lowlands are more subject to this disease than the more robust races living in elevated mountain regions. Similarly, animals on the open pasture are less susceptible than stabled animals. This may, however, be due to concentration of virus in the stables. The disease is likewise far more common in cows than in oxen, owing to the strain to which bringing forth young and milking subject the females. Animals subjected to special feeding, such as cows in distilleries, breweries, and other manufactories having waste available as food, are the most susceptible to the disease. In general the greatest number of cases occur in the immediate environment of cities where there are not only abundant opportunities for infection, owing to the frequent introduction of new animals into herds, but where the sanitary conditions may be regarded as the poorest.

Nature of the disease.—The bacillus of tuberculosis was discovered by Robert Koch in 1882. It (see Plate XXIX Fig. 6) is a slender rod-like body from one-third to two-thirds the diameter of a red-blood corpuscle in length. When the bacillus has become lodged in any organ or tissue it begins to multiply, and thereby causes an irritation in the tissue around it which leads to the formation of the so-called tubercle, whence the general name of the disease—tuberculosis. The tubercle, when it has reached its full growth is a little nodule about the size of a millet seed. It is composed of several kinds of tissue cells. Soon a change takes place within the tubercle. Disintegration begins, and a soft, cheesy substance is formed in the center which may contain particles of lime salts. When these tubercles continue to form in large numbers they run together, forming masses of various size. The disintegration which attacks them leads to the formation of large cheesy masses of a yellowish color, containing more or less of lime salts in the form of gritty particles. These large, tuberculous masses are surrounded by or imbedded in layers of fibrous tissue which in some cases becomes very dense and thick.

The disease is thus a development of these tubercles in one or more organs of the body. The distribution and number of these determine the course of the disease.

In a large number of cases the changes are limited to the lungs and the serous membranes * of the thorax and abdomen. Pathologists have been in the habit of calling the lung disease tuberculosis and the disease of the serous membranes "pearly disease." Statistics have shown that in about one-half the cases both lungs and serous membranes are diseased, in one-third only the lungs, and in one-fifth only the serous membranes. At the same time the lymphatic glands near the diseased organs are usually involved. Other organs, such as the liver, not infrequently contain tubercles. Though the disease may remain restricted to a single organ, it now and then is found generalized, affecting all organs of the body.

* These comprise the smooth, very delicate, glistening lining of the large body cavities. In the thorax the serous membrane (pleura) covers the ribs and diaphragm as well as the whole lung surface. In the abdomen a similar membrane (peritoneum) lines the interior of the cavity and covers the bowels, liver, spleen, etc.

In the lungs (Plate XXXIV) the changes observed vary according to the age and intensity of the disease process. They usually begin with the appearance of very minute tubercles. These may appear in large numbers on the surface of the lungs or within the lung tissue. Later the contents become cheesy and partly calcified. When these tubercles are sufficiently numerous to become confluent large masses may be formed, which undergo the same retrogressive changes of caseation and calcification. In addition to the formation of tubercles in the lung tissue certain other changes take place. There is usually present bronchitis with abundant catarrhal secretion. This plugs up the smaller air-tubes, and the lung tissue supplied by these tubes with air collapses. Subsequently it becomes filled with yellowish, cheesy matter, which greatly distends the small air-tubes and air vesicles (broncho-pneumonia). The connective tissue between the lung lobules, around the tubercles and around the air tubes, becomes thickened and indurated. In the larynx and the bronchi tubercles may vegetate upon the mucous membrane, and ulcers may result from their breaking down. The inflammatory irritation which the growth of the tubercles on the surface of the lungs arouses gives rise to adhesion of the lungs to the ribs and diaphragm. This adhesion is sometimes so firm and extensive that the lungs appear grown to the chest wall.

When, therefore, the lungs in advanced stages of the disease are cut open we observe large yellowish masses, from one-quarter to three-quarters of an inch in diameter, of a cheesy texture, in which calcified, gritty particles are embedded and which are surrounded by very firm connective tissue. The neighboring lung tissue, when collapsed and involved in broncho-pneumonia, has the color and consistency of pale red flesh. The air-tubes, large and small, stand out prominently on the cut surface. They are distended with a pasty, yellowish, cheesy mass, surrounded and enveloped in thick mucus, and their walls greatly thickened. The larger bronchi may be sacculated, owing to the distension produced by the cheesy contents.

The disease usually attacks the bronchial glands, which are situated on the trachea and bronchial tubes at the bifurcation. The changes in the glands are the same as those going on in the lung tissue, and they frequently reach an enormous size.

The tubercle formation on the serous membranes covering the lungs and chest wall, which may go on at the same time with the lung disease or independent of it, has been called "pearly disease," on account of the peculiar appearance of the tubercles. These begin as very minute grayish nodules, which give the originally smooth, lustrous membrane a roughened appearance. These minute tubercles enlarge, become confluent, and project above the surface of the membrane as wart-like masses, attaining the size of peas. In this stage their attachment to the membrane is by means of delicate fibers. The attachment is loose, so that the tubercle hangs by a short pedicle or neck and may be moved slightly to and fro. Large masses are frequently formed by a coalescence of many tubercles and the secondary formation of the same. These may be found on the lungs, the ribs, and the diaphragm. These tubercles likewise undergo degenerative changes. The center partly softens, partly calcifies into a grayish mortar-like mass, and when cut into they are found to be gritty. Associated with the formation of tubercles on the pleura, those glands situated back of the lungs (posterior mediastinal) become greatly enlarged and the center cheesy. (Plate XXXVI.) They may compress the esophagus and interfere with swallowing. The size attained by these tumors and new growths is well illustrated by the fact that, taken together, they not infrequently weigh from 60 to 80 pounds. The bronchial glands, which in the healthy state are not as large as horse-chestnuts, have been found to attain a weight of over 10 pounds.

In the abdominal cavity tubercles may be found, both in the organs and on the serous membranes covering them. They are situated preferably on the omentum or caul (see Plates XXXVII, XXXVIII, Fig. 2), the diaphragm, and the walls of the abdomen. In the liver large and small tubercular masses are occasionally encountered. (See Plate XXXV.) The mesenteric glands (see Plate XXXVIII, Fig. 1) are occasionally enlarged and tuberculous; likewise the glands near the liver. Tubercles may also develop in the spleen, the kidneys, the uterus and ovaries, and the testicles.

Tubercular affection of the intestines seems to be quite rare, although ulcers of the large intestines have been observed. Nodules may also form under the serous covering of the intestines.

The brain and spinal cord are occasionally found tuberculous. Of 40 cases, Semmer found tuberculosis of the brain in 4. It is not improbable that, owing to the infrequency of exposing the brain and spinal cord, tuberculosis may have escaped the attention of pathologists, and it may be that it is not so uncommon as is generally supposed. The tubercles occur on the membranes of the brain as well as in the substance of the brain itself. They project into the ventricles as masses varying in size from a pin's head to a hen's egg. They finally lead to various inflammatory changes. Johne has observed numerous small tubercles on the membranes of the spinal cord.

Very rarely tuberculous lesions have been observed in the bones and muscles of the body. Not so rare, however, is the affection of the lymphatic glands imbedded in the muscular tissue and those which can be felt beneath the skin. These are situated at the joints, under the jaw, and along the neck.

Tubercular disease of the udder in cows has received considerable attention of late from sanitarians, owing to the infection of the milk with the virus of tuberculosis. According to those who have given this subject special attention the udder becomes swollen uniformly and quite firm. This swelling, which is painless, frequently attacks but one quarter, more rarely two, these being usually the hind quarters. The larger milk ducts contain yellowish cheesy particles, in which are many tubercle bacilli. Later on, larger nodules can be felt within the udder, which undergo the various changes to which tubercles are subject. The udder may grow very hard to the touch and become very large, weighing in some cases up to 40 pounds. The milk, at first normal, becomes thin and watery after a month or so, and is mixed with flakes and tubercle bacilli.

As regards the frequency of the tubercular processes in the different organs, the following carefully compiled statistics of the disease in Bavaria and Baden may serve as a guide:

	Per cent.
Bavaria:	
Tuberculosis of lungs and serous membranes	41
Tuberculosis of lungs alone	33
Tuberculosis of serous membranes alone (pearly disease)	17
Tuberculosis of other organs	8
Baden:	
Tuberculosis of lungs alone	21
Tuberculosis of serous membranes alone	28
Both combined	39
Generalized tuberculosis	9
Tuberculosis of the sexual organs alone	3

Symptoms.—The beginning of the disease usually passes unnoticed, inasmuch as it is very slow and insidious and rarely accompanied by fever. When the lungs are involved a dull, short cough is noticed, which may later on become prolonged, convulsive, and very troublesome to the animal. The cough is more frequent in the morning after movement and drinking. The breathing varies. Only when much of the lung tissue is diseased, it is labored and accompanied by active movements of the chest and nostrils. Discharge from the nose is rare or absent. At times, however, when the tubercles have broken down and cavities containing cheesy masses have formed in the lung tissue, or when the air-tubes have become filled with cheesy and mucous masses, coughing will dislodge these and cause their discharge. In advanced stages the breath may have a disagreeable odor. Pressure on the chest wall may give rise to pain.

The general effect on the body is at first slight. In fact, animals may remain in good flesh for a considerable time. Invariably, as the disease progresses, loss of flesh and appetite and paleness of the mucous membranes become manifest. These are accompanied by a gradual diminution of the milk secretion. The debilitated condition of the animal is also manifested by a staring coat and a tough, dry, harsh skin (hide-bound). Digestive disturbances are indicated by tympanitis, or distension of the rumen by gas, colic, and diarrhea, alternating with constipation. The animal generally dies from exhaustion after a period of sickness which may last months and years.

Tuberculosis in the abdominal organs is often signalized by abortion and by abnormal sexual manifestations. When the brain is involved the disease may cause convulsions, unconsciousness, paralysis, as well as peculiar movements in a circle, oblique position of the head, etc.

Lydtin quotes the following description of the disease as taken from a Swiss sanitary order:

> A dry, short, interrupted, hoarse cough, which the sick animals manifest especially in the morning at feeding time, still more after somewhat violent exertion. At first these animals may be full-blooded and lay on a considerable amount of fat when well fed. As the disease progresses they grow thin and show more and more those appearances which indicate diseased nutrition, such as a staring, lusterless, disheveled coat; dirty, tense skin, which appears very pale in those regions free from hair. The temperature of the skin is below normal. The loss of fat causes sinking of the eyes in their sockets. They appear swimming in water, and their expression is weak. The cough is more frequent, but never or very rarely accompanied with discharge. The body continues to emaciate even with plenty of food and a good appetite, so that the quantity of milk is small. At times, in the early stages of the disease, still more in the later stages, the diseased animals manifest considerable tenderness when pressure is applied to the front or the sides of the chest, by coughing, moaning, etc. Often all symptoms are wanting in spite of the existence of the disease.

Lydtin also quotes at length a description of the abnormal sexual desire occasionally observed among cows when affected with this disease.

Diagnosis.—A disease so varied in its attack upon the different organs of the body and in the extent of the disease process must necessarily lead to mistakes of diagnosis. It has been confounded with the later stages of pleuro-pneumonia, with parasitic diseases of the brain, the lungs, the intestines, and with actinomycosis. In the early stages of the disease diagnosis is very difficult. The various procedures which have been suggested from time to time are all based on the detection of the tubercle bacilli, and therefore can only be made use of by trained veterinarians. At present a method is under trial which may be destined to solve the difficulty. It consists in injecting beneath the skin a certain quantity of a liquid which represents an extract of tubercle bacilli. In cattle which are tuberculous, even to a slight degree, an elevation of temperature or a temporary fever will follow the injection. In those which are healthy no such reaction takes place. Whether the method will prove to be all that it promises can not be definitely stated at this time. If it should it will be a great assistance to the veterinarian in the detection of this disease.

Treatment of the disease is not seriously considered by any authorities at the present time.

The measures to be adopted to prevent the spreading of the disease must take into consideration not only the tubercle bacillus, but likewise all those circumstances which make cattle more susceptible to the disease, which have already been dwelt upon. It would be useless to repeat here all that has been said above on the transmission of tubercle bacilli from one animal to another, and on the dangers of certain debilitating influences. A careful study of these will show how tuberculosis may, at least in some cases, be prevented. The difficulty of determining when cattle first become tuberculous makes it impossible to prevent the possibility of infection. Great care should therefore be bestowed upon the breeding, the surroundings, and the food of the animal, so that the latter may be put into a condition to resist infection even when exposed to it. If the method of diagnosis referred to above proves a success, this should be used whenever strange cattle are introduced into a herd. A rigid exclusion of tuberculous animals, if this were possible, would be all that is necessary to prevent the appearance of the disease, provided cattle are not infected by consumptive persons and animals, which we can not consider as impossible at the present time.

Tuberculosis in cattle must also be considered as bearing upon tuberculosis of other domesticated animals, particularly swine. In Europe this disease is not so uncommon among swine, while in our own country it seems to be practically unknown. The reason for its existence in Europe may be looked for in the feeding of pigs with whey in dairies, with the offal of the abattoirs and the household refuse generally. If tuberculosis is common among cattle it is likely to be transmitted to swine kept in this way. There is, however, still some confusion of tuberculosis with other swine diseases, and it may be that the statistics are much too high.

The carcasses of animals which have died of tuberculosis should be buried deeply, so that they can not be eaten by other animals. This is likewise true of all organs or tissues of slaughtered animals containing tubercles. These should never be fed to other animals, such as swine, dogs, and cats, and should either be destroyed by fire or else deeply buried.

Bovine tuberculosis and the public health.—The identity between human and animal tuberculosis, combined with the extraordinary mortality of human beings from this disease, often amounting to from 10 to 14 per cent, has raised the question in all civilized countries as to how far animal, and especially bovine, tuberculosis was to blame for this high mortality. The medical and veterinary professions have approached this problem with equal zeal, and much has come to light within recent years which enables us to come to some conclusion. If this disease is transmitted from animals to man, how does the transmission take place? As comparatively few people come in direct contact with tuberculous cattle, it must be, if at all, either through the meat or the milk, or through both, that the virus enters the human body. The question has thus narrowed itself down to the food products furnished by cattle.

It has become a very urgent question, especially in the poorer countries of Europe, whether all flesh from tuberculous animals is unfit for human food. It is argued there that if it can be shown that in the majority of cases of tuberculosis the bones and the muscular system are free from infection, there is no reason why the meat should not be put on sale under certain restrictions. The question may be resolved into two divisions: (1) How frequently does the disease invade those parts of the body which are used as food? (2) When the disease process is manifestly restricted to the internal organs do tubercle bacilli circulate in the blood and lymph, and can they be detected in the muscular tissue?

(1) Disease of the bones is not unknown, although very rare. According to Walley it appears chiefly in the spongy bones of the head and backbone and in the long bones of the limbs. Occasionally the ends of the bones, where they are covered by the synovial membrane of the joints, are dotted with tubercles. The muscular system itself is very rarely the seat of tubercular deposits, although the lymphatic glands lying near and among the muscles may be not infrequently diseased.

(2) Whether tubercle bacilli are found in muscle juice independent of any tubercular deposits is a question which must be approached experimentally. There is on record a great variety of opinions on this matter, some authorities considering all flesh from tuberculous animals unfit for food, while others hold a contrary view. Experiments have shown that in rare cases the flesh of tuberculous cattle contains a small number of tubercle bacilli. In Germany the flesh of animals in which the disease is just beginning, or in which it is restricted to one or more related organs, is not rejected. When, however, the disease has affected the muscles, or bones, or lymphatic glands situated on or between them, the flesh is condemned as unfit and dangerous. Animals are also rejected in which it is evident, from the general distribution of tubercles throughout the various organs, that the bacilli have been distributed by the blood and may have been carried into the muscular system (generalized tuberculosis).

Concerning the infectious nature of milk secreted by tuberculous cows, authorities have universally agreed that when the udder itself is in the slightest degree involved the milk possesses infectious properties, and is therefore dangerous. Tubercle bacilli have been found in large numbers in the milk and the udder under such circumstances. Unlike other affections of the udder, tuberculosis of this organ does not at once change the appearance and the quality of the milk secreted. Bang states that for at least a month after the disease has appeared the milk is normal in appearance and may be consumed and sold without arousing the suspicion of the owner. There is, therefore, considerable danger involved in this disease, and the necessity for the careful inspection of dairy cows seems more urgent than ever before.

Authorities are, however, not fully agreed as to whether the milk from tuberculous cows in which the udder is apparently not invaded by the disease should be considered dangerous or not. Some are inclined to believe that the milk secreted by healthy udders is never infectious even when the lungs or other organs are affected; that, in other words, the tubercle bacilli are rarely, if ever, separated from the lesions which they produce, and that the udder itself must be diseased before tubercle bacilli can appear in the milk. Experiments made with the milk of tuberculous cows in which there were no indications of udder disease do not bear out this theory, since tubercle bacilli have been found in the milk of such cows. Some authorities, among them Nocard, still believe that the udder is diseased when the milk is infected, but that the disease escapes observation. However this may be, the fact that the udder may be diseased and the disease not recognizable, simply casts suspicion upon all milk from tuberculous animals. The question as it now stands leaves the matter unsettled. We know that the milk of tuberculous cattle may or may not contain tubercle bacilli when the udder is apparently free from disease. But we have no rapid method of determining whether in any given case the milk contains tubercle bacilli or not. Moreover, the bacilli may be absent at one time and present at another in milk from the same cow. When we consider, therefore, the extent of tuberculosis and the hidden character of the disease, a certain amount of suspicion rests upon all milk. Fortunately tubercle bacilli are readily destroyed by the temperature of boiling water, and hence both meat and milk are made entirely safe, the former by the various processes of cooking, the latter by boiling for a few moments. Until better means of diagnosis are at hand it is incumbent upon all communities to have dairy cows examined or inspected at least to the extent of finding out whether the udder shows any signs of disease. If this is detected the affected animal should be at once killed, or else all opportunity for the sale of such milk removed by appropriate measures. The dangers from infected milk might by these means be very materially lessened.

TUBERCULOSIS.

[Description of plates.]

PLATE XXXIV. Tuberculosis of the lungs. The upper figures represent a large cheesy mass, surrounded by a capsule of connective tissue, the whole embedded in healthy lung tissue. The lower figure illustrates in section a mass of tubercles which have undergone cheesy degeneration, and some of which are embedded in dense connective tissue.

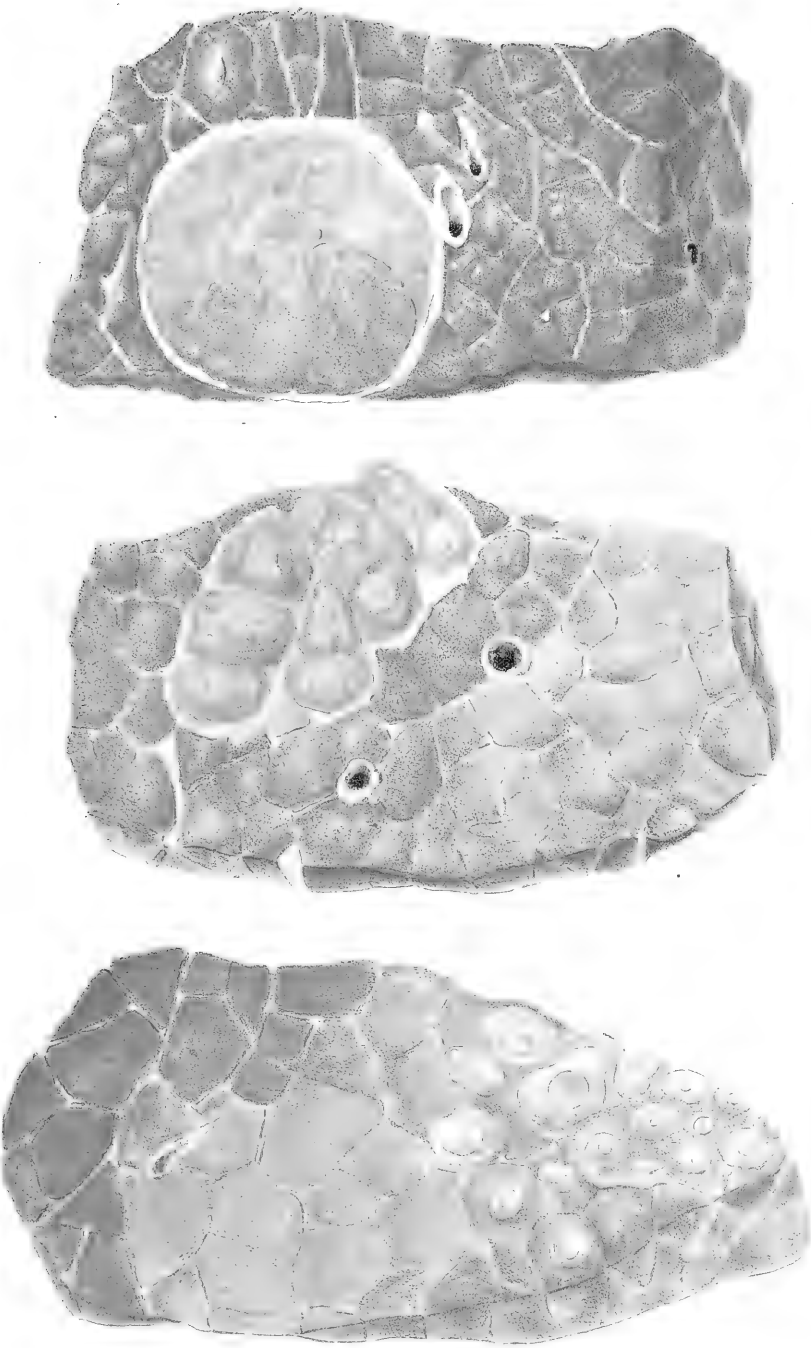
PLATE XXXV. Tuberculosis of the liver. A large portion of the lobe represented in the plate has undergone tuberculous changes. The whitish, very fine, newly formed connective tissue contains the yellowish, partly cheesy, partly gritty masses characteristic of advanced tuberculous degeneration. This large mass projected above the surface of the liver. In the plate the diseased mass is shown cut through its central portion with the cut surface presented.

PLATE XXXVI. A lymph gland from the region of the thorax behind or above the œsophagus or gullet (posterior or dorsal mediastinum). The gland is shown cut through and laid open. It is very much enlarged, and the yellowish cheesy masses surrounded by dense connective tissue are well shown on the cut surface.

PLATE XXXVII. Represents the omentum or caul of a tuberculous cow. The preparation had been in alcohol for some time. The projecting masses are the tubercles, whence the name "pearly disease," for that form of the malady in which these tubercles are present. They are mainly restricted to the lining membrane of the thorax and abdomen.

PLATE XXXVIII. Fig. 1. Lymphatic gland of the mesentery (the fold of membrane to which the small intestines are attached) cut open. The gland is very much enlarged. The yellowish portions represent tissue which has undergone tuberculous changes.

Fig. 2. Omentum or caul resting upon the paunch. The reddish nodules with which the membrane is beset are tubercles, the product of the disease. Both specimens are from the same animal, a Jersey cow.



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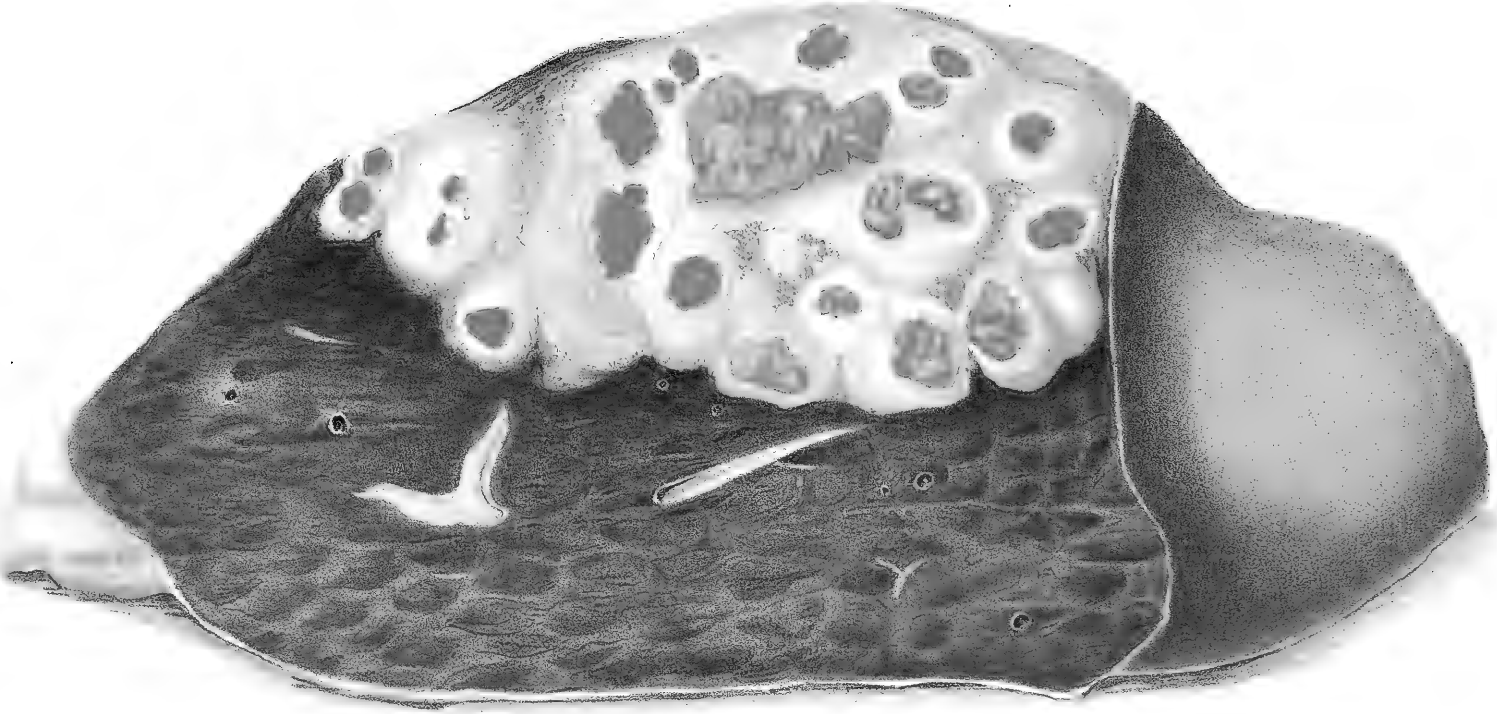
TUBERCULOSIS OF THE LUNGS.

PLATE XXXV



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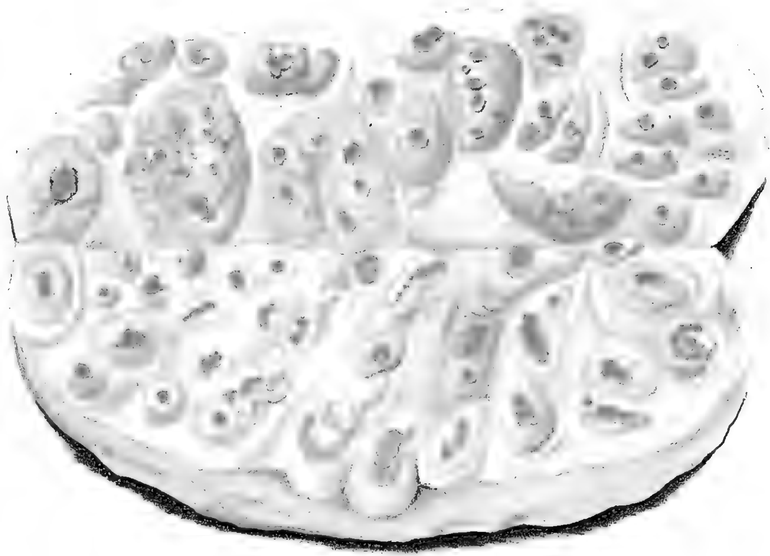
TUBERCULOSIS OF THE LIVER.



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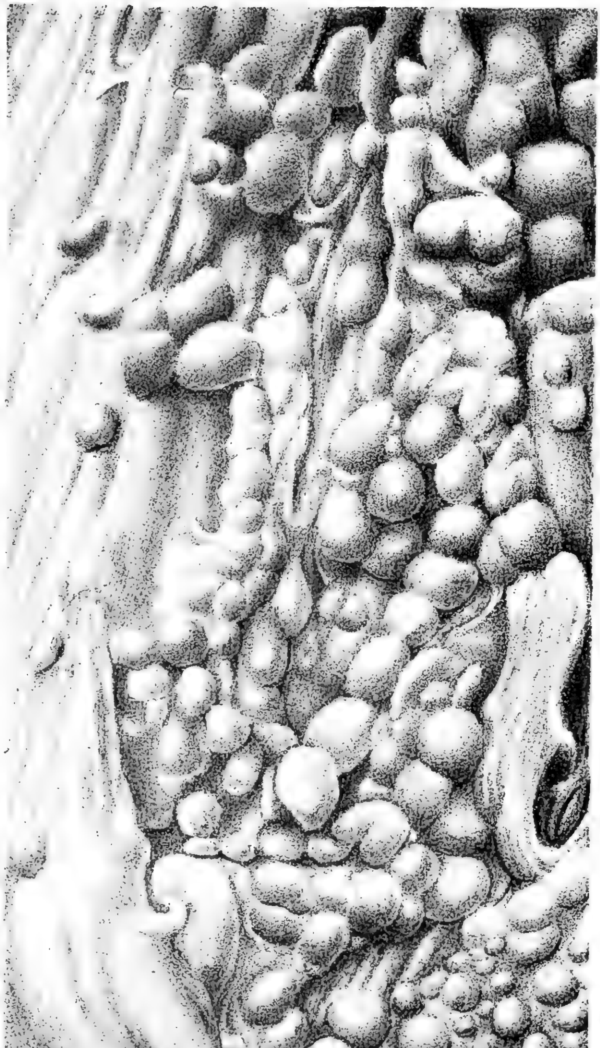
TUBERCULOUS LYMPHATIC GLAND.



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TUBERCULOSIS OF THE OMENTUM (CAUL).

Fig. 1

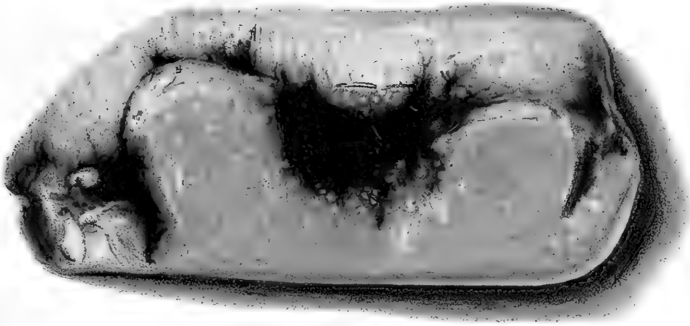
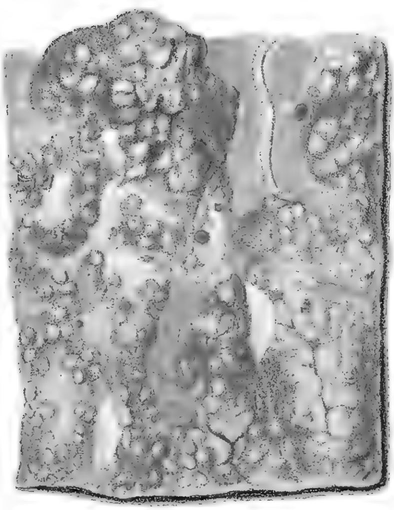


Fig. 2



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TUBERCULOSIS OF LYMPHATIC GLAND AND OF OMENTUM (Caul).

ACTINOMYCOSIS.

(Plates XXXIX to XLI, inclusive.)

Actinomycosis, also known as lump-jaw, big-jaw, etc., is a local disease due to the formation of peculiar tumors in various regions of the body, more particularly the head. In these tumors a certain fungus (actinomyces) is always present and regarded as the cause of the disease process.

Although these tumors on cattle had been the object of study for many years, it was not until 1877 that the constant presence of actinomyces was pointed out by Bollinger, of Munich, and since that time considered the cause. This fungus had been observed in these tumors as early as 1863 by Rivolta, and by others subsequently, without having been suspected as causing them.

Since Bollinger's publication a large amount of work has been done, many observations made, and many hitherto obscure disease processes brought into relation with this fungus. Furthermore, a similar disease in man was first definitely shown to be associated with the same fungus in 1878 by Israel, and in the following year Ponfick pointed out that the disease described by Bollinger in animals and that found by Israel in man were due to the same cause; that is, that the fungi described by these observers were one and the same.

The tumors and abscesses wherever they may be situated are all found to be the same in origin by the presence of the actinomyces fungus. When they are incised, a very close scrutiny with the naked eye, or at most a hand lens, will reveal the presence of minute grains which vary from a pale yellow to a sulphur-yellow color. They may be very abundant or so few as to be overlooked. They are embedded in the soft tissue composing the tumor or in the pus of the abscess. With a needle they are easily lifted out from the tissue and then they appear as roundish masses about one-half millimeter ($\frac{1}{50}$ inch) in diameter. To anyone familiar with the use of a microscope the recognition of these grains or particles without any previous preparation is a comparatively easy task.

When examined in the fresh condition under a microscope magnifying up to 250 diameters the general structure is made out without much difficulty. These grains consist of collections of minute roundish masses. Their outer surface is made up of club-shaped bodies all radiating from the center of the mass (see Fig. 2 of Plate XXXIX), somewhat like a rosette. If the fungus be crushed the interior is found made up of bundles of very fine filaments, which are probably continuous into the club-shaped bodies. The addition of a dilute solution of caustic soda or potash greatly aids the examination, since it removes the layer of cells adhering to the fungus which obscures the structure. Now and then these grains are found to be in a calcified condition. The exterior is incrusted in lime salts, which are dissolved by adding some weak dilute acid like acetic acid. Only by this procedure can the fungus be definitely recognized when in a mummified condition.

These are the bodies whose presence causes sufficient irritation in the tissues into which they find their way to set up inflammatory growths. These growths increase as the fungus continues to multiply until they reach enormous dimensions, if the affected animal is permitted to live long enough. The true nature of this parasite is not yet definitely settled, although many excellent observers have occupied themselves with it. According to earlier observers it is a true fungus. Later ones are inclined to place it among the higher bacteria. Further investigations will be necessary to clear up this subject. Whatever be the situation of the disease caused by actinomyces, its nature is fundamentally the same and peculiar to the fungus. The pathological details which make this statement clear can not be entered upon in this place, nor would they be of any practical value to the farmer. We will simply dwell upon a few obvious characters.

The consistency of the tumor varies in different situations according to the quantity of fibrous or connective tissue present. When very little of this is present the tumor is of a very soft consistency. As the quantity of connective tissue is increased the tumor is firmer and of a more honeycombed appearance. The individual actinomyces colonies are lodged in the spaces or interstices formed by the mesh work of the connective tissue. There they are surrounded by a mantle of cellular elements which fill up the spaces. By scraping the cut surface of such a tumor these cell masses inclosing the fungi come away, and the latter may be seen as pale or sulphur-yellow specks, as described above.

Location of the disease.—In cattle the disease process may be located both externally, where it is readily detected, and in internal organs. Its preferred seat is on the bones of the lower and upper jaw, in the parotid salivary gland in the angle of the jaw, and in the region of the throat. It may also appear under the skin in different parts of the body. Internally it may attack the tongue and appear in the form of a tumor in the mouth, pharynx, and larynx. It may cause extensive disease of the lungs, more rarely of the digestive tract.

It appears, furthermore, that in certain districts or countries the disease seems to attack by preference certain parts. Thus in England actinomycosis of the tongue is most prevalent. In Denmark the soft parts of the head are most prone to disease. In certain parts of Germany actinomycotic tumors of the throat (pharynx), in others disease of the jawbones is most frequently encountered.

A description of actinomycosis of the jaw (lump-jaw) and of the tongue has already been given by Dr. Murray, and hence they will be dealt with here only very briefly. When the disease attacks the soft parts of the head a rather firm swelling appears in which are formed one or more smaller projecting tumors varying from the size of a nut to that of an egg. These push their way outward and finally break through the skin as small, reddish, fungus-like bodies covered with thin sloughs. Or the original swelling, in place of enlarging in the manner described, may become transformed into an abscess which finally bursts to discharge creamy pus. The abscess cavity, however, does not disappear, but is soon filled with fungus-like growths which force their way outward through the opening.

When the tumors are situated within the cavity of the pharynx, they have broken through from some gland, perhaps beneath the mucous membrane, where the disease first appeared, and hang or project into the cavity of the pharynx, either as pendulous masses with a slender stem or as tumors with a broad base. Their position may be such as to interfere with swallowing and with breathing. In either case serious symptoms will soon appear.

The invasion of the bones of the jaws by actinomycosis must be regarded as one of the most serious forms of the disease. (Plates XXXIX, Fig. 1, XLI.) It may start in the marrow of the bone and by a slow extension gradually undermine the entire thickness of the bone itself. The growth may continue outward, and after working its way through muscle and skin finally break through and appear externally as stinking fungoid growths. The growth may at the same time work its way inward and appear in the mouth. The disease may also begin in the periosteum or covering of the bone and destroy the bone from without inwards.

Actinomycosis of the lungs is occasionally observed, and it is not improbable that it has been mistaken at times for tuberculosis. The actinomyces grains are, however, easily observed if the diseased tissue be carefully examined. The changes in the lungs as they appear to the naked eye vary considerably from case to case. Thus, in one animal the lungs were affected as in ordinary broncho-pneumonia as to the location, extent, and appearance of the disease process. The affected lobes had a dark-red flesh appearance, with yellowish areas sprinkled in here and there. (See Plate XL, Figs. 1, 2.) These latter areas were the seat of multiplication of the actinomyces fungus. In another case, of which only a small portion of the lungs was sent to the laboratory, these were completely transformed into a uniformly grayish mass, very soft and pulpy to the touch, and appearing like very soft and moist dough. (Plate XL, Fig. 3.) The actinomyces grains were exceedingly abundant in this tissue, and appeared when the tissue was incised as minute sulphur-yellow grains, densely sprinkled through the tissue, which readily came away and adhered to the knife blade. In still another case, a portion of the lung tissue was converted into large soft masses from 1 to 3 inches in diameter, each partly inclosed in very dense connective tissue. These soft grayish-yellow masses likewise resembled moist dough in their consistency, and the actinomyces grains, though neither very distinct nor at all abundant, were easily fished out and identified as such. A portion of this growth, which was as large as a child's head, was converted into an abscess filled with creamy semi-liquid pus.

This case differed from the preceding in that all appearance of lung tissue was gone from the diseased mass. Only on the exterior the lung tissue could be recognized, although even there it had been largely converted into very dense whitish connective tissue inclosing the fungoid growth. In the other case the external form of the lung and the shape and outline of the lobules were preserved, but the lung tissue itself was not recognizable as such. In the case first mentioned the changes were still less marked, and actinomycosis would not have been suspected by a simple inspection. These few illustrations suffice to show that actinomycosis of the lungs may appear under quite different forms, and that the nature of the disease can be accurately determined only by finding the fungus itself. Rarely actinomycosis attacks the body externally in places other than the head and neck. Crookshank describes the case of a bull in which the flank was attacked and subsequently the scrotum became diseased. A large portion of the skin of the flank was destroyed and covered with a leathery crust. When this was pulled away the pus beneath it showed the actinomyces grains to the naked eye.

Actinomycosis may in some cases be confounded with tuberculosis. The diagnosis does not offer any difficulties, since the presence of the actinomyces fungus at once removes any existing doubts. As has already been intimated, these grains are visible to the naked eye, and their nature is readily determined with the aid of a microscope.

The course of the disease is quite slow. As the tumors grow they may interfere with the natural functions of the body. According to their situation, mastication, rumination, or breathing may be interfered with, and in this way the animal may become emaciated. Actinomycosis of the jawbones leads to destruction of the teeth and impedes the movements necessary to chewing the food. Similarly, when the disease attacks the soft parts of the head obstructions may arise in the mouth by an inward growth of the tumor. If tumors exist in the pharynx they may partially obstruct the movements necessary to breathing, or close the air-passages and cause partial suffocation. Actinomycosis of the tongue, in interfering with the many and varied movements of this important organ, is also a serious matter. There is no reason to suppose that the localized disease interferes with the general health in any other way than indirectly, until internal organs, such as the lungs, become involved.

Prevention.—The question as to how and where animals take this disease is one concerning which we are still in the stage of conjecture, because we possess as yet very little information concerning the life history of the actinomyces itself. The quite unanimous view of all observers is that animals become infected with the food. The fungus is lodged upon the plants and in some way enters the tissues of the head, the lungs, and the digestive tract, where it sets up its peculiar activity. It is likewise quite generally believed that the fungus is, as it were, inoculated into the affected part. This inoculation is performed by the sharp and pointed parts of plants which penetrate the mucous membrane and carry with them the fungus. The disease is therefore inoculable rather than contagious. The mere presence of the diseased animal will not give rise to disease in healthy animals unless the actinomyces grains pass directly from the diseased into some wound or abrasion of the healthy, or else drop upon the food which is consumed by the healthy. Not only are these views deducible from clinical observation, but they have been proved by the positive inoculation of calves and smaller animals with actinomyces. The danger therefore of the presence of actinomyces for healthy animals is a limited one. Nevertheless an animal affected with this disease should not be allowed to go at large or run with other animals. If the fungus is being scattered by discharging growths we certainly can not state at this stage of our knowledge that other animals may not be infected by such distribution, and we must assume that this actually occurs until more positive information is at hand.

It is, however, the opinion of the majority of authorities that when actinomycosis appears among a large number of animals they all contract it in the same way from the food. Much speculation has therefore arisen whether any particular plant or group of plants is the source of the infection, and whether any special condition of the soil favors it. Very little positive information is at hand on these questions. It would be very desirable for those who live in localities where this disease is prevalent to make statistical and other observations on the occurrence of the disease with reference to the season of the year, the kind of food, the nature of the soil (whether swampy or dry, recently reclaimed or cultivated for a long time) upon which the animals are pastured or upon which the food is grown.

It is highly probable that such investigations will lead to an understanding of the source of the fungus and the means for checking the spreading of the disease itself. Veterinarian Jensen, of Denmark, made some observations upon an extensive outbreak of actinomycosis, about ten years ago, which led him to infer that the animals were inoculated by eating barley straw harvested from pieces of ground just reclaimed from the sea. While the animals remained unaffected as long as they pastured on this ground, or ate the hay obtained from it, they became diseased after eating the straw of cereals from the same territory. Others have found that cattle grazing upon low pastures along the banks of streams and subject to inundations are more prone to the disease. It has also been observed that food gathered from such grounds may give rise to the disease even after prolonged drying. Much additional information of a similar kind must be forthcoming before the source and manner of infection in this disease and its dependence upon external conditions will be known. It is not at all improbable that these may vary considerably from place to place.

Treatment—This has been until recently almost entirely surgical.

When the tumors are external and attached to soft parts only, an early removal may lead to recovery. This, of course, can only be undertaken by a trained veterinarian, especially as the various parts of the head and neck contain important vessels, nerves, and ducts which should be injured as little as possible in any operation. Unless the tumor is completely removed it will reappear. Disease of the jawbones is at best a very serious matter, and treatment is likely to be of no avail.

In March, 1892, an important contribution to our knowledge of this subject was made by M. Nocard, of the Alfort Veterinary School, in a communication to the French Central Society of Veterinary Medicine. He showed clearly that the actinomycosis of the tongue, a disease which appears to be quite common in Germany, and is there known as "wooden-tongue," could be quickly and permanently cured by the administration of iodide of potassium. M. Nocard calls attention to the success of M. Thomassen, of Utrecht, who recommended this treatment as long ago as 1885, and who has since treated more than eighty cases, all of which have been cured. A French veterinarian, M. Godbille, has treated a number of cases of actinomycosis in the tongue with the same remedy, all of which have been cured. M. Nocard also gives details of a case which was cured by himself.

All of the cases referred to were of actinomycosis of the tongue, and no one appears to have attempted the cure of actinomycosis of the jaw until this was undertaken by Dr. Norgaard, veterinary inspector of the Bureau of Animal Industry. He selected a young steer in April, 1892, in fair condition, which had a tumor on the jaw, measuring 15½ inches in circumference, and from which a discharge had already been established. This animal was treated with iodide of potassium, and the result was a complete cure.

The treatment with iodide of potassium consists in giving full doses of this medicine once or twice a day until improvement is noticed, when the dose may be reduced or given less frequently. The size of the dose should depend somewhat upon the weight of the animal. M. Thomassen gives one and one-half drams of iodide of potassium daily in one dose, dissolved in a pint of water until improvement is noticed, which he states is always within eight days. Then he decreases the dose to one dram. The animals do well under this treatment, showing only the ordinary symptoms which follow the use of iodine, the principal ones being discharged from the nose, weeping of the eyes, and peeling off of the outer layer of the skin. These symptoms need cause no uneasiness, as they never result in any serious disturbance of the health.

M. Godbille has given as much as four drams (half an ounce) in one day to a steer, decreasing the dose half a dram each day until the dose was one and one-fourth drams, which was maintained until the twelfth day of treatment, when the steer appeared entirely cured.

M. Nocard gave the first day one and one-half drams in one dose to a cow; the second and succeeding days a dose of one dram in the morning and evening, in each case before feeding. This treatment was continued for ten days, when the animal was cured.

Dr. Norgaard gave two and one-half drams dissolved in water once a day for three days. He then omitted the medicine for a day or two, and continued it according to symptoms. These examples of the treatment as it has been successfully administered by others will serve as a sufficient indication for those who wish to test it.

Actinomycosis and the public health.—The interest which has been aroused concerning this cattle disease is largely due to the fact that the same disease attacks human beings. Its slow progress, its tendency to remain restricted to certain localities, and the absence of any directly contagious properties, have thus far not aroused any anxiety in other countries as to its influence on the cattle industry, not even to the point of placing it among the infectious diseases of which statistics are annually published. Its possible bearing on public health has, however, given this disease a place in the public mind which it hardly deserves.

It has already been stated that the actinomyces fungus found in human disease is considered by authorities the same as that occurring in bovine affections. It is therefore of interest to conclude this article with a brief discussion of the disease in man and its relation to actinomycosis in cattle.

In man the location of the disease process corresponds fairly well with that in cattle. The majority of cases which have been reported in different parts of the world, and they are now quite numerous, indicate disease of the face. The skin or the jawbones may become affected, and by a very slow process it may extend downward upon the neck and even into the cavity of the chest. In many cases the teeth have been found in a state of more or less advanced decay and ulceration. In a few cases disease of the lungs was observed without coexisting disease of the bones or soft parts of the head. In such cases the fungus must have been inhaled. The disease of the lungs after a time extends upon the chest wall. Here it may corrode the ribs and work its way through the muscles and the skin. An abscess is thus formed discharging pus containing actinomyces grains. Disease of the digestive organs caused by this fungus has also been observed in a few instances.

Granting the identity of the disease in man and cattle, the question has been raised whether cattle are responsible for the disease in man. Any transmission of the infectious agent may be conceived of as taking place during the life of the animal and after slaughter from the meat. That human beings have contracted actinomyces by coming in contact with diseased cattle is not shown by the cases that have hitherto been reported, for the occupations of most of the patients did not bring them into any relation whatever with cattle. While the possibility of such direct transmission is not denied, therefore, it must be considered extremely rare. Practically the same position is maintained at present by most authorities as regards the transmission of the disease to man by eating meat. Israel, who has studied this question carefully, found the disease in Jews who never ate pork* and who likewise were protected by the rigorous meat inspection practiced by their sect from bovine actinomycosis. Furthermore it must be borne in mind that actinomycosis is a local disease causing great destruction of tissue where the fungus multiplies, but very rarely becoming generally disseminated over the body from the original disease focus. The fungus is only found in places where the disease process is manifest to the eye or becomes so in a very short time after the lodgment of the fungus. Only the greatest negligence would allow the actually diseased parts to be sold and consumed. Finally this parasite, like all others, would be destroyed in the process of cooking. The majority of authorities thus do not believe that actinomycosis in man is directly traceable to the disease in animals, but are of the opinion that both man and animals are infected from a third source. This source has already been discussed above. How far these views may be modified by further and more telling investigations of the parasitic fungus itself no one can predict. There are still wide gaps in our knowledge, and the above presentation simply summarizes the prevail-

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ACTINOMYCOSIS.

[Description of plates.]

Plate XXXIX. Fig. 1. Actinomycosis of the jaw. The lower jawbone has been extensively eaten away by the disease. Fig. 2. Actinomyces fungus from a tumor of the jawbone in cattle, magnified 550 times. Both figures are taken from Johne (Encyklopädie d. ges. Thierheilkunde).

Plate XL. Actinomycosis of the lungs, Fig. 1. Transverse section of the ventral lobe of the right lung from a case studied in the laboratory. The yellowish dots represent the places where the actinomyces fungus is lodged. The larger yellowish patches are produced by the confluence of a number of isolated centers. The entire lobe is of a dark flesh-red color due to collapse and broncho-pneumonia. Fig. 2. The cut surface of a portion of the principal lobe of the same lung, showing the recent invasion of antinomycosis from the other lobe: *a*, Large air tube; *b*, artery; *c*, a pneumonic lobule; *d*, lobule containing minute yellowish dots. In these the actinomyces fungus is lodged. Fig. 3. Cut surface of a small portion of another lung, showing a few lobules *a*. The fungus is sprinkled throughout the lung tissue in the form of yellowish grains, as shown in the illustration. The pleural covering of the lung tissue is shown in profile above.

Plate XLI. Actinomycosis of the jaw (lumpy-jaw, etc.), reduced one-half. (From Johne, in Encyklopädie d. gesammt. Thierheilkunde.) The lower jaw is sawn through transversely, *i. e.*, from right to left, and shows the disease within the jawbone itself; *a*, within the mouth, showing the papillæ on the mucous membrane of the cheek; *b*, front view of a molar tooth; *c*, the skin covering the lower surfaec of the jawbone; *d*, the jawbone hollowed out and enlarged by the formation of cavities within it, which are filled with the soft growth of the actinomycotic tumor. The section makes it appear as if the bone were broken into fragments and these forced apart; *e*, a portion of the tumor which has broken through the bone and the skin and appears as a tumor on the cheek. The little roundish masses represent the granulomata (minute tumors) in which the fungus vegetates.

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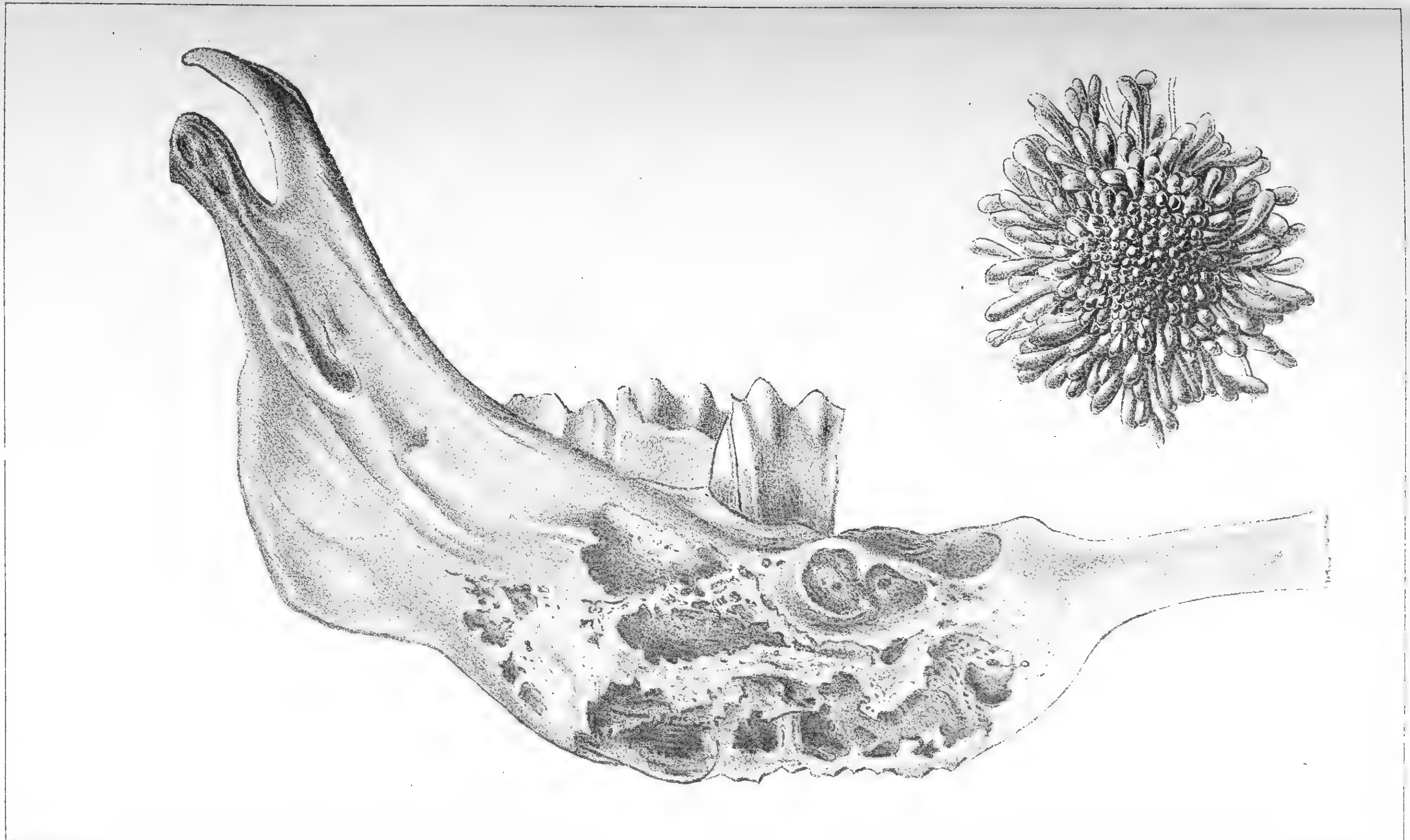
*Swine are subject to actinomycosis.



after Johne.

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OCTINOMYCOSIS.

Fig. 2

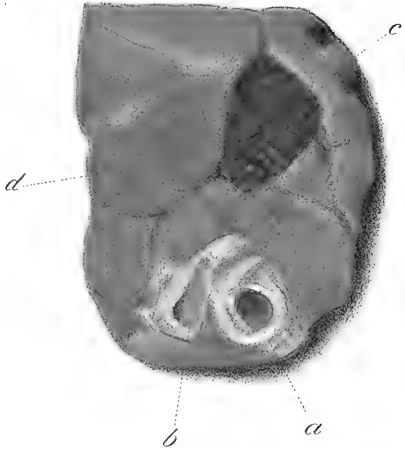


Fig. 3

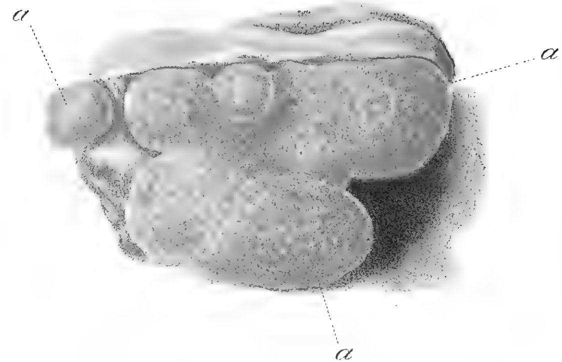
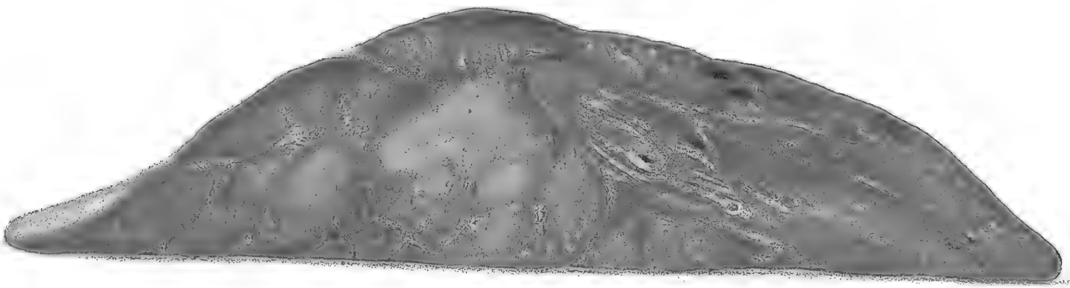


Fig. 1



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ACTINOMYCOSIS OF THE LUNGS.

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ACTINOMYCOSIS OF THE JAW.

ing views to which there are of course dissenters. An attempt to give the views of both sides on this question would necessitate the summarizing and impartial discussion of all the experiments thus far made—a task entirely beyond the scope of the present work.

Whether an animal affected with actinomycosis should be used for human food after all diseased organs and tissues have been thoroughly removed is a question the answer of which depends on a variety of circumstances. Among these may be mentioned the thoroughness of the meat inspection itself, which allows no really diseased animal to pass muster, the extent of the disease, and the general condition of the animal affected. If the vital organs have become involved, or if the disease has become generalized, the condition of the animal will show it. Animals seriously diseased and in which the general condition is affected should in all cases be condemned. Hard and fast lines it would be impossible to draw in this as in some other diseases, and it must be left to the skill of the inspector, reinforced by the knowledge and practice of the entire civilized world and the advances constantly made in our interpretation of disease, to settle the fitness or unfitness of each case as it comes up.

ANTHRAX.

Anthrax or charbon may be defined as an infectious disease which is caused by specific bacteria, known as anthrax bacilli, and which is more or less restricted by conditions of soil and moisture to definite geographical localities. While it is chiefly limited to cattle and sheep it may be transmitted to goats, horses, and certain kinds of game. Smaller animals, such as mice, rabbits, and guinea-pigs speedily succumb to inoculation. Dogs and swine are nearly insusceptible. The variety of domesticated animals which it may attack renders it one of the most dreaded scourges of animal life. It may even attack man. Of this more will be stated farther on.

The cause of anthrax is a microscopic organism known as the anthrax bacillus. (See Plate XXIX, Fig. 7.) In form it is cylindrical or rod-like, measuring $\frac{1}{5000}$ to $\frac{1}{2500}$ inch in length and $\frac{1}{25000}$ inch in diameter. Like all bacteria these rod-like bodies have the power of indefinite multiplication, and in the body of infected animals they produce death by rapidly increasing in numbers and producing substances which poison the body. In the blood they multiply in number by becoming elongated and then dividing into two, each new organism continuing the same process indefinitely. Outside of the body, however, they multiply in a different way when under conditions unfavorable to growth. Oval bodies appear within the rods which are called spores, and which remain alive and capable of germination after years of drying. They also resist heat to a remarkable degree, so that boiling water is necessary to destroy them. The bacilli themselves, on the other hand, show only very little resistance to heat and drying. It has long been known that the anthrax virus thrives best under certain conditions of the soil and on territories subject to floods and inundations. The particular kinds of soil upon which the disease is observed are black, loose, warm, humus soils, also those containing lime, marl, and clay, finally peaty, swampy soils resting upon strata which hold the water, or, in other words, are impervious. Hence fields containing stagnant pools may be the source of infection. The infection may be limited to certain farms, or even to restricted areas on such farms. Even in the Alps, over 3,000 feet above sea level, where such conditions prevail in secluded valleys anthrax persists among herds.

Aside from these limitations to specific conditions of the soil, anthrax is a disease of world-wide distribution. It exists in most countries of Europe, in Asia, Africa, Australia, and in our own country in the Lower Mississippi Valley and perhaps elsewhere.

Meteorological conditions have also an important share in determining the severity of the disease. On those tracts subject to inundations in spring, a very hot, dry summer is apt to cause a severe outbreak. The relation which the bacillus bears to these conditions is not positively known. It may be that during and immediately after inundations or in stagnant water the bacilli find enough nourishment in the water here and there to multiply and produce an abundant crop of spores, which are subsequently carried, in a dry condition, by the winds during the period of drought and disseminated over the vegetation. Animals feeding upon this vegetation may contract the disease if the spores germinate in the body.

Another source of the virus, and one regarded by many authorities as perhaps the most important, are the bodies of animals which have died of anthrax. It will be remembered that in such bodies the anthrax bacilli are present in enormous numbers, and wherever blood or other body fluids are exposed to the air on the surface of the carcass there the formation of spores will go on in the warm season of the year with great rapidity. It will thus be readily understood how this disease may become stationary in a given locality and appear year after year and even grow in severity if the carcasses of animals which have succumbed to it are not properly disposed of. These should be buried deeply, so that spore formation may be prevented and no animal have access to them. By exercising this precaution the disease will not be disseminated by flies and other insect pests.

We have thus two agents at work in maintaining the disease in any locality, the soil and meteorological conditions and the carcasses of animals that have died of the disease. Besides these dangers, which are of immediate consequence to cattle on pastures, the virus may be carried from place to place in hides, and it may be stored in the hay or other fodder from the infected fields and cause an outbreak among stabled animals feeding upon it in winter.

How cattle are infected.—We have seen above that the spores of the anthrax bacilli, which correspond in their functions to the seeds of higher plants, and which are the elements that resist the unfavorable conditions in the soil, air, and water longest, are the chief agents of infection. They may be taken into the body with the food and produce disease which begins in the intestinal tract; or they may come in contact with scratches, bites, or other wounds of the skin, the mouth, and tongue, and produce in these situations swellings or carbuncles. From such swellings the bacilli penetrate into the blood and produce a general disease.

It has likewise been claimed that the disease may be transmitted by various kinds of insects which carry the bacilli from the sick and inoculate the healthy as they pierce the skin. When infection of the blood takes place from the intestines the carbuncles may be absent. It has already been stated that since the anthrax spores live for several years the disease may be contracted in winter from food gathered on permanently infected fields.

The disease may appear sporadically, *i. e.*, only one or several animals may be infected while the rest of the herd remain well, or it may appear as an epizoötic attacking a large number at about the same time.

Symptoms.—The symptoms in cattle vary considerably, according as the disease begins in the skin, in the lungs or in the intestines. They depend also on the severity of the attack. Thus we may have what is called *anthrax peracutus* or apoplectiform, when the animal dies very suddenly as if from apoplexy. Such cases usually occur in the beginning of an outbreak. The animal, without having shown any signs of disease, suddenly drops down in the pasture and dies in convulsions, or an animal apparently well at night is found dead in the morning.

The second type—*anthrax acutus*—without any external swellings is the one most commonly observed in cattle. The disease begins with a high fever. The temperature may reach 106° to 107° F. The pulse beats from 80 to 100 per minute. Feeding and rumination are suspended. Chills and muscular tremors may appear and the skin show uneven temperature. The ears and base of the horns are cold, the coat staring. The animals are dull and stupid and manifest great weakness.

To these symptoms others are added in the course of the disease. The dullness may give way to great uneasiness, champing of the jaws, spasms of the limbs, kicking and pawing the ground. The breathing may become labored. The nostrils then dilate, the mouth is open, the head raised and all muscles of the chest are strained during breathing while the visible mucuous membranes (nose, mouth, rectum and vagina) become bluish. If the disease has started in the bowels there is much pain, as shown by the moaning of the animal; the discharges at first firm become softer and covered with serum, mucus and blood.

As the disease approaches the fatal termination the weakness of the animal increases. It leans against supports or lies down. Blood-vessels may rupture and give rise to spots of blood on the various mucous membranes and bloody discharges from nose, mouth, rectum and vagina. The urine not unfrequently contains blood (red-water). Death ensues within one or two days.

A third type of the disease—*anthrax subacutus*—includes those cases in which the disease is more prolonged. It may last from three to seven days and terminate fatally or end in recovery. In this type, which is rarely observed, the symptoms are practically as described in the acute form, only less marked.

In connection with these types of intestinal anthrax swellings may appear under the skin in different parts of the body, or the disease may start from such a swelling, caused by the inoculation of anthrax spores in one of the several different ways already described. If the disease begins in the skin it agrees in general with the subacute form in prolonged duration, and it may occasionally terminate in recovery if the swellings are thoroughly incised and treated.

These swellings appear as œdemas and carbuncles. The former are doughy tumors of a more or less flattish form passing gradually into the surrounding healthy tissue. They are situated as a rule beneath the skin in the fatty layer, and the skin itself is at first of healthy appearance, so that they are often overlooked, especially when covered with a good coat of hair. When they are cut open they are found to consist of a peculiar jelly-like mass of a yellowish color and more or less stained by blood. The carbuncles are firm, hot, tender swellings which later become cool and painless and undergo mortification. The œdemas and carbuncles may also appear in the mouth, pharynx, larynx, in the tongue and in the rectum.

The bodies of cattle which have died of anthrax soon lose their rigidity and become bloated, because decomposition sets in very rapidly. From the mouth, nose, and anus blood-stained fluid flows in small quantities. When such carcasses are opened and examined it will be found that nearly all organs are sprinkled with spots of blood or extravasations of various sizes. The spleen is enlarged from two to five times, the pulp blackish and soft and occasionally disintegrated. The blood is of tarry consistency, not firmly coagulated, and blackish in color. In the abdomen, the thoracic cavity, and in the pericardium or bag surrounding the heart more or less blood-stained fluid is present. In addition to these characteristic signs the carbuncles and swellings under the skin already described will aid in determining the true nature of the disease. The most reliable method of diagnosis is the examination of the blood and tissues for anthrax bacilli. This requires a trained bacteriologist.

Treatment.—This is as a rule ineffectual and useless, excepting perhaps in cases which originate from external wounds. The swellings should be opened freely by long incisions with a sharp knife and washed daily several times with carbolic acid solution (one ounce to a quart of water). When suppuration has set in, the treatment recommended in the chapter on wounds should be carried out.

Prevention.—Since treatment is of little or no avail in this disease, prevention is the most important subject demanding consideration. The various means to be suggested may be brought under two heads: (1) The surroundings of the animal; and (2) protective inoculation.

(1) What has already been stated in the foregoing pages on those conditions of the pastures which are favorable to anthrax will suggest to most minds after a little thought some of the preventive measures which may be of service in reducing losses in anthrax localities. All that conduces to a better state of the soil should be attempted. The state or nation should do its share in preventing frequent inundations, by appropriate engineering. If pools of stagnant water exist on the pastures, or if any particular portions are known by experience to give rise to anthrax, they should be fenced off. Efforts should likewise be made towards the proper draining of swampy lands frequented by cattle. Sometimes it has been found desirable to abandon for a season any infected and dangerous pastures. This remedy can not be carried out by most farmers, and it is liable to extend the infected territory. In some instances withdrawal of cattle from pastures entirely and feeding them in stables is said to have reduced the losses.

It is of the utmost importance that carcasses of animals which have died of anthrax should be properly disposed of, since every portion of such animal contains the bacilli ready to form spores when exposed to the air. Perhaps the simplest means is to bury the carcasses deep, where they can not be exposed by dogs or wild animals. It may be necessary to bury them on the pasture, but it is better to remove them to places not frequented by susceptible animals. If they are moved some distance it must be borne in mind that the ground and all objects which have come in contact with the carcass should be disinfected. This is best accomplished with chloride of lime. For washing utensils, etc., a 5 per cent solution may be prepared by adding 3 ounces to 2 quarts of water. This should be prepared fresh from the powder, and it is but little trouble to have a small tin measure of known capacity to dip out the powder to be added to the water whenever necessary. The carcass and the ground should be sprinkled with powdered chloride, or if this be not at hand, an abundance of ordinary slaked or unslaked lime should be used in its place.

The removal of carcasses to rendering establishments is always fraught with danger, unless those who handle them are thoroughly aware of the danger of scattering the virus by careless handling in wagons which are not tight. As a rule, the persons in charge of such transfer have no training for this important work, so that deep burial is to be preferred. Burning large carcasses is rarely feasible. It is, however, the most certain means of destroying infectious material of any kind, and should be resorted to whenever practicable. When stables have become infected they should be thoroughly cleaned out, and the solution of chloride of lime freely applied on floors and woodwork. The feed should be carefully protected from contamination with the manure or other discharges from the sick.

Protective inoculation was first introduced by Louis Pasteur about ten years ago, and has been quite extensively practiced in France and to some extent in other European countries. The fluid used for inoculation consists of bouillon in which modified anthrax bacilli have multiplied and are present in large numbers. The bacilli have been modified by heat so that they have lost to a certain degree their original virulence. Two vaccines have been prepared. The first or weakest for the first inoculation, and the second or stronger for a second inoculation some twelve days later.

These vaccines have been used for cattle and sheep. Their power to prevent an attack of anthrax subsequently has been the subject of controversy ever since their use began. The French claim that the vaccines are successful in protecting cattle and sheep and that the losses from anthrax in France have been much reduced by their persistent application. According to other observers there are several difficulties inherent in the practical application of anthrax vaccination. Among these may be mentioned the variable degree of attenuation of different tubes of the vaccine and the varying susceptibility of the animals to be inoculated. It would be impossible at present to decide from published statistics as to the relative value of these anthrax inoculations in preventing losses. While some authorities regard the vaccination of sheep of little use because of the losses directly due to the vaccination, they admit that vaccination of cattle is accompanied by fewer losses, and that it seems to be protective and of use in localities where the disease regularly appears every year, and is, so to speak, bound to the soil.

It is very important to call attention to the possibility of distributing anthrax by this method of protective inoculation, since the bacilli themselves are present in the culture liquid. It is true that they have been modified and weakened by the process adopted by Pasteur, but it is not impossible that such modified virus may regain its original virulence after it has been scattered broadcast by the inoculation of large herds. No vaccination should therefore be permitted in localities free from anthrax.

ANTHRAX IN MAN—(MALIGNANT PUSTULE, OR CARBUNCLE.)

Anthrax may be transmitted to man in handling the carcasses and hides of animals which have succumbed to the disease. The infection usually takes place through some abrasion or slight wound of the skin into which the anthrax spores or bacilli find their way. The point of inoculation appears at first as a dark point or patch, compared by some writers to the sting of a flea. After a few hours this is changed into a reddened pimple which bears on its summit, usually around a hair, a yellowish blister or vesicle which later on becomes red or bluish in color. The burning sensation in this stage is very great. Later on, this pimple enlarges, its center becomes dry, gangrenous, and is surrounded by an elevated discolored swelling. The center becomes drier and more leather-like, and sinks in as the whole increases in size. The skin around this swelling, or carbuncle, is stained yellow or bluish, and is not infrequently swollen and doughy to the touch. The carbuncle itself rarely grows larger than a pea or a small nut, and is but slightly painful.

Anthrax swellings, or œdemas, already described as occurring in cattle, may also be found in man, and they are at times so extensive as to produce distortion in the appearance of the part of the body on which they are located. The color of the skin over these swellings varies according to the situation and thickness of the skin and the stage of the disease, and may be white, red, bluish, and blackish.

As these carbuncles and swellings may lead, sooner or later, to an infection of the entire body and thus be fatal, surgical assistance should at once be called if there is well-grounded suspicion that any swellings resembling those described above have been due to inoculation with anthrax virus. Inasmuch as physicians differ as to treatment of such accidents in man, it would be out of place to make any suggestions in this connection.

To show that the transmission of anthrax to man is not so very uncommon we take the following figures from the last report of the German Government (1890). One hundred and eleven cases were brought to the notice of the authorities, of which eleven terminated fatally. The largest number of inoculations were due to the slaughtering, opening, and skinning of animals affected with anthrax. Hence the butchers suffered most extensively. Of the one hundred and eleven, thirty-six belonged to this craft.

In addition to anthrax of the skin (known as malignant pustule), human beings are subject, though very rarely, to the disease of the lungs and the digestive organs. In the former case the spores are inhaled by workmen in establishments in which wool, hides, and rags are worked over. In the latter case the disease is contracted by eating the flesh of diseased animals which has not been thoroughly cooked. These forms of the disease are more fatal than those in which the disease starts from the skin.

BLACK-QUARTER.

Black-quarter, black-leg, *charbon symptomatique* of the French, *Rauschbrand* of the Germans, is a rapidly fatal infectious disease of young cattle, associated with external swellings which emit a crackling sound when handled. This disease was formerly regarded identical with anthrax, but the investigations of the past ten or fifteen years have definitely proved that it is a specific disease produced by bacilli, readily distinguishable from anthrax bacilli. (Plate XXIX, Fig. 4.) Cattle between 6 months and 4 years of age are the most susceptible. Sucking calves under 6 months are not attacked, nor are they as susceptible to inoculation as older animals.

Like anthrax, black-quarter is more or less restricted to definite localities. There are certain pastures upon which the disease regularly appears in the summer and fall of the year. As to any peculiarities of the soil nothing is definitely known. Some authors are inclined to regard moist, undrained, and swampy pastures favorable to this disease. It occurs in different parts of our own country. In Europe it exists in France, various parts of Germany, in Belgium, Italy, in the Alps, and in Algeria.

The cause of the disease is a bacillus resembling in some respects the anthrax bacillus, and differing but little from it in size. It also possesses the power of forming within itself a spore. In Plate XXIX, Fig. 4, this is represented as an uncolored spot located in one end of the rod, which is enlarged so that the rod itself appears more or less club-shaped. What has already been stated concerning the significance of the spore of the anthrax bacillus applies equally well to these bodies. They resist destructive agents for a considerable length of time, and may still produce disease when inoculated after several years of drying. This fact may account for the occasional appearance of black-quarter in stables. The dry spores are carried in the hay or other feed from the field, and cause disease when eaten by the susceptible animals. Several observers have found this organism in the mud of swamps. By placing a little of this mud under the skin the disease has been called forth.

Since the disease may be produced by placing under the skin material containing the specific bacilli and spores, it has been assumed that cattle contract the disease mainly through wounds, either of the skin or of the mouth, tongue, and throat. Slight wounds into which the virus may find access may be caused by sharp or pointed parts of the food.

The symptoms of black-quarter are both of a general and a local nature. The general symptoms are very much like those belonging to other acute infectious or bacterial diseases. They begin from one to three days after the infection has taken place, with loss of appetite and of rumination, with dullness and debility and a high fever. The temperature may rise to 107° F. To these may be added lameness or stiffness of one or more limbs, due to the tumor or swelling quite invariably accompanying the disease. After a period of disease lasting from one and a half to three days the affected animal almost always succumbs. Death is preceded by increasing weakness, difficult breathing, and occasional attacks of colic.

The most important characteristic of this disease is the appearance of a tumor or swelling under the skin of the affected animal a few hours after the setting in of the constitutional symptoms described above. In some cases it may appear first. This tumor may be located on the thighs (hence "black-leg," "black-quarter"), the neck, the shoulder, the breast, the flanks, or the rump; never below the carpal (or knee) and the hock joint. It more rarely appears in the throat and at the base of the tongue. The tumor, at first small and painful, spreads very rapidly both in depth and extent. When it is stroked or handled a peculiar crackling sound is heard under the skin. This is due to a collection of gas formed by the bacilli as they multiply. At this stage the skin becomes dry, parchment-like, and cool to the touch in the center of the tumor. If the swelling is cut into, a frothy, dark red, rather disagreebly smelling fluid is discharged. The animal manifests little or no pain during the operation.

As it is frequently desirable to know whether the disease is anthrax or black-quarter, a few of the most obvious post-mortem changes may here be cited. The characteristic tumor with its crackling sound when stroked has already been described. If, after the death of the animal, it be more thoroughly examined, it will be noted that the tissue under the skin is infiltrated with blood and yellowish, jelly-like material and gas bubbles. The muscular tissue beneath the swelling may be brownish or black, shading into dark red and dark yellow. It is soft and easily torn and broken up. In the abdomen and the thorax blood-stained fluid is not infrequently found, together with blood-staining of the lining membrane of these cavities. Blood spots (or ecchymoses) are also found on the heart and lungs.

Among the features of this disease which distinguish it from anthrax may be mentioned the unchanged spleen and the ready clotting of the blood. It will be remembered that in anthrax the spleen (milt) is very much enlarged, the blood tarry, coagulating feebly. The anthrax carbuncles and swellings differ from the black quarter swellings in not containing gas and in causing death less rapidly. Other means of diagnosis, which have reference to the specific bacilli, to the inoculable character of the virus upon small animals, and which are of decisive and final importance, can be utilized only by the trained bacteriologist and veterinarian.

Treatment.—In this disease remedies have thus far proved unavailing. Some writers recommend that the swelling be opened by deep and long incisions and a strong disinfectant applied to the exposed parts. For such application a strong carbolic-acid solution (1 ounce carbolic acid to a pint of water) is perhaps the most easily obtained. Others recommend that if the tumor appears low down on a limb a cord be tied around the limb just above the tumor and the latter opened and treated as stated above. Since nearly all those attacked die, there is no harm in trying these rather heroic suggestions.

Prevention.—The various means suggested under anthrax to prevent the spread or recurrence of this disease are equally applicable to black-quarter, and hence do not need to be repeated here. Furthermore, there is practically no danger of a transmission of this disease from one animal to another, since it is contracted on the pastures from the ground and in stables from the food.

Before closing this brief account of the disease it may be interesting to mention the efforts which have been made in the direction of preventive inoculation. Three French veterinarians, Arloing, Cornevin, and Thomas, have devised a method of inoculation which produces immunity from subsequent attacks. The method has undergone various modifications in their hands, and at present consists in an inoculation of weakened virus beneath the skin of the tail. The virus is prepared as follows:

The muscular tissue from the site of the swelling is dried rapidly and then mixed with two parts of water. The mixture is allowed to dry in ovens raised to a certain temperature. Two vaccines are prepared, a first or weaker vaccine which has been exposed to a dry heat of 212° F. for six hours, and a second or stronger vaccine exposed to the lower temperature of 185° F. for the same length of time. Of each of these dried vaccines a small quantity is ground up with water and injected under the skin of the tail. The second vaccine is injected ten days after the first. Those who have tried this method regard it as safe and valuable in those districts where the disease annually recurs.

MALIGNANT CATARRH.

Malignant catarrh or infectious catarrhal fever may be defined as an acute infectious disease of cattle, in which the respiratory and the digestive organs are involved in the disease. The cause of this affection has not as yet been determined, although the general belief among authorities is that it is a disease due to microörganisms, perhaps belonging to the bacteria. It is not, strictly speaking, a contagious disease, like rinderpest or foot-and-mouth disease, for example, and hence it does not appear in extensive outbreaks like these, but chiefly in isolated or consecutive cases. The predisposing causes are but little known, and various theories have been offered to explain observed facts. One author claims that the infection may arise in stables not kept well cleaned and dry. That it may recur year after year on the same farm or in the same locality has been frequently noticed by veterinarians in Europe. Nothing positive is known whether the conditions of the soil have any bearing on this disease, as they undoubtedly have in anthrax, for instance, for it seems to exist both in valleys and in elevated regions. Fortunately it is not a disease which spreads to any great extent, or which causes severe losses, and hence legislative enactments do not seem to be necessary for its restriction.

Symptoms.—Malignant catarrh attacks by preference young and well-nourished animals in the spring of the year. According to authorities a period of incubation of three to four weeks follows the infection before outward signs of disease appear. These vary very markedly from case to case, and observers differ more or less in their accounts of the disease as they have found it. It usually begins with a chill, followed by high fever (104° to 107° F). The head droops, the skin is hot and dry, and the coat staring. Quivering of the muscles in various parts of the body is frequently observed. Marked dullness passing, according to some observers, into an almost stupefied condition later on, is quite common. The secretion of milk stops in the beginning of the disease.

Affections of the eyes are characteristic of this malady. There is an abundant formation of tears, which run down over the face. The lids are swollen and inflamed, and the animal shuns the light by keeping them closed. This simple inflammation may be followed by an inflammation of the cornea, which may lead to permanent clouding. Inflammation of deeper parts of the eyes (iris) is occasionally seen.

Inflammation of the mucous membrane of the mouth, nose, and the sinuses of the head leads to discharges from the nose and mouth. The mucous membrane of the nose is reddened, and may be covered later on with inflammatory deposits. The discharge is at first watery, then thicker, and occasionally streaked with blood and foul smelling. The inflammation of the mouth is like this and leads to much dribbling of saliva. It may extend to the nasal pad and to the nose. Inflammation of the throat, with deposits of a croupous or diphtheritic character, leads to difficult breathing. Various noises are produced as the air passes in and out, depending on the place where its passage is partly obstructed by mucus and exudation. If the obstruction is great signs of suffocation may appear. According to some observers the horns become loosened by inflammation and may be knocked off easily by the uneasy, blinded animal.

The bowels are at first constipated; later, diarrhea sets in and the discharges become soft, offensive, and streaked with blood. Some authors mention the discharge of exudation in the form of membranous patches, which have been observed to be 6 to 9 feet long. The kidneys are usually inflamed, the urine is passed with difficulty and pain, and contains abnormal elements (albumen, casts, etc.), indicative of disease. The vaginal mucous membrane may be affected in a manner similar to that of the mouth and nose, and occasionally abortion follows.

In connection with these various symptoms there may be much uneasiness on the part of the animal, leading in some cases to madness and furious delirum, in others to spasms and convulsions or paralysis. Rapid emaciation is quite invariably associated with the disease in all its grades.

Like other infectious diseases, malignant catarrh pursues a longer or shorter course in accordance with the severity of the attack. In acute cases death is said to take place from three to seven days after the appearance of symptoms. When recovery ensues it may take three or four weeks. According to statistics, from 50 to 90 per cent of the affected animals die.

If animals which have died of this disease be examined, there will be occasionally found, in addition to the changes of the mucous membrane of mouth and nasal cavities referred to above, shallow ulcers in these situations. In severe cases membranous (croupous) deposits are found in the throat. Similar deposits have been found upon the mucous membrane of the fourth stomach and intestine, which is always inflamed. There is more or less inflammation of the membranes of the brain. In countries where rinderpest occasionally appears it may be difficult to distinguish between it and malignant catarrh, owing to a general similarity of the symptoms. In such cases only a trained veterinarian who takes into consideration all the different symptoms and lesions of both diseases should decide.

Treatment.—There is no specific treatment for this affection, and the various symptoms may be dealt with, if desired, according to the methods given in the first part of this volume. Preventive treatment, which insists on a removal of the infected animals and a thorough cleaning and disinfection of infected stables, may prevent the subsequent appearance of the disease. If the floors are low and damp they should be raised and made dry.

SOUTHERN CATTLE FEVER (TEXAS FEVER).

This disease, which is more commonly known as splenetic or Texas fever, is a specific fever communicated by cattle which have recently been moved northward from the infected district, or which is contracted by cattle taken into the infected district from other parts of the world. It is characterized by the peculiarity among animal diseases that the animals which disseminate the infection are apparently in good health, while those which sicken and die from it do not as a rule infect others.

It is accompanied by high fever, greatly enlarged spleen, destruction of the red blood corpuscles, escape of the coloring matter of the blood through the kidneys, giving the urine a deep red color, by a yellowness of the mucous membranes and fat, which is seen more especially in fat cattle, by a rapid loss of strength, and by fatal results in a large proportion of cases.

This disease has various names in different sections of the country where it frequently appears. It is often called Spanish fever, acclimation fever, red-water, black-water, distemper, murrain, dry murrain, yellow murrain, and bloody murrain.

The earliest accounts we have of this disease date back to 1814, when it was stated by Dr. James Mease before the Philadelphia Society for Promoting Agriculture that the cattle from a certain district in South Carolina so certainly disease all others with which they mix in their progress to the North, that they are prohibited by the people of Virginia from passing through the State; that these cattle infect others while they themselves were in perfect health, and that cattle from Europe or the interior taken to the vicinity of the sea were attacked by a disease that generally proved fatal. Similar observations have been made in regard to a district in the southeastern part of Virginia, the eastern portion of North Carolina, nearly the whole of South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, the southern portion of Tennessee, and a large part of Arkansas, Indian Territory, and Texas. It was the frequent and severe losses following the driving of cattle from the infected district in Texas into and across the Western States and Territories which led to the disease being denominated Texas fever. It is now known, however, that the infection is not peculiar to Texas or even to the Gulf coast, but that it extends far inland and northward almost to the southern line of Maryland.

When cattle from other sections of the country are taken into the infected district they contract this disease usually during the first summer, and if they are adult animals, particularly milch cows or fat cattle, nearly all die. Calves are much more likely to survive. The disease is one from which immunity is acquired, and, therefore, calves which recover are not again attacked, as a rule, even after they become adult.

When the infection is disseminated beyond the permanently infected district, the roads, pastures, pens, and other inclosures are dangerous for susceptible animals until freezing weather. The infection then disappears, and cattle may be driven over the grounds or kept in the inclosures the succeeding summer and the disease will not reappear. There are some exceptions to this rule in the section just north of the boundary line of the infected district. In this locality the infection sometimes resists the winters, especially when these are mild. There is some reason for believing that the infected district is gradually extending toward the north, but more careful observations need to be made before safe conclusions on this point can be adopted.

In regard to the manner in which the disease is communicated, experience shows that this does not occur by animals coming near or in contact with each other. It is an indirect infection. The cattle from the infected district first infect the pastures, roads, pens, cars, etc., and the susceptible cattle obtain the virus second hand from these. Usually animals do not contract disease when separated from infected pastures by a fence. If, however, there is any drainage or washing by rains across the line of fence this rule does not hold good.

The investigations made by the Bureau of Animal Industry demonstrate that the ticks which adhere to cattle from the infected district are the chief means of conveying the infection to the bodies of susceptible cattle. The infection, so far as we know, is not spread by the saliva, the urine, or the manure of cattle from the infected district. In studying the causation and prevention of this disease, attention must therefore be largely given to the ticks, and it now appears probable that if the cattle could be freed from this parasite when leaving the infected district they would not be able to cause the malady. The discovery of the connection of the ticks with the production of the disease is so recent that it is impossible to predict at this time the influence which it may have in preventing its spread. It establishes an essential point, however, and indicates many lines of investigation which are likely to yield important results.

*Nature of the disease.**—Texas fever is caused by an organism which lives within the red blood-corpuscles and breaks them up. It is therefore simply a blood disease. The organism does not belong to the bacteria but to the protozoa. It is not, in other words, a microscopic plant, but it belongs to the lowest forms of the animal kingdom. This very minute organism multiplies very rapidly in the body of the infected animal, and in acute cases causes an enormous destruction of red corpuscles in a few days. How it gets into the red corpuscle it is not possible to state, but it appears that it enters as an exceedingly minute body, probably endowed with motion, and only after it has succeeded in entering the corpuscle does it begin to enlarge. Concerning the more detailed description of this micro-organism we must refer the reader to the forthcoming special report on Texas fever. We shall simply delay in this place to describe its main characters. Plate XLIII, Fig. 4, illustrates an early stage of this blood parasite. The red corpuscle contains a very minute roundish body which is stained blue to bring it into view. The body is as a rule situated near the edge of the corpuscle. Fig. 5 illustrates an older stage in the growth of the parasite, in fact the largest which has thus far been detected. It will be noticed that there are usually two bodies in a corpuscle. These bodies are in general pear shaped. The narrow ends are always toward each other when two are present in the same corpuscle. If we bear in mind that the average diameter of the red blood corpuscles of cattle is from $\frac{1}{4000}$ to $\frac{1}{5000}$ inch, the size of the contained parasite may be at once appreciated by a glance at the figures referred to.

The various disease processes which go on in Texas fever, and which we may observe by examining the organs after death, all result from the destruction of the red corpuscles. This destruction may be extremely rapid or slow. When it is rapid we have the acute, usually fatal, type of Texas fever which is always witnessed in the height of the Texas-fever season; that is, during the latter weeks of August and the early weeks of September. When the destruction of corpuscles is slower a mild, usually non-fatal, type of the disease is called forth which is only witnessed late in autumn or more rarely in July and the early part of August. Cases of the mild type occurring thus early usually become acute later on and terminate fatally.

* The investigations from which the facts in the remainder of this article are taken will be published in full in a forthcoming report of the Bureau of Animal Industry by Drs. Theobald Smith and F. L. Kilborne.

The acute disease is fatal in most cases, and the fatality is due not so much to the loss of blood corpuscles as to the difficulty which the organs have in getting rid of the waste products arising from this wholesale destruction. How great this may be a simple calculation will serve to illustrate. If we take a steer weighing 1,000 pounds, the blood in its body will amount to about 50 pounds, if we assume that the blood represents one-twentieth of the weight of the body, a rather low estimate. According to experimental determination at the Bureau Station, which consists in counting the number of blood corpuscles in a given quantity of blood from day to day in such an animal, the corpuscles contained in from 5 to 10 pounds of blood may be destroyed within twenty-four hours. The remains of these corpuscles and the coloring matter in them must either be converted into bile or excreted unchanged. The result of this effort on the part of the liver causes extensive disease of this organ. The bile secreted by the liver cells contains so much solid material that it stagnates in the finest bile canals and chokes these up completely. This in turn interferes with the nutrition of the liver cells and they undergo fatty degeneration and perish. The functions of the liver are thereby completely suspended and death is the result. This enormous destruction of corpuscles takes place to a large extent in the kidneys, where a great number of corpuscles containing the parasites are always found in acute cases. This accounts largely for the blood-colored urine or red water which is such a characteristic feature of Texas fever. The corpuscles themselves are not found in the urine; it is the red coloring matter or hemoglobin which leaves them when they break up and passes into the urine.

Symptoms.—After a period of exposure to infected soil, which may vary from thirteen to ninety days, and which will be more fully discussed further on, under the subject of cattle ticks as bearers of the Texas-fever parasite, the disease first shows itself in dullness, loss of appetite, and a tendency to leave the herd and stand or lie down alone. A few days before these symptoms appear the presence of a high fever may be detected by the clinical thermometer. The temperature rises from a normal of 101°–103° F. to 106° and 107° F. There seems to be little or no change in temperature until recovery or death ensues. The period of high temperature or fever varies considerably. As it indicates the intensity of the disease process going on within, the higher it is the more rapid the fatal end. When it does not rise above 104° F. the disease is milder and more prolonged.

The bowels are mostly constipated during the fever; towards the end the feces may become softer and rather deeply tinged with bile. The urine shows nothing abnormal during the course of the disease until near the fatal termination, when it may be deeply stained with the coloring matter of the blood. (Hemoglobinuria; see Plate XLIII, Fig. 3.) Although this symptom is occasionally observed in animals which recover, yet it may generally be regarded as an indication of approaching death. The pulse and respiration are usually much more rapid than during health.

Other symptoms in addition to those mentioned have been described by observers, but they do not seem to be constant, and only the above are nearly always present. As the end approaches emaciation becomes very marked, the blood is very thin and watery, and the closing of any wound of the skin by clots is retarded. The animal manifests increasing stupor and may lie down much of the time. Signs of delirium have been observed in some cases. Death occurs most frequently in the night.

The course of the disease is very variable in duration. Death may ensue in from three days to several weeks after the beginning of the fever. Those that recover ultimately do so very slowly, owing to the great poverty of the blood in red corpuscles. The flesh is regained but very gradually, and the animal may be subjected to a second though mild attack later on in the autumn, which pushes the full recovery onward to the beginning of winter.

In the mild type of the disease, which occurs in October and November, symptoms of disease are well nigh absent. There is little if any fever, and if it were not for loss of flesh and more or less dullness the disease might pass unnoticed, as it undoubtedly does in a majority of cases. If, however, the blood corpuscles be counted from time to time a gradually diminishing number will be found, and after several weeks only about one-fifth or one-sixth of the normal number are present. It is, indeed, surprising how little impression upon the animal this very impoverished condition of the blood appears to make. It is probable, however, that if two animals kept under the same conditions, one healthy and the other at the end of one of these mild attacks, be weighed, the difference would be plainly shown.

Pathological changes observable after death.—In the preceding pages some of these have already been referred to in describing the nature of the disease. It is very important at times to determine whether a certain disease is Texas fever or some other disease, like anthrax, for example. This fact can, as a rule, be determined at once by a thorough microscopic examination of the blood. The necessary apparatus and the requisite qualifications for this task leave this method entirely in the hands of experts. There is, however, a considerable number of changes caused by this disease, which may be detected by the naked eye when the body has been opened. These, put together, make a mistake quite impossible. The presence of small ticks on the skin of the escutcheon, the thighs, and the udder is a very important sign in herds north of the Texas fever-line, as it indicates that they have been brought in some manner from the South and carried the disease with them, as will be explained later. Another very important sign is the thin, watery condition of the blood, either just before death or when the fever has been present for four or five days. A little incision into the skin will enable anyone to determine this point. Frequently the skin is so poor in blood that it may require several incisions to draw a drop or more.

The changes in the internal organs, as found on post-mortem examinations, are briefly as follows: The spleen or milt is much larger than in healthy animals. It may weigh three or four times as much. When it is incised the contents or pulp is blackish (see Plate XLII, Fig. 1), and may even well out as a disintegrated mass. The markings of the healthy spleen (Fig. 2) are all effaced by the enormous number of blood corpuscles which have collected in the spleen and to which the enlargement is due. Next to the spleen the liver will arouse our attention. (See Plate XLIII, Fig. 2.) It is larger than in the healthy state, has lost its natural brownish color (Fig. 1), and now has on the surface a paler yellowish hue. When it is incised this yellowish tinge or mahogany color, as it has been called by some, is still more prominent. This is due to the large amount of bile in the finest bile capillaries, and as these are not uniformly filled with it the cut surface has a more or less mottled appearance. This bile injection causes in many cases a fatty degeneration of the liver cells, which makes the organ appear still lighter in color.

In all cases the gall bladder should be examined. This is distended with bile, which holds in suspension a large quantity of yellow flakes, so that when it is poured into a tall bottle to settle fully one-half or more of the column of fluid will be occupied by a layer of flakes. If mucus is present at the same time the bile may become so viscid that when it is poured from one glass to another it forms long bands. The bile in health is a limpid fluid containing no solid particles.

If the animal has not been observed during life to pass urine colored with blood or red water, the bladder should be opened. This quite invariably, in acute cases, contains urine which varies in color from a deep port wine to a light claret. In many cases the color is so dense that light will not pass through even a thin layer. (Plate XLIII, Fig. 3.) The kidneys are always found congested in the acute attack. The disease exerts but little effect on the stomach and intestines beyond more or less reddening of the mucous membrane. Hence an examination of these may be safely omitted. The lungs are, as a rule, not diseased. The heart usually shows patches of blood extravasation on the inside (left ventricle), and less markedly on the outer surface.

We have observed jaundice of the various tissues but very rarely. It has been observed by some quite regularly, however.

The cattle tick, Ixodes bovis (Riley) *Boöphilus bovis* (Curtice), *as the carrier of Texas fever.* (Plate XLIV.)—The cattle tick is, as its name indicates, a parasite of cattle in the southern part of the United States. It belongs to the group of *Arthropoda* and to the genus *Ixodes* (*Boöphilus*), which is included in the order *Acarina.* Its life history is quite simple and easily traced from one generation to another. It is essentially a parasite, attaching itself to the skin and drawing the blood of its host. It is unable to come to maturity and reproduce its kind unless it becomes attached to the skin of cattle, whence it may obtain its food.

The eggs laid on the ground after the female has dropped from the host begin to develop at once. When the embryo is fully formed within the shell it ruptures this and gains its freedom. The time required from the laying of the eggs to their hatching varies considerably according to the temperature. In the laboratory in the heat of midsummer this was accomplished in about thirteen days. In the late fall, under the same conditions, it required from four to six weeks. The larva after emerging from the egg is very minute, six-legged, and just visible to the naked eye. (Plate XLIV, Fig. 3.) If these larvæ be kept on a layer of moist sand or earth in a covered dish they may remain alive for months, but there is no appreciable increase in size. As soon, however, as they are placed upon cattle growth begins.

On pastures these little creatures soon find their way upon cattle. They attach themselves by preference to the tender skin on the escutcheon, the inside of the thighs, and on the base of the udder. Yet when they are very numerous they may be found, in small numbers, on various parts of the body, such as the neck, the chest, and the ears.

The changes which they undergo during their parasitic existence were first studied by Dr. Cooper Curtice in 1889. The young tick within a week molts and the second or nymphal stage of the parasite's life is thus ushered in. After this change it has four pairs of legs. Within another week another molt takes place by which the tick passes from the nymphal to the sexual or adult stage. Impregnation now takes place, and with the development of the ova in the body the animal takes an increased quantity of blood, so that it becomes very much larger in a few days. That the rapid growth is due to the blood taken in may be easily proved by crushing one. The intestine is distended with a thick tarry mass composed of partly digested blood. When the female has reached a certain stage of maturity it drops to the ground and begins to lay a large number of eggs, which hatch in the time given above.

The life of the cattle tick is thus spent largely on cattle, and although the young or larvæ may live for a long time on the ground in the summer season they can not mature excepting as parasites on cattle. We have purposely omitted various details of the life history, including that of the male, as they are not necessary to an understanding of our present subject—Texas fever. How this is transmitted we will proceed to consider.

Southern cattle sent north during the spring and summer months carry on their bodies large numbers of the cattle tick. These when matured drop off and lay their eggs on northern pastures. These hatch, and the young tick soon gets upon any northern cattle which happen to be on the pasture. As soon as they have attached themselves to the skin they inoculate the cattle and Texas fever breaks out a week or more thereafter. That ticks may and do produce Texas fever had been suspected for many years in various parts of the country. A definite proof was not offered, however, and the experiments carried on by the Bureau of Animal Industry were the first to demonstrate this important fact. It is not within the scope of this work to describe the steps by which this conclusion was reached, nor the experiments made in this direction. These will be found in the forthcoming report. There are some important facts in the disease itself cleared up by these experiments which require mention here.

The so-called period of incubation.—After the young ticks have attached themselves to cattle the fever appears about ten days thereafter in midsummer. When the weather is cool, as in autumn, this period may be a little longer. The actual period of incubation may be shorter than this, for if blood from a case of Texas fever be injected into the blood-vessels of healthy cattle the fever may appear within five days. When cattle graze upon pastures over which Southern cattle have passed, the time when the disease appears varies within wide limits. When the animals have been put upon pastures immediately after Southern cattle have infected them with ticks, it may take from thirty to sixty days, or even longer, before the disease appears. This will be readily understood when we recall the life history of ticks. The Southern cattle leave only matured ticks which have dropped from them. These must lay their eggs and the latter be hatched before any ticks can get upon native cattle. The shortest period is thus not less than thirty days, if we include ten days for the period of incubation after the young tick has attached itself to native cattle. When the infection of pastures with ticks has taken place early in the season, or when this is cold, the period will be much longer because it takes longer for the eggs to hatch.

If native cattle are placed upon pastures which have been infected some time before with ticks, the disease will appear so much sooner because the young ticks may be already hatched and attack the cattle at once. It will be evident, therefore, that the length of time elapsing between the exposure of native cattle on infected fields and the appearance of the disease will depend on the date of original infection and on the weather, whether cold or hot. When native cattle are placed upon fields on which young ticks are already present they will show the fever in thirteen to fifteen days if the season be hot.

The fever appears before the ticks have matured. In fact they are still small enough to be overlooked. In any case very careful search should be made for them in those places upon which they prefer to locate, the thighs, escutcheon, and udder. After the acute stage of the fever has passed by the ticks begin to swell up and show very plainly. (Plate XLIV, Figs. 6 and 7.)

Prevention.—So far as our experiments have gone they indicate that

Texas fever is carried north only by the cattle tick. That there may be other sources of infection can not be denied, but if there be such they come into operation rarely and perhaps in very restricted localities. Hence, to prevent Texas fever north of the permanently infected area is to keep the pastures free from cattle ticks, and to do this no Southern cattle with ticks must be allowed upon them. Ticks may, however, reach pastures in other ways. Cattle cars from the South may leave the sweepings and manure in places where cattle may get access to them. These will contain ticks or eggs which will give rise to a brood of young ticks in due time, ready to inoculate cattle when the opportunity presents.

How to rid pastures of ticks without destroying the vegetation upon it we do not know at present. Every pasture once infected is dangerous during the entire season. Fortunately the winter destroys the tick and a fresh importation from the South is necessary to produce the disease again during the following season. This is not strictly true for sheltered places near the Texas-fever line, for they may live through very mild winters in such places and produce disease the following summer. The precise temperature at which the egg or the various stages of the cattle tick are destroyed can not be accurately ascertained, because it depends on the amount of protection and shelter which they may obtain. It is therefore impossible to state how late in the winter ticks carried from the South are still likely to perish in the North before the ensuing spring. We know that cold greatly retards the development of ticks in the egg and afterwards, and that any fatal disease in cold weather is not likely to occur, but if the ticks should survive until summer the danger of an outbreak is imminent. This danger diminishes, of course, the farther north we go and the period of time during which ticks may be carried thither with impunity is greater, owing to the longer season of cold.

Treatment.—When the disease has broken out, all animals, the sick as well as the healthy, should at once be removed to another non-infected pasture. While this may not cut short the disease, it may save the lives of some by removing them from the possibility of being attacked by more young ticks. Removal from infected pastures likewise prevents a second later attack in October or early in November, which is caused by another generation of ticks. It is true that sick natives infect with a new generation of ticks the pasture to which they are removed, but these usually appear so late that they have but little opportunity to do any damage. Hence, sick natives do not, as a rule, cause visible disease in other natives.

It is of importance to remove all ticks, as far as this is possible, from sick animals, since they abstract a considerable amount of blood and thereby retard the final recovery. No systematic experiments have as yet been made in the medicinal treatment of the sick, as the study of the cause of the disease has taken all the time that could be given to these investigations in past years. Sulphate of quinia, in doses of 15 to 30 grains, according to the size of the animal, has apparently given good results in the hands of some veterinarians, and tincture of aconite root and Epsom salts have been combined with it according to indications of the individual cases.

The previous pages have reference only to northern pastures. Whether the tick alone, or perhaps other pests also infect cattle which have been taken south, we are unable to state without having recourse to experimental inquiries. It is reasonable to assume, however, that the same causes are operative in the permanently infected area, and that ticks must be kept away from imported animals, especially during the warmer half of the year if disease is to be prevented.

Of the means by which ticks may be most easily and effectually removed from cattle or kept away from those not yet attacked, nothing definite can be said at present, and there is abundant room for experimentation in this direction, especially within the area permanently infested with the cattle tick.

Sanitary regulations.—The disease, outside of the infected district, may be prevented by proper regulations governing the movement of cattle from that district during the season of the year that infection is possible. Such regulations are now made yearly by the Secretary of Agriculture. They define the boundary of the infected district, and provide that no cattle shall go out of it except for immediate slaughter during that portion of the year included between the dates of February 15 and December 1. Cattle from the district going to slaughter can not be driven, but must be shipped by rail or boat. The waybills and cars are marked "Southern cattle" when they cross the boundary line, and when they are unloaded for feeding, watering, or sale they are placed in pens set apart for such animals and into which native stock is not allowed to go. The cars and boats which have transported such cattle must be cleaned and disinfected before native stock can be carried.

By these simple regulations the disease has been almost entirely prevented during the last two years, and little or no hardship has been caused to those shipping or handling cattle from the infected district. This success is one of the best illustrations of the value of proper regulations made in accordance with the principles of veterinary science and intelligently administered.

TEXAS FEVER.

[Description of plates.]

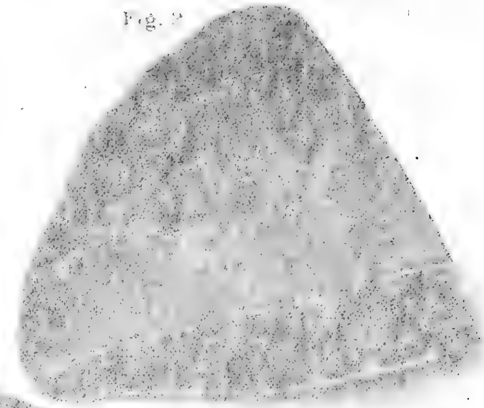
PLATE XLII. Fig. 1. Spleen of an acute fatal case of Texas fever. The narrow end of the spleen is here represented. Fig. 2. Spleen of healthy steer. Though the latter animal weighed one-half more than the former, the weight of the diseased spleen, $6\frac{7}{8}$ pounds, was nearly three times that of the healthy spleen, $2\frac{3}{8}$ pounds.

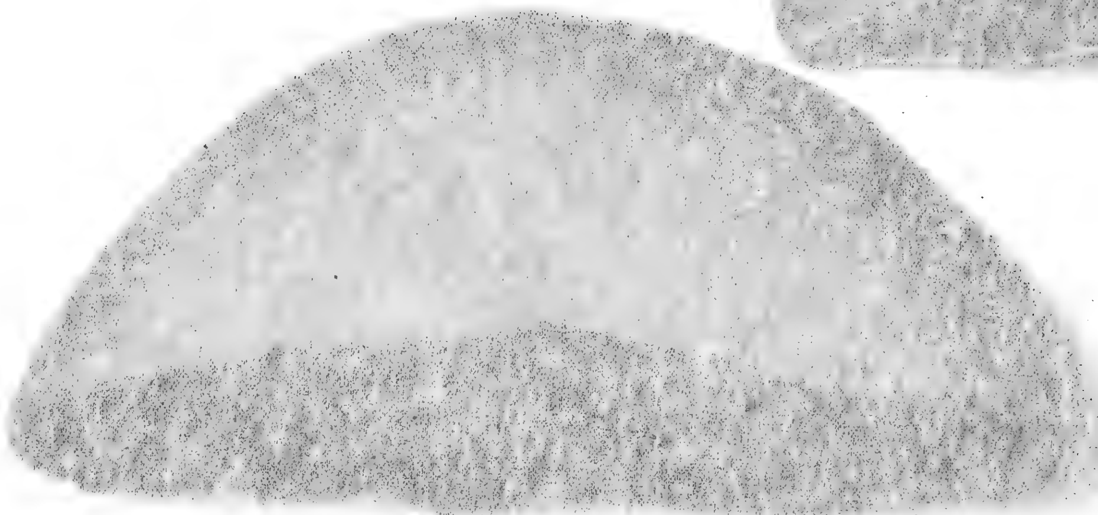
PLATE XLIII. Showing the cut surface of a healthy liver taken from a steer slaughtered for beef. Fig. 2. Showing the cut surface of the liver in Texas fever. Fig. 3. Represents the appearance of the urine in an acute fatal case of Texas fever. Fig. 4. Shows red corpuscles, magnified a thousand diameters, containing the parasite of Texas fever. This appears as a blue point, *a*, near the edge of the corpuscle. The blood was taken from a skin incision. The case was non-fatal and occurred late in fall. Fig. 5. Shows red corpuscles from the blood of an acute fatal case, twenty hours before death. The Texas fever microbes, *a*, are shown as pear-shaped bodies stained with methylene blue within the red corpuscles. The larger body on the right, *b*, is a white blood corpuscle also stained with methylene blue. Magnified a thousand diameters.

PLATE XLIV. The cattle tick, the carrier of Texas fever. Fig. 1. A series of ticks, natural size, from the smallest, just hatched from the egg, to the mature female ready to drop off and lay eggs. Fig. 2. Eggs, magnified 5 times. Fig. 3. The young tick just hatched, magnified 40 times. Fig. 4. The male after the last molt, magnified 10 times. Fig. 5. The female after the last molt, magnified 10 times. Fig. 6. A portion of the skin of the udder, showing the small ticks. From a fatal case of Texas fever produced by placing young ticks on the animal. Natural size. Fig. 7. A portion of the ear of the same animal showing same full-grown ticks, ready to drop off. Natural size.

PLATE XLII

Fig. 2





TEXAS FEVER.

[illegible]

[illegible] The narrow [illegible] Though the [illegible] the diseased [illegible] pounds.

[illegible] taken from a steer [illegible] of the liver in Texas fever. Fig. 3. Represents the appearance of the urine in an acute fatal case of Texas fever. Fig. 4. Shows red corpuscles, magnified a thousand diameters, containing the parasite of Texas fever. This appears as a blue point, *a*, near the edge of the corpuscle. The blood was taken from a skin incision. The case was non-fatal and occurred late in fall. Fig. 5. Shows red corpuscles from the blood of an acute fatal case, twenty [illegible] The Texas fever microbes, *a*, are shown as pear-shaped bodies [illegible] corpuscles. The larger body on the [illegible] with methylene blue. Magnified a thousand diameters.

PLATE XLIV. The cattle tick, the carrier of Texas fever. [illegible] A series of ticks, natural size, from the smallest [illegible] female ready [illegible] The young tick [illegible] moult, magnified [illegible] Fig. 6. A por- [illegible] fatal case of Texas [illegible] natural size. Fig. 7. A por- [illegible] ticks, ready to drop off.

PLATE XLII

Fig. 2

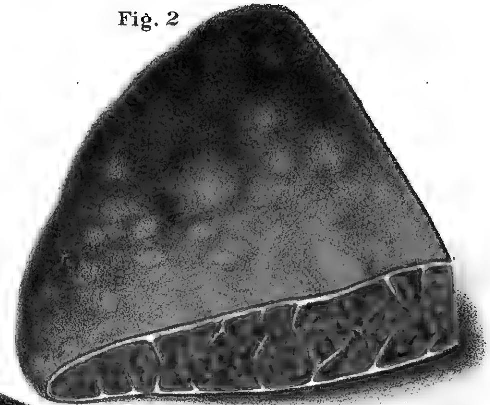


Fig. 1

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SPLEEN IN TEXAS FEVER.

PLATE XLIII

Fig. 1

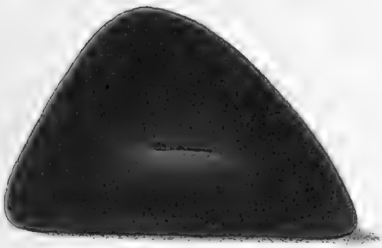
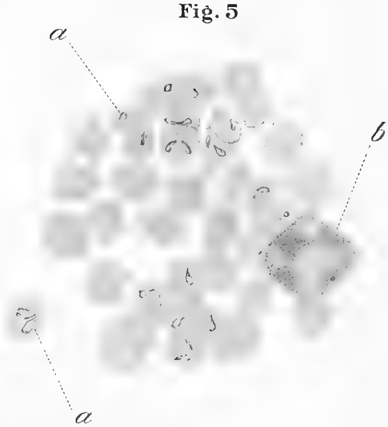


Fig. 3

Fig. 2

Fig. 4

Fig. 5



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TEXAS FEVER.

PLATE XLIV

Fig. 1

Fig. 2

Fig. 3

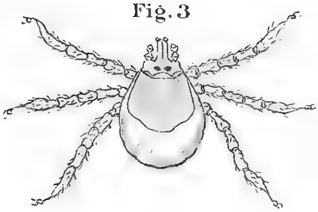


Fig. 4

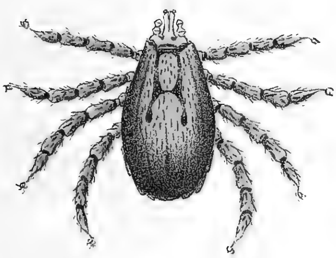


Fig. 5

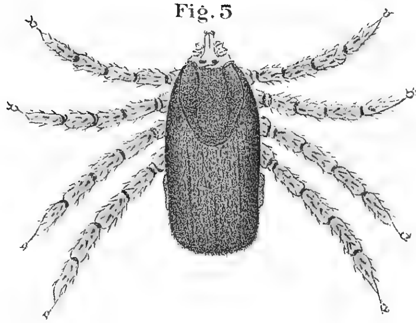


Fig. 7

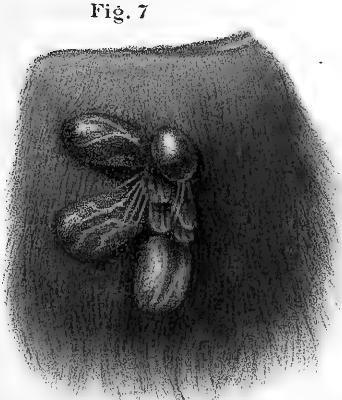
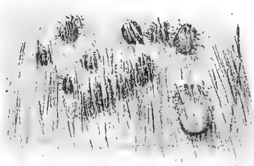


Fig. 6



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THE CATTLE TICK- THE CARRIER OF TEXAS FEVER.

THE FEEDING AND MANAGEMENT OF CATTLE.

By W. A. HENRY,

Professor of Agriculture and Director of the Agricultural Experiment Station, University of Wisconsin.

Ten years ago the cattle business of the country was undergoing a great and wonderful change; companies were being formed to control vast herds which were to range unrestrained over the western plains, with no provisions as to feed except the seeming abundance of natural grasses, and little care except rounding up and branding. With this unprecedented expansion came the natural attendant of good prices for cattle of almost any quality in the older agricultural sections, and beef-producers everywhere made money. It mattered little in Illinois or Iowa whether a fattening steer ate half a bushel of corn a day or only a third of a bushel, for there was profit in the business, and giving attention to little details about feeding was not to be thought of in such times. Those farmers who had advanced in dairying far enough to make fine goods likewise found high prices awaiting their products and were satisfied to continue their feeding operations with little thought of closer economy.

But times have changed; the young stock bought from our western farms at good prices to go to the plains proved fruitful and multiplied amazingly, and hordes of their descendants have been coming back year after year to aid in depressing the cattle market. Dairy products have kept up wonderfully well, but I do not think we can hope for higher prices at any time than have ruled the past year.

We are passing through a period of falling prices which began years ago with the manufacturer, carrier, and merchant, and which is now bearing down most heavily upon our agricultural industries. The marvelous advancement made in transportation facilities the world over has brought about a new set of conditions; stock, bred thousands of miles apart and reared under the most diverse conditions of range, climate, feed, and cost of production, meet at the great commercial centers, to be sold according to supply and demand, quality alone being the varying factor. The problem is still further complicated by the production of meat in distant parts of the world, which is now shipped as frozen carcasses to the great meat-consuming centers. Nor is there any going backward in this matter. We can not hope that any of the potent forces now at work, which all tend to equalizing the markets, will cease for even a single day. While legislation may aid in some minor matters, the general law that supply and demand rule prices remains inviolable. I know of but two means of successfully meeting the sharp competition which is certain to continue, first, by making products of a higher quality, and, second, by cheapening the cost of production.

While lack of space prevents more than a mere mention of the subject, I can not help but urge that our farmers and stockmen endeavor to secure the very best machines possible for converting coarse feeds into beef and dairy products. To have any other than the best cattle obtainable for the specific purpose in view is to start handicapped in what is sure to be a severe contest.

In the other line of improvement there is also much opportunity for careful study and the exercise of discretion and good judgment. The farmer and stockman should have a clear knowledge and good understanding of the several different kinds of stock foods, their relative values, and the combinations of those best suited for different animals in different stages of growth and usefulness. With an earnest desire to help the feeder in the study of the great problem which constantly confronts him this chapter is written.

SCIENCE AND STOCK-FEEDING.

Fifty years ago those great lights in agricultural chemistry, Liebig, of Germany, Boussingault, of France, and Lawes and Gilbert, of England, began investigations of agricultural problems, many of which were immediately helpful to agriculture and all tended to awaken an interest in an art previously neglected by scientific investigators. Out of this awakening grew the movement for a better knowledge of animal nutrition, and how and by what means the products of our fields were manufactured into flesh, milk, and other animal products. Germany has led the world in founding agricultural-experiment stations, and to German chemists and animal physiologists are we largely indebted for what is known in this most important field. Though the investigations began over a generation ago and have occupied the energies of many eminent men, the records of whose observations fill hundreds of books, so great is the subject that it now seems but fairly begun. Still, much has been found that is of great importance and utility to the practical stockman.

THE GERMAN FEEDING TABLES.

Mainly through the studies of the German investigators has come the first attempt to place the great art of feeding on a scientific basis. The various investigations in animal nutrition have been summarized and set forth in the writings of Wolff and Kuehn, of Germany, and very ably presented to English readers by Dr. Armsby in his "Manual of

Cattle Feeding." The leading features of this system have also been given in some of the reports of our American experiment stations. Being largely the result of German investigations and formulations, it is naturally spoken of as the "German system," while the tables of data relative to feeding stuffs and feeding rations are usually spoken of as the German feeding tables or the tables of Kuehn or Wolff, as compiled and arranged by those writers.

Table I of this chapter presents the studies of chemists both in this country and abroad, summarized and placed in the most available condensed form. The figures giving the composition of fodders are in most cases taken from the compilation of analyses of American fodders by Dr. E. H. Jenkins and A. L. Winton, jr., first published in Volume II of the Experiment Station Record, Department of Agriculture (pp. 702–709). That portion of the table which gives the digestible constituents was derived from the first part of the table through coefficients of digestibility given by Dr. Jenkins in the Report of the Connecticut Experiment Station for 1886 or from later sources.

There was a time when farmers thought that science, and even agricultural science, could bring little that would be helpful to them, but happily that day is past, and I approach the scientific side of the subject of feeding with no fear whatever that it will prove uninteresting to my readers, but rather that a large majority will gladly avail themselves of any opportunity which may offer for a better understanding of the great problem of stock feeding. It will be remembered in studying the table that like most first attempts at definite expression of difficult and complex problems, what is here given is but a crude expression of important laws, and that the tables will no doubt be considerably modified or perhaps supplanted in time by better ones, when the animal physiologist has enlarged our knowledge of what becomes of plant constituents in the animal body. In its present form it contains so much of value that it will well repay all the study and time devoted to it.

WHAT THE TABLE SHOWS.

This table looks formidable enough, but when we have studied it, column by column, I do not think it will be regarded as difficult, nor will its contents seem dry to farmer readers. In the first column are given the names of fodders, all of which are used in some portion of the country for stock-feeding purposes; next to this comes a statement of the number of analyses from which the succeeding average figures are derived.

Water.—In the laboratory the scales of the chemist are so delicate that he can weigh a thimbleful of corn meal with a smaller proportional error than the farmer weighs a wagon load of corn. In a small dish on these scales he places a sample of the fodder with which he is to work and determines its weight. Placing this in an oven it is dried at a temperature of 212° F. for several hours and weighed again. The heat has driven off the water and the difference in the two weights represents the water which the sample contained. The average amount of water found in the various samples in the list is placed in the column headed "Water." It will be seen that the proportion of water in the different feed stuffs varies greatly. In 100 pounds of pasture grass there are 75.3 pounds of water on an average; with roots the amount reaches as high as 90 pounds, while for straw and grain it varies from 8 to 16 pounds of water per hundred weight. Water is the great vehicle for transporting food both in the plant and animal, and, while of the highest importance to both, it is so universal and abundant that we need not further consider it at this time.

Ash.—Carefully burning a sample of the fodder, the chemist determines the ash. By the table we find that in 100 pounds of pasture grass there are 2.5 pounds ash, while in clover hay there are over 6 pounds. One hundred pounds of shelled corn contains only 1.5 pounds of ash, while the same weight of wheat bran yields over 5 pounds. The ash elements in plants are very important, since they enter into the composition of all the tissues of the body in a small way, and form the larger part of the bones. Experience shows that when the stockman feeds his animals abundantly with a variety of nutritious foods they are amply supplied with ash for all necessities of the body, so that as with water this part of the plant substance need not receive special attention when considering the constituents of feeds, though there are a few special cases where the supply of ash is apt to be lacking, even when the animals are seemingly well nourished.

Crude protein marks a very important group of substances in fodders, the characteristic element of all being nitrogen. The chemist has found that protein compounds weigh 6.25 times as much as the nitrogen contained; by a complicated process he determines the weight of nitrogen in a sample of feed, and multiplies this by 6.25, which gives the crude protein. A considerable portion of the bones, the ligaments which hold the bones together, the muscles which surround the bones, the tendons which bind the muscles to the bone, and the great nervous system, as well as the internal organs of the body, are largely composed of protein compounds. From this we can readily understand that protein is a very important part of stock foods, being especially needed with young, growing animals. We turn with interest to the table and note that the total crude protein in pasture grass is 4 pounds to the hundred, while in oats there are 11.8 pounds, in corn, 10.5 pounds, and nearly 33 pounds in 100 of linseed meal.

Crude fiber is determined by boiling a sample of the fodder first with a weak alkali, and then with a weak acid in order to dissolve out as much of the substance as possible. The undissolved portions represent the tougher parts of the framework of the plant, usually termed cellulose or crude fiber. The table shows that a large portion of rye straw is crude fiber, while in grains like corn or wheat the amount is very small.

Ether extract.—On another sample of the fodder the chemist places ether, which dissolves out whatever fats and wax it contains, and this dissolved portion is called the ether extract or crude fat. Hay and straw contain very little fat, and still less is found in mangolds or turnips, while corn contains considerable, and oil meal and cotton-seed meal a relatively large amount.

Nitrogen-free extract signifies what is left of the organic matter of the plant after deducting the preceding groups of elements. It contains starch, sugar, dextrine, and gums.

Carbohydrates.—The nitrogen-free extract and the crude fiber are grouped together under the term carbohydrates. The leading function of the carbohydrates is to furnish fuel for the animal body. Portions not needed for immediate wants may be converted into fat and stored up in the tissues awaiting future demands.

The figures given in all the columns of the table we have passed over are derived from analysis in the laboratory, and represent the total amount of each of the plant constituents in the several groups. Thus far the investigation is purely a chemical one, though the grouping of the substances has some relation to the uses of the food in the animal system. Having learned the amount of each of the constituents in a given fodder, the chemist proceeds to feed it to some farm animal, usually an ox or a sheep, in order to ascertain what portion of each is digestible. The value of gold ore is not rated by the total amount of gold contained, but rather by that portion which can be recovered by practical processes; so with our feeds, only those portions which can be digested and utilized by the animal are really valuable. The results of digestion trials are grouped in the last columns of the table under the head "Per cent of digestible matter," and these data have cost the chemist and animal physiologist much patient labor; even now the results are crude and far from satisfactory.

Let us study this table item by item, as we did the first part. We learn that while the total crude protein in pasture grass is 4 in 100 pounds, the digestible crude protein is 2.8 pounds in a hundred weight. The digestible carbohydrates, the compounds of crude fiber and nitrogen-free extract are 12.3 pounds, and the digestible ether extract 0.6 pound. The chemist has found that a pound of fat will give about 2.2 times as much heat as a pound of carbohydrates. Since the fats serve the same purpose in the body as the carbohydrates, we can reduce the fat found in a fodder to a carbohydrate equivalent by multiplying it by 2.2. To obtain the nutritive ratio expressed in the last column of the table, the digestible fat is multiplied by 2.2 and added to the digestible carbohydrates, and the sum divided by the digestible protein. The nutritive ratio of pasture grass is 1: 4.9; that is, for every pound of digestible protein in pasture grass there are 4.9 pounds of digestible carbohydrates and carbohydrate equivalents. The following table summarizes the results of analyses in digestion trials as just explained:

TABLE I.—*Average composition of American feeding stuffs.*

Feeding stuffs.	Number of analyses.	Percentage composition.						Per cent digestible matter.			Nutritive ratio.
		Water.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Crude protein.	Carbohydrates.	Ether extract.	
Green fodders and silage.											
Pasture grass	10	75.3	2.5	4.0	5.9	11.4	.9	2.8	12.3	.6	1:4.9
Red top (*Agrostis vulgaris*) in bloom	5	65.3	2.3	2.8	11.0	17.7	.9	2.0	20.5	.6	1:10.9
Orchard grass (*Dactylis glomerata*) in bloom	4	73.0	2.0	2.6	9.4	15.8	.9	1.8	18.1	.6	1:10.8
Kentucky blue grass (*Poa pratensis*)	18	65.1	2.8	4.1	9.1	17.6	1.3	2.9	19.2	.8	1:7.2
Timothy (*Phleum pratense*)	56	61.6	2.1	3.1	11.8	20.2	1.2	1.9	21.9	.7	1:12.3
Maize (corn) fodder:											
Flint varieties	40	79.8	1.1	2.0	4.3	12.1	.7	1.5	12.0	.5	1:8.7
Dent varieties	63	79.0	1.2	1.7	5.6	12.0	.5	1.2	12.8	.4	1:11.8
Sweet varieties	21	79.1	1.3	1.9	4.4	12.8	.5	1.4	12.6	.4	1:9.6
Red clover	43	70.8	2.1	4.4	8.1	13.5	1,1	2.9	14.1	.7	1:5.4
Alsike clover in bloom	4	74.8	2.0	3.9	7.4	11.0	.9	2.5	11.1	.5	1:4.9
Alfalfa (lucerne)	23	71.8	2.7	4.8	7.4	12.3	1.0	3.6	11.4	.4	1:3.4
Cowpea	10	83.6	1.7	2.4	4.8	7.1	.4	1.3	7.7	.2	1:6.3
Sorghum (whole plant)	11	79.4	1.1	1.3	6.1	11.6	.5	.8	12.7	.4	1:17.0
Rye fodder	7	76.6	1.8	2.6	11.6	6.8	.6	2.1	14.1	.4	1:7.1
Oat fodder	5	62.2	2.5	3.4	11.2	19.3	1.4	2.7	22.7	1.0	1:9.2
Corn silage	99	79.1	1.4	1.7	6.0	11.1	.8	1.2	11.8	.6	1:10.9
Sorghum silage	6	76.1	1.1	.8	6.4	15.3	.3	.6	14.9	.2	1:25.6
Red clover silage	5	72.0	2.6	4.2	8.4	11.6	1.2	2.2	10.0	.5	1:5.0
Hay and dry coarse fodders.											
Corn (maize) fodder, field cured	35	42.2	2.7	4.5	14.3	34.7	1.6	2.8	29.5	1.0	1:11.3
Corn (maize) stover, field cured	60	40.5	3.4	3.8	19.7	31.5	1.1	2.0	34.1	.6	1:17.7
Hay from mixed meadow grasses	11	16.0	4.6	6.4	29.9	41.0	2.1	3.6	42.7	1.0	1:12.5
Timothy hay	68	13.2	4.4	5.9	29.0	45.0	2.5	3.0	43.9	1.2	1:15.5
Hay from Hungarian grass	12	7.7	6.0	7.5	27.7	49.0	2.1	4.5	46.4	1.0	1:10.8
Red clover hay	38	15.3	6.2	12.3	24.8	38.1	3.3	6.5	34.9	1.6	1. 5.9
Alsike hay	9	9.7	8.3	12.8	25.6	40.7	2.9	6.8	36.9	1.4	1:5.9
Alfalfa hay	21	8.4	7.4	14.3	25.0	42.7	2.7	7.6	37.8	1.3	1:5.4
Cowpea hay	8	10.7	7.5	16.6	20.1	42.2	2.9	8.1	37.3	1.7	1:5.1
Wheat straw	7	9.6	4.2	3.4	38.1	43.4	1.3	.6	38.3	.5	1:65.7
Rye straw	7	7.1	3.2	3.0	38.9	46.6	1.2	.6	40.6	.4	1:69.1
Oat straw	12	9.2	5.1	4.0	37.0	42.4	2.3	1.6	41.7	.7	1:27.0
Roots and tubers.											
Mangels	9	90.9	1.1	1.4	.9	5.5	.2	1.1	4.8	....	1:4.4
Rutabagas	4	88.6	1.2	1.2	1.3	7.5	.2	.9	7.1	....	1:8.9
Turnips	3	90.5	.8	1.1	1.2	6.2	.2	.6	5.5	....	1:9.2
Red beets	9	88.5	1.0	1.5	.9	8.0	.1	.9	7.6	....	1:8.4

Sugar beets	19	86.5	.9	1.8	.9	9.8	.1	1.1	9.3	....	1:8.5
Carrots	8	88.6	1.0	1.1	1.3	7.6	.4	1.0	7.1	....	1:7.1
Potatoes	12	78.9	1.0	2.1	.6	17.3	.1	1.4	16.1	....	1:11.5
Grains and other seeds.											
Corn (maize):											
Dent	86	10.6	1.5	10.3	2.2	70.4	5.0	7.0	63.4	3.9	1:10.3
Flint	68	11.3	1.4	10.5	1.7	70.1	5.0	7.1	63.0	3.9	1:10.1
Sweet	26	8.8	1.9	11.6	2.8	66.8	8.1	7.9	61.4	6.3	1:9.7
Average for all varieties, and analyses	208	10.9	1.5	10.5	2.1	69.6	5.4	7.1	62.7	4.2	1:10.1
Wheat, spring varieties	13	10.4	1.9	12.5	1.8	71.2	2.2	9.8	55.3	1.8	1:6.1
Winter varieties	262	10.5	1.8	11.8	1.8	72.0	2.1	9.2	55.9	1.8	1:6.5
Average for all varieties and analyses	310	10.5	1.8	11.9	1.8	71.9	2.1	9.3	55.8	1.8	1:6.4
Barley	10	10.9	2.4	12.4	2.7	69.8	1.8	9.5	66.1	1.2	1:7.2
Rye	6	11.6	1.9	10.6	1.7	72.5	1.7	8.3	65.5	1.2	1:8.3
Oats	30	11.0	3.0	11.8	9.5	59.7	5.0	9.1	44.7	4.1	1:5.9
Buckwheat	8	12.6	2.0	10.0	8.7	64.7	2.2	7.7	49.2	1.8	1:6.9
Sorghum seed	10	12.8	2.1	9.1	2.6	69.8	3.6	7.0	52.1	3.1	1:8.4
Pease	2	10.5	2.6	20.2	14.4	51.1	1.2	18.0	56.0	.9	1:3.2
Soja bean	8	10.8	4.7	34.0	4.8	28.8	16.9	29.6	17.7	15.9	1:1.8
Cowpea	5	14.8	3.2	20.8	4.1	55.7	1.4	18.1	34.5	1.3	1:2.1
Flaxseed, ground	2	8.1	4.7	21.6	7.3	27.9	30.4	18.5	26.0	27.4	1:4.7
Mill products and refuse feeds.											
Corn (maize) meal, bolted	77	15.0	1.4	9.2	1.9	68.7	3.8	6.3	61.8	3.0	1:11.0
Corn and cob meal	7	15.1	1.4	8.5	6.6	64.8	3.5	6.5	56.3	2.9	1:9.6
Corncob	18	10.7	1.4	2.4	30.1	54.9	.5	1.6	43.9	.3	1:27.8
Corn bran	2	10.9	1.7	9.4	4.8	67.3	5.9	6.2	50.9	3.4	1:9.4
Wheat bran from roller mills	7	12.0	5.6	16.1	8.4	53.7	4.2	12.6	44.1	2.9	1:4.0
Wheat bran, old process	9	12.0	4.9	13.0	8.1	58.2	3.8	10.1	47.5	2.6	1:5.3
Wheat bran, all analyses	88	11.9	5.8	15.4	9.0	53.9	4.0	12.0	44.5	2.8	1:4.2
Wheat shorts	12	11.8	4.6	14.9	7.4	56.8	4.5	11.6	45.4	3.2	1:4.5
Wheat middlings	33	12.1	3.4	15.7	4.7	60.2	4.0	12.2	47.2	2.9	1:4.4
Wheat screenings	10	11.6	2.9	12.5	4.9	65.1	3.0	9.8	51.0	2.2	1:5.7
Barley meal	3	11.9	2.6	10.5	6.5	66.3	2.2	8.1	57.7	2.2	1:7.7
Rye bran	7	11.6	3.6	14.7	3.5	63.8	2.8	9.7	48.0	1.6	1:5.3
Rye shorts	1	9.3	4.9	18.0	5.1	59.9	2.8	11.9	45.1	1.6	1:4.1
Oatmeal	6	7.9	2.0	14.7	.9	67.4	7.1	11.3	49.9	5.8	1:5.5
Oat shorts	1	5.5	3.9	18.1	8.9	57.3	6.2	14.1	46.2	4.5	1:4.0
Oat dust	2	6.5	6.9	13.5	18.2	50.2	4.8	8.9	38.4	2.8	1:5.0
Oat feed	4	7.7	3.7	16.0	6.1	59.4	7.1	12.5	47.0	5.0	1:4.6
Buckwheat bran	2	10.5	3.0	12.4	31.9	38.8	3.3	7.4	30.4	1.9	1:4.7
Buckwheat shorts	2	11.1	5.1	27.1	8.3	40.8	7.6	21.1	33.5	5.5	1:2.2
Buckwheat middlings	6	12.7	5.1	28.2	4.2	42.3	7.5	22.0	33.4	5.4	1:2.1
Rice hulls	3	8.2	13.2	3.6	35.7	38.6	.7	2.4	30.4	.4	1:13.0
Rice bran	5	9.7	10.0	12.1	9.5	49.9	8.8	8.0	36.9	5.1	1:6.0
Malt sprouts	5	9.6	5.9	24.8	11.0	47.0	1.7	19.8	36.2	1.7	1:2.1
Brewers' grains	15	75.7	1.0	5.4	3.8	12.5	1.6	3.9	9.5	1.3	1:3.2
Brewers' grains, dried	5	7.7	3.6	22.2	12.3	47.9	6.3	16.2	35.5	5.3	1:2.9
Germ meal	3	8.6	1.0	10.9	10.2	64.0	5.4	9.3	63.6	4.1	1:7.8
Gluten meal	32	9.6	.7	29.4	1.6	52.4	7.4	25.0	49.4	5.6	1:2.5

TABLE I.—*Average composition of American feeding stuffs*—Continued.

Feeding stuffs.	Number of analyses.	Percentage composition.						Per cent digestible matter.			Nutritive ratio.
		Water.	Ash.	Crude protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Crude protein.	Carbohydrates.	Ether extract.	
Mill products and refuse feeds—Continued.											
Starch feed, wet	12	65.4	.3	6.1	3.1	22.0	3.1	5.1	21.7	2.4	1:5.3
Hominy feed	12	11.1	2.5	9.8	3.8	64.5	8.3	8.3	61.9	6.3	1:9.1
Cotton-seed hulls	10	9.9	2.9	4.2	47.4	33.2	2.2	1.0	26.2	1.8	1:30.2
Cotton-seed meal	37	8.2	7.2	42.4	5.6	23.8	12.9	36.9	18.1	12.3	1:1.2
Linseed meal, old process	21	9.2	5.7	32.9	8.9	35.4	7.9	28.3	32.2	7.1	1:1.7
Linseed meal, new process	14	10.1	5.8	33.2	9.5	38.4	3.0	27.2	31.8	2.7	1:1.4
Palm-nut meal	3	8.3	3.7	14.4	21.4	38.9	3.3	13.5	54.1	2.9	1:5.4
Apple pomace	7	76.7	.5	1.4	3.9	16.2	1.3	1.0	17.2	.9	1:19.2
Dried blood	3	8.5	4.7	84.4	....	....	2.5	59.1	......	2.3	1:0.1
Meat scraps	144	10.7	4.1	71.2	....	.3	13.7	68.4	.3	13.5	1:0.4
New milk from cows	793	87.2	.7	3.6	....	4.9	3.7	3.5	4.8	3.7	1:3.7
New milk from goats	38	85.7	.8	4.3	....	4.5	4.8	4.2	4.4	4.8	1:3.6
New milk from ewes	33	80.8	.9	6.5	....	4.9	6.9	6.4	4.8	6.9	1:3.1
New milk from mares	47	90.8	.4	2.0	....	5.7	1.2	2.0	5.5	1.2	1:4.1
New milk from sows	7	84.6	1.1	6.4	....	3.2	4.8	6.3	3.1	4.8	1:2.2
Skimmed milk	96	90.4	.7	3.3	....	4.7	.9	3.1	4.7	.8	1:2.1
Skimmed milk, centrifugal	7	90.6	.7	3.1	....	5.3	.3	2.9	5.2	.3	1:2.0
Buttermilk	85	90.1	.7	4.0	....	4.0	1.1	3.9	4.0	1.1	1:1.7
Whey	46	93.4	.7	.9	....	4.8	.3	.8	4.7	.3	1:6.7

Before passing to the next division of the subject, let us review briefly how animals grow and live. All animals live directly or indirectly on foods furnished by plants. The plant grows through the union of chemical compounds taken from the air and soil and brought up into its structure, through that mysterious principle called life, by the energy of the sun. The sun pouring its rays day after day in summer time, furnishes the energy which welds the simpler compounds into the more complex ones of the plant organism. In summer time our animals crop the grasses of the fields, and in the fall man gathers plants and their seeds into barns and storehouses that in winter time he may pass them over to his farm animals for sustenance and growth. The compounds in the plant substance are separated in the laboratory of the stomach and digestive tract and carried about the body, where they are built up into the body tissues or stored up as fat, or they may be burned up at once if needed to give out energy and warmth. Dr. Armsby has happily used the figure of a coiled spring to illustrate this wonderful phenomenon. The energy of the sun in summer time winds up the spring in the plant, and when the animal consumes the plant the spring is unwound and exhibits just as much energy in the unwinding as was used in winding it up.

In studying these plant compounds we have divided those which need especial attention into three groups, under the heads protein, carbohydrates, and fat. As already shown, the protein compounds are that portion of the food material which may go to build up the muscular portion of the animal body. Among the list of food articles used by man rich in protein are the lean part of meat, the white of egg, the cheese of milk, and the gluten of wheat; of stock foods rich in protein we have cotton-seed meal, oil meal, pease, wheat bran, clover, and alfalfa hay. The first great use of protein is in building up the muscular portion of the body, but we should not forget that it also gives off heat and energy in being broken down to simpler compounds, and may also be converted into fat and stored up in the tissues of the body for future use.

Since the carbohydrates contain no nitrogen they can not go to build up the muscular portion of the body, but nevertheless they are of great importance and form the largest part of foods used by our farm animals. The first great use of carbohydrates is to furnish fuel for warming the body and enabling it to perform work. Of human foods rich in carbohydrates we have sugar and starch, both almost chemically pure, while the grain of wheat and corn are both very rich in carbohydrates. In animal foods corn, oat straw and cornstalks are all rich in carbohydrates. As the protein compounds may be called the muscle-formers, so the carbohydrates may be called the fuel or energy givers of the body. The fats in foods serve the same purpose as the carbohydrates, but are more potent, giving off more heat in burning. A pound of fat is generally regarded as 2.2 times as valuable as a pound of sugar or starch in food.

AMOUNT OF NUTRIENTS REQUIRED BY OUR FARM ANIMALS.

The next step in our study is to ascertain the amount of the several constituents in feeding materials required by different farm animals under varying conditions for maintenance, growth, and fattening. Since the weights of our animals vary according to age and breed it is well to take some simple standard of weight, and for convenience it has been placed at a thousand pounds. The needs of growing animals differ from those that are mature, and the requirements of work animals are not the same as those at rest or taking on fat. In Table II is summarized the amount of digestible nutrients required by a thousand pounds, live weight, of farm animals.

To study this table let us take the first case—that of an ox at rest in his stall. This ox is supposed to weigh 1,000 pounds, and to be kept perfectly comfortable as to temperature and environment, and to do no work, neither gaining nor losing in weight. The amount of food required under these conditions will be the minimum for such an animal, of course. It will be found when we have furnished this ox with the digestible nutrients required that the total organic substance, which is the weight of the fodder, less the water and ash it contains, will amount to 17.5 pounds. Every beat of the heart, every respiration, the tension of the muscles while standing, all mean wear and destruction of muscular tissue. Indeed, every manifestation of life means the consumption of food to repair the waste of some portion of the body. The Germans have held that 0.7 of a pound of crude protein is necessary to make good this loss. For warming the body and running its machinery, if we may so speak, there are required 8 pounds of digestible carbohydrates and 0.15 pounds of ether extract. Adding the digestible protein, carbohydrates, and ether extract together, we get a total of 8.85 pounds of total nutritive substance. If we multiply the digestible ether extract by 2.2 and add it to the digestible carbohydrates the sum is 8.33, which, divided by 0.7, gives a quotient of 12 in round numbers. That is, for every 1 pound of crude protein required by the ox, he needs 12 pounds of digestible carbohydrates or their equivalents in fat. Investigations by several American experimenters have shown that the amount of nutrients stated by the Germans as only sufficient to maintain a thousand-pound ox is more than sufficient for that purpose under our conditions, and that the ox will make a small gain therefrom. Our work, however, has not progressed far enough to reconstruct even this portion of the table, so that we shall have to let it stand as stated by the Germans.

In the same table we learn that the ox heavily worked requires 2.4 pounds of digestible protein per day, or three times as much as when at rest. We are not surprised at this, for when performing labor the muscles must be worn down much more rapidly than when an animal is idle. A milch cow of the same weight requires more protein and almost as much carbohydrates as the heavily worked ox. Though there is little tax on the muscles, yet a large amount of protein is needed for the cheese portion of the milk. To elaborate this, as well as the sugar and fat, makes a heavy demand for food by the dairy cow.

Table II is compiled by the German scientist, Dr. Emil Wolff, and gives the amount of digestible substances he considers necessary by our farm animals:

TABLE II.—*Feeding standards.* (*According to Wolff.*)

[Per day and per 1,000 pounds, live weight.]

Animals, etc.	Total organic substance.	Nutritive (digestible) substances. Crude protein.	Carbohydrates.	Ether extract.	Total nutritive substances.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
1. Oxen in rest in stall	17.5	0.7	8.0	0.15	8.85	1:12.0
2. Wool sheep, coarser breeds	20.0	1.2	10.3	0.20	11.70	1:9.0
Wool sheep, finer breeds	22.5	1.5	11.4	0.25	13.15	1:8.0
3. Oxen moderately worked	24.0	1.6	11.3	0.30	13.20	1:7.5
Oxen heavily worked	26.0	2.4	13.2	0.50	16.10	1:6.0
4. Horses moderately worked	21.0	1.6	10.0	0.50	12.10	1:7.0
Horses heavily worked	23.0	2.5	12.1	0.70	15.30	1:5.5
5. Milch cows	24.0	2.5	12.5	0.40	15.40	1:5:4
6. Fattening oxen, 1st period	27.0	2.5	15.0	0.50	18.00	1:6.5
Fattening oxen, 2d period	26.0	3.0	14.8	0.70	18.50	1:5.5
Fattening oxen, 3d period	25.0	2.7	14.8	0.60	18.10	1:6.0
7. Fattening sheep, 1st period	26.0	3.0	15.2	0.50	18.70	1:5.5
Fattening sheep, 2d period	25.0	3.5	14.4	0.60	18.50	1:4.5
8. Fattening swine, 1st period	36.0	5.0	27.5		32.50	1:5.5
Fattening swine, 2d period	31.0	4.0	24.0		28.00	1:6.0
Fattening swine, 3d period	23.5	2.7	17.5		20.20	1:6.5
9. Growing cattle:						
Age, months. *Average live weight, per head.*						
2—3 165 lbs.	22.0	4.0	13.8	2.0	19.8	1:4.7
3—6 330 lbs.	23.4	3.2	13.5	1.0	17.7	1:5.0
6—12 550 lbs.	24.0	2.5	13.5	0.6	16.6	1:6.0
12—18 770 lbs.	24.0	2.0	13.0	0.4	15.4	1:7.0
18—24 940 lbs.	24.0	1.6	12.0	0.3	13.9	1:8.0
10. Growing sheep:						
5—6 62 lbs.	28.0	3.2	15.6	0.8	19.6	1:5.5
6—8 73 lbs.	25.0	2.7	13.3	0.6	16.6	1:5.5
8—11 84 lbs.	23.0	2.1	11.4	0.5	14.0	1:6.0
11—15 90 lbs.	22.5	1.7	10.9	0.4	13.0	1:7.0
15—20 95 lbs.	22.0	1.4	10.4	0.3	12.1	1:8.0
11. Growing fat pigs:						
2—3 55 lbs.	42.0	7.5	30.0		37.5	1:4.0
3—5 110 lbs.	34.0	5.0	25.0		30.0	1:5.0
5—6 137 lbs.	31.5	4.3	23.7		28.0	1:5.0
6—8 187 lbs.	27.0	3.4	20.4		23.8	1:6.0
8—12 275 lbs.	21.0	2.5	16.2		18.7	1:6.5

From Tables I and II we are now in position to calculate a ration for a fattening steer or a dairy cow. Let us form a ration for a dairy cow weighing 1,000 pounds and yielding a full flow of milk. Suppose we have at hand the following common feeding stuffs: Corn fodder, clover hay, bran, corn meal, and cotton-seed meal. By the last table we find the requirements for a cow weighing 1,000 pounds to be 2.5 pounds digestible protein; 12.5 pounds digestible carbohydrates, and 0.4 pound digestible ether extract.

We place these amounts at the head of our table at *A*:

TABLE III.—*Showing how to construct a ration for a dairy cow.*

Nature and weight of feed.	Organic matter.	Digestible. Protein.	Digestible. Carbohydrates.	Digestible. Ether extract.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
A. Required by standard	24.0	2.5	12.5	0.4
B. 14 pounds fodder corn	7.71	0.39	4.13	0.14
6 pounds clover hay	4.71	0.39	2.09	0.10
5 pounds roller bran	4.12	0.63	2.20	0.15
5 pounds ground corn	4.38	0.36	3.14	0.21
First trial ration	20.92	1.77	11.56	0.60
C. 2 pounds cotton-seed meal	1.69	0.74	0.36	0.25
Second trial ration	22.61	2.51	11.92	0.85

In order to properly distend the rumen the feed should have a certain bulk, and will amount on the average to about 24 pounds of organic matter, which sum is placed in the first column. This portion of the table can vary more than any other without serious detriment. Having the requirements before us in the table, let us approximate it by combining several food materials from our list. For trial we will take 14 pounds of corn fodder. By adding the water given in Table I to the ash and subtracting from 100, we have the total organic matter in 100 pounds of fodder corn. For 14 pounds of fodder corn the amount of organic matter is 7.71, which we place under the column headed "Organic matter." By Table 1, again, we learn that the digestible crude protein of field-cured fodder corn is 2.8 per 100 pounds; for 14 pounds it is 0.39. The digestible carbohydrates in the fodder corn is 29.5 for 100 pounds, and for 14 pounds 4.13. The ether extract in 100 pounds of fodder corn is 1 pound, and in 14 pounds is 0.14. We place these sums in their respective columns, which gives the total organic matter and digestible material for 14 pounds of fodder corn. In the same manner we find the organic matter and digestible nutrients in 6 pounds of clover hay, then in 5 pounds of bran, and, finally, 5 pounds of ground corn, all of which is summarized under *B* of the table. We next add the several columns to ascertain the total constituents. The sums are found under the first trial ration. We now compare this trial ration, which is the sum of the items under *B*, with the required ration at *A*. We notice the organic matter is a little more than 3 pounds short of the requirements, and there is still about three-fourths of a pound of protein and a pound of carbohydrates lacking, while the ether extract is already 0.2 of a pound in excess. Our ration is short of the requirements, and to bring *B* still nearer *A* we add to the trial ration as given 2 pounds of cotton-seed meal, choosing this feed because we must add some substance rich in protein. Determining the nutrients in 2 pounds of cotton-seed meal we place them at *C*, and adding the items to the first trial ration, or *B*, we get the second trial ration. In the second trial ration we observe that the organic matter is 1.31 pounds short of the requirements, the protein .01 of a pound in excess, the carbohydrates 0.58 of a pound short, while ether extract is 0.45 pound in excess of requirements. We have learned that the ether extract is worth 2.2 times as much as the same weight of carbohydrates. We multiply the excess, 0.45 by 2.2 and find that the excess is equal to 0.99 of a pound of carbohydrates. This sum brings the carbohydrates above the required standard. Our second trial ration is, therefore, slightly lacking in organic matter, but contains the full amount of protein required and a slight excess of carbohydrates or their equivalents. We find the nutritive ratio of this ration by multiplying the ether extract 0.85 by 2.2, adding it to the carbohydrates and dividing by 2.51, and obtain the nutritive ratio of 1:5.5, or about the requirements given in Table II. This is as close as we can expect to work in practice.

Having studied this problem over carefully, the student is in position to use Tables I and II in a study of the requirements of his stock and the feeds he has at hand. With a little patience feed combinations can be made which will conform to the requirements. I have gone over this problem carefully in order to show just how the tables are used. The student can select from the first table such feed stuffs as he has at hand or can secure, and from these construct rations to meet the wants of his particular case. The exercise will prove not only interesting, but profitable, for it will throw much light on the proper combinations of food to best meet the wants of our farm animals.

CONCLUSIONS IN REGARD TO THE GERMAN SYSTEM.

In presenting the German system I have followed it closely, so that the reader may be able to make practical use of it. About 1880 Prof. J. W. Sanborn objected to the feeding standards as laid down by the Germans, and especially to Table II, claiming that an ox weighing 1,000 pounds, when fed with the nutrients stated by Wolff, as required for mere maintenance, might actually show considerable gain in weight. Results at Cornell University and other experiment stations in this country go to sustain Prof. Sanborn's objections. Inquiries sent out from this station to successful, intelligent dairymen, bring information which shows that some are feeding rations which correspond very closely to the requirements laid down by Wolff, while others are giving less protein than in the standard. Practical experience seems to show that good results may be obtained with less protein than 2½ pounds per day per thousand pounds of cow. In many rations I think if the amount is 2 pounds it will be ample for the dairy cow. The total amount of digestible substance should not vary materially from the standard. These tables may be compared to a crude and often incorrect map of an unknown country, which is better than nothing, though far from satisfactory. It is well for the reader to familiarize himself with them, for their teachings are very helpful in the practical work of feeding.

PRACTICAL FEEDING—THE CALF.

In successful stock management we must start with a strong, vigorous calf. This means good blood in both sire and dam, and that there has been liberal feeding and good care for generations back. Where cattle are reared under practically natural conditions, the rule that young stock come in the spring must continue, but I am not so sure that spring is the best time for the dropping of calves in the older settled portions of the country. Spring calves are incapable of receiving much benefit from grass during the first season, because for some time after birth the ruminating stomach is undeveloped, and between summer heat and pestering flies the thin-skinned creature has a sorry time of it. Winter comes on with its dry food just when good progress has commenced, and this is apt to check growth, so that the animal is a full year old before it starts on its career untrammeled. Our experience at this station corresponds with that of thousands of farmers who are strong advocates of having calves dropped in the fall. There is then much time to give them the little attentions needed, and since they live largely on milk they are easily managed in barn or shed, and occupy but little room. When spring comes the youngsters are large enough to make good use of the pasture, and the result is good progress from the start, and when fall comes they return to the barn large enough to make good use of the feed there provided. Cows fresh in the fall yield a good flow of milk during the winter, if well fed and comfortably housed; just when the milk flow begins to decrease materially comes the favorable change to grass, under the stimulus of which the yield is increased and held for some time. From our experience I put the annual yield of milk at from 10 to 15 per cent greater from cows fresh in fall than those which calve with the springing of the grass. Breeders of pedigreed cattle will find an equal advantage with dairymen, I think, with fall calves, for the six months gained make stock a year from the next spring of sufficient age to show up in fine style and practically command the prices of two-year-olds.

FEEDING THE CALF.

Where the calf is allowed to run with the dam few precautions are needed, the most important being to see that it does not get too much milk, which may cause indigestion. If the calf remains with the dam the cow's udder should be stripped out clean night and morning. Any neglect in this particular may result in soreness to the teats and udder. If the calf scours, the cow should be stripped three times a day; in other words, reduce the quantity of milk the calf gets. A young calf had better be a little hungry than gorged. After two or three months separate the calf from the dam and allow it to suckle three times a day, afterwards twice. The greatest danger under this system comes at weaning time, when, if the calf has not been properly taught to eat solid food, it is apt to pine and shrink in weight, or at least make little gain. Teach the calf early to eat grain, using ground corn, bran, oil meal, and fine cut hay. The system of allowing calves to take the milk direct from the cow can only be practiced with the very best representatives of beef breeds, where the most rapid and perfect development is desired, either for making early matured beef or for developing fine pedigreed stock.

I believe no breed of cattle can be continued as a first-class dairy breed where the calves run with the cows. There is something about hand milking which causes a cow to give more milk and for a longer period than when it is drawn by the calf. Fine calves, even for beef purposes, can be made where the calves drink full milk from the pail, but the stockman will usually choose to have the calf do its own milking, or, if not, to subsist on skimmed or partly skimmed milk.

In dairy districts few calves are raised except on skim-milk, and very satisfactory dairy stock can be made by this process if a few simple rules are intelligently followed. The young calf should be taken away from the mother not later than the third day, and for two weeks given from 10 to 15 pounds of full milk, not less frequently than three times a day. At the end of two weeks some skim-milk may be substituted for a portion of the full milk, making the change gradually until in three or four weeks skim-milk only is fed. Full milk of the Jersey or Guernsey cow is often too rich for the calf, and part skimmed milk should be used from the very start. At the end of a month or six weeks the calf will do nicely on two feeds per day. Feeding Table I shows that the cow's milk has a nutritive ratio of 1 to 3.7. In skim-milk the ratio is 1 to 2.1. Skim-milk contains all the elements of full milk excepting the fat, and we can in a measure make up for this with cheaper substitutes. Probably the best simple substitute is flaxseed, which should be boiled until reduced to a jelly, and a small quantity given at each feed stirred in the milk. Oil meal is cheaper than flaxseed, more easily obtained, and serves practically the same purpose. Keep each calf tied by itself with a halter in comfortable quarters, with a rack in front for hay and a box for meal. For feed use either whole or ground oats, bran, oil meal, or a mixture of these. By the third week have a mixture containing the grain feed at hand, and as soon as the calf is through with the milk slip a little meal into its mouth. It soon learns the taste, and, following that instinct so strongly marked, takes kindly to the meal in the box, and in a few days eats with the regularity of an old animal. Have the meal boxes movable, and place the meal in them sparingly, emptying out all that remains before each feeding time. Change the kind or combination of grain if the calves seem to tire with what is given.

A prime requisite to success in calf feeding is regularity; let the calves be fed at the same time and in the same order each day. Next to regularity, regard the amount of milk fed. While 15 to 18 pounds of full milk is a ration, with skim-milk from 18 to 24 pounds may be fed, depending on the ability of the calf to assimilate its food. More skim-milk calves are killed by overfeeding than underfeeding. Milk should be fed at blood temperature, say 98° to 100° F., and a thermometer should be used in ascertaining the temperature. The feeding pail should be kept scrupulously clean by scalding once a day, a precaution often neglected.

Scouring, the bane of calf rearing, usually indicates indigestion, and is brought on by overfeeding, irregular feeding, giving the feed too cold, or the animal getting chilled or wet. Prevention of disease by rational feeding and systematic good care is far better than poor care and unskillful feeding, followed by attention and solicitude in giving medicines. To check indigestion we have found the use of a tablespoonful of limewater in each feed very satisfactory. Successful management of the calf lies at the very foundation of the stock business, and calls for regularity of attendance, discerning at once all the little wants of the animal, and a generous disposition to supply every need as soon as apparent.

FEED AND CARE OF YOUNG STOCK.

With well-bred calves, thrifty and sleek coated, the foundation of a good herd is laid. Though the subject will be discussed more fully later on, it is well to remind the reader at this point that gain is never so cheaply made as with the calf, and that for financial reasons if no other it should be pushed ahead as rapidly as possible. Our table of feeding stuffs shows that milk contains a large amount of protein or muscle-making food, and it also contains a large amount of ash for building up bone. From the composition of milk, nature's food for the young animal, we get a hint at the formation of rations for young animals. Pasture grass has a nutritive ratio by the table of 1:4.9, so that it is also high in muscle elements. But nature put a large amount of fat in cow's milk, and calves reared on full milk show a very considerable development of fat. They should not grow poorer after weaning time, but the first fat, as the stockman calls it, should be kept on all representatives of the beef breeds, whether intended for breeding purposes or for beef. This can be accomplished with oil meal and corn; a little oats will do no harm. Counteract the tendency of the grain foods to making a rigid dry flesh, by using roots or silage, which, combined with grain, make the animal growthy while keeping it plenty fat. For roughage use cornstalks, clover or alfalfa hay. The dairy calf should never be allowed to become as fat as those intended for beef, yet this does not mean that it should be the sorry representative that we often find it. Very little corn should be used in its ration, and the proportion of oil meal stinted, while oats should form a larger part of the ration. This, with silage or roots and plenty of roughage in winter and pasture in summer, will give animals of the desired quality. Calves, like colts, pass through a period of growth when they are not particularly attractive, nor do they need very close attention at this time; yet the watchful eye of the master should note the development from day to day and see that all the wants are fully supplied.

STEER FEEDING—PASTURES.

There are two theories in regard to the proper time of turning steers to pasture, each of which seems based on good reasons. That generally advocated by agricultural writers is to keep the stock in the barn and yard on the same food as given during the winter months until the pastures are well along and able to furnish an abundance of nutritious grass. Often when stock are turned on such pastures the ration of the feeding stable is cut off at once. The other system is to turn to pasture just as the grass begins to shoot, when the sparse blades are watery and furnish very little nutriment. The lack of food in the pasture forces the stock to rely mainly on what is obtained in the stable to satisfy hunger. The first grass is washy and has little nutriment, but has its effect on the digestive system and gradually prepares the animal for the change from grain to pasture. It is a fact that stock often shrink badly when changed from stable to pasture, and I suspect the practice of early turning to grass, at the same time keeping up heavy stable feeding, is better than holding the cattle longer and then turning at once to full pastures. If stock is turned to pasture early, and in any event, let food in abundance be offered them at the stable. It is troublesome to bring them back to the barn each night, yet it is little attentions like these that pay.

The question of large or small pastures is one frequently discussed. I believe the majority of experienced American feeders are in favor of single ranges rather than numerous small pasture lots. The grasses, both in variety and quality, are never quite the same all over a large pasture, and cattle soon learn to detect the little differences and satisfy their like for variety by ranging from one sort of feed to the other. The habit of the herd in large pastures becomes very regular; they will be found in the morning on this side in the valley, a little later over on the hillside, while at noon they are resting at still a third point. Continuity of habit in grazing and feeding conduces to comfort and quiet, and are of great importance to profitable returns. Where the pastures are cut up into several lots of course the fresh bite which comes with changing from one lot to another is tempting, but this leads to irregularity and unrest.

GAINS OF STEERS ON PASTURE.

Prof. Morrow, of the Illinois Experiment Station, has made some interesting studies on this point. He reports the gain per head of steers maintained wholly on pasture during the season from May 1 to November 1 to be as follows:

Yearlings.

	Pounds.
4 head of steers showed an average gain of	332
10 head of steers showed an average gain of	285
2 head of steers showed an average gain of	440

Two-year-olds.

	Pounds.
7 head of steers showed an average gain of	466
8 head of steers showed an average gain of	384
4 head of steers showed an average gain of	406

I think these figures are very satisfactory, and probably up to the average which can be attained on good pastures by grade steers in fair flesh when turned to pasture. No doubt animals in thin flesh when turned to pasture will show larger gains. An interesting phase of the same question is the amount of gain made by steers from an acre of pasture land. In different trials Prof. Morrow obtained returns of 246, 206, and 138 pounds of increase live weight per acre from steers on pasture. The average of these gains shows that when beef brings a reasonable price such pastures have a value of something like $100 per acre.

FEEDING GRAIN TO STEERS ON PASTURE.

J. D. Gillett, Illinois's great stock-feeder of the last generation, used to say that he could not afford to fatten steers in winter. His cattle were mostly summer and fall fed, getting their grain from boxes in the pasture fields. Unfortunately we have little accurate data at command to show the value of grain feeding on pastures. Prof. Morrow has made several trials, but the results so far do not seem to confirm the statements of Gillett and others. Prof. Morrow sums up the experience at the Illinois Station as follows:

> The results from two years' trial indicate that a grain ration to young steers on good pastures is not usually profitable. The value of the increase in weight by the grain-fed steers over those having grass only will hardly repay the cost of food and labor. The increased value of the animals from earlier maturity and better quality may make grain feeding profitable.

While his results to date do not show very favorably for grain feeding on good pasture not overstocked, he strongly advocates the addition of grain or other feed before grass fails in the fall.

INDIAN CORN FOR STEER FEEDING.

Corn is the great fattening food of America, and no other grain is so cheaply raised or equals it in the economical production of wholesome meat. Our stockmen long ago learned this fact, and have used corn so exclusively that not always the most economical results have been obtained. With the almost continual plethora of grain careless habits have been acquired in handling the crop, some of which will cost much to unlearn. The roughage of the corn crop, the stalk portion, has been largely wasted through ignorance of its real value and how it should be fed to stock. Dr. Armsby has made some very careful studies of the corn plant, and some of his results are given in Tables IV and V. Table IV shows the proportion of ears to stover. By stover is meant all of the dried corn plant less the ear, or practically shock corn with the ears removed.

TABLE IV.—*Showing the actual weights of ear corn and stover at four experiment stations.*

Name of experiment station.	Ears.	Stover.
	Pounds.	*Pounds.*
New Jersey	4, 774	4, 041
Connecticut	4, 216	4, 360
Wisconsin	4, 941	4, 490
Pennsylvania	3, 727	2, 460
Average	4, 415	3, 838

We see that nearly half of the weight of a corn crop is in the stalk, husk, leaf, and top. In Table V is given the digestible portions of the ear and stover.

TABLE V.—*Showing the yield of digestible matter in pounds per acre.*

Constituents.	Ears.	Stover.	Total crop.
	Pounds.	*Pounds.*	*Pounds.*
Protein (including amides)	244	83	327
Carbohydrates	2, 301	1, 473	3, 774
Fat	125	22	147
Total	2, 670	1, 578	4, 248

This table shows that of the digestible matter in an acre of corn 2,670 pounds are in the ears and 1,578 pounds are in the stover or cornstalks. On many farms the stover is almost wholly wasted, or at least but poorly saved and carelessly fed. Can the farmers of the Mississippi Valley much longer afford to waste 37 per cent of this great crop after they have gone to the expense of producing it? Of course I do not hold that all the cornstalks produced in a corn crop can be fed to fattening steers, for this would mean the consumption of too much roughage in proportion to grain. But there are always on the farm horses, cows, and young things that can well be maintained on the surplus stover of the corn crop. That farm which can not utilize all of the cornstalks produced should change its management.

I do not think the heavy corn-feeding commonly practiced at the West nearly so wasteful as many have thought. The corn is fed with a prodigal hand, but this does not necessarily mean a heavy loss when the cost of material and the economical conditions under which it is often fed are all duly considered. But now that the price of beef is lower and the price of land and corn rising, it is time for a careful study of the problem in order to save as much as possible. Corn may be fed to a steer as the only grain for a couple of months, with excellent returns, even without grinding or shelling, providing the grain is not too hard or the ears too large and good shotes follow the steers to utilize the waste corn in the droppings. But steers can not be fully fattened on corn alone with profit, for the concentrated grain soon burns out the digestive tract and the steer comes to make poor use of his food. Whole corn may be fed early in the period, but generally, and always later on, it should be crushed or ground into meal. I think crushed corn or coarsely ground meal will be found preferable to that which is finely ground. In all cases where much meal is fed care is needed lest the animal get off feed. Some oil meal or bran should be fed to lighten the ration, starting with 1 pound of oil meal and gradually increasing the amount until, toward the close of the period, as much as 5 pounds may be fed. In the same manner from 2 to 8 pounds of bran may be fed. The effect of oil meal is to give good handling qualities and a fine, glossy coat of hair, besides affording much real nutriment. Bran is likewise cooling and lightens the heavy corn very materially. Roots or silage have much the same effect. I know objections will be raised that if all feeders were to use oil meal there would not be enough to go round, but why be solicitous when in 1890 we shipped $8,000,000 worth of oil meal to the feeders of the Old World?

With the grain there must always be fed coarse feeds in order to properly distend the rumen, and nothing is better for this purpose than good corn stover. Most stockmen know how satisfactory shocked corn is for steers. That portion of the stover not needed for the steers should be given to other farm stock.

BALANCED RATIONS.

In order to show what sort of a ration a steer should receive if fed according to the German standard, two rations are here presented which conform fairly near to the requirements. The first is one which may well be used in the corn belt where corn is cheap and oil meal close at hand. The second presents more variety, and has silage and cotton-seed meal for two of its constituents.

TABLE VI.—*Showing rations for fattening steers.*

RATION NO. I.

Character of rations.	Organic matter.	Digestible— Protein.	Digestible— Carbohydrates.	Digestible— Ether extract.
Required by standard	27.0	2.50	15.00	.50
Corn fodder, 8 pounds	4.41	.22	2.36	.08
Clover hay, 2 pounds	1.57	.13	.70	.03
Corn (maize), 14 pounds	12.31	.98	8.88	.55
Oil meal, o. p., 4 pounds	3.41	1.13	1.29	.28
Total	21.69	2.46	13.23	.94

TABLE VI.—*Showing rations for fattening steers*—Continued.

RATION NO. II.

Character of rations.	Organic matter.	Digestible—		
		Protein.	Carbohydrates.	Ether extract.
Corn silage, 30 pounds	5.85	.36	3.54	.18
Oat straw, 5 pounds	4.29	.08	2.09	.04
Roller bran, 10 pounds	8.24	1.26	4.41	.29
Corn and cob meal, 4 pounds	3.34	.26	2.25	.12
Cotton-seed meal, 2 pounds	1.69	.74	.36	.25
Total	23.41	2.70	12.65	.88

In both tables there is less organic matter than called for by the standard, but this is not important. The carbohydrates are less than the standard, but this lack is nearly made up by the excess of ether extract or fat.

SILAGE FOR STEER FEEDING.

The British farmer leads the world in the perfection of farm stock, and while this may not be altogether due to his system of feeding, yet that must be a large factor. Under the English system farm animals do not go for any long period on dry food. The cattle go to pasture early and remain late, and when in the stable or yard still have succulent feed in the shape of roots. How different the American system, where our cattle are on pasture a few months in summer and then return to the stable and yard to subsist on dry food of limited variety for nearly six months! It may not pay in many cases for farmers to grow roots for stock, but we have a means of providing a cheap substitute for turnips and mangolds in corn silage. I do not at this time wish to discuss the relative merits of silage and roots, but rather to plead for more general introduction of the silo with those farmers who do not take kindly to root culture. The wonderful development of machinery for planting and cultivating corn enables the farmer to produce a large amount of excellent feed with very little labor. If by some means the juicy, tender stalks can be carried over to winter we have a very fair substitute in cheap form for the root crop, and this is accomplished by the silo, which gives us at a very small cost a succulent food, palatable to horses, cattle, and sheep.

The use of silage came through dairymen, and to this day the steer-feeder seems to hold that silage is only suitable for dairy cows and too sloppy and sour for beef-making. Gradually the prejudice is breaking away and beef-makers as well as butter-makers are beginning to appreciate the silo.

SILAGE COMPARED WITH ROOTS FOR STEER-FEEDING.

The great silage material is Indian corn. In the corn belt from 10 to 20 tons of green fodder may be raised on an acre of fertile land. If we put the average crop at 15 tons as it goes into the silo, it will feed out 12 or 13 tons. When corn is planted to yield the material above stated the stalks stand thin enough to produce a good many ears, or nubbins. To show the value of corn silage for steer-feeding I present the results just published by Prof. Shaw, of the Ontario Agricultural College, where six grade Shorthorn steers were fed in three groups of two each.

To Group I was fed all the steers would eat of corn silage, with about 12 pounds of corn meal.

To Group II were fed 30 pounds of silage per day, about 12 of meal, and all the cut hay the steers would eat.

To Group III were fed 45 pounds of sliced roots, and about 12 pounds of meal, with all the cut hay they would eat. The hay was timothy and clover, the roots turnips and mangolds, and the meal consisted of equal weights of ground pease, barley, and oats. The hay was chaffed and the food mixed at the time of feeding and given in three feeds per day.

The food actually consumed per animal per day was as follows:

Group I	57.47 pounds silage. 11.72 pounds meal.
Group II	30.6 pounds silage. 11.13 pounds meal. 9.3 pounds hay.
Group III	43.07 pounds roots. 11.12 pounds meal. 11.22 pounds hay.

The following table shows the results of the trial, beginning December 1, 1890, and lasting 146 days.

TABLE VII.—*Showing results of steer-feeding trials at Ontario Agricultural College.*

	Group I. (2 steers.)	Group II. (2 steers.)	Group III. (2 steers.)
	Pounds.	*Pounds.*	*Pounds.*
Weight at commencement	2,789.00	2735.00	2672.00
Gain of two steers 146 days	555.00	448.00	537.00
Average gain per steer	277.00	224.00	268.00
Average gain per steer per day	1.90	1.53	1.84

Prof. Shaw places the following value on the feeds:

Oats	24½ cents per bushel.
Peas	47 cents per bushel.
Barley	38 cents per bushel.
Sliced roots	8 cents per bushel.
Cut hay	$5.00 per ton.
Corn silage	1.75 per ton.

Six cents per bushel allowed for grinding grain.

The financial results are presented in the following table:

TABLE VIII.—*Showing financial results.*

Value of animals and cost of feed.	Group I.	Group II.	Group III.
Value of two steers in beginning	$111.56	$109.40	$106.88
Cost of feed	42.92	41.45	51.75
Cost of attendance	6.08	6.08	6.08
Value of animal at close of test	183.93	175.10	176.53
Value of manure	13.14	13.14	13.14
Total value	197.07	188.24	189.67
Gain	36.51	31.31	24.96
Per cent gain on investment	22.70	20.00	15.20

At the commencement the steers were valued at 4 cents per pound, live weight, and were worth 5½ cents per pound at the close. It will be seen that the heaviest gain per day was made by the steers receiving silage, and further that they returned the best per cent on the investment; the root-fed steers gave the poorest returns of the three groups.

At this station we have fed silage to steers with most excellent results. In one trial four 2 and 3-year old steers were fed corn silage alone and made a gain of 222 pounds in thirty-six days, or 1½ pounds per day. It required 3,558 pounds of silage to make 100 pounds of gain. Four steers from the same lot were fed silage with a mixture of corn and bran, when it was found that 654 pounds of corn silage with 394 pounds of corn and 180 of bran produced 100 pounds of gain. Four shotes running with the steers were fed only 92 pounds of corn to make a gain of 100 pounds, showing that they must have received most of their food from the droppings. Let the feeder place any reasonable value he may choose on the silage in these two trials and he will see that we produced 100 pounds of gain at a very small cost. The objection to our experiment is that the steers were only fed silage forty-three days, the first week not being counted, but further feeding with a heavy grain ration and hay showed that the gains from the silage were well held when the animals were placed on dry feed.

This brings me to the point I desire to make in favor of silage for steer feeding. As with roots, silage makes the carcass watery and soft to the touch. Some have considered this a disadvantage, but is it not a desirable condition in the fattening steer? Corn and roughage produce a hard, dry carcass, and corn burns out the digestive track in the shortest possible time. With silage and roots digestion certainly must be more nearly normal and its profitable action longer continued. The tissues of the body are juicy and the whole system must be in just that condition which permits rapid fattening. While believing in a large use of silage in the preliminary stages and its continuance during most of the fattening period, I would recommend that gradually more dry food be substituted as the period advances, in order that the flesh may become more solid. Used in this way I believe silage will become an important aid in steer feeding in many sections of the country. Results from Canada, Wisconsin, and Texas, given in this chapter, show the broad adaptation of this food for stock-feeding purposes.

BEEF-MAKING AT THE SOUTH.

Few realize the possibilities of beef production over a large portion of the South. For centuries the study there has been toward cotton production, which demands scrupulously clean culture; grass has been despised and considered a pest, but now it has overrun some of the old plantations, and while restoring the soil to something like its former fertility, is giving good annual yields of nutritious food for cattle. Many a cotton plantation can be made to return in Bermuda grass, Johnson grass, or Japan clover an amount of feed that would surprise even a northern stockman. Equally important with the growth of grasses is the enormous production of cotton seed, which furnishes a most nutritious feed. For every pound of cotton fiber there are about 2 pounds of cotton seed. A ton of cotton seed yields about 35 gallons of oil and 750 pounds of cotton-seed meal, besides nearly a thousand pounds of cotton-seed hulls. The cotton seed itself, when boiled, and the cotton-seed meal are valuable stock foods, and recently even the hulls have been found to possess considerable feeding value, proving a very good substitute for hay. The following table shows results obtained by Prof. Gulley in feeding cotton-seed meal at the experiment station.

TABLE IX.—*Showing feed consumed for 100 pounds gain in weight at the Texas Experiment Station.*

No. of steers.	Days of experiment.	Average weight at beginning.	Cotton seed, raw.	Cotton seed, cooked.	Cotton-seed hulls.	Cotton meal.	Corn in ear.	Corn and cob meal.	Silage.	Hay.	Cost per 100 pounds gain.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
6	90	755		417					1,230	218	$2.70
4	90	737				217			1,676		3.83
3	90	780			561	228			595		3.71
4	90	713			759	259					3.72
4	90	785			724	178		212			4.09
8	90	725			579	247				264	4.13
10	79	671			365	154			630		2.72
9	79	662	194				219		411	167	2.67
3	79	636		147			519			254	3.86

The values placed on the food articles in this table are as follows:

Cotton seed, raw or cooked	per ton	$7.00
Cotton-seed hulls	do	3.00
Cotton-seed meal	do	20.00
Corn and cob meal	per bushel	.40
Mixed hay	per ton	6.00

These gains are very satisfactory, and I doubt if in any other section of the United States a pound of beef can be produced at so low a cost for food as is here given.

FOOD REQUIRED FOR MAKING A POUND OF BEEF.

Our experiment stations are helping in the matter of determining the amount of food required to produce a pound of beef, and the results are proving most interesting reading. In the following table is summarized the amount of food required to produce 100 pounds of gain, live weight, with calves and steers at different ages. It will bear careful study.

TABLE X.—*Food required for 100 pounds of gain, and daily gain in weight, with calves and steers, at different ages.*

No. of animals on experiment.	Breed.	Average age at beginning of experiment.	Length of experiment.	Average weight at beginning of experiment.	Food required for 100 pounds of gain.							Average daily increase.
					Whole milk.	Skimmed milk.	Grain feed.	Hay.	Silage.	Roots.	Green feed.	
		Days.	*Days.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
	WISCONSIN EXPERIMENT.											
6	4 Jersey, 2 Holstein	46	84	152	....	477.1	90.9	81.2	....	....	....	1.75
6	......do	130	63	299	....	422.6	226.0	62.2	218.7	....	....	1.75
	ONTARIO A. C. EXPERIMENT.											
7	6 different breeds, 1 native	15	182	[3]90	971.6	....	48.5	31.7	....	....	20.2	2.15
7	......do	195	183	482	....	....	475.1	239.2	....	479.8	179.5	1.84
1	Shorthorn	[1]7	182	[3]82	1,262.0	....	50.5	47.2	....	....	57.0	2.04
1	......do	189	183	454	....	....	419.3	268.7	....	827.5	....	2.15
	MICHIGAN EXPERIMENT.											
10	6 different breeds	105	260	244.2	....	....	236.0	236.3	7.0	....	....	1.79
10	......do	365	365	709.4	....	....	555.9	667.4	128.8	78.8	....	1.37
10	......do	730	358	1208.8	....	....	826.4	613.1	186.6	196.5	....	1.07
8	5 different breeds	322	184	693.8	....	....	375.8	272.1	([2])	162.2	....	1.16
8	......do	506	181	917.2	....	....	523.1	342.2	314.7	347.3	....	1.90
8	......do	687	179	1260.8	....	....	749.2	322.5	719.9	7.1	....	1.57

[1] "Less than nine days old."
[2] Pasture.
[3] Assumed.

The table shows results obtained at the Wisconsin station with skim-milk fed to Jersey and Holstein calves. At the Ontario College calves representing six different breeds were fed on full milk at first, the trial lasting a year. The Michigan experiments are the most complete, and cover three trials with two lots of steers representing six different breeds in the first trial and five in the last. In the Wisconsin experiments the grain consisted of oats, bran, and oil-meal. At Michigan it was wheat bran, oats, corn, and some oil meal. At the Ontario College peas, oats, wheat screenings, bran, and oil-cake were fed.

INCREASED FOOD REQUIRED WITH INCREASED WEIGHT.

I ask the reader to carefully review the results obtained at the Michigan station and note the steady increase in the amount of food required to produce 100 pounds of gain. With so many animals on trial, representing different breeds and long feeding periods, these results can not be accidental, but must represent some rule of nature of great importance to the feeder. As we have learned from the second table in this chapter, an animal requires a very considerable amount of food for mere maintenance of the body, so that, as the body weight increases, more and more feed must be given for its mere maintenance, and only from the excess which the animal may consume comes the increased weight. At first the young animal is able to eat and digest much more than is required for its maintenance, and out of the large excess a rapid increase in weight results. Though the total amount of food consumed increases very considerably with the age of the animal, yet gradually the amount required creeps up until finally all is required for mere maintenance of the body, and there is no gain in weight for profit to the feeder.

EARLY MATURITY A NECESSITY.

The facts just noted lead to the last suggestion in regard to steer-feeding. Some of my readers will recall a period when it was not considered well to fatten a steer until he was 5 years old. A much larger number will recall the early exhibits of cattle at the Chicago Fat Stock Show, where prizes were offered for big steers. The long-legged, raw-boned creatures that competed for premiums in those days are now almost a thing of the past, but there is still room for large improvement. Early maturity has worked wonders in pork-making, and is more slowly but surely accomplishing equally striking results with beef cattle. While in parts of the Old World hogs are not fattened until 2 or 3 years old, on thousands of American farms in the corn belt April-born pigs are started for Chicago in November. Prices are now so low for beef that cattle must be quickly turned and every pound of food made to do its utmost. What can be accomplished in the way of early maturity is illustrated by results obtained by Mr. W. A. Harris, of Linwood, Kans., who reports, in the Breeders' Gazette, his experience with "baby" beef. He feeds pure-bred and grade Shorthorn calves coming in December, January, and February until the following December, when they average 11 months old. These calves generally had most of their dams' milk until 6 or 7 months old and Mr. Harris figures that they each consumed:

20 bushels of corn, worth	$5.00
1,000 pounds bran, worth	6.00
300 pounds oil-meal, worth	3.00
Total cost of grain	14 00

In addition they had pasture and what hay they would eat, which, together, he estimates at $4. These calves weighed from 910 to 920 pounds each at eleven months, and brought from $3.80 to $5.00 per hundred, which returns are certainly satisfactory, while yearlings have but held their own and required the space and feed of nearly two calves during the additional twelve months, to say nothing of interest and accidents. While Mr. Harris' figures doubtless represent the extreme limit in the direction of early maturity, and it is probable that many will not dare to attempt to sell beef at twelve months old, there is no good argument for not making a vigorous effort to steadily reduce the age at which steers are marketed. The first requisite is good breeding, for without a good calf further effort is of little avail. There is a gross error abroad which it seems almost impossible to down, and that is the idea that blooded stock can live on less food than the common cattle of the country. The truth is that such animals, being more artificial, really require better care and more abundant food. Their point of vantage is their ability to consume a large amount of food, making the most of it and putting it on the most valuable parts of the body in the shape of meat; further, they do this at an early age, long before native cattle have reached anything like maturity. Improved stock means an improved feeder with an intelligent understanding and good corn cribs. Having good stock, feed liberally. I know of no greater crime toward our stock in this country than parsimonious feeding. It is even more common to hear men boast of how little their cattle have wintered on than how much they have been fed and what large gains they have made. There must be a great change in this particular before genuine improvement comes.

THE DAIRY COW—INTRODUCTORY.

Enormous as is the dairy industry of this country, its continued growth for some time yet seems almost certain, for the reason that our progress has been largely in the direction of an improved product rather than a mere increase in gross output. Low prices for beef cattle have been brought on in no small measure through flooding the market with lean or half-fatted steers, which must be consumed in some way and drag down the prices of well-fatted representatives of their kind. The spread of the creamery system does not necessarily mean that more cows are used in the production of butter, but rather that more butter of a uniformly high quality is being made to take the place of dairy butter, much of which has a doubtful reputation. Increased consumption naturally follows improvement in quality, and with more good butter on the market more is consumed, and for this reason more than any other I think the prices of dairy products have held up so well in the past.

But dairying will continue for another reason, which lies at the foundation of stock-feeding, and this is because the cow gives a larger return for her food than does the steer. I doubt if many of my readers have ever reflected upon just this phase of the question, but it is one of large importance and will some day be carefully studied.

In Table III we have given the ration of a dairy cow weighing 1,000 pounds, as follows:

	Pounds.
Corn fodder	14
Clover hay	6
Bran	5
Corn meal	5
Cotton-seed meal	2

From this ration we may suppose a good dairy cow will yield about 25 pounds of average milk. Supposing we feed the same ration to a steer weighing 1,000 pounds. I am sure the majority of feeders will agree that 2 pounds of increase, live weight, will be a fair return for this amount of food. Lawes and Gilbert, of England, made careful analyses of the carcasses of ninety-eight oxen to determine the character of their increase while fattening, which they found to be as follows:

	Per cent.
Ash	1.47
Protein (dry lean meat)	7.69
Fat	66.2
Water	24.6

Let us place the food constituents of a day's increase of 2 pounds live weight of the fattening steer beside what is contained in 25 pounds of average cow's milk:

TABLE XI.—*Showing the returns from a dairy cow and a fattening steer for one day.*

Constituents.	Returns from—	
	Twenty-five pounds cow's milk.	Two pounds increase in steer.
	Per cent.	*Per cent.*
Ash	0.17	0.03
Protein	0.90	0.15
Fat	0.90	1.30
Sugar	1.20	0.00
Total	3.17	1.48

Our dairy cow has given nearly six times as much ash, six times as much protein, and 70 per cent as much fat as is returned by the steer, with 1.2 pounds of milk sugar, against which the steer has nothing to show. If we reduce this milk sugar to its fat equivalent by dividing by 2.2 we find the milk sugar given by the cow to be worth for food purposes 0.56 of a pound of fat. All of the constituents of the milk are digestible and furnish the best of human food, while much of the increase of the steer is hardly available for food as we commonly use meat. At the present time, when coarse feeds and grains are raised in such enormous quantities in America, we are more or less indifferent to the relative economy of the cow and steer in condensing gross hay and the coarse grains into human food, but when population becomes great the steer must give way before the cow in the contest of economically producing food for men.

THE ART OF DAIRYING BASED ON THE MATERNITY OF THE COW.

Nature's purpose in storing fat beneath the skin and between the muscular tissues of the animal body is to lay up heat and energy material against the time of need. This process goes on rapidly at first, but after a time the system seems gorged, and further storage is secured at a high cost for feed. How different with the dairy cow. Food given at night, for instance, is digested and elaborated into milk ready for the calf in the morning, and is at once disposed of instead of being stored up and added to the body to be utilized and carried about, and it is for this reason, probably, that the cow surpasses the steer in the economical manufacture of human food.

It is the appropriation by man of food material intended for the calf that makes possible the great art of dairying. Under the stimulus of good feed and long selection our dairy cow produces much more milk than is needed for the calf, and has become more or less an artificial creature.

The basis of the whole dairy system is the maternity of the cow, and the successful management of a dairy depends upon fully comprehending and intelligently following out this idea. To ex-Governor W. D. Hoard, of Wisconsin, belongs much credit for bringing this view to the attention of our dairymen, and the effort has been of untold value, for no one can fairly consider the problem as thus stated without regarding the dairy cow in a new light.

SHELTER.

I have spoken favorably of open sheds for steer feeding, urging that with his load of fat and stomach filled with heating grain this creature has a better appetite and is more comfortable with the freedom of such quarters than in the average stable. For reasons just shown our dairy cow is under very different conditions and shrinks from cold and exposure. Any other animal on the farm will stand more exposure without suffering than a cow giving a large flow of milk.

Close confinement in the barn during the whole winter is a subject now being much discussed by dairymen, and some argue for the practice, reporting favorable results. I can not believe that it is well to keep cows confined for four or five months in one spot. The dread disease tuberculosis has already found a lodgment in too many herds scattered over the country, and its spread is something greatly to be feared. It is not unreasonable to hold that dairy stock confined generation after generation in the stable, out of the sunlight and fresh air, for many months each year, must, after a time, become more susceptible to this disease than where more freedom is allowed.

PROF. ROBERTS'S SYSTEM.

It is not well to turn stock out into the bleak winter storm to obtain fresh air and exercise, but can we not modify our present system so that the cows shall have the freedom and avoid the exposure? At Cornell University Prof. Roberts has for years followed a plan which seems of great value in its teachings to the dairymen of this country. The cows stand in stanchions while feeding and being milked, but immediately afterward they are turned into a large covered yard where they are free to stand or lie, entirely unconfined except by the walls, so that they have a dining room and living room, each adapted to its purpose. The accumulations from the horse stable are spread over the floor of the covered yard where the cows spend most of their time, and is covered with straw and land plaster, used to prevent odors arising. This perfect system of saving manure should alone pay in a few years for the cost of the additional room required. The stable can be reduced to the smallest size compatible with holding the cows and permitting milking and feeding, and can be kept scrupulously clean and thoroughly aired, since the cows are in it but a few hours each day. Under these conditions the cows should come to their meals each day with the best of appetites and return to their larger quarters to ruminate in comfort. Where dairymen are buying and selling cows constantly, using each animal but a few years, close confinement and little attention to the health of the herd may not bring unfortunate results, but there are many persons breeding choice herds of dairy animals who wish to take as little risk as possible from weak constitutions or inducing tuberculosis. To such I commend a careful review of the Cornell system.

REGULARITY AND KINDNESS IN THE DAIRY.

The dairy cow is the creature of habits, as well as most other animals, and is very susceptible to favorable or unfavorable influences. At this station a record of every milking is kept, and in looking over it we can tell when Sunday comes by the smaller yield on that day. Our men milk a little later Sunday morning and a little earlier at night, probably hurrying the operation, and the cows resent the treatment by a somewhat smaller yield of milk. Dr. Babcock has found that a new milker will get less milk from a cow at first than the milker to which she is accustomed. Milking the teats in a different order also affects the percentage of fat in the milk and the amount of milk given. Irregularity in the order of feeding must also have an unfavorable effect.

Probably a very considerable portion of the milk is elaborated by the cow during the time of milking, and if this is true it is not difficult to understand that the cow should be in perfect comfort of mind and body during this time. The dairyman should follow a regular system in his feeding operations, supplying the same kinds of food at the same time in the day and in the same order. Milking should be performed with regularity, the cows being milked in the same order and so far as possible by the same milkers.

RECORDING AND ANALYZING MILK.

We have found nothing more helpful for its cost than the use of scales in the dairy barn for recording the milk yield of each cow at each milking. A sheet of manila paper can be quickly ruled with a lead pencil and the names of the cows placed at the head, with the days of the week along the side of the sheet. These sheets can be made to hold either a week's or a month's record, the former being preferable, we think. A pair of spring balances, tested occasionally, prove very satisfactory for weighing the milk. The fraction of a minute is all the time required for the milker to get the weight and enter it upon the record sheet. The effect is most salutary and conduces to better milking and more kindly care for the cows, since each milker is desirous of making a good record.

The fat contained in the milk practically measures its market value, and the milk of different cows varies so in the fat content that the dairyman really knows very little of what his cows are doing when he goes no farther than weighing the milk. Churn tests to learn how much butter a cow can make have been recommended, but to set the milk of each cow separately and churn it carefully involves so much labor that this system is hardly practical. In the Babcock test the dairymen now have a simple, rapid, and inexpensive means of determining just how much fat there is in the milk of each cow in the herd. The dairyman who will use this test will be surprised at what it reveals. Some cows that were supposed to be among the best are found to yield milk poor in butter fat; while others, giving less quantity, may be leaders in the total amount of fat produced. With the scales to show how much milk the cow gives during the year, and the Babcock test for analyzing the milk and determining the percentage of fat from time to time, the dairyman is in position to know just what his herd is doing, and can dispose of unprofitable animals and keep the good ones and their progeny. At last he has a means of measuring the true worth of each cow in the herd, and there is no longer any excuse for keeping and feeding unprofitable animals.

THE QUALITY OF MILK A RESULT OF BREED RATHER THAN OF FEED.

The opinion generally prevails among dairymen that the quality of milk is directly due to the feed supplied, most of them holding that certain feeds will make milk rich in fat, while other feeds will make it watery and thin. The results of carefully conducted trials in order to study the effects of feed on the quality of milk have generally shown that the composition is quite regular and little modified by the feed, though the total yield of milk of course varies greatly with the feed. I think in this particular case popular opinion is largely in error. With certain kinds of feeds the dairyman does increase the amount of butter he receives, but it is because the total amount of milk has been increased and not because a higher per cent of fat has been put into the milk.

And when we give the matter due thought the position here advanced seems the tenable one. We do not expect a fruit tree to change its variety of fruit through good or poor feeding. A Baldwin apple tree always produces Baldwin apples, though the number may be increased or diminished by the treatment of the tree. If feed were the controlling factor, the strong characteristics of the dairy breeds would all disappear with the art of the feeder. Is it not more reasonable to hold that we must breed for quality and feed for quantity?

PREPARATIONS OF FOODS AND METHODS OF FEEDING.

We know that a horse standing idle in the stable in winter will live on oat straw and a little grain and keep in very fair condition. His digestive powers are untaxed and utilize the coarse material without difficulty, but as soon as the hard work of spring comes on he not only needs a good deal more feed, but, if very hard worked, the hay should be chaffed and the grain ground. The labor he performs has made such demands upon the body that there is not energy enough left to work over the coarse food and get enough out of it to make up the increased wastes of the body. We should always remember that our dairy cow is really performing a very large amount of work when giving a large flow of milk, and her food should not only be in large quantity but put in the best form possible for easy digestion. Even with an abundance of food carefully prepared, so strong are the inherent tendencies toward milk-giving that many cows will take from their own bodies a large amount of fat stored there and put it into the milk. If we will only come to regard our good dairy cows as working very hard while giving milk we are in position to treat them properly.

THE FEED-CUTTER.

There should be a good feed-cutter on every dairy farm, useful for silo filling in the fall and for chaffing feed in the winter. All cornstalks should be put through this machine, for then they are in better condition for feeding, and the coarser portions left uneaten are in good form for bedding and the manure heap. Long cornstalks are a nuisance in a feeding manger, worthless for bedding, and troublesome in the manure pile. Many farmers find difficulty in feeding cut cornstalks, since sometimes the cows refuse to eat them. In a few cases we have found that the sharp ends of the cornstalks, when cut certain lengths, injure the mouths of the cows. This difficulty can usually be avoided by changing the length of cut. Judging from experiments at the Kansas station, it is possible that in the lower portions of the corn belt cornstalks are so coarse and poor that they are not useful for feeding dairy cows, but farther north I am sure they will pay for the cutting. Where they are not well eaten the cause is often due to overfeeding, or endeavoring to have the cows live on too limited a variety of foods. Keep the mangers clean and feed the cut fodder with care, and usually very little will be left over, and that only the coarsest portion. Experiments at the Wisconsin station show that with the varieties of corn raised there much more of the cut stalks will be eaten than if fed uncut under the same conditions.

Where corn is cheap and labor high, uncut shock corn of small varieties can be very successfully fed to dairy cows. It is surprising to see how they thrive on it, and the undigested grain can be gathered from the droppings by lively shotes. This system is somewhat crude, but not without advantages in the pioneer stage of dairying in the corn belt, where it helps to educate the farmers to a proper appreciation of the value of corn and corn stover for dairy cows. After a time this practice should give way to more improved methods commonly followed in the older dairy sections.

Much has been written in regard to wetting hay, straw, and stalks, putting meal thereon and mixing up before feeding. The English are accustomed to pulp or slice roots, mix these with cut hay or "chaff," as they call it, and then sprinkle the meal over the mass, shoveling it over. Such mixtures must be very palatable to the cow, and give excellent results. In most dairy sections we have not yet progressed so far in our feeding methods, and the simpler practice of giving hay and grain separately will probably be continued by many, as it gives very fair results.

The best general rule to follow is to put the food of a cow into just that form which seems most palatable to her. Many labor under the mistaken idea that food will not be properly mixed in the rumen unless it is mixed before being swallowed. Examinations of the rumens of cows fed experimentally show that different kinds of feed are all intimately mixed together within half an hour after they have been swallowed, and that the mixing is much more thorough than is possible to get in the feed-box. It is better to let the appetite of the cow govern in that matter rather than the theory of the feeder.

FOODS FOR DAIRY COWS.

First in the requisites place palatability, next quantity, and finally proper proportions of nutrients, being guided somewhat by the German standard as expressed in Tables I and II. From the large amount of protein represented by the cheese part of the milk and the albumen, it is certain that a very considerable amount of protein should enter into the composition of the food. The carbohydrates supply the material out of which the milk-sugar and fats are elaborated, though of course these can also be made from the protein substances. The protein and fat of the foods are the more expensive portions, and for that reason we should be careful not to feed them in more liberal allowance than is actually needed.

Among grain foods for the dairy the following are worthy of special mention:

Corn.—Indian corn is a most valuable food and one of the cheapest used in the dairy, and the quality of milk and butter produced from it usually above question. Corn meal is a very concentrated food and packs too closely in the stomach, and should be extended with something coarser, like bran, if possible. As the table shows, corn does not furnish much protein.

Oats are probably the best single food on the list, and are just as valuable in the cow stable as in the horse barn. At this station we have found oats to have the value of about 10 per cent in excess of an equal weight of bran for producing milk and butter fat. Oats contain much ash and a larger proportion of protein than corn, and should have a prominent place in the feed bin of our dairy farms whenever the cost is not too high.

Barley is a very common food for cows in the Old World, and is used to considerable extent on the Pacific coast. It should be crushed by rolling rather than grinding.

Wheat is sometimes so low in comparison with other grains that it can be fed very profitably. Frequently on the Pacific coast it is the cheapest dairy food in the market.

Peas.—Table I shows peas to contain a very large amount of protein, and they are an excellent food for dairy cows. Being very rich in protein, but a few pounds should be used in a ration.

Cotton seed.—The progress of Southern live-stock interests depends largely upon an intelligent use of cotton seed, cotton-seed meal, and cotton-seed hulls. Cotton seed boiled is used at the South with good results, if fed in reasonable quantity. Cotton-seed meal is very rich and heavy and should be fed with care; it should be extended by some other food like bran and mixed with roughage. Cotton seed and cotton-seed meal have a deleterious effect on butter, if fed in large quantities, but with care they can be fed at any season of the year with profit. Cotton-seed meal should be used more generally at the North, its high fertilizing value after passing through the animal often being worth the first cost.

Oil meal or oil cake.—This by-product of the linseed-oil factories is a a most valuable food in the dairy barn, though it should be used in lim ited quantities. It is especially useful for calves, and a couple of pounds a day may be fed to dairy cows with profit. It is very rich in fertilizing elements. Oil meal to the value of $8,000,000 is annually shipped to the Old World. For the fertility it contains, if for no other reason it should all be fed in this country and dairy products instead shipped abroad.

Bran is one of the most valuable feeds in the dairy. From its loose, husky nature and cooling effect on the system, it can be given in almost any quantity, with little danger of overfeeding. It is the safest food in the dairy barn, and should always be in store to mix with corn meal or the ground grains, cotton-seed meal, or oil meal. We know that wheat rapidly depletes the soil of its fertility, and the chemist has found that the larger part of the fertility that goes into the wheat grain is stored near the outside of the grain in what becomes the bran on grinding. A few farmers still hold that bran is little better than sawdust. Such notions belong to the past generation. Exporters are studying how to compress bran in order to ship it abroad. This movement should be stopped by a lively home demand.

Shorts and middlings are now but a finer form of bran. Sometimes they contain much starch and form a first-class food, but, again, they carry the dirt and dust of the mill, and are not so palatable as bran.

Malt sprouts and brewers' grains, either wet or dried, are valuable foods, rich in protein, and often sell at such low prices as to admit of very profitable use in the dairy barn. Wet brewers' grains, because of their cheapness and abundance, are often misused. The sloppy drainings saturate the feed boxes and mangers and become putrid, endangering the lives of the cows and those who use the milk. If fed when fresh, and in reasonable quantity, and the surroundings kept perfectly clean and wholesome, brewers' grains are an excellent food for dairy cows.

Gluten meal, a by-product in the manufacture of starch or glucose, is very rich in protein. The heavy forms of this meal should be fed cautiously and extended with some light substance like bran.

Corn stover or corn fodder is an excellent and healthful cattle food, being quite free from dust, and very palatable to the cow. The amount of nutriment which can be gathered from a cornfield, and the portion which remains in the stalks has already been discussed under steer feeding, and the reader is referred to that portion of this chapter for information on this important point.

Clover hay, when well cured and bright, is especially valuable for dairy cows, since it furnishes a large amount of protein.

Timothy hay is at best a poor food for dairy cows; it should be left for horse feeding.

Wheat hay, *oat hay*, or *barley hay*, if cut early, are all excellent dairy foods, and their use should become much more common than it is.

Millet hay is satisfactory if cut very early, before the seeds form.

The reader is referred to Table I for the proportions of nutrients in the above and many other feeds used in the dairy.

SILAGE IN THE DAIRY.

I have already spoken favorably in regard to the use of silage in steer feeding; in the dairy barn it has a still more important place. Milk is a watery product, and the cow should be fed upon juicy, succulent foods. We all know the value of good pastures, but their season is short in this country, and in the Northern States our cows must subsist on dry feed between six and seven months each year unless we can give them a substitute in the shape of roots or silage. Many dairymen have learned the value of roots, but there are thousands who for one reason or another will not grow them, and to such I strongly urge the use of silage for supplying a moist food most palatable to dairy cows. Silo construction has now been greatly simplified, and we have learned at what stage to cut the corn and how to secure it in the silo at very low cost. An acre of good land will furnish from 15 to 18 tons of green corn stalks, many of which will carry small ears or nubbins. This material can be placed in the silo at small cost while full of juice, and kept there with little waste. From 20 to 40 and even 60 pounds of corn silage can be fed to each cow daily during the winter with profit. There is a prejudice among many dairymen that silage being somewhat sour will injure the teeth or the digestive apparatus of dairy cows, but the practical experience of thousands who use the silo show such charges to be without foundation. In the Indian corn crop we have the best and cheapest means of producing a large amount of wholesome cattle food; with the silo we now have the means of keeping this crop in a succulent condition for winter feeding so that it proves an admirable and cheap substitute for roots.

There are two classes of dairy farmers. Those who desire to raise upon their farms about all that is fed to their stock constitute the first class, while those in the second are usually located on high-priced land near some city or railroad station, and can not grow all of the food required by their cows, and make heavy purchases of grain feed each year. The first class of dairymen here referred to will doubtless find it more profitable to grow such varieties of corn only, for silage, as will fully mature in their locality, and plant the corn so thinly that many ears will form on the stalks. These ears will make the silage very rich, and a fine ration is provided by giving a few pounds of clover hay and 2 or 3 pounds of bran or oats. Where it is desirable to raise a large amount of roughage, the farm furnishing only the bulky feed, let the corn for silage be of some large variety, which will barely mature in the given locality, planted on very rich land, so thick that very few ears will form. The amount of coarse feed furnished per acre is enormous, but it must be backed up by a full grain ration. Some farmers put silage into the pit without cutting, but a good feed-cutter elevates it so economically, and cut silage packs so well and is so much more easily removed at feeding time, that cutting the corn should generally be practiced.

FOOD REQUIRED TO PRODUCE 100 POUNDS OF MILK.

The dairyman should so study the operations of his farm that he knows what it costs to produce a hundred pounds of milk or butter. The calculation is a complex one, but it is possible, and has been done by a good many farmers, who have found much interest and profit in the work. In order to give some idea of the amount of food required to produce a hundred pounds of milk, I have prepared a table giving the results of observations at experiment stations in four States and Canada.

TABLE XII.—*Food required for 100 pounds of milk.*

Station.	No. of cows.	Breed.	Length of trial.	Grain feed.							Roughage.							Fat in 100 pounds milk.
				Corn meal.	Oats.	Pea meal.	Wheat bran.	Wheat shorts.	Oil meal.	Cotton-seed meal.	Corn silage.	Green clover.	Green corn.	Fodder corn.	Corn fodder.	Mixed hay.	Oat straw.	
			Days.	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Wisconsin	5	Holstein Jersey Native	125	...	9.7	...	24.2	...	...	...	...	...	...	...	77.3	29.0	...	4.05
	8	....do	84	...	10.6	...	15.9	...	...	...	312.0	...	...	...	...	10.6	...	4.23
	8	....do	84	...	...	...	17.1	...	...	...	...	...	...	113.9	...	11.4	...	4.11
	20	....do	112	...	...	...	27.5	11.0	...	...	326.0	...	...	...	...	22.0	...	4.54
	20	....do	112	...	...	...	27.5	11.0	...	...	...	...	...	103.0	...	22.0	...	4.47
New York (Geneva).	2	Jersey	26	14.3	...	...	9.6	...	...	14.3	...	...	...	...	...	94.0	...	5.44
	2	....do	...	26.6	...	...	8.9	...	...	...	...	...	...	...	...	86.4	...	4.95
Maine	5	Holstein Ayrshire Jersey	365	15.2	...	...	10.2	...	...	6.3	35.2	...	...	...	...	88.5	...	4.08
	6	....do	366	17.0	...	...	11.7	.4	...	7.3	...	...	...	...	...	91.9	...	4.04
Canada	6	....do	90	...	...	...	...	...	...	...	137.4	...	...	...	...	45.8	91.6	3.67
	6	....do	90	...	...	...	...	...	13.6	17.0	...	...	...	...	...	68.2	...	3.49
	6	....do	90	25.1	15.7	12.6	...	...	...	...	...	...	...	...	...	62.7	...	3.25
	6	....do	90	9.1	...	...	16.9	...	...	...	168.6	...	...	...	...	20.2	...	3.83
Pennsylvania	7	....do	99	7.1	7.2	...	14.3	...	...	...	...	...	...	...	...	127.7	...	4.15
	7	....do	99	9.1	9.1	...	16.5	...	...	...	...	479.0	...	...	...	39.6	...	4.32
	7	....do	99	9.8	9.8	...	12.7	...	...	...	...	...	633.4	...	...	42.4	...	4.54

The value of milk is mainly dependent upon its fat content, and a given weight from different herds varies greatly in actual value. For this reason in the last column of the table the amount of fat actually found in the milk is reported. It will be seen that this varies from 3.25 pounds in one case to 5.44 in another. The wide variation is an admirable example in showing how important it is for the dairyman to analyze the milk and learn just what his cows are doing. It shows us how little we know of the value of the herd when we stop short with merely weighing the milk. By weighing the feed occasionally and weighing the milk regularly and analyzing it from time to time the dairyman is in position to know just how his business is running.

FEED WITH A GENEROUS HAND.

All through this chapter I have endeavored to convey the impression that the calf, the steer, and the cow are living machines for the concentration of hay, grains, and grasses into human food. The successful operation of these machines depends upon the manager and is controlled by inviolable laws. Often it would seem from appearances as though the stockman was hostile to his cattle, and regarded every pound of feed given them as so much material filched from the feed bin to his personal loss. The man who wrote in a letter that he had a wife, 3 children, and 6 cows to support, doubtless took just this view of the situation; had cruel fate thrust 10 or 20 cows upon him he would have broken down entirely under the burden. With some the greatest effort in conducting feeding operations seems to be the study of how to save a little feed and still keep the animals in existence.

The successful feeder works on exactly the opposite principle. He fully appreciates the fact that an animal in order to be profitable must be liberally fed. He understands that first of all it must have sufficient food to carry on the bodily functions and maintain life, and that no returns can come to the owner if only this amount of food is supplied, and that all increase in weight, fat, and all yield of milk come through the excess of food over the wants of the body. This leads him to breed and select animals with large consumptive power, a strong digestion, and to feed them up to their limit so long as they are useful.

If our farmers only fully understood this first great law of stock-feeding and acted intelligently thereon, our stock interests would be revolutionized.

THE EYE OF THE MASTER FATTENS HIS CATTLE.

I wish the above legend could be written over the door of every feeding stable in the land, for it expresses a most important truth in concise form. If a man has no natural liking for the stock business, it is really useless for him to attempt that vocation, for the art can only be acquired by students having a certain natural adaptation. If one has this love for the business, then by patience and study the details can be successfully worked out. First comes a love of order and regularity, which are of prime importance at all times. Stock must be fed with great regularity and in the same order, day by day, and all possible violent changes in feeding and handling avoided. The feeder should move among his animals quietly and in a way to win their confidence, which is easily acquired and as easily lost. As he passes among them daily in his round of duties he should have a quick eye to scrutinize every member of the herd and detect any little irregularity or trouble. He avoids disasters or serious accidents by constantly studying the little comforts and individual wants of the animals under his care. He feeds with a liberal hand, and none of his animals lie down hungry or discontented.

The successful management of live stock is dependent upon good judgment in handling the cattle. If one lack this, all his other qualifications count for but little. He may understand the theory of cattle-breeding and how to compound rations from a scientific standpoint; he may know the chemistry of the foods he handles and of the bodies of the animals to which they are fed; he may have the literature of the stock business at easy command, but, if he lacks sympathy for his animals and judgment in handling them, all his knowledge is of no avail.

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