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# MEAT INSPECTION.

C. A. CARY, Veterinarian.

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# MEAT INSPECTION.

BY C. A. CARY.

## INTRODUCTION.

Sanitary science has been greatly extended since the advent of the bacterial origin of many diseases. It is now a well established fact that some parasitic diseases are common to man and many of the domestic animals. In some instances a disease may not always manifest the same symptoms or pathological lesions in a man that it does in animals, and the disease, wherever found, may be caused by the same micro-organism. Yet, such a disease is transmissible from animals to man or from man to animals. The common illustrations of such diseases are found in tuberculosis and anthrax. It is now a positive fact that during the past five or six years a sufficient number of cases of anthrax, tuberculosis, swine plague, hog cholera, etc., have been observed in this State to justify a system of thorough and efficient meat inspection in the larger cities and, if practicable, in the smaller cities and towns of the State. There is no occasion for alarming statements; meat inspection only means that one of the numerous ways of transmitting or spreading the cause of disease can and should be checked.

It is not only the aim of the meat inspector to cut off one of the ways of transmitting the germs of disease to man' but also to eliminate from the food of man the poisonous chemical compounds, known as *ptomaines*, *leucomaines* and *organic ferments* that may be developed in the body of an animal during disease or may be developed in decomposing

meat. Many of these chemical compounds are very poisonous and they can not always be destroyed by cooking the meat as can the germs of disease. For instance, in the disease known as tetanus (lock-jaw) the tetanus bacillus develops, or in some way produces, a chemical substance called *tetanin* which is a very powerful poison; in fact, it will kill a healthy man or horse in a short time if a comparatively small quantity of it is injected into the circulation. It is in the same way that many other poisonous chemical compounds are developed in the body of animals during disease. All of these chemical substances do not possess the same degree of poisonous potency; but the power of the poison will vary in almost every case or kind of germ, by which it is produced or with which it is associated. Many animal parasites are common to man and the domestic animals. *Trichina spiralis* has been found in this State; also the cystic stage of many of the tape worms, especially of *tænia solium*, have been observed in Alabama. It is obvious to any well informed medical man that thorough and efficient meat inspection is a practical means of preventing many diseases in the human family. The writer uses the words "thorough" and "efficient" because there is a tendency on the part of the powers, who appoint inspectors, to appoint political favorites, regardless of their qualifications. That day is passed when a man can be an expert in more than one thing. It is a great mistake to think that a druggist, a carpenter, a horse-trader, a liveryman or a butcher can make an efficient meat inspector without two or more years of specific preparation. A man, through ignorance or a desire for gain, can deceive himself. For example, I have seen butchers, let us hope through ignorance, pass carcasses to the market that were absolutely unfit for human food and in many instances dangerous; and no doubt in some cases produced sickness in the consumers that could not be accounted for by the family physicians;

because they knew not the condition of the meat their patients had eaten.

In a prominent city of the United States, the writer found the inspector sitting in a chair watching the animals pass by him. No inspection of the carcass was made at the slaughter. A glance at the animals as they passed to the slaughter is almost equivalent to no inspection. A practical inspection law and honest, competent inspectors always mean thorough and efficient meat inspection.

## Hog Cholera.

Synonyms.—Swine Fever (England), Swine Pest (Germany).

*Symptoms.*—In hog cholera, the skin is usually red on the nose, the ears, the abdomen, on the inside of the front limbs, on the inside of the thighs, on the skin of the groins and around the anus. Sometimes red spots may appear on the skin of any region of the body. This redness of the skin varies from a light red tint to a deep bluish red or purple. It may be confined to spots or it may become diffuse and extend over considerable skin surface.

It is well to note here that the skin may be covered with red spots or diffuse red patches in some cases of American swine plague (Salmon and Smith), in infectious pneumonia (Schütz) and in the European swine plague (Löffler, Schütz).

In some chronic cases of hog cholera skin eruptions may appear over the head, neck, body and limbs. In such cases the redness of the skin may be very slightly marked.

Diphtheritic ulcers may appear on the tongue, on the inside of the cheeks, on the palate, the gums and the tonsils. These ulcers are covered with grayish-white or yellowish-gray scab-like material; in some cases they have a greenish tint.

The chronic case may cough from time to time; the respirations may be normal, but they are accelerated and

labored in acute cases. The conjunctiva of the eye is red and the eye lids may be stuck together with dried mucus.

The temperature in chronic cases may be normal (101° to 104° Fah. according to Kilborne), but in acute attacks it may be 3 to 5 degrees above the normal. In acute cases the appetite is entirely or partially lost, and the bowels are constipated; in a short time diarrhœa appears and the excrements are liquid and fetid, occasionally mixed with blood. In chronic cases the appetite may remain good; yet the animal may have diarrhœa. The color of the excrement always depends upon the character of the food eaten. In hogs fed corn it is yellow; in those which are fed slops and mixed foods, the excrement is grayish or black. Vomiting is rare in hog cholera; but more common in swine plague.

In acute cases some animals become weak, greatly depressed in vigor; lie quietly, huddled together, hide under litter, and toward the end of the disease lose control of the hind limbs. Friedberger and Fröhner state that death is preceded by convulsions and Kilborne states that "death ensues quietly. Rarely convulsive kicking is observed." It is well to note that all of the foregoing symptoms are not distinctly marked in each hog but that the symptoms will vary in intensity and some of them may not appear or be overlooked on account of their being slightly marked and of short duration. It is difficult, many times impossible, to make a positive diagnosis with only an ante-mortem examination. The mortality, in hog cholera, is very high; 80 to 90 per cent., of those attacked die (Salmon and Smith).

### Post-Mortem Appearances:

*In acute cases.*—Salmon and Smith suggest that acute cases might be embraced under the general head *hemorrhagic type*; because the chief morbid changes that occur are hemorrhagic in character. (The hemorrhagic spots or patches that are so common in these cases result from the

escape of blood from small blood vessels or capillaries; they vary from a scarlet red to a black red in color. They also vary in size and are spoken of as "blood extravasations," "ecchymoses," "petechiæ," "hemorrhagic spots or patches." These changes are most distinct immediately after the death of the animal.)

The spleen is usually enlarged, engorged with blood; it may be twice as large and long as the normal spleen.

The mucous membrane lining the stomach is very red and sometimes there may be blood on its surface. This red or bloody portion of the mucous lining is usually confined to a large patch in the base or fundus of the stomach. There may be numerous hemorrhagic (bloody) spots or large patches in or beneath the mucous membrane lining the small and large intestines; these spots may be so numerous as to give the lining membrane a dark red color. Occasionally food in the intestines is found encased in sheets of blood clots, a result of hemorrhage on the surface of mucous membrane. Hemorrhagic spots are quite frequently found beneath the external covering or serous coat of the intestines. These blood spots are occasionally found beneath the serous lining of the thorax and abdomen; under the serous membrane (peritoneum) near the kidneys, over the diaphragm (midrif) under the serous membrane (pleura) that lines the walls of the thorax, blood extravasations may occasionally appear, that are nearly one inch in diameter. Sometimes in the kidneys there are extensive hemorrhagic changes. When a kidney is cut into halves, large blood extravasations will appear in the central or medullary portions and small red spots (engorged glomeruli) will be observed in the cortical or outer part of the kidney. In some cases numerous blood spots will be observed under the serous (pleura) coverings of the lungs, and on cutting into the lung tissue small hemorrhagic spots may be seen in all parts of the lungs. In rare cases hemorrhagic changes may involve one or more

lobes of the lungs. The subcutaneous connective tissue may be filled with small hemorrhages. These are found mostly in the subcutis over the abdomen but may appear in any part of the surface of the body. Occasionally in the subcutis, around the mammary glands of sows that have suckled pigs, may be seen more or less large, bluish black patches of pigment, a result of the irritation and inflammation induced by the "rooting" of the pigs when sucking. Occasionally small blood collections may be found in the surface muscles and in various tissues of the body. Some authorities suggest that hemorrhages may be found in the brain and spinal cord. However, few records have been made upon the frequency of these lesions in the brain and spinal cord. As a rule the lymphatic glands of the large intestines, of the stomach, of the peritoneum, those in the pelvis, at the root of the lungs and along the posterior part of the aorta in the thorax, and sometimes lymphatic glands in other parts of the body, are more or less filled with extravasated blood. Sometimes the extravasations may be confined to the outer cortex or be infiltrated throughout the entire gland. These glands may have a light red color or be almost black.

*In chronic cases.*—These cases are the ones that are most commonly observed in the slaughter houses and are always more fully described in the literature on hog cholera than acute cases. As a rule, the post-mortem appearances are more definite and distinct in chronic than in acute cases. However, chronic and acute cases may be found in the same herd; and both chronic and acute post-mortem appearances may be found, in some instances, in the same hog.

In some chronic cases ulcers may appear in the mouth. They are usually found on the sides of the tongue along about its upper third, in the corners (commissures) of the mouth, on the tonsils and on the inside of the cheeks. These ulcers are usually circular or oval in outline and have

a grey, dry, dead appearance, resembling very closely the diphtheritic ulcers that are so constant and prominent in the intestines.

In rare cases there are a few (two or three) ulcers found in the stomach.

In the lower or terminal part of the small intestine, its lining mucous membrane presents small circular ulcers, which are produced by a diphtheritic inflammation that destroys the mucous membrane in spots and the dead (necrotic) parts of the membrane become detached leaving the depressed red ulcers. Occasionally, these ulcers may be more extensive or larger, especially near the end of the ileum. As a rule, these ulcers are formed earlier and heal more rapidly than those of the large intestines. The diphtheritic

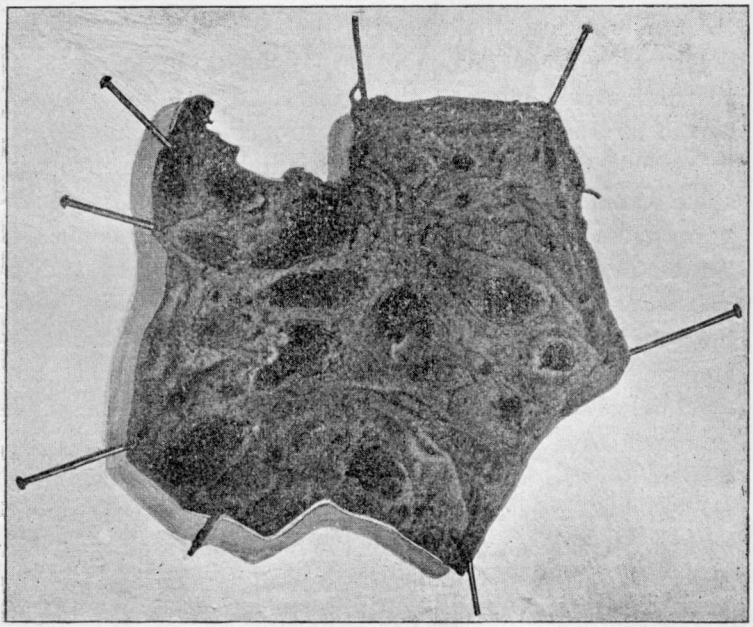

FIG. 1. Diphtheritic ulcers in large intestine of hog cholera (after Detmers).

inflammation that produces the death of the mucous membrane is said to be "a diffuse superficial necrosis (death) of the mucous membrane, accompanied by the coagulation of a thin layer of croupous or fibrinous exudate. Sometimes only the superficial parts (the villi propria mucosa, and crypts of Lieberkìihn) are destroyed, but in other cases the entire thickness of the mucous membrane is destroyed, and included in the slough."

In four days or more after the manifestation of the disease, diphtheritic ulcers appear in the mucous membrane of the large intestine. They are found most commonly in the cæcum (blind pouch) the first part of the colon and in the rectum. They vary in size and outline; may be small (one-fourth to one-half inch in diameter) or involve large patches; may be circular, oval or irregular in outline. The greater the number and more extensive the outline, the greater the degree of infection and more severe the disease. It seems that the development of these ulcers have never been observed in their early stage. It is propable that they appear as a result of a diffuse diphtheritic inflammation involving spots or patches of the superficial parts, or the entire thickness of the mucous membrane. The death or necrosis of the mucous membrane usually begins in small spots and involves the surface; it extends in depth until the entire thickness of the mucous membrane is involved, and, in rare instances, it may involve the middle (muscular) and outer (serous) coats of the intestine, leading to perforation of the bowel and thus producing peritonitis and death. The necrosis also extends regularly in all directions around the beginning spot; this increases the size of the ulcer, maintains its circular outline and accounts for the alternate black and white concentric rings of old ulcers. The diphtheritic or fibrinous exudate, first thrown out on the surfrce, is probably soon detached, but the fibrious exudate in the dead parts of the mucous membrane remains until the death of the animal

or the entire dead part of the ulcer is detached and the healthy healing (cicatrization) process begins. The diphtheritic ulcers are greyish, yellowish, greenish or black in color. Sometimes, in ten or twenty days after the beginning of the disease, the dead parts of some of the ulcers are cast off and the healing begins.

The epithelium grows gradually from the margin of the ulcer; but if the glands (Lieberkiihn's, solitary glands or Peyer's patches) have been destroyed they are never restored. After healing is completed (in recovered cases) "a smooth shining depressed scar marks the seat of the original ulcer." These scars are somewhat difficult to find and thorough search must be made after the intestines have been carefully washed.

Some authorities (Salmon and Smith) assert that the ulcers(?) immediately around the opening of the small intestine into the cæcum are very constant and characteristic. McFadyean says: "Not infrequently, especially in old pigs, these crypts (Lieberkiihn's glands) in the mucous membrane around the ileo-cæcal opening contain masses of what appears to be inspissated (dried) secretion, which may be squeezed out of them under slight pressure between the finger and thumb; indeed this condition is so common that it can hardly be considered an abnormality, and in many cases it has nothing to do with swine fever."

In some instances, the liver is involved. Near the center of each lobule begins a necrosis which extends to its border. These dead specks in many of the lobules may be mistaken for miliary tubercles and to the naked eye appear as "greyish opaque specks about the size of a mustard seed." "These necrotic areas contain large numbers of the swine fever (hog cholera) bacillus in pure culture" (McFadyean).

The lymphatic glands of the mesentery are usually swollen and frequently exhibit morbid changes that are similar to those that take place in lymphatic glands when effected with

tuberculosis. In these cases, the caseous centres in the lymphatic glands are surrounded by a connective tissue envelope. Friedberger and Fröhner state that caseous centres may occasionally appear in the lungs; these centres are located in or near the surface of the lungs and produce an exudative pleurisy which results in adhesions of the lungs to the walls of the thorax, the diaphragm and the pericardium. The spleen, in chronic cases, is usually not involved but may sometimes be swollen or enlarged. The liver, kidneys, heart and muscles may show degenerative changes.

### American Swine Plague.

*Symptoms:*—Inasmuch as the lungs are most frequently involved, the breathing is more labored and oppressive, and the cough is more aggravated and painful than in hog cholera. In other respects the symptoms are not noticeably different from those manifested in hog cholera. In fact, Dr. Salmon states that in some instances, both hog cholera and swine plague may be present in the same hog.

*Post-Mortem Appearances:*—Since the germs are distributed evenly throughout the blood in swine plague and rarely plug up capillaries and cause them to burst or rupture as in hog cholera, hemorrhagic spots or patches are seldom observed in swine plague. However, hemorrhagic inflammatory changes may be seen in the mucous membrane of the stomach and intestines, especially the large intestines. This may lead to fibrinous exudative deposits on the surface of the large intestines. According to Dr. Salmon, there is no distinct hemorrhagic changes in the skin; and in only a few cases, have swellings (under the skin along the neck) been observed. These swellings are very common in the German swine plague and are due to an infiltration of yellow lymph in the subcutaneous connective tissue.

In American swine plague, the chief or characteristic lesions are found in the lungs. They may be inflamed and

exhibit large numbers of small, pale, points or dots where the tissue is dead. Cheese-like masses from one to one-half to two inches in diameter may also be found in the lungs.

The serous membranes, which line the abdomen and thorax, and are reflected over the organs in these cavities, are usually inflamed. As a result of the inflammation in these serous membranes, fibrinous inflammatory deposits are found on their surfaces.

Dr. Salmon briefly states the difference between hog cholera and the American swine plague as follows: "We find the most characteristic lesions of hog cholera to consist of:

(1) Hemmorrhages, particularly in the subcutaneous, sub-mucous and subserous connective tissue; in the lymphatic glands and in the various organs of the body.

(2) Ulcerations of the large intestines.

(3) Callapse of lung tissue, and, less frequently, broncho-pneumonia."

"The most characteristic lesions of swine plague are:

(1) Inflammation of the lungs; numerous small necrotic points in these organs, or a few larger cheesy masses.

(2) Inflammation of serous membranes with fibrinous deposits.

(3) Congestion of mucous membrane of intestine, or inflammation of the same with fibrinous deposits."

All cases of hog cholera or American swine plague should be rejected at the ante-mortem inspection or condemned and tanked at the post-mortem examination.

## Tuberculosis of Cattle.

*Symptoms.*—Inasmuch as this disease in cattle develops very slowly and may exist for months without presenting any marked changes in the apparent health of the animal, it becomes extremely difficult for an expert to make a clinical diagnosis in all cases, except those in the advanced stages.

1. *Pulmonary Tuberculosis.*—This form involves chiefly the lungs; it is the most common form of tuberculosis and is sometimes designated consumption. It is also the most serious and dangerous to the health of the diseased animal and as a means of spreading the tubercle bacilli to other animals. The broken down nodules or tuberculous abscesses in the lungs, in many cases, empty virulent masses into the bronchi and this germ ladened material is scattered here and there by coughing. It dries and floats about into the air; is carried into the air passages where the bacilli may begin to multiply or it may become mixed with the food and infect another animal by way of the digestive tract.

In the early stages there may be a slight cough; it is dry and short; occurs in the morning at time of eating or drinking or when turned from a warm stall out in the cold air. If, in the early stages, the temperature is taken regularly, one may find sudden and temporary rises in temperature of 1 to 3 degrees Fah.

With exercise the animal may exhibit shallow breathing which is slightly increased in rapidity. If it is a cow, she may have frequent and long periods of heat and be very difficult to get with calf.

In the second stage the animal may become sensitive to pressure over the region of the kidneys; pressure on the ribs or over the kidneys may cause groaning and coughing. The cough is dry, hoarse, wheezy, frequent and painful. Sometimes the cough is moist, and yellow purulent material (sputa) may be thrown out of the mouth and nostrils during paroxyisms of coughing. That part of the sputa which drops into or remains in the throat (pharynx) after coughing may be swallowed. The hair is rough, dull and stands more erect than usual; the skin is dry and closely adheres to the tissue beneath it. During exercise the breathing becomes irregular, hurried, short, interrupted and difficult or labored. If the changes in the lungs are extensive or if tubercles develop over considerable pleural surface, striking over these places in the rib region may give a dull sound. If the

muscles are not too thick over the thorax, by placing the ear in contact with the rib region, one may detect the bubbling of air through purulent matter in the small bronchi. As a rule, percussion (striking) and auscultation (listening) are very indefinite and in the majority of cases the expert is baffled. The appetite may be poor and variable. Rumination is irregular and slow and gaseous distention of the abdomen may appear. The secretion of milk may become diminished; the milk may be "watery" and have a faint bluish tint; yet these changes are not always distinct.

In the last stage the development of the disease becomes rapid. The animal becomes emaciated; the skin very dry and "bound down to the bones;" the hair is dull and bristling. The eyes sink back into their sockets; they are watery and the lids are covered with scaly matter. A yellow bad smelling discharge may trickle from the nostrils. The breathing is short, irregular and quick; the elbows may be thrown outward in order to aid expansion of the thorax and the animal remains standing most of the time. The cough is weak, frequent and painful. The stethoscope and other instruments will now reveal, to a greater or less degree, the location of large pleural or lung lesions. Percussion may locate extensive dull areas. Sometimes an extra resonance may be manifested in some places; this is due to the pus cavities which have empted their pus into the bronchi. Rattling cavernous sounds, irregular murmurs and splashing sounds may be heard without great difficulty by applying the ear to the thorax. As a rule, during this stage the disease becomes more and more general, extending to various organs of the body. Consequently, numerous symptoms may appear. As a rule, the animal dies from asphyxia (suffocation) and exhaustion.

*Abdominal Tuberculosis:*—When the intestines and mesentery are involved the animal may have repeated attacks of colic and of diarrhœa alternating with obstinate constipation. If the peritoneum is involved, the genital organs become tuberculous; this leads to frequent and long periods of heat;

such a cow rarely becomes pregnant, and, when she does, the full term of pregnancy will rarely be completed.

*Uterine tuberculosis* may be manifest by a purulent discharge; this may be injected into some small susceptible animal or examined under the microscope for the bacilli. From a clinical standpoint it is impossible in a majority of cases to make a clinical diagnosis of abdominal tuberculosis.

*Tuberculosis of the Udder:*—A slightly hard diffuse swelling, without heat or tenderness of the udder indicates a tubercular change in that organ. As a rule, only one-quarter of the udder is involved. In the early stages the milk is normal, but it gradually becomes more and more watery and yellowish in color; then it may contain small coagulated clots which contain tubercle bacilli. Later the milk becomes more and more purulent and then the cow may cease to give milk. The toughness and hardness of the udder may increase until it becomes almost as hard as wood. At the same time the mammary lymphatic glands become enlarged, hard and nodular.

*The lymphatic glands* in any part of the body may be involved. The superficial ones may be detected, if involved in tuberculous changes. The glands below the ear, back of the lower jaw, back of the throat (pharynx), along the neck, in front of the shoulder, in front of the stifle, etc., may become enlarged and hard in tuberculosis.

When time is not an important item, the discharge from the nostril, purulent sputa, the purulent or yellowish milk, or the discharge from an open gland or joint may be injected into the peritoneal cavity of a guinea pig and in from one to three weeks typical lesions of tuberculosis will have developed. Or these materials may be examined microscopally to determine whether the germs are present or absent in the discharge. Also the tuberculin test may be employed; this is the most accurate means of determining the presence or absence of tuberculosis in all kinds of cases.

*Symptoms of Tuberculosis of the Pig* :—Sometimes local or general tuberculosis in the hog is indicated by changes in the condition of the animal, which vary according to the part involved.

Primary pulmonary tuberculosis is very rarely found in the hog. It is usually preceded by abdominal tuberculosis. In the first stage the cough is dry and short, and later it becomes painful and is frequently followed by vomiting. Respirations are, at first, slightly difficult and accelerated and gradually become, more difficult and hurried, and finally become painful. The abdominal organs are usually the primary seat of tuberculosis. The fattening of the hog is first checked; then it gradually becomes more and more emaciated; the skin becomes dirty; the visible mucous membranes become pale; constipation may alternate with diarrhœa. The animal becomes weak and shy, hides in the litter. The abdomen becomes pendulous and sensitive to pressure. Sometimes a glandular tumor may be found in the space between the branches of the lower jaw, under the throat or along the under surface of the neck. The lymphatic glands, which lie beneath the parotid glands, that are located below the base of the ears, may become swollen and lift up the parotid gland. Hence, a distinct, but not painful, swelling is observed in the parotid region. The sublingual, posterior pharyngeal (throat) and superior neck lymphatic glands are usually involved in connection with the lymphatic glands under the parotids. When all are involved a chain of swellings or knots are found extending from one ear around to the other. Sometimes these hard knotty enlargements may appear at the base of the neck, behind the shoulder or in the groins. These hard tumors may adhere to surrounding tissues and occasionally become soft, and form abscesses which erupt and dischage a small amount of thick, grumous pus. The bones are frequently involved; enlargement in the bones near the joints may lead to constant lameness, and finally to a fistulous opening which discharges a bad smelling pus indicative of

destruction of bone. The foregoing changes usually appear very slowly and are not always distinct. The tuberculin test may be applied to the hog; but remember that the normal temperature of the hog may vary from 101 to 104 degrees Fah.

*Symptoms of Tuberculosis in Birds*:—The most prominent symptom is the progressive wasting of the bird. The breast bone is very sharp, a result of the wasting of the breast muscles. The diseased bird (chicken, turkey, etc.,) are listless and dumpish; the comb is soft and pale. Sometimes the infected bird becomes lame and this lameness may be due to a swelling about some joint, or to an open joint which discharges pus that contains numerous tubercle bacilli that may be examined microscopically.

Dogs and cats may have tuberculosis. They obtain it by eating tuberculous meat or milk or other food contaminated with tuberculous sputa or dust. Or, they may contract it by living in close contact with tuberculous persons. The sheep and the goat rarely have tuberculosis.

## Post-Mortem Appearances—Morbid or Pathological Anatomy of Tuberculous Cattle.

According to Nocard tuberculosis may attack any of the organs of the body but appears more frequently in some tissues or organs than in others. The following organs or tissues are most frequently involved in the order in which they are named: The lungs, the lymphatic glands, serous membranes (pleuræ, peritoneum, etc.), the liver, the intestine, the uterus, the spleen, the marrow of the bones, the joints, the udder, the skin.

*Characteristic Appearances of Tuberculous Lungs*:—Usually the diseased lungs are bulky and heavy, and only partially collapse. They may weigh from 40 to 70 lbs. The surface of the lungs may be covered with nodules that vary in size and outline and are composed of collections of tuberculous lesions. Sometimes these nodules are hard and tough, and creak when cut with a knife; the freshly cut surface is in-

tensely yellow, with softened places between the rough and tough parts. Somewhat hard grains are felt when the cheesy matter, from the softened places, is rubbed between the fingers. The larger nodules may, when cut open, exhibit a yellow, thick, grumous, mortar-like material; this would indicate that the tuberculous nodule had partially undergone caseous and calcareous degeneration.

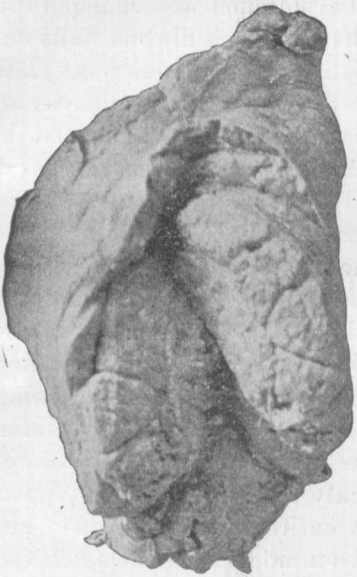

FIG. 2. Section of a lung tubercle from Vermont cow "Sadie's Delight." The tubercle is the bean-shaped mass standing out from the cut. It contained caseous and calcareous matter. (Borrowed cut from Vermont Station.)

The small tubercles or nodules are sometimes surrounded by a thick capaule of very tough white fibrous tissue; the tubercle may be surrounded by healthy pink colored lung tissue or the surrounding lung tissue may become more or less solidified (hepatized).

If a nodule or tubercle is of recent formation or growth, it appears as a small round body about the size of a millet-seed; it is translucent, grayish and homegenous and at its border may be seen a narrow inflammatory zone. These miliary tubercles are usually observed when an animal is slaughtered during the course of generalized tuberculosis. As the tubercle develops there appears in its center a yellowish white point which gradually increases in size as the nodule grows larger. The outer parts of the tubercle become more dense and form a more or less thick, tough, fibrous membrane around the tubercle. The yellowish cheesy material in the center of this tubercle is rapidly infiltrated by lime salts. In rare instances these tubercles remain isolated; but as a rule other tubercles develop near

the primary one and all may be enclosed in the same fibrous sheath. When the disease has existed for some time, these accumulated tubercles may be softened and changed into large, tuberculous abscesses, having thick fibrous walls and containing yellowish or greenish thick, grumous pus. This pus will not smell badly until the walls of the abscess are broken and the pus partly escapes into a bronchus and decomposition begins. The walls of a tuberculous abscess or cavity are always irregular and tortuous in outline. Sometimes the abscess cavity is crossed by thick, tough bands, covered by fleshy buds. These are arteries or nerves or bronchi that are involved in the tubercles. Sometimes numerous round tubercles, as large as a hazel-nut or walnut, may be found in the lungs; they have a firm consistency, are dirty white in color and are free from central softening. Local centres of caseous pneumonia may develop by preference in the anterior lobe of the lung; they are slate colored or yellowish in color and quickly undergo caseous or purulent softening. Sometimes an entire lung is solidified and a freshly cut surface resembles a moderately firm, cheesy mass. This gray mass contains irregular cavities, filled with bad smelling pus and mucus; these cavities appear to follow the bronchi and are very propably dilatations of the smaller bronchi.

Sometimes the bronchus that runs to the anterior lobe becomes obstructed; this cuts off the inspired air from that lobe; it collapses and becomes engorged with impure blood which gives it a purple red tint. The small bronchi may be slightly dilated and filled with a thick mixture of mucus and pus.

The smaller bronchi are often surrounded by collections of miliary tubercles; they at first compress the bronchi and finally obstruct them. The bronchi beyond the obstruction dilate and become filled with mucus and pus. Sometimes the bronchi become involved in chronic inflammation; their lining mucus membrane becomes thickened and folded and contain yellow muco-pus. Occasionally yellowish gray granulations are found in the lining mucous membrane of

the bronchi; and sometimes the mucous membrane of the bronchi may be covered with deep, irregular ulcers. Similar nodules and ulcers may appear in the trachea and larynx. The nodules may be isolated, close together or arranged in lines; they quickly soften in their centres, erupt and form irregularly bordered ulcers which have hard margins; branches from these ulcers may contain specks of bright yellow tuberculous material. The bronchial and posterior mediastinal lymphatic glands (see plates) which collect lymph from tuberculous lungs may become infected. When tuberculous these glands may be enlarged, hard and knotty; a freshly cut surface will exhibit a number of yellow, hard, calcified miliary tubercles. These tubercles or nodules increase in number and unite into one dry fibrous mass which becomes infiltrated with lime salts; this dry mass may occupy from one-third to three-fourths of the gland. Finally all this mass softens and the gland becomes a fibrous sack filled with thick grumous, yellow, cheesy material.

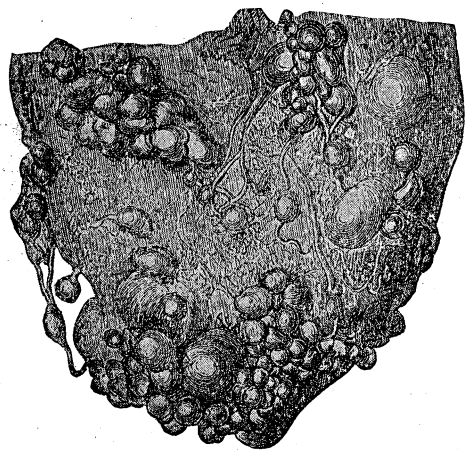

FIG. 3. A portion of a tuberculous lung (bovine). [After Virchow.] (Borrowed from Vermont Station.)

*Tuberculosis of the Serous Membranes:*—In some cases the pleura the peritoneum, the synovial membranes and the meninges of the brain and spinal cord may become tubercu-

lous; while the organs may remain free from tuberculous invasion. In the serous membrane very small, transparent pinkish gray and round granulations develop. Around each granule is an abnormally vascular zone and a growth of new connective tissue progresses until small, round, flat tumors are developed; they project more or less from the serous surface and are united to it only by a small pedicle that is usually quite long and very small, strong or tough. These tuberculous tumors or nodules have a shining surface like mother-of-pearl; they are hard and whitish and are sometimes scattered over the surface of the serous membrane or may be collected in masses like bunches of grapes; or they may grow to considerable size. At first these nodules are soft but soon undergo calcareous infiltration. Their contents are then hard, firm, dry and they are enclosed in a thick, tough, fibrous case. These pearly masses are found chiefly on the pleura and peritoneum; they are not so distinct on the synovial membranes of the joints and tendons; and in the coverings of the brain and spinal cord they rarely develop beyond the earliest stage or the gray miliary tubercle. Miliary tubercles may also appear on the pericardium. Sometimes the serous surfaces of the epicardium and pericardium may be changed into a thick layer of tuberculous material; this mass is firm, yellowish white and rarely does it become caseous.

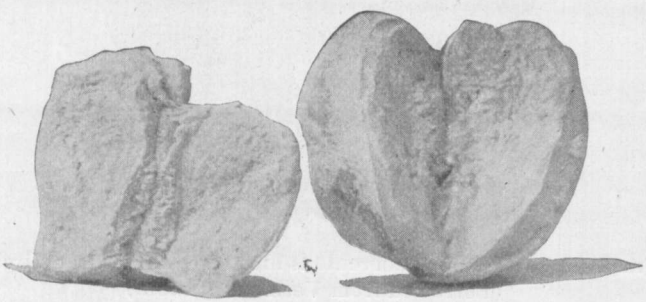

FIG. 4. Opened glands from Experiment Station cow "Floss." The caseous degeneration is shown by the roughened surfaces. These glands are several times normal size. (Borrowed from Vermont Station.)

*Tuberculosis of the Lymphatic Glands.*—It is not uncommon to find the tuberculous changes in the body limited to one or more lymphatic glands. Occasionally the posterior pharyngeal gland is the only one in which tuberculous lesions may be found (Smith). As a rule, more than one gland is involved. Usually certain groups are involved: for example, the lymphatic glands beneath the parotid gland and along the superor posterior border of the lower jaw, the posterior pharyngeal, the superior and inferior cervical (neck) lymphatic glands may be involved entirely or partially (see plate); the bronchial and mediastinal may be alone tuberculous, and the abdominal lymphatic glands (sublumbar, mesentiric, hepatic, intestinal, etc.,) may alone be tuberculous. These glands may be tuberculous when the organ with which they are attached and connected by lymphatic vessels are almost or entirely free from tuberculous lesions. The reasons why the lymphatic glands are tuberculous without the organs being involved is not readily explained. However, it is very probable, that the tubercle bacilli get into the lymphatic vessels and are carried to the lymphatic glands; when one gland is destroyed, the bacilli invade another and thus a closely connected group of glands becomes tuberculous. At first the lymphatic gland is enlarged, indurated (hardened) and filled with small knotty tubercles that are yellow and calcified; the regular tuberculous changes may proceed until the "dry fibrous mass" is formed and later central caseous softening appears, forming an abscess, a fibrous sack of grumous, yellow, mortar-like, semi-liquid material.

*Tuberculosis of the Organs and Glands of the Abdomen.*—The peritoneum and the lymphatic glands are most frequently tuberculosis. The liver, the uterus and its appendages and the spleen are next involved in frequency in the order named.

Miliary tubercles are sometimes found in the mucous or submucous tissue of the small intestine and the cæcum. These tubercles are occasionally found in the mucous or

submucous tissue of the small intestine and the cæcum. These tubercles may be isolated or in groups; they very

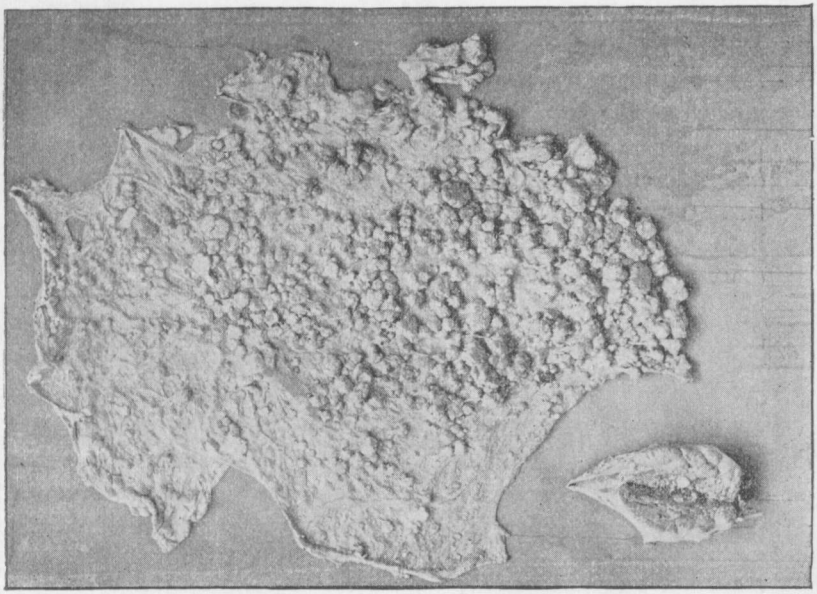

FIG. 5. An aggravated case of tuberculosis of the omentum (covering of the abdominal viscera); also a tuberculous gland. (Borrowed from Vermont Station.)

quickly undergo softening and empty their purulent contents into the alimentary canal; small ulcers, which have little or no inclination to heal, mark the place of the tubercles. These ulcers appear as if they were punched out with an irregular punch; their margins are always thick and hard. The isolated ulcers are at first very small but gradually increase in size. They are usually found involving the solitary glands and Peyer's patches; yet they are not limited to these lymph glands. Frequently the mesenteric lymphatic glands may be tuberculous when there are no visible tuberculous lesions in the intestine.

Tuberculous lesions in the liver usually appear as more or less large masses scattered through its substance. These masses may be numerous and greatly increase the weight of the liver. The tubercles in the liver, as a rule, undergo central softening more rapidly and completely than in other organs.

Tuberculous lesions of the uterus may be found in the mucous or submucous tissue. Sometimes one horn may be involved. The tuberculous uterus may become so large as to suggest the presence of a fœtus. The mucous membrane may be crowded with miliary tubercles that usually undergo caseous and muco-purulent softening, an d finally erupt then the cavity of the uterus becomes filled with yellow grumous muco-pus and the surface of the mucous membrane is covered with ulcers. Sometimes the tubercles do not undergo caseation; the mucous membrane becomes thick, hard and white; these infiltrated tubercles have numerous giant cells, and very few tubercle bacilli. In the kidney the tubercles develop in the fibrous capsule or in the subcapsular layer of connective tissue. The spleen is very rarely tuberculous. It may be filled with a great number of minute gray granulations (miliary tubercles); but usually the tuberculous changes in the spleen are few, comparatively large, hard, calcified and are surrounded with a tough fibrous capsule.

The marrow of the bones may contain numerous gray granulations. Sometimes the yellowish white, somewhat firm, round nodules, as large as a pea or a walnut, may be found in the breast bone, the bodies of the vertebræ, or in the articular ends of the long bones. These lesions are usually developed in the cancellated or spongy bone tissue, but the neighboring compact bone tissue may be irritated, thickened and a layer of subperiosteal bone developed. Occasionally these tuberculous lesions may soften and form fistulous openings into the articulation or discharge their contents externally.

In the udder, the tuberculous change usually begins by

an increase in the growth of the interlobular connective tissue. This tissue is filled with minute miliary tubercles which are at first gray but may become yellow and caseous and scattered here and there in various numbers. Later these tubercles may become softened or infiltrated with lime salts. The mammary glandular tissue is gradually destroyed by the pressure of the greatly developed interlobular connective tissue. The excretory milk ducts are dilated in places by masses of yellow caseous material which is very rich in tubercle bacilli; the walls of the ducts may be filled with minute yellow granulations.

Tuberculosis of the testicles, vagina, spermatic cord, prostrate gland, the tongue, the subcutaneous connective tissue, and intra-muscular connective tissue, may occasionally occur. However, tuberculosis does not appear in all of the foregoing locations in any one animal. It is very rarely that any one of these places are involved. In generalized tuberculosis or acute miliary tuberculosis, many of the abdominal organs (liver, spleen, kidneys, etc.), the lungs and the pleura may be filled with an infinite number of very small (as large as a millet seed) transparent gray granulations (miliary tubercles). If all of these tubercles have reached the same stage in their development, it signifies that the generalization occurred through the blood vessels, thus infecting many of the organs at about the same time.

*Post-mortem Appearances of Tuberculosis in the Hog.*—Miliary tuberculosis is the most common form in the pig; these gray granulations quickly become yellow and caseous. If generalization occurs the lungs and abdominal organs are filled with miliary tubercles; these are translucid, or have opaque centres, and are very like the gray granulations in cattle. Inasmuch as the pig is usually infected by eating infectious material, the digestive apparatus and the lymphatic glands along the digestive tract are usually first and most frequently involved. The tonsils and the submaxillary, the parotid, the post-pharyngeal, the superior cervical, the mesenteric, the sublumbar and the intestinal lymphatic

glands may become distinctly tuberculous before the organs manifest any distinct signs of the disease. Ulcers and miliary tubercles of the mucous membrane are occasionally found in the small intestine and the cæcum; sometimes tuberculous infiltrations may involve the mucous membrane, the muscular and serous coats of the intestine. The liver is usually involved; yellow, caseous miliary tuberculous centres may be scattered through the substance of the liver, or there may be round, yellowish white, tough tubercles, as large as a pea or hazel-nut; these tubercles may, upon inspection, appear as if they were composed of fibrous material, with a small, soft centre. The peritoneum and the pleura are occasionally filled or covered by numerous fine miliary tubercles which have no tendency to undergo other changes. The lungs may be involved similar to the tuberculous lesions in the liver, but as a rule the lungs contain numerous miliary tubercles only in acute generalized tuberculosis. In acute generalized tuberculosis, the liver, the spleen, the kidneys, the marrow of the bones, and the mammary glands, are filled with miliary tubercles. In some cases the disease may be localized in one or more of the lymphatic glands. The post-pharyngeal or the submaxillary lymphatic glands and the tonsils are most frequently tuberculous; they become enlarged, hard and knotty; they undergo a true fibrous change; are hard to cut out, and when cut with a knife the tissue creaks and the section appears very like old fibrous tissue. In these tuberculous glands there may be small soft spots or somewhat large pus collections. Nocard says bacilli may not be found in these soft materials by microscopic examinations; yet they are present; because, when a guinea pig or rabbit is inoculated into the peritonial cavity with this material, tuberculosis develops.

The slow growing glandular changes have been considered as scrofula of the pig and sometimes the tuberculous changes in the bones are called scrofula. As a rule, most of the so-called cases of scrofula in the pig are true cases of tuberculosis.

*Post-mortem Appearances of Tuberculosis of Birds.*—The tuberculous changes are found almost entirely limited to the digestive apparatus; and the liver is the organ that is most frequently involved. It is greatly enlarged and filled with tubercles, varying in size. In some cases the tubercles appear as small hard, white or yellow nodules, varying in size from a millet seed to a pea; in other cases the tuberculous lesions in the liver may be as large as a hazel-nut or walnut, white and fibrous, hard or softened in the centre. The liver tissue between the tubercles may appear normal, yet is more friable and liable to rupture. The spleen is involved in the order of frequency next to the liver. It may be filled with very small white granulations (tubercles) or it may contain hard calcareous nodular masses which are sometimes very large. Sometimes granular or nodular masses may become so large in the intestine as to obstruct the canal. Occasionally the tnberculous lesion in the intestine may be in the form of an infiltration of all three coats of the intestinal wall; ulcers may appear on the mucous surface that are more or less deep. The peritoneum is occasionally the location of white and hard miliary tubercles. The lungs are rarely tuberculous in birds. In the lungs of birds masses of miliary tubercles will at first develop and these will develop into small white caseous masses. The joints and their surrounding tissue may become tuberculous; these may be hard or soft; the joints may be ulcerated and have an opening discharging infected and broken down tissue material.

According to some authorities many of the diphtheritic membranes that develop in the mouth, pharynx, nose and eyes are tuberculous lesions and always contain tubercle bacilli. Also, certain horny, warty tumors that develop in the skin of the face, head, neck or feet are tuberculous because they contain numerous tubercle bacilli.

In all tuberculous lesions of birds, the tubercule bacilli are numerous; they collect in tufts or clusters. According to Nocard the tubercle bacilli in birds is a little longer

than those in tuberculous mammals. The bacillus from birds is more vigorous; grows more rapidly and will withstand a higher temperature than the bacilli from mammals. However, the bacilli have the same peculiarities in reference to the culture media upon which they grow, and also in regard to their staining. Yet avian tuberculosis cannot be transmitted by inoculation to mammals and the mammalian form cannot be transmitted to birds. Some authorities believe that tuberculosis of birds is entirely distinct from tuberculosis in mammals. Nocard, however, believes that the bacillus of avian tuberculosis is a variety of the bacillus of mammalian tuberculosis.

### STAINING THE TUBERCLE BACILLI.

Many times a microscopic examination will confirm the presence of the exciting cause (*bacillus tuberculosis*) in the muco-pus products of a tuberculous lesion. However, there are cases where no bacilli can be detected by the microscope, and yet when some of the tuberculous material is injected into the guinea pig or rabbit, the disease is produced and the bacilli may be discovered by microscopic examination. Hence, if the microscopic examination fails to find the bacillus, the proof is not absolutely positive that the disease is not tuberculosis.

Ziehl's method is one of the very best and the simplest for staining tubercle bacilli, especially cover glass smears. His staining solution is made as follows:

Carbolic Acid (5 per cent. solution)..90 parts.
Alcohol (90 per cent.).....10 parts.
Fuchsin..... 1 part.
Mix thoroughly and filter before using.

A very small quantity of the suspected tuberculous material (sputa, purulent nasal discharge, pus from a tuberculous articulation, pus from any tuberculous abscess, etc., etc.) is spread over an absolutely clean cover glass (No. 0 or No. 1) and slowly dried over an alcohol lamp or a Bunsen burner; when dry it is passed two or three times

through the flame to fix it on the cover glass. The cover glass is plunged into alcohol and then into the staining solution, or the staining solution is placed on the cover glass with a dropper. The cover glass is now held over a flame until the vapor begins to rise; this heating may be repeated as often as the stain on the cover glass cools, and the staining continued from four to ten minutes. Or the cover glass may be floated (smear side down) on the surface of the staining solution in a watch glass, and the solution may be kept warm in the incubator or on a paraffine water bath for thirty to sixty minutes. The cover glass is next washed in distilled water and decolorized, in a 33 per cent. nitric acid or a 20 per cent. sulphuric acid solution.

The decolorization (usually takes five or ten seconds) should be continued until all or nearly all of the visible color is removed from the cover glass. Next it is washed in distilled water; dried over the flame and mounted in balsam. A 1–12 in. oil-immersion objective and a substage condenser are necessary to make an accurate examination of the prepared slide. Some prefer to make a double stain by using gentian violet or Bismarck brown just after the decolorizing acid is washed from the cover glass smear. This gives the pus cells and other bacteria a brown or a blue color, while tubercle bacilli stand out in contrast, a distinct red color. Tubercle bacilli are in length from $\frac{1}{2}$ to $\frac{2}{3}$ the diameter of a red blood corpuscle, and their breadth is about 1–15 of their length. They are very slender and usually straight, but may be curved. In recent or new tubercles they appear as solid rods, but in old lesions, sputum and muco-pus they appear to be made up of ovoid grains, closely adhering to one another. It is very probable that short or broken chains of micrococci (streptococci) are sometimes mistaken for tubercle bacilli.

In cases where it is impossible to detect the tubercle bacilli by microscopic examination, a small quantity of the muco-pus or tuberculous material may be injected into the peritoneal cavity of a guinea pig. In a short

time the inoculated guinea pig will begin to grow thin, and if killed in fifteen or twenty days after the inoculation, tuberculous lesions will be found in the spleen, liver, etc. Villemin and others claim that the lesions will always be the same in the spleen, no matter what is the origin of the tuberculous material (from animal or man) with which the guinea pig is inoculated. The spleen is always greatly enlarged in all directions; in the early stages it is always filled with a great number of minute tuberculous granules; later its surface will appear "marbled;" surface lines are formed where the spleen substance has undergone caseous degeneration. These lines are said to "design variable arabesques of curious and asymmetrical shape." In old cases, the liver will exhibit similar changes, except that they are less distinct than those in the spleen.

If the tuberculous material be injected into the subcutaneous connective tissue of a guinea pig, it will become tuberculous; but the disease will develop more slowly than by the peritoneal method of injection. When the tuberculous material is injected into a vein general tuberculosis very quickly appears. The lungs, liver, spleen, marrow of the bones and all other vascular organs very quickly become filled with a great number of miliary tubercles; the tubercles in the liver, spleen and marrow of the bones contain numerous tubercle bacilli. To the naked eye these organs appear enlarged, engorged with blood, and very friable. In fifteen or twenty days the intravenously inoculated guinea pig will die from a veritable tuberculous septicaemia; during this time it will lose from one-third to one-half of its weight.

In all cases, no matter what is the source of the tuberculous material (from man or other mammals) and no matter if the microscopic examination of the tuberculous material fails to discover tubercle bacilli, a microscopic examination of the tuberculous material from the inoculated guinea pig, always discovers the bacillus.

HISTOLOGY OF TUBERCULOUS LEGIONS.

There are three kinds or forms of tuberculous lesions:

(1) Miliary tubercles, or small gray granulations, which vary from one-two hundred and fiftieth to one-twenty fifth of an inch in diameter, are gray, translucid, and occasionally have a light tinted centre.

(2) The yellow, hard, calcified mass, varying from the size of a pea to that of a walnut or apple.

(3) A yellowish opaque infiltration of the tissues.

Nocard sums up the anatomical characteristics of the tuberculous granulation, as follows:

(1) "The nodular form of the mass."

(2) "The tendancy of the central portion to become caseous."

(3) "The frequent occurrence of giant cells in the centre."

(4) "The concentric arrangement of the peripheral cellular elements."

(5) "The complete absence of vessels."

"The miliary tubercle" consists of the aggregation of a certain number of elementary granulations in a single fibrocellular envelope, the toughness of which gradually increases.

'Tubercular masses,' whether small or great, are collections of a variable number of caseous, calcareous or softened miliary tubercles surrounded by a more or less thick and tough fibrous shell."

"The 'caseous infiltration' of the tissues is the result of the development of a considerable number of tuberculous follicles, whose peripheral elements, having no tendency to undergo fibrous transformation, remain in a cellular state and retain their concentric arrangement, until they are attacked, like the centre of the follicle, by caseous degeneration. This latter form of lesion rarely undergoes calcification."

CONDEMN TUBERCULOUS ANIMALS OR CARCASSES.

The German inspectors condemn the carcass of an animal when tuberculous lesions are found in the thorax and in

the abdomen, or when there is generalized tuberculosis. By a direct vote of the Inter-National Veterinary Congress of 1896, it was decided that it was safest and best to condemn the entire carcass of a tuberculous animal no matter how much localized or generalized the lesions may be. Since it is very difficult to fully determine the extent of the tuberculous lesions without great expense and considerable time and, in many cases, without almost entirely ruining the carcass for beef, the only practicable and safe method is to *condemn the entire carcass when it is tuberculous in any degree.*

The following cuts were taken from Bulletin No. 7, of the Bureau of Animal Industry, Dep't of Agriculture, Washington. Prepared by Theobold Smith.

FIG. 6.—*Dorsal aspect of the bovine lungs.*

The lungs are laid so that the dorsal (or upper) surface is shown. The various lobes are drawn apart so that their outlines may be distinctly seen. The lobes are named in the text as follows:

*a*, $a_1$, right and left caudal lobes, respectively.
*b*, $b_1$, right and left ventral lobes.
*c*, $c_1$ the two portions of the right cephalic lobes, denominated first and second cephalic lobes.
$c_2$, left cephalic lobe.
*e*, trachea.
*x*, region most frequently involved in the earliest stages of pulmonary tuberculosis. The lesions in this stage are, as a rule, embedded in the lung tissue so as to remain invisible from the surface.

FIG. 7.—*Ventral aspect of the bovine lungs.*

The letters correspond to those on Fig. 6.

*a*, $a_1$, right and left caudal lobes.
*b*, $b_1$, right and left ventral lobes.
*c*, $c_1$, first and second right cephalic lobes.
$c_2$, left cephalic lobe.
*d*, azygos or median lobe (belonging to the right lung). This lobe is involved in the most advanced cases only.
*e*, trachea.
*x*, usual location of the earliest lesions of tuberculosis.

FIG. 8.—*Trachea and bronchial tubes of the bovine lungs showing attached bronchial glands.*

*a*, $a_1$, air tubes supplying the right and left caudal lobes.
*b*, $b_1$, air tubes supplying the right and left ventral lobes.
*c*, $c_1$, branches of the right supernumerary bronchus supplying the first and second cephalic lobes of the right lung.
$c_2$, air tube supplying the left cephalic lobe.
*d*, branch to azygos lobe.
*e*, trachea.
*A*, left bronchial lymph gland.
*B*, right tracheal lymph gland.
*C*, lymph gland at root of right supernumerary bronchus.
*D*, gland in the angle between bronchi; not always present.
The minute intra-pulmonary glands, situated along the main bronchi, are not shown.

FIG. 9.—*Dorsal aspect of the bovine lungs showing the position of the posterior mediastinal glands.*

*a*, $a_1$, caudal lobes.
*b*, $b_1$, ventral lobes.
*c*, $c_1$, $c_2$, cephalic lobes.
*e*, trachea.
*f*, œsophagus.
*g*, muscular pillars of the diaphragm.
*h*, posterior aorta cut through just beyond the arch and reflected so as to uncover the left bronchial gland A, resting against the root of the left bronchus.
*i*, caudal margin of the ligament of the lungs (*ligamentum latum.*)
The mediastinal glands are shown, most of them resting on the œsophagus. The aorta fat, and pleural layers which inclose the posterior mediastinal space laterally, are removed.

*a*, the large caudal gland resting below œsophagus on the pillars of the diaphragm. This gland may be left in the body when the lungs and heart are removed unless special care is taken.
The remaining mediastinal glands are arranged in two sets, on the right and the left margin of the œsophagus. In this animal there is but one gland in the left chain. *a* is the gland most frequently diseased and in many cases enormously enlarged.
*a'*, the most cephalic of the mediastinal series.

FIG. 10.—*Section through the median plane of the head of a cow to show location of the (left) retropharyngeal gland.*

*a*, brain cavity.
*b*, nasal septum.
*c*, lower jaw, sawn through.

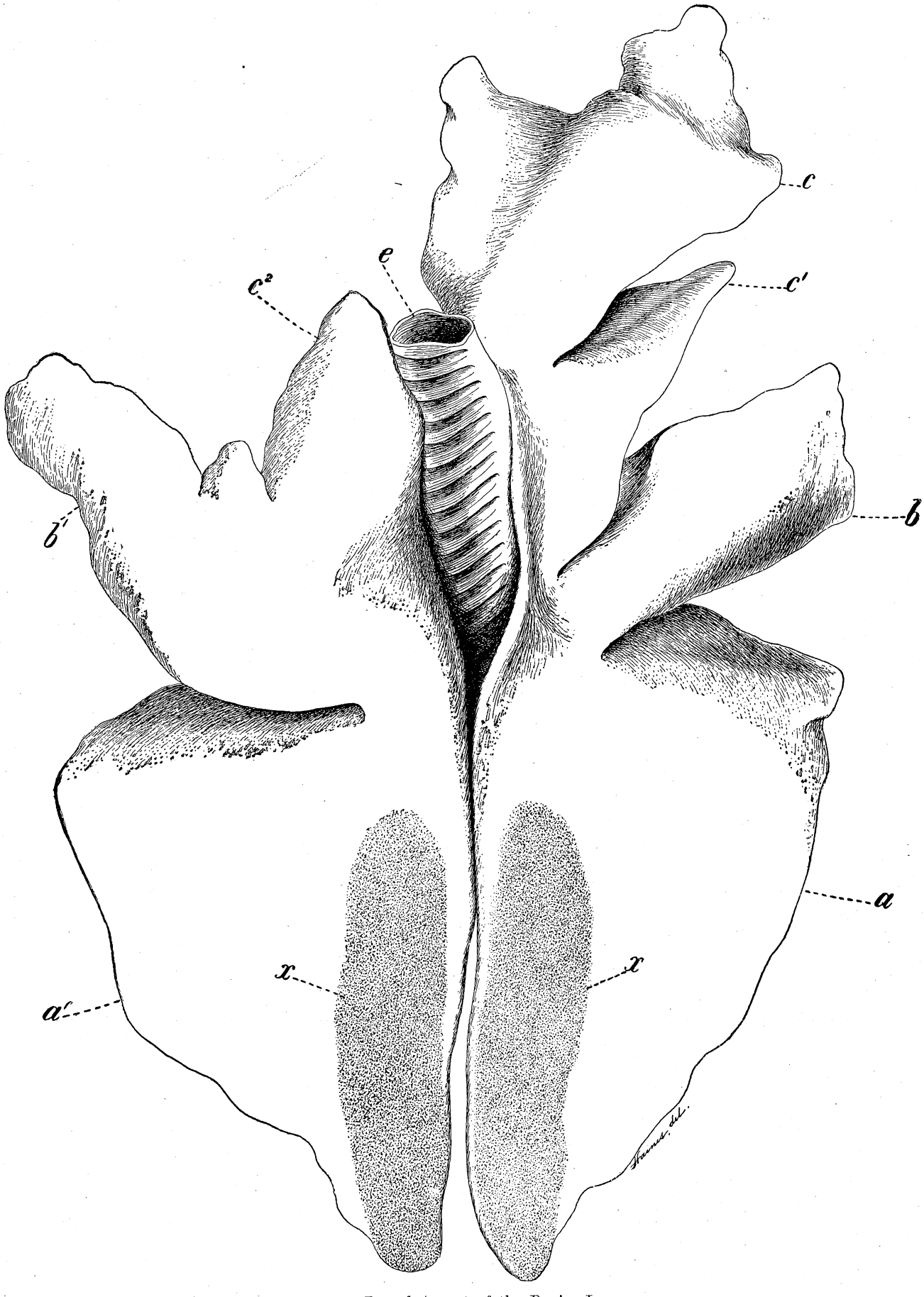


FIG. 6.—Dorsal Aspect of the Bovine Lungs.

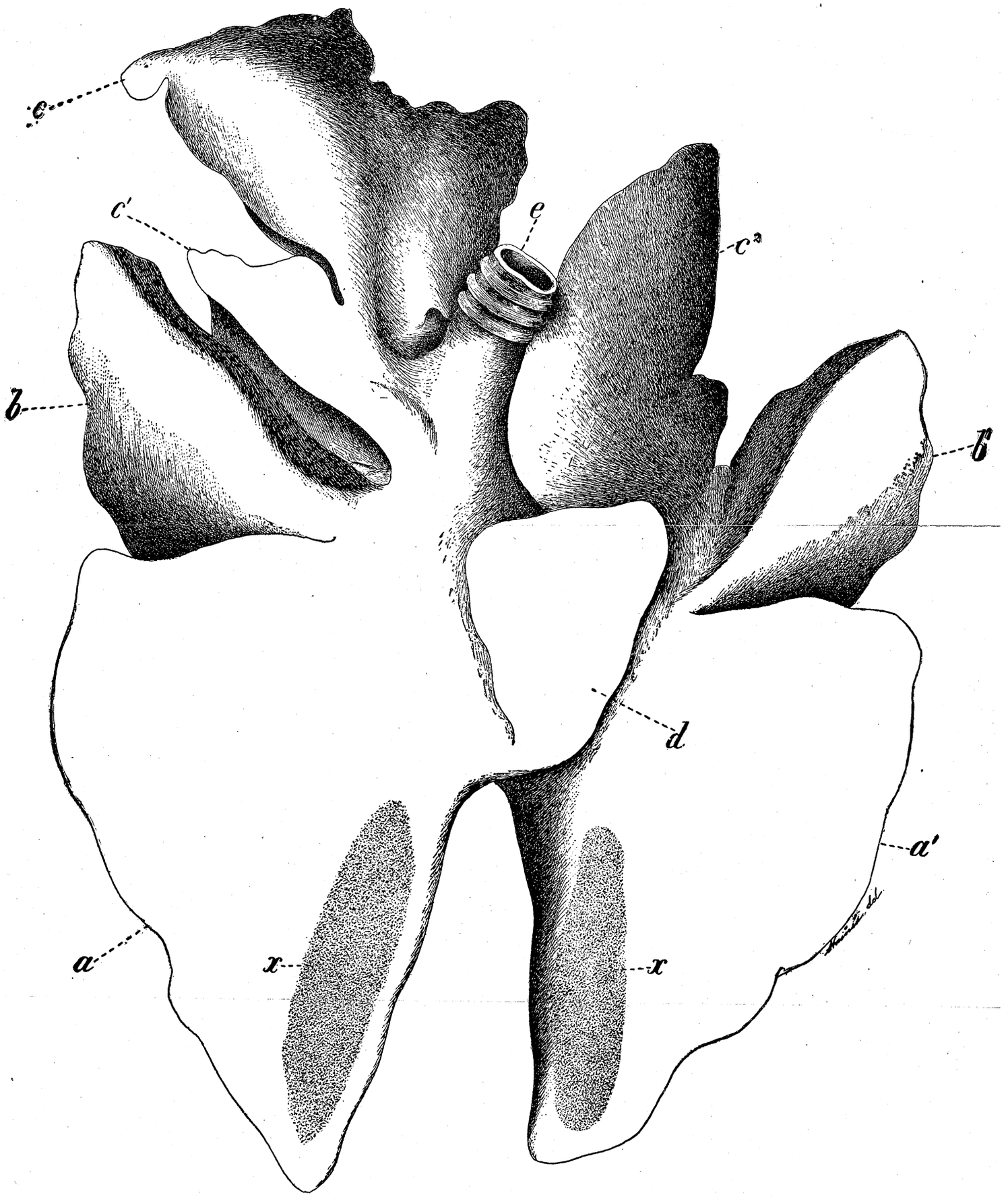


FIG. 7. Ventral Aspect of the Bovine Lungs.

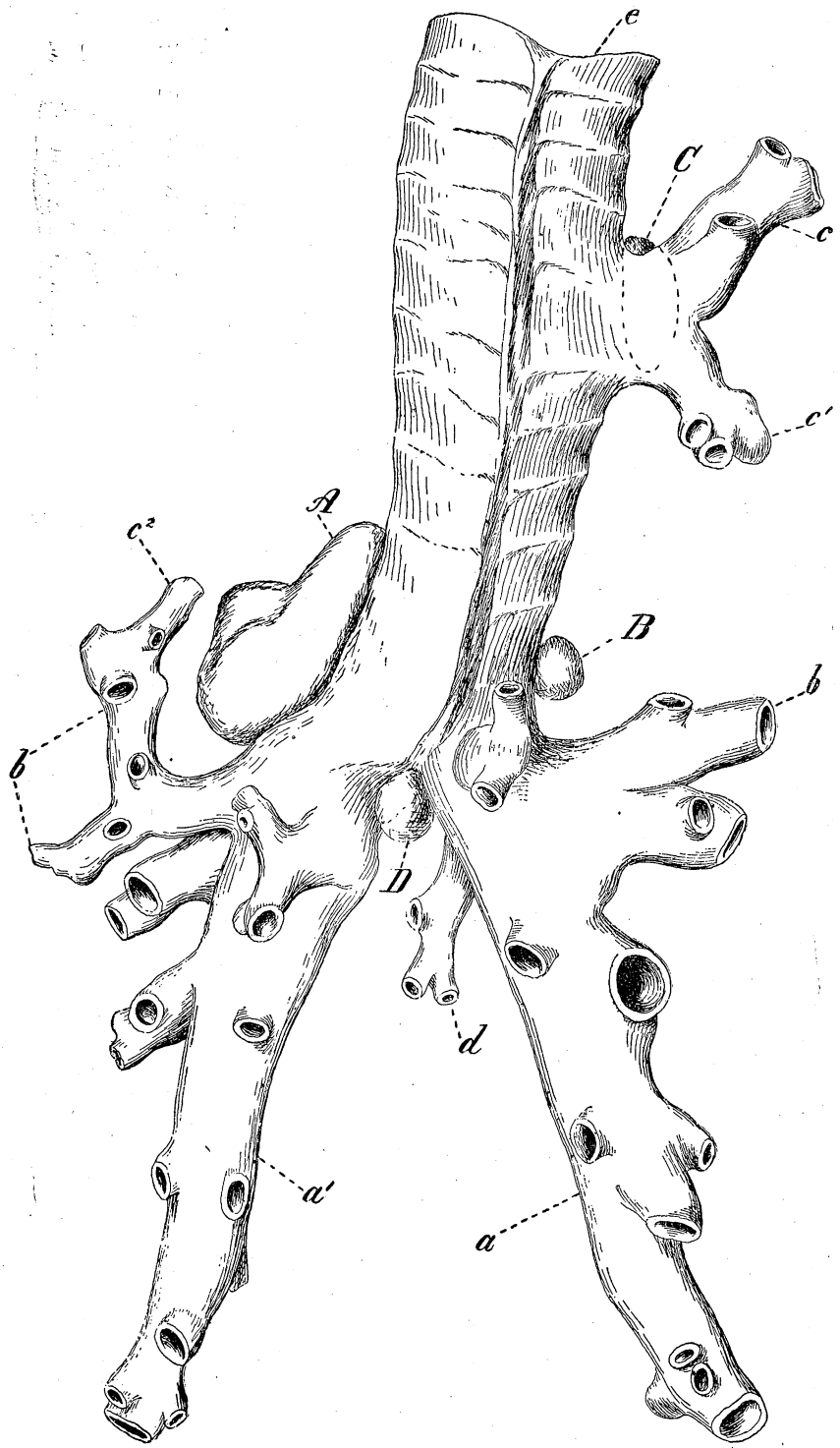


FIG. 8. Trachea and Bronchial Tubes of the Bovine Lungs, showing Attached Bronchial Glands.

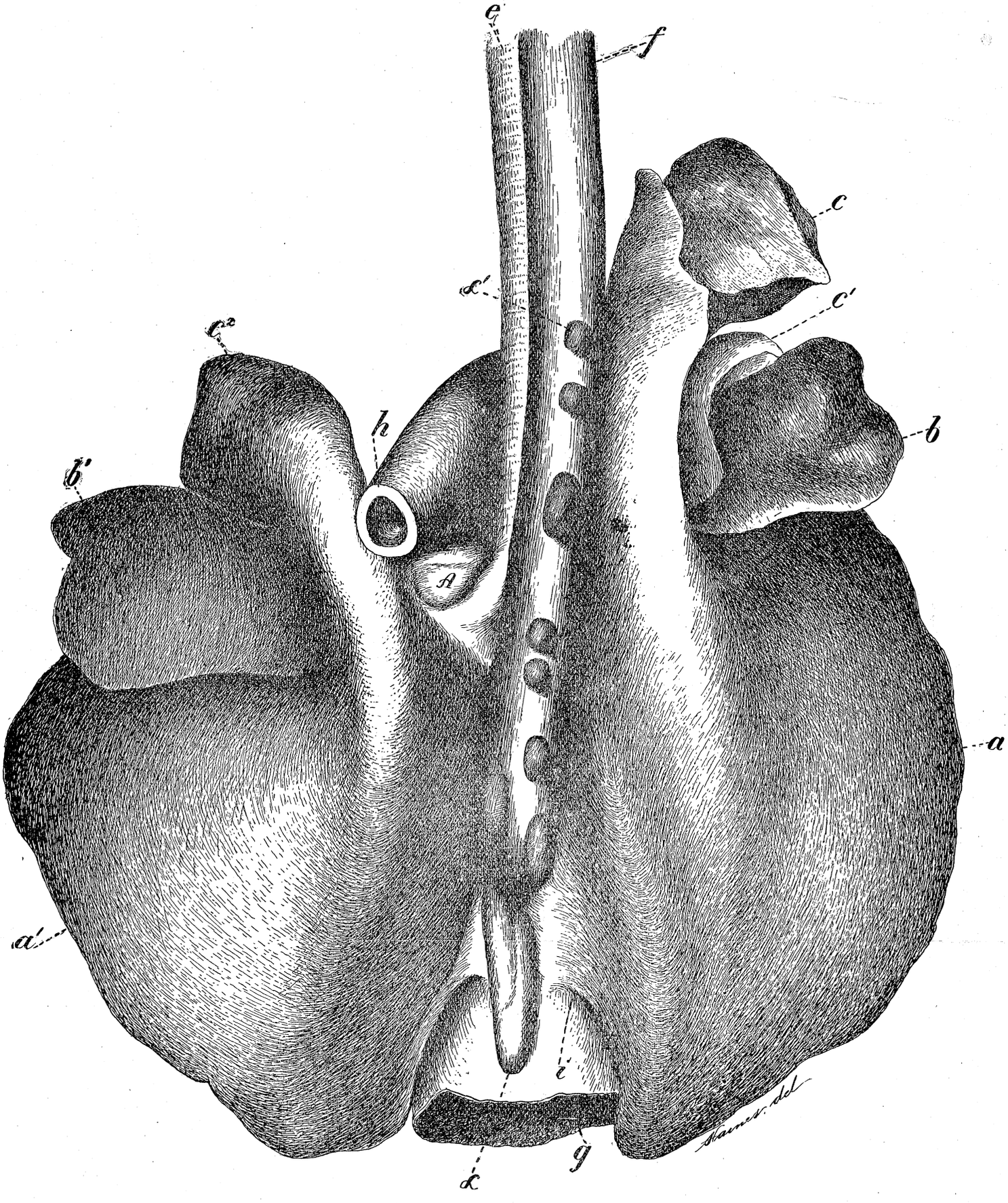


FIG. 9. Posterior Mediastinal Glands. (x3/8).

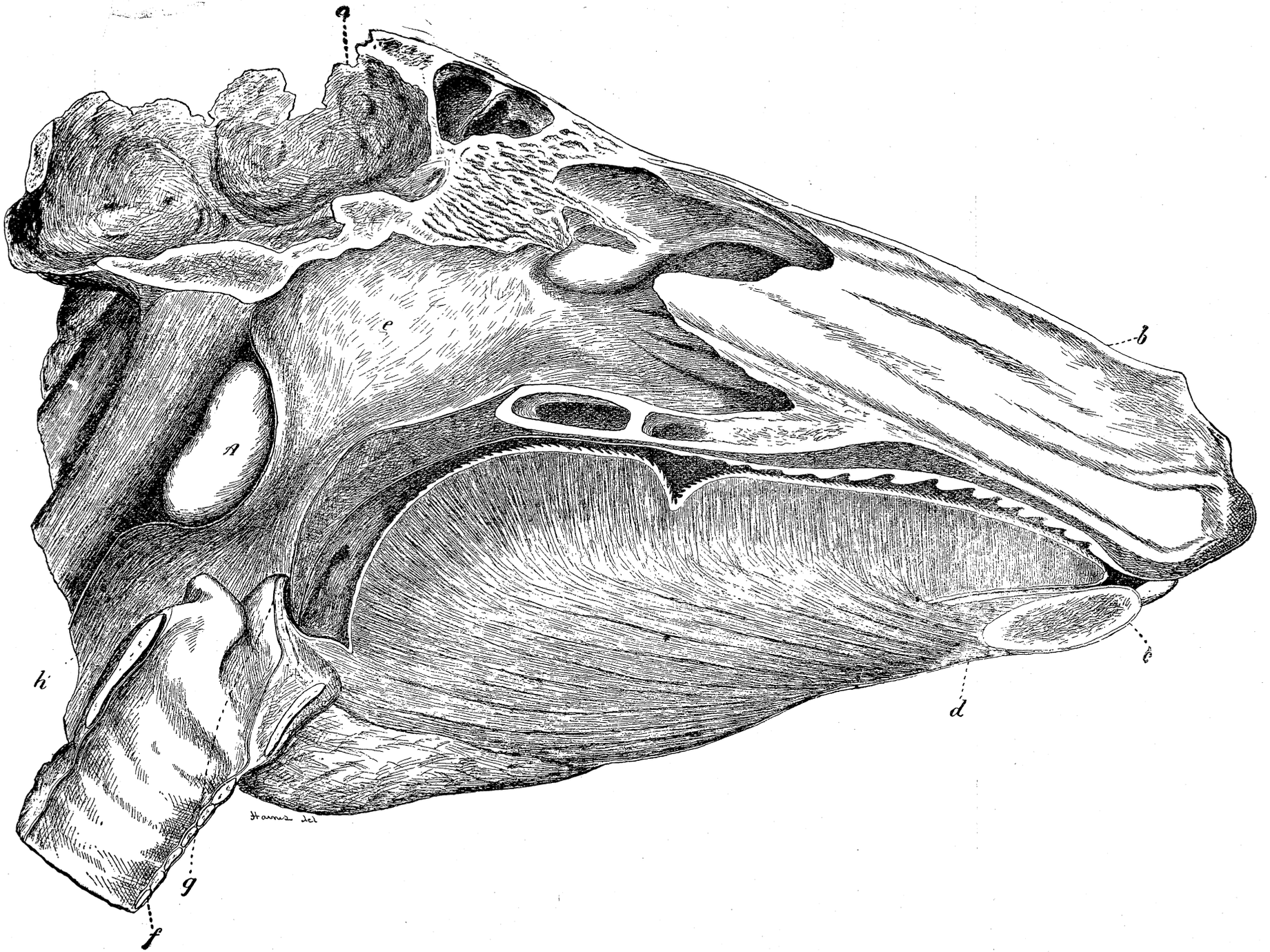


FIG. 10. Section through the Median Plane of the Head of a Cow to show location of (left) Retropharyngeal Lymph Gland.

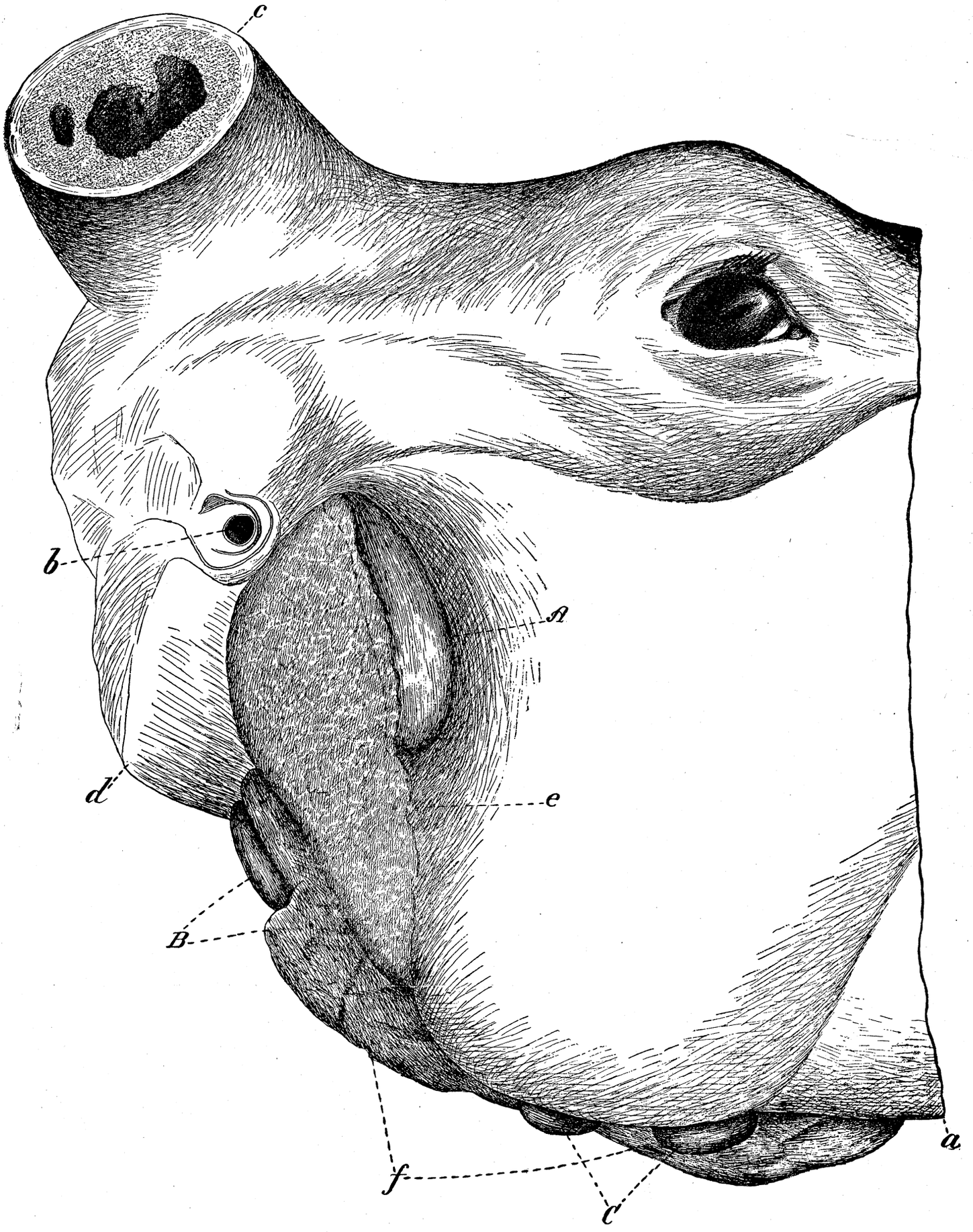


Fig. 11. Lateral Aspect of Posterior Half of a Steer's Head to Show Location of Lymph Glands.

*d*, tongue.
*e*, posterior nasal passage.
*f*, trachea.
*g*, epiglottis, resting against soft palate.
*h*, œsophagus.
*A*, left retropharyngeal gland, in this case enlarged to twice the normal size by tuberculous deposits.

The opening into the left tonsil is shown as a dark spot under the soft palate. The tonsil itself is situated beneath the mucous membrane, where the cut surface of the palate appears and projects slightly above this, so as to lie in part under the mucosa of the posterior nasal passage.

FIG. 11.—*Right lateral aspect of posterior half of a steer's head with skin and superficial fat removed to show location of lymph glands.* (x⅔.)

*a*, lower jaw.
*b*, ear passage.
*c*, horn, sawn through near base.
*d*, styloid process of occipital bone.
*e*, parotid salivary gland.
*f*, submaxillary salivary gland.
*A*, right parotid lymph gland, partly hidden under the anterior border of the parotid salivary gland.
*B*, right post-maxillary lymph glands, the greater portion concealed beneath the submaxillary salivary gland.
*C*, right submaxillary lymph glands between ramus of lower jaw and submaxillary salivary gland.

## ACTINOMYCOSIS.

*Synonyms.*—Lumpy-jaw, Big-jaw, Big-head in cattle.

*Symptoms.*—This disease is caused by a plant parasite called the ray fungus or cauliflower-like fungus (*actinomyces bovis*). This plant parasite gains admission to the system by way of the mouth, the stomach, the intestines, and sometimes by way of the respiratory apparatus. It is said to grow upon plants, especially *hordeum murinum* (Brazola). Fragments of this grass are supposed to penetrate the mucous membrane and thus inoculate the animal. It may be that an ulcer or wound is present before the infection occurs. The infection extends by direct invasion of the tissues surrounding the point of inoculation; later it extends by way of the lymphatics and the blood vessels.

It may attack the lower or the upper jaw, the tongue, the throat (pharynx), the larynx and the lymphatic glands and tissues lying near these parts or organs. It also may involve the lungs, the liver, the spleen, the kidneys and the intestines. The parts most frequently attacked are the lower jaw, the tongue, the upper jaw, the pharynx and the lymphatic glands near the lower jaw and throat. The lungs are also frequently attacked; and the skin may be, in rare instances, involved.

As a rule, a large hard swelling first appears somewhere along the lower jaw, in the intermaxillary space, on the side of the face or in the throat, the mouth or the tongue. These hard tumor-like growths continue to enlarge and finally break open or erupt through the skin or into the mouth or throat; then discharge pus-like material for an indefinite time. These lesions may or may not interfere with mastication or swallowing; if they do, the animal will become more or less emaciated. The parasite may extend to the lymphatic glands and also to the lungs and digestive tract. When the pus-like material is discharged into the mouth, throat or larynx, the digestive tract and the lungs are liable to become secondarily infected. However, there are instances where the internal organs (lungs, etc.) may be primarily involved. The tongue becomes so large and hard that it has been called the "wooden tongue;" in such cases the mastication and swallowing are very difficult. When the pharynx or larynx are involved the breathing may be more or less difficult, and the animal may have a cough. When the lungs and other internal organs are involved, the symptoms are very similar to those of tuberculosis. In fact, a physical ante-mortem examination would not enable one to determine whether the animal is tuberculous or actinomycotic in cases where the lungs or other internal organs alone were involved. As in tuberculosis the animal having actinomycosis may be apparently healthy, fat and apparently in condition for beef. Or the actinomycotic

animal may exhibit all the various degrees from a slight local infection to severe general infection.

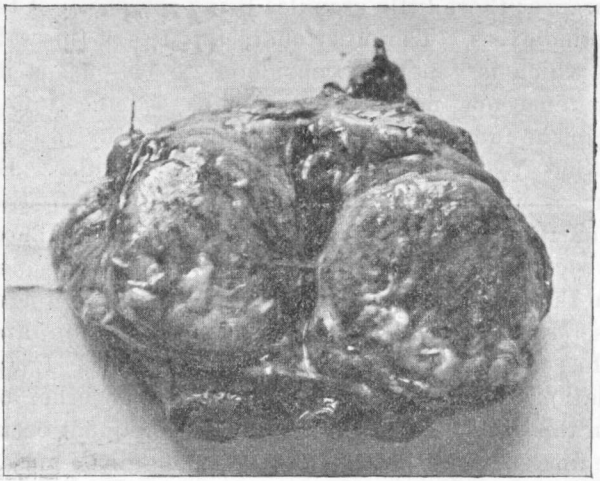

FIG. 12. Actinomycotic tumor from lung of an Ox. Tumor cut open, divided into right and left halves. Lung tissue surrounding the base of each half.

In pigs the actinomycotic tumors may be found involving the lower jaw, the larynx, the mammary glands, the bones and the lungs. Abscesses are formed in the invaded tissues; these break or open upon the external surface as a rule, but may occasionally erupt internally.

*Post-Mortum Appearances.*—In this connection I can not do better than give the opinion of Dr. Trumbower, State Veterinarian of Illinois, who has had more experience in both ante–and post-mortem examinations of actinomycosis than any other American veterinarian. The following was kindly furnished the writer by Dr. Trumbower:

"The rapid development of the parasite causes absorption of the structure invaded, and penetrates in various directions until it forms a rupture on the external part of the body or into an internal organ or cavity; until the streptococci or the staphylo-cocci obtain admission to the channel thus made by this parasitic growth, no true pus formation

occurs, and the contents of the tumor are always of a characteristic color without odor; the color is generally described as a sulphur yellow, having a more or less granular appearance; these little granules being composed of tufts of the actinomyces. The other characteristics of this soft material, which is generally considered to be pus, is its peculiar tenaceous nature; occasionally calcification tak' place in the fungus tufts so that the actinomycotic nodu somewhat resembles miliary tubercular nodules. By t power of its rapid multiplication or growth the gans surrounding the point where it gained entrance may soon become invaded; thus if we have the tumor located within the lower maxilla, or at the base of the tongue, we may soon have the lymphatic glands in that region involved, and thus the actinomyces gain entrance to the lymphatic circulation, and in this manner are carried to other organs within the body. This accounts for the frequent occurence of the disease in the lungs, the liver, inguinal, mesenteric and other lymphatic glands. As a rule, the disease is confined to the head or neck, but it is impossible to state to what extent an animal is effected without a post-mortem examination, for we commonly find mild cases of head affection, even when the animal is apparently in a good state of health, where the lungs or liver are largely involved by this disease.

My guide, in condemning carcasses as unfit for human food, is principally based upon the condition of the lymphatic glands; more so than when the disease is only located within the lung tissue. I believe that when the lymphatic glands become involved, two or three or more in a chain, that it must gain entrance to the circulation, and it is then impossible to state what portion of the carcass might be free from this growth, for lymphatic glands within the muscular structure may be affected, but cannot possibly be discovered by anyone without tracing out the lymphatics throughout the body, and thereby ruining the carcass for market. In cases where the upper or lower jaw is affected

wheter he discharge is external; that is, where there is an external rupture discharging the contents of the tumor, the lymphatic glands near by not being invaded, then I pass the carcass as being fit for market.

If, however, the head has been largely involved, and the rupture has been into the mouth or the nasal chambers so that the discharge was being swallowed, or inhaled into the lungs, then I make a close examination of the internal organs, and if I find them at all affected I condemn the whole carcass; the head, however, is always rejected, no matter how slightly it is affected. In some cases we may not find any disease of the head whatever, but the fungus has gained entrance in some other portion of the body through the presence of a wound or other injury. So long as the disease is localized and none of the lymphatic glands affected, only that part of the carcass should be rejected; I have seen such local effects in almost every part of the body."

A microscopic examination of the pus-like material will always give a positive diagnosis. The white, gray or sulphur yellow granules or sand-like particles in the pus always contain bunches or clusters of actinomyces. T hese small, sulphur yellow particles may be stained with eosin in a watch glass; then placed upon a slide and covered with a small drop of glycerine; next drop a cover glass over them, pressing it down so as to mash and spread out the stained particles into a thin layer. The mount is now ready for examination under the microscope; use a $\frac{1}{2}$ or $\frac{1}{4}$ inch objective. Weigert employs a double staining process, using orseillin and gention violet. Isreal uses orceine and Baranski employs picrocarmine.

Inasmuch as actinomycosis is usually confined to the head and may be said, in one sense, to be a local disease, many of the European inspectors condemn only the parts involved—the head as a rule. However, Dr. Trumbower's methods appear to be the safest and most practicable. Whenever the actinomycotic abscess opens into the mouth,

pharynx, larynx or any part of the digestive or the respiratory tract, the entire carcass is condemned. Also when the lymphatic glands are involved or there are antinomycotic tumors in the lungs or the lesions have become generalized, the entire carcass is condemned. In cases where the antinomycotic lesions are positively localized and the abscesses have erupted only upon the external surface, the infected parts may be cut away and the balance of the carcass used for food.

ANTHRAX.

This disease is caused by a plant (*bacillis anthracis*). This parasite may gain an entrance to the system by way of the digestive tract (mouth, stomach, intestine) by way of the skin and by way of the respiratory passages. The first mode of infection is very common, while the last two ways are very rare. Anthrax attacks man and many of the lower animals. The susceptibility of animals occurs in the following order: Cattle, sheep, goat, horse, stag, antelope, deer, camel, cat, rabbit, guinea pig, mouse, hare, dog, pig, and fox. The black rat and fowls are almost insusceptible. Ostertag claims that the sheep is the most susceptible of all animals to anthrax.

*Symptoms of Anthrax.*—The clinical symptoms will vary greatly according to the mode of infection and to the susceptibility of the species of animal. In the acute form the animal may die so suddenly that few, if any, symptoms will be noted. There are, however, in cattle, two somewhat distinct forms of anthrax. The acute form where no external swelling appears. In this form, the temperature is elevated (104 to 107 degrees Fah.); the pulse rate may be as high as 80 to 100 per minute; the animal ceases to eat and to ruminate. The animal may be dull and stupid, and this is followed by uneasiness, kicking, and pawing, and champing of the jaws. The nostrils may become dilated and the breathing labored; the visible mucous membranes become bluish. When the bowels are first involved the animal will show signs of abdominal pain, and the bowel discharges

may become covered or mixed with blood and mucus. Finally the animal grows very weak; blood vessels rupture and produce spots of blood in the visible mucous membranes, and may lead the bloody discharges from the nose, the mouth, the vagina, and the rectum. Many times the urine contains blood, a result of the rupture of blood vessels in some part of the urinary apparatus. These cases may live from one to seven days, terminating in death or recovery.

The disease may be attended with external swellings; these appear under the skin and are usually doughy and more or less extensive; in the early stages of the disease they may be somewhat firm, hot, tender, and later pass into the soft, cool swellings.

*Post-Mortem Appearances of Anthrax.*—The body is liable to undergo rapid decomposition; the blood is very black and "tar-like" in color. Hemorrhages appear in nearly all the organs. Soft, yellowish gelatinous and black hemorrhagic infiltrations may be found under the peritoneum, the pleura and the skin. The spleen is greatly enlarged and sometimes partially disintegrated; the liver and kidneys may show signs of inflammatory changes. If the intestines are involved, the first part of the small intestine (duodenum) is more frequently attacked than any other portion. The crucial test is to find the *bacillus anthracis* in the blood or in the tissues of the spleen, the liver, the intestines, or in the hemorrhagic infiltrations of the mesentery. The *bacillus anthracis* is very readily stained with fuchsine or methyl blue. A cover glass smear can be stained in a weak aqueous solution of either of these stains; decolorize with alcohol and water; then dry over the flame and mount in balsam. It is then ready for microscopic examination. This bacillus is so large that it may be observed moderately well by a one-sixth or a one-eighth inch dry objective; yet it is far more satisfactory to examine it under a one-twelfth inch oil immersion objective. The average length of the bacillus is about two times the diame-

ter of a red blood corpuscle; its width is about one-eighth of its length. These bacilli are straight and rod-like in form; occasionally they may be curved; many times a number of them are loosely united end to end, forming a filament or jointed thread. As a rule, the end of a bacillus appears indented, or as if it were cut off at right angles to its long axis. Spores are sometimes observed in the body of the bacillus; these spores do not take up stain very quickly, and consequently appear as an unstained spot in the bacillus. Spores may be stained by special methods. The bacillus will grow on almost any of the artificial culture media. It grows best at a temperature of 85 degrees Fah., and in contact with air or oxygen. In case the smears from the suspected animal do not show the bacillus in its true or most common form, or they are not sufficiently pure or isolated to make a diagnosis positive, roll or plate cultures can be made and the bacillus very readily isolated; or the house mouse may be inoculated with some of the infected material; it will die in a short time, and from its spleen or liver you may obtain the bacillus.

All anthrax carcasses should be condemned, regardless of the extent of the lesions. The carcass, hide and all its contents should be thoroughly cooked or rendered, or burned. There is no pathogenic germ that will live outside of the animal body and retain its virulence longer than the *anthrax bacillus*, especially its spores. It is questionable whether an anthrax carcass should be rendered, especially not in any other way than in the improved, modern, closed rendering tanks.

### TEXAS FEVER.

This disease is caused by small animal parasite (*Pyrosoma bigeminum*) which lives within the red-blood corpuscles. In fact, it destroys the red-blood corpuscles in great numbers. Sometimes these parasites will destroy three-fourths to four-fifths of the red-blood corpuscles, before the infected animal dies. This parasite, in some respects, is similar to

the parasite that is said to cause malaria in men. "Texas fever" 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 (Salmon and Smith).

*Symptoms.*—This parasite is carried from the diseased to the healthy animals by the cattle tick (Boöphilus bovis). Hence the presence of the ticks upon the animal is one of the prominent symptoms. The period of incubation varies from 12 to 90 days. The temperature becomes elevated (104 to 107 degrees Fah.); this fever continues until death or recovery begins. The bowels are usually constipated during the high fever, but in the last stages they may become loose and the fæces may be colored yellow with bile. The urine remains normal until near the fatal termination, then it may become deeply stained with the coloring matter of the blood. Sometimes this red colored urine may be observed in cases that recover. The animal may live from three days to several weeks after the beginning of the attack.

*Post-mortem Appearances of Texas Fever.*—Red colored urine may be found in the bladder. The spleen is greatly enlarged; the liver is yellowish in appearance, enlarged, and engorged with bile; the bile in the gall bladder is flaky, thick and in an excessive quantity; there may be ecchymoses (blood spots) on the external and internal surfaces of the heart. The blood is thin and watery, a result of the great reduction in the number of the red-blood corpuscles.

The diagnosis is made positive by the discovery of the animal parasite in the blood by the aid of the microscope. Cover glass smears of blood from the kidneys, the liver, the skin, the spleen or the heart muscles should be made. Theobald Smith advises that a very small quantity of the blood be picked up with a platinum loop and placed a little to one side of the centre of a clean cover glass; another clean square cover glass, held between the thumb and finger

of the right hand, is then drawn over the droplet of blood so as to spread it out in a very thin layer; the smear is then dried over a flame and then it is passed through the gas flame somewhat slower than usual four times, or the smears are to be kept in dry-air oven at a temperature of 110 to 120 degrees C. for one and one-half to two hours; the smears are now ready for staining. "The cover glass is either allowed to float on a filtered solution of Löffler's alkaline methyl blue, or else the staining fluid is dropped upon the cover glass and allowed to remain from one and one-half to two minutes. It is thereupon washed in distilled water and dipped into a one-third per cent. solution of acetic acid for an instant to remove any diffuse stain in the red corpuscles: hastily the acid is washed away in distilled water. It is then ready for examination in water or for drying and mounting in xylol balsam. Care must be taken to make the action of the acetic acid solution momentary, otherwise the decolorization may go too far (Smith)." The stained smear should be examined with a one-twelfth inch oil immersion objective. Certain corpuscles will be found to contain two pear shaped bodies, with their tapering ends close together and directed towards each other. These intraglobular parasites are not all pear-shaped and in pairs. Some of them may be single and somewhat irregular in outline. About 10 per cent. of the red corpuscles from the blood of the skin contain these parasites, while 80 per cent. of the red corpuscles from the blood of the kidneys may contain the parasite.

The carcasses of all Texas fever cases are condemned by the U. S. inspectors. This is, no doubt, the proper and safe course to follow.

### MALIGNANT CATARRH OF CATTLE

This is an infectious disease that is probably due to an undiscovered germ. It certainly appears very like a specific infectious disease. As a rule it involves the mucous membrane of the nasal passages of the sinuses (cavities) of th-

head, of the throat and of the mouth. It may involve the digestive tract, the kidneys, the bladder, the respiratory apparatus and sometimes manifest cerebral (brain) symptoms. "From the entrance of the nose to the smallest bronchi the mucous membrane may exhibit all grades of inflammation—catarrhal, crupous and diphtheritic." This produces a variable discharge from the nose; at first it is watery, then thicker and sometimes streaked with blood, and later it may become very foul smelling. Usually this disease is ushered in by a chill, a depressed head with a nasal discharge, and an overflow of tears from the eyes. The eyelids become swollen; the conjunctiva inflamed; the cornea may become clouded and inflamed and the iris will occasionally become involved. The temperature rises (104 to 107 degrees Fah.). The symptoms will vary according to the parts involved.

*Post-mortem Appearances.*—The mucous membrane of the nose is swollen, brownish or bluish red; small hemorrhagic spots may be present over the nasal membranes or they may be covered with yellowish white crupous membranes. The turbinated bones and the ethmoid cells may show signs of beginning necrosis (death of the part). The mucous membranes of the sinuses are thickened and covered with a purulent (pus) exudate; the cavities in the horns are filled with pus and the matrix of the horns is inflamed. Catarrhal hemorrhagic, crupous or diphtheritic lesions may be observed in the pharynx, larynx, trachea, and bronchi. The mucous membrane of the mouth is swollen and bluish around the teeth. The stomach and intestines may show a diffuse red color and exhibit ulcers and diphtheritic exudates. Pryer's patches and the solitary glands may become ulcerated; but, according to Bollinger, the intestines never become perforated. The kidneys may become inflamed and undergo fatty degeneration.

According to the U. S. government inspector's rules, all malignant catarrh carcasses are condemned. It is evident that all acute cases should be prohibited from passing to the slaughter,—condemned "on foot." Usually all cases

which show sufficient pathological lesions at the slaughter to make a positive diagnosis, should be condemned and tanked.

MISCELLANEOUS SUGGESTIONS.

There are many other diseases that may be occasionally found at the slaughter that should be condemned. We would describe them in full here, but our space is limited. Among them are the following: Acute pneumonia in any form; long standing cases of pleurisy; enteritis (inflammation of the bowels or intestines); peritonitis; acute inflammation of the liver; acute inflammation of the kidneys; in fact, almost any acute or chronic inflammatory disease would justify condemnation, especially long existing cases.

Poisoning of any kind—medicines, wild plants, snake-bites, dog-bites, or the absorption of poisonous gases—should always be met with a positive condemnation.

Animals that have tetanus (lock-jaw), rabies, septicæmia, pyæmia, or malignant tumors (sarcomas and carcinomas) should be condemned without reserving any part of the carcass for food.

In cases of drowning, suffocation, or burning, it is generally best to condemn the entire carcass. It is, however, sometimes possible to save part of the carcass in a case of burning, if the animal is immediately killed and the burned part cut away and destroyed. In cases where animals are wounded, they should be killed at once; then the carcass, if otherwise healthy, is edible. But when animals have carried an open wound for several days before they are killed, the inspector will be required to pass upon the condition of the carcass. Generally speaking, if the wound is large and of long standing, the entire carcass should be condemned. Broken limbs and bruises of recent origin may be cut away and the remainder reserved for food if the carcass is otherwise healthy. Pregnant cows that are within one month of delivery should be prohibited from going to the slaughter. Cows that have recently (2 to 4 weeks) given

birth to a calf should be rejected. At the slaughter, the uterus may be found inflamed; if there is reason to believe that this inflammation has existed some time and that the inflammatory products have been absorbed, the entire carcass should be condemed. Boars should always be rejected. Bulls that are poor or that have recently been in service should be rejected. In fact, it is best to reject all bulls; however, some people appear to prefer bull beef; consequently, bulls must be passed if otherwise all right.

Calves under 30 days old and pigs or other animals under 14 days old are considered "unripe" or unfit for food. Hence, they should be rejected until they reach the ripe age. No doubt, some animals may become too old to make wholesome and healthful meat. The inspector must judge the meat of aged animals according to its condition.

### PUTRIFYING OR DECOMPOSING MEATS.

When meat is kept at room temperature for 24 hours or more, it begins to undergo decomposition. This is due to septic organisms. In warm weather it occurs very rapidly, especially when the meat is not kept upon ice or in an ice chest. The signs of decomposition are the changes in the odor, a decrease in the firmness or solidity of the meat and an increase in the moisture of the meat. Of course, the toughness is decreased or the meat becomes more friable. As a rule, it is easy to distinguish the bad odor in a case where meat has decomposed to a great degree; but when the meat that has just begun to decay or when the odor has been changed by some deodorant, the inspector must then examine the consistency, the toughness or friability and the degree of moisture. The color of decomposing meat is usually paler than normal healthful meat of the same kind; it may have a green tint. However, the color of fresh meat will vary with the age and kind of animal. Veal is lighter in color than beef. An intense yellow may be due to the food containing a large quantity of margarine and olein, or it may be a result of the bile coloring the tissues in dis-

eases of the liver or bile ducts. In the former case the yellow coloration is largely confined to the fat, while in the latter case the bile tinges all the tissues—especially the white ones—a distinct yellow.

Experience is the very best instructor in learning how to recognize decomposing meats. The smell, the color, the consistency, the variations in moisture can be learned only by experience. In condemning decomposing meats one must be guided by the degree of the decomposition; however, if the putrifaction is distinct or well advanced, the meat should always be condemned.

### COURSE OR ORDER OF POST-MORTEM EXAMINATIONS.

The following is the order or course, with slight modification, given by Ostertag:

For Cattle—

1. Skin (wounds, actinomycosis, anthrax swellings, parasitic skin diseases, etc.)
2. Head:
   (a) Outer appearance (actinomycosis, tumors).
   (b) Nasal openings, lips, hard palate (mouth diseases.)
   (c) Tongue (actinomycosis, stomatitis).
   (d) Inner surface of cheeks or masseter muscle. (Tape worm cysts, etc.)
   (e) Lymphatic glands, intermaxillary, laryngeal, subparotid, base of ear, etc. (tuberculosis, actinomycocis).
   (f) Sinuses, frontal, maxillaries, ethmoid cells. (Malignant catarrh).
3. Liver, its appearance and consistency, cut into the portal lymphatics, and if necessary cut open the lobes (degeneration, inflammation, parasites, tumors, abscesses, tuberculosis).
4. Heart, appearance after opening the pericardium, open the right and left ventricles (degeneration, hemorrhages, endocarditis, measles or tape worm cysts, echinococcus cysts, etc.)
5. Lungs, consistency, cut into them in various direc-

tions, cut into the mediastinal and bronchial lymphatic glands, (tuberculosis, echinococcus cysts, small round worms, blood and food materials in the bronchi; actinomycosis, etc.)

6. Spleen, its consistency, cut into it and the lymphatic glands (engorgement, echinococcus cysts, tubercles, etc.)

7. Kidneys, cut them into halves, cut open the renal lymphatic glands, etc., (degeneration, inflammation of the kidney and of the pelvis of the kidney, parasites, tubercles.)

8. Stomach, internal and external surfaces (inflammation, tumors, parasites, actinomycosis, secondary tuberculosis).

9. Intestines, (inflammation, intestinal anthrax tuberculosis, parasites, etc.)

10. Mesentary, cut open the lymphatic glands of the mesentary (hemorrhages, parasites, tuberculosis.)

11. Omentum, (hemorrhages, tuberculosis).

12. Testicles—Uterus,—cut them open, (inflammation, tuberculosis).

13. Bladder, appearance, press out the contents (red, cloudy urine, etc.)

14. Examine the quarters:—

(a) External appearance, (amount blood, hemorrhages, swellings, tumors, tape-worm cysts, broken bones); note the consistency of the udder and cut open the lymphatic glands around it, (mammitis, tuberculosis).

(b) Internal surface, peritoneum, pleura (hemorrhagic spots, inflammation, tumors, tuberculosis, etc).

The surfaces of the diaphragm should also be examined for similar changes.

(c) The vertebræ, pelvis, and breast-bone, (fractures osteo-myelitis, tuberculosis).

The brain should always be examined when brain symptoms are observed before the slaughter of the animal at the ante-mortem examination.

For Calves: The post-mortem examination of calves is similar to that of cattle, special attention should be given to the condition:—

1. Of the stomach (peptic ulcers).
2. Of the small intestine (hemorrhagic enteritis).
3. Of the mesenteric and portal lymphatic glands (beginning tuberculosis.)
4. Of the naval (omphaloplebitis).
5. Of the articulations (polyarthritis, septic and suppurative).

For Sheep: Examine the liver (tape worms, tape worm cysts, liver, flukes); the spleen (anthrax); the brain (tape worm cysts); lungs (nemotodes); stomach (nematodes); œsophagus (coccidia).

For Swine: Examine the intestines, the vertebræ, the pelvis, the breast-bone; they are usually examined in the same order and manner as for cattle. The liver, lungs, heart, trachea and tongue should be examined in the order in which they hang after removal from the carcass. The following special observations should be made:

1. Examine closely the abdominal muscles, the pillars of the diaphragm, the intercostal muscles, the laryngeal muscles for cysticercus cellulolosæ (tape worm cysts or measles).
2. Examine the lungs (swine plague changes, etc.)
3. Examine the smaller bronchi for *strongylus paradoxus.*
4. Examine the skin for red spots or red patches hemorrhagic spots.
5. Examine the mammary glands (actinomycosis).
6. Examine the feet (foot and mouth diseases).
7. Examine the muscles (hemorrhages, cysts and calcareous deposits).
8. Examine the cæcum and ileum for diphtheritic ulcers in hog cholera.
9. Examine the intestines for parasites.
10. Examine the liver for flukes, echinococcus cysts; round worm (*stephanurus dentatus, ascaris lumbricoides*).

# ANIMAL PARASITES OF DOMESTIC ANIMALS.

## TAPE-WORM CYSTS OR MEASLES OF CATTLE.

Synonyms.—*Cysticercus bovis, cysticercus inermis, cysticercus taenæ saginatae.*

The mature tape-worm is found in man and is called *taenia saginata.* It is said that cattle become infected by eating plants that have been fertilized by non-sterilized human excrement, or by drinking water that has been poluted by sewage.

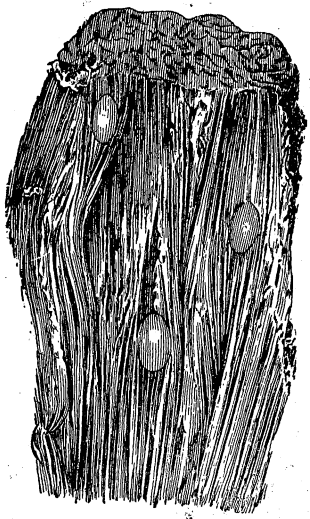

FIG. 13. Measle worm in muscles of cow—natural size.

The cysts are very small (see cut), varying in size from that of a pin-head to that of a pea; at one part of the bladder cyst is a small yellowish spot about the size of a millet seed; this spot contains the scolex (head and neck) of the tape-worm; it may be pressed out and examined under a low power microscope. These cysts are imbedded in the fibrous tissue of the muscles; and are found most frequently in the masseter muscles, the heart, the tongue, the neck and breast muscles, and sometimes many or nearly all the muscles of the body may be infected. If persons eat the cysts without thorough cooking, the mature tape-worm will develop in the alimentary canal from the scolex (head and neck) found in the yellowish white spot in the cyst.

Walley advises the condemnation of the entire carcass in all cases of measly beef; this is the safest plan but there are cases where only a few cysts can be found, and in some cases they are all confined to one locality or region. In such cases it would be sufficient to cut away and tank the parts involved.

NOTE.—All of the cuts 13-25 were kindly loaned to us by the North Carolina Experiment Station.

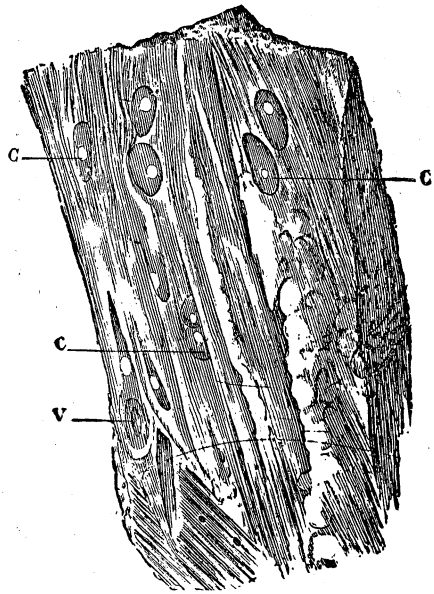


FIG. 14. Measle worm in muscle of pig; cc measles, v cell from which worm has escaped—exact size.

The *cysticercus cellulosæ* is the cystic stage or larval form of the *tænia solium* of man. These cysts are eliptical or spherical, and about one-fourth of an inch in diameter. The cysts are composed of a transparent connective tissue membrane; at one point in the wall of the cyst is the invaginated scolex, which may be evaginated or pressed out for examination. The head contains a double crown of hooks (24 to 28). Pork cysts are tougher than beef cysts. Mea-

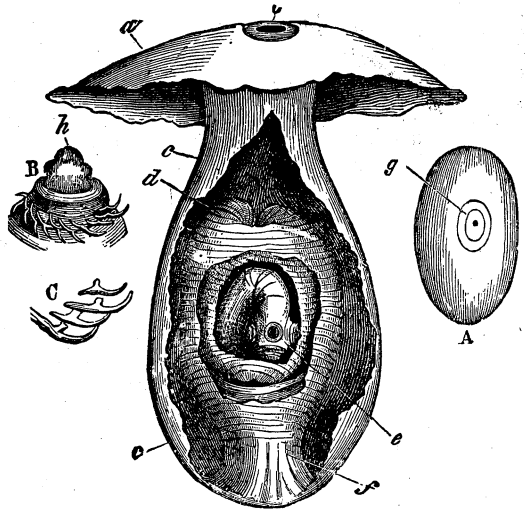


FIG. 15. Measle worm—much magnified. *A*. cell containing worm; *B*. head of worm; *C*. hooks from head; *c*. cell; *A*. highly magnified and cut away to show worm.

sles of pork are also more liable to involve all the organs of the body. In fact there is no part of the body, except the fat, that may not be involved.

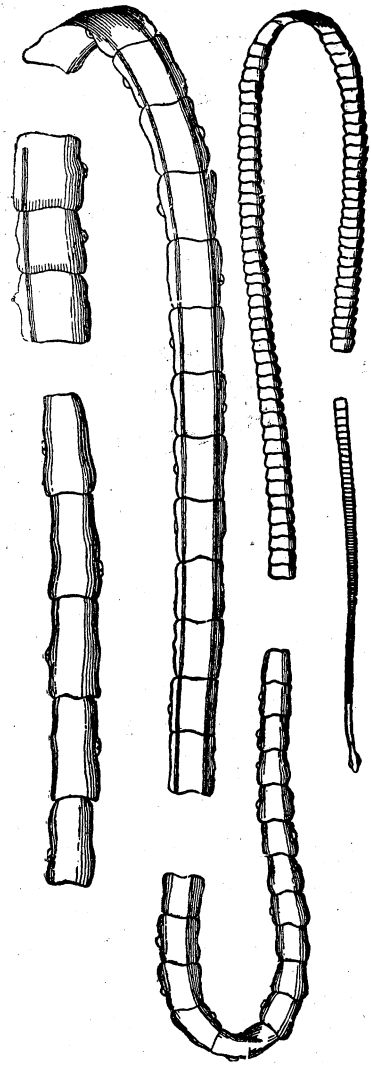

FIG. 16. Tape worm. (Taenia solium)—natural size.

As a rule, it is best to condemn all cases of pork measles; however, some very slightly infected cases might be partially saved by cutting away all infected parts and cooking thoroughly all the apparently non-infected parts. *More than one per cent.* of the hogs slaughtered at Montgomery during the first three months of this year were infected with *cysticercus cellulosæ* (measles).

CÆNURUS CEREBRALIS.

This is the cystic stage of the *tænia cœnurus*. The adult tape-worm is usually found in the alimentary canal of the dog. It is claimed that the segments of the adult tape-worm pass into the alimentary canal of the sheep or other animals with the food; the shells of the ova are dissolved by the gastric juice and the embryos are set free; they penetrate tissues and by some method (possibly in the blood current) reach the brain or spinal cord. In the brain or on the surface of the brain or spinal cord, they develop the vesi-

cles or cysts which sometimes become very large. These cysts produce the disease known as "gid" or "turnsick." The derangement in the action of the brain is a result of the pressure of the cysts upon the brain or nerve centres. As a rule, these cysts call only for condemnation of the head and other parts that are involved. There have been a few cases recorded where man has been infected but these cysts are most commonly found in sheep and occasionally in the ox, the goat, the horse and rarely in man.

THE BLADDER WORM.—*Cysticercus Tenuicollis.*—This is the larval form or cystic stage of the *tœnia marginata* of the dog. The cystic stage is found in the ox and sheep and sometimes the pig. The cysts are large bladder-like vesicles located in the peritoneum and sometimes the pleura and pericardium. They gain entrance to the abdomen by way of the liver. Some cysts have been seen as large as a hen's egg.

The organs or parts involved are cut away and condemned and the balance of the carcass is passed.

*Cysticerus pisiformis* is the cystic stage of the *tœnia serrata* of the dog. The cysts are developed in the peritoneum; the embryos pass through the liver and thus produce serious lesions in the body of the rabbit.

ECHINOCOCCUS VETERINORUM.

The echinocci are the cystic forms of the *tœnia echinococcus* of the dog. The cysts are found most frequently in the liver and lungs of the pig, the ox, sheep, and goat, and sometimes in man. The wall of the echinococcus cyst possesses two distinct membranes; the external one is quite thick and is composed of a number of concentric layers; the internal one is the germinal membrane and is very thin. The cysts may contain a number of heads of the *tœnia echinococcus.*

In all cases the parts or organs involved are cut away and condemned. This parasitic cyst has been observed at the new Montgomery slaughter house quite frequently. During the first three months of 1897, two and one-half per cent., of all the hogs slaughtered contained echinococcus cysts—the liver being most frequently infected.

TAPE WORMS.—The adult tape-worms are not very frequently found in meat-producing domestic animals. The *tœnia expansa* (lately classed as *Moniezia expansa* by Stiles) may be found in cattle and sheep, goats and deer.

Fig. 17—Tape worm. (Tænia echinococcus,) magnified.

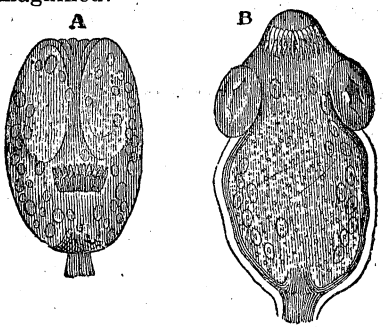


Fig. 18—Echinococcus veterinorum. *A*. Immature. *B*. Full grown, natural size.

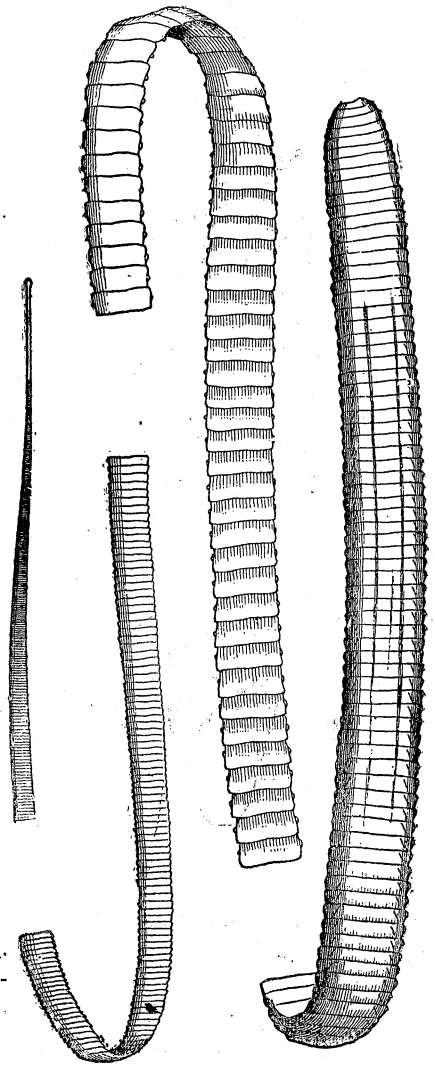

FIG. 19.—Broad tape worm, Moniezia expanza.—Natural size.

*Tænia denticulata* or *Moniezia denticulata* may be found in cattle.

*Tænia fimbriata* or *Thysanosoma actinoides*, Dies. may be found in the intestines and liver ducts of sheep.

The preceding tape-worms are probably the most common adult forms found in cattle and sheep in America. Many others may be studied by referring to "Bulletin No. 4. A revision of the Adult Cestodes of Cattle, Sheep and Allied Animals" by Stiles and Hassel of the Bureau of Animal Industry.

LIVER FLUKE—DISTOMA HEPATICUM.

This parasite is flattened and leaf-like in outline; about one inch long and one-third to one-half an inch broad; pale brown in color; at its head end it has a conical neck. This parasite is most frequently found in the liver ducts of sheep in European countries but in Alabama, and in most of the Southern States, it is observed most frequently in the liver ducts of cattle. This is due to the fact that few sheep are bred in the South. The writer has observed these flukes in the pig in one case at the Montgomery slaughter house.

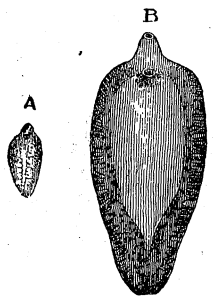


Fig. 20.—Liver fluke worm. *A*, young; *B*, adult form—natural size.

The eggs pass from the biliary ducts to the intestines and thence to the ground; under favorable temperature and moisture the little cap of the "shell" opens and a young embry comes forth; it is covered with fine hair-like projections that enable it to swim about in the water. It must meet a water snail (Limnæus truncatulus, Raillet) in one or two days or die. If it meets the water snail it bores into the snail and lodges in the respiratory cavity where it contracts into an oval mass (sporacyst) and rapidly develops. This sporacyst divides into five to eight rediæ (about one-weltth of an inch long; the rediæ escape from the sac and then each redia

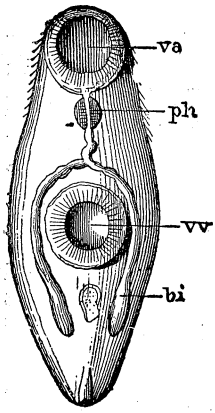


Fig. 21.—Cercaria of fluke worm. *va.* head sucker; *vv*, abdominal sucker; *ph*, throat; *bi*, intestines

in its turn develops from 15 to 20 cercariæ within itself and these escape through an orifice under the neck of the redia. The cercariæ escape from the body of the water snail and then each one becomes encysted; at this stage it may swallowed by a sheep, an ox, or goat; and the cyst will be broken open in the stomach or small intestine and finally the parasite makes its way into the biliary ducts where it develops into a mature fluke. About 75 flukes may develop from one egg. Yet many are lost in the round of life before they reach maturity.

There are other species of flukes some of which may be present in this State.

A liver infected by flukes should be condemned. Only a few cases have been observed at Montgomery .

NEMATODES OR ROUND WORMS.

*Trichina Spiralas.*—As a rule, the adult form of this parasite is found in the intestines and the larval form is found mainly in the muscles. The adult male is one-twentieth of an inch long and the female one-tenth to one-sixth of an inch long. The larvæ in the muscles are about one-twenty-fifth of an inch long. In the mucles the larvæ are encysted usually in the sarcolemma; there may be from one to four larvæ in a cyst. In these cysts, they may retain their vitality for a long time ; in the pig from 8 to 11 years and in man for 24 years or more.

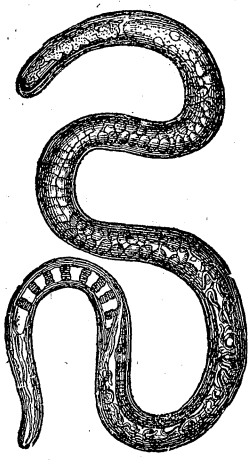

Fig. 22.—Pork worm. Female—mature form much enlarged. (*Trichina Spiralis.*)

The embryos are found in the intestines of man or some vertebrate animal; the adult female brings forth living embryos—not eggs. These embryos begin to be "born" in about seven days after the infected meat has been eaten; the juices of the stomach and intestines dissolve the cysts and set free the larvæ which soon develop into adults that begin to produce embryos. The embryos soon begin to migrate or emigrate and this period continues for nine or ten days they pass through the intestinal walls and then into the involuntary muscles of the body where they become encysted. It requires from one to four months from the time of eating the infected meat until the encysting stage is completed.

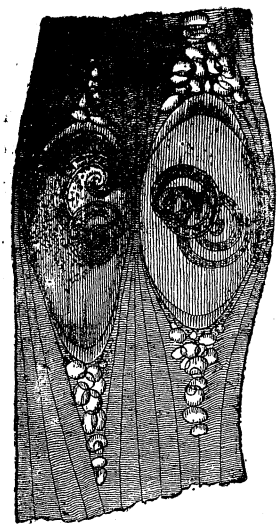

Fig. 23.—Pork worm—encysted form in muscle magnified.

Many times the capsule of the cyst becomes infiltrated with lime salts; this may occur in three months or one and a half years; it hides the trichina. The trichina themselves may become infiltrated with lime salts or may undergo fatty degeneration.

During the period of migration of the embryos the host experiences the pains of trichinosis, a disease something like rheumatism; in many cases it causes death in man and it is possible that it may kill hogs. The hog becomes infected by eating infected meats. Man contracts the disease by eating infected pork. The encysted larval stage has been ob-

served in man, the rat, mouse, hog, guinea pig, rabbit, dog, horse, calf, bear, mole, fish, etc.

All pork should be examined microscopically for trichina. Bausch and Lomb of Rochester, N. Y., make a "trichina microscope" which is very useful and cheap. They also make a "compressor" that is handy and useful. Small pieces from the psoas muscle, from the muscular pillars of the diaphragm, from the inner aspect of the shoulder should be examined. Small pieces of these muscles are "teased" out upon the compressor glass and then pressed into a thin layer in the compressor. Now they are ready for examination under a two-thirds inch objective. Some inspectors examine pieces from 10 different muscles of the body. In Prussia, 1 hog in every 1,000 is found to be infected with trichina; in America the per cent. is said to be 3 to 4 per 1,000. The number of cases observed in this State have not been sufficient to give the percentage of cases. However, sufficient cases have been found at Montgomery to justify a microscopic examination of all the work.

It is well to note here that none of the big packing houses of the North or West have the pork that they sell in the South inspected microscopically for trichina. It would be best for Alabama to pass a law excluding all such pork from her markets. As it is, the people of Alabama consume the meat, from these large packing houses, without any assurance that it is pure and healthy.

Measly pork should be condemned. Some assert that it could be passed if it is well cooked under the supervision of the inspector; this, however, is objectionable because the quality of the meat is very poor and the numerous cooked larval trichina in such meat are not stimulating to the appetite nor very nutritious. It is stated by some that when the trichina cysts and the trichina are calcified the meat is innocuous; this would be true if all the parasites were dead. It is always questionable whether all are dead or not. Then the great amount of lime salts in the muscles would seriously interfere with the quality of the meat.

Hence, as a rule, it is best to condemn all pork infected with trichina.

KIDNEY WORM—*stephanurus dentatus.*

This nematode is very common and is found in the fat around the kidneys, in the substance of the kidneys and in the liver. Out of 964 hogs examined at the Union Slaugter House in Montgomery, during January, February and March, 1897, 302 were infected with this parasite. As a rule, it was confined to the fat, but in many instances it had penetrated the kidneys and liver doing considerable injury to these organs. The male is about one inch, and the female is about one and a half inches long. It was suggested at one time these nematodes were important factors in the cause of hog cholera; but it is now quite certain that they have nothing to do do with the production of that disease. It has also been suggested that they produce paralysis of the hind limbs in hogs; this has not been verified; it is simply a theory.

The parts infected should be cut away and condemned; the balance of the carcass should be passed if otherwise in proper condition.

PARASITIC WORMS INFECTING THE LUNGS.

*Strongylus micrurus.*—This is a hair-like round worm, 1 to 3 in. long. It is found in the wind-pipe and small air tubes of the lungs. These parasites cause difficult breathing, coughing, an extra flow of mucus from the air passages and sometimes suffocation in calves.

The parts infected should be condemned and if the calf is greatly emaciated and shows signs of this disease at the *ante-mortem* examination it should be prohibited from going to the slaughter.

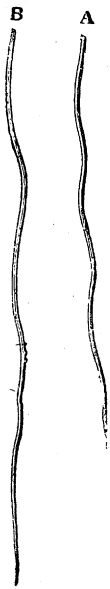


FIG. 24. *Strongylus micrurus*. A. male. B, female—natu ral size.

*Strongylus filaria.*—This is a very small nematode worm; the female is about $\frac{1}{3}$ of an inch, and the male $\frac{1}{4}$ of an inch long. They infect the small air tubes in the lungs of sheep.

*Strongylus rufescens* or *Strongylus ovis-pulmonalis.*—The male is about 1 inch and the female about $1\frac{1}{2}$ in. long. These hair-like round worms infect the extreme ends of the air tubes in the lungs of sheep and there break down the tissues and become encysted, producing tubercular enlargements that might be mistaken for the tubercles of consumption or tuberculosis. The finding of the parasite will always prevent one from calling the disease tuberculosis.

These parasites produce trouble similar to that caused by the small worms in the lungs of calves. The disease is sometimes called *verminous pnemonia.*

If the sheep is in good condition, the parts infected should be cut away; but if it is in poor condition, ematiated and weak, condemn it at the *ante-mortem* examination.

*Strongylus paradoxus.*—The male is one in. and female 1 to $1\frac{1}{2}$ inches long. They are small hair-like round worms found in the air tubes of the lungs of the pig.

Condemn the parts involved. About 25 per cent. of the cases examined at the Union Slaughter House in Montgomery were infected.

*Strongylus commutatis.*—This is a small round worm found in the bronchi (air tubes) of the lungs of rabbits and hares.

### ŒSOPHAGOSTOMA COLUMBIANUM.

This is a small nematode found in the intestines of sheep and cattle. The adult worm ($\frac{1}{2}$ to $\frac{2}{3}$ in. long) lives in the first portion of the large intestine. But the larval stage is found beneath the mucus membrane of the intestines where it produces tumors varying in size from that of a pin-head to that of a hazel-nut. In the early stages these tumors may be more or less soft, but they become infiltrated with lime salts and sometimes the parasite is destroyed by this infiltration. Indeed it is very difficult to find the small parasite. The hard tubercular nodules may be scattered along the small and large intestines in variable numbers and sizes, and might be mistaken for tuberculous nodules.

If the animal is in good condition otherwise, condemn only the parts infected.

### THE SPINE HEADED WORM—*Echinorhynchus Gigas.*

This is a very large round worm that infects the intestines of the pig. The male is about 4 in. and the female 12 in. long. This parasite penetrates the mucus membrane of the intestine with its head and this causes considerable irritation and inflammation. Sometimes they produce small abscesses around the head which project above the outer surface of the intestine. Again they may cause complete perforation of the intestine and thus produce peritonitis which results in the death of the pig.

The larvæ of this parasite live in the larvæ of the June-bugs or May-beetles (*Melolontha vulgaris.*)

Condemn the parts infected.

*Ascaris lumbricoides* (varieties-*vitula* in the ox and *suilla* in the pig).—The former variety is not very common; but the latter is very frequently found in the intestines, stomach and liver ducts of the pigs. According to most authorities this parasite requires no intermediate host; the eggs pass out and infect the pastures, pens, etc.; and other animals become infected by eating food upon or in which the eggs are found. It is said that an infected lot or pen may be disinfected by using kainit or lime. These nematodes are from 7 to 10 inches long. Condemn the parts infected.

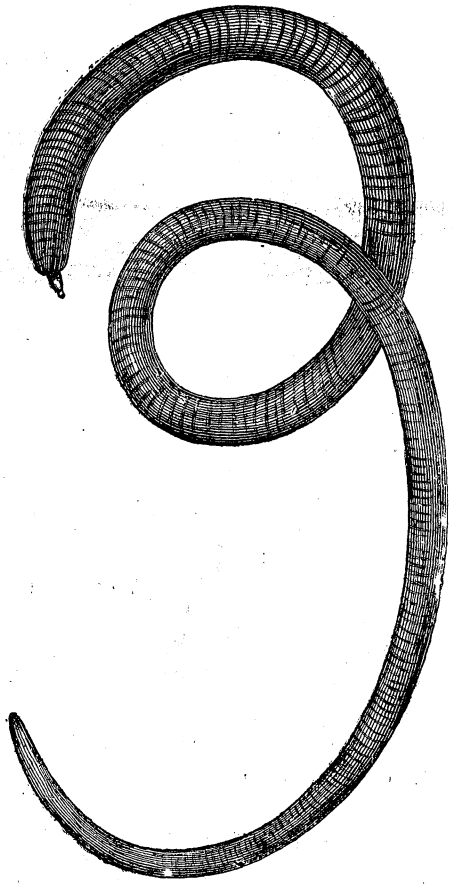

Fig 25. Spine-headed worm. Female—natural size.

*Lingulata tœnoides* and *L. denticulatum.*—This parasite is usually found in the nasal passages of the dog, but has also been found in the nasal passages of the horse, mule, sheep, goat and man. It has been observed in this State most frequently in the liver of cattle, and, in two cases, in the liver of the rat. Its natural host is the dog. It is said to have been observed in the lungs and intestines of sheep and cattle. The parts infected should be condemned.

The following is the Meat Inspection law as it was passed by the City Council of Montgomery in September, 1896. Of course, it would not be applicable to many of our smaller towns and cities. However, if any of the towns or cities desire to inaugurate a system of meat or milk inspection, the Veterinarian of the College and Station will do all he can to aid them in formulating a meat inspection law and in establishing the work. Montgomery is proud of her efficient system of inspection. In some respects Montgomery has the most thorough and efficient meat inspection of any city in the United States:

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AN ORDINANCE

To further regulate the slaughter of cattle for sale in the city of Montgomery.

Section 1. Be it further ordained by the City Council of of Montgomery, as follows: That an ante-mortem examination of all animals shall be made. Any animal found to be diseased or in a condition unfit for human food shall be marked by placing a metal tag in the ear bearing a serial number and "Condemned, Montgomery, Ala.;" the condemned animal shall also be marked with yellow paint in letters not less than four (4) inches long and wide, with the legible word "Condemned." Condemned animals shall be placed in pens set apart for this purpose, and removed only by a numbered permit signed by the inspector to that part of the abbatoir or to rendering works designated by the in-

spector, where they shall be killed under the supervision of the inspector and rendered in such a manner as to make their products unfit for human food.

Sec. 2. Be it further ordained. That all animals rejected on account of their pregnant or parturient condition shall be held in special pens during gestation and for ten days thereafter, unless removed by permit for stockers or for rendering in the same manner as specified in Section 1 for condemned animals.

Sec. 3. Be it further ordained. No animal shall be allowed to pass to the slaughter room until it has passed the ante-mortem inspection. All animals found on either ante-mortem or post-mortem examination to be affected with any of the following diseases or conditions are to be con-condemned and their carcasses treated as specified in Section 5:

1. Hog cholera.
2. Swine plague.
3. Anthrax, including Symptomatic Anthrax (black leg).
4. Rabies.
5. Malignant epizootic catrarrh.
6. Pyaemia and septicaemia.
7. Mange or scab in advance stages.
8. Actinomycosis (lump-jaw) in advanced stages.
9. Inflammation of the lungs, the intestines or the peritoneum.
10. Texas fever.
11. Tuberculosis, extensive or generalized.
12. All animals in an advanced stage of pregnancy or which have recently given birth to young.
13. Any disease or injury causing an elevation of temperature, or affecting the system of the animal to a degree which would make the flesh unfit for food.
14. Carcinomas (cancers) or malignant sarcomas, or any form or kind of tumors where extension (metastasis) has taken place to such a degree that the flesh is unfit for human food.

Sec. 4. Be it further ordained. That any organ or part of a carcass badly bruised or so diseased that the balance of the carcass is not affected, said organ or part shall be cut away and condemned.

Sec. 5. Be it further ordained, That all animals slaughtered shall be inspected at the time of slaughter by the inspector or his assistant. The head and internal organs of each animal shall be held until the inspection is completed, in order that they may be identified in case the carcass is condemned. If the carcass of any animal on ante-mortem or post-mortem examination be found diseased and unfit for human food, said carcass shall be marked with a yellow condemnation tag, and the sides, shoulders and quarters slashed and mutilated. The entire carcass, with the head, organs and the parts thereof, shall be removed under the supervision of the inspector, or his assistant, to tanks, deposited therein and rendered in such a manner that it cannot be withdrawn or used in any way as human food.

(a.) In cases where only a portion of the carcass is condemned, the condemned part may be cut away and sent to the rendering tank.

(b.) The inspector or his assistant shall remove the stub of the yellow condemnation tag at the time of placing the carcass or part of carcass into the rendering tank, and return said stub to the inspector's office, with a report of the number of carcasses and parts of carcasses destroyed, the reason for their destruction, and also state that they were tanked in his presence.

Sec. 6. Be it further ordained, That all hogs that are to be slaughtered shall be marked by placing a metal tag in the ear bearing a serial number and the words "Montgomery, Ala."

Sec. 7. Be it further ordained, That the microscopic inspection of pork shall be conducted as follows:

When the slaughtered hog is passed into the cooling room, or at the completion of the post-mortem examination, the inspector or his assistant shall take from each carcass three samples of muscles, one from the "pillar of the

diaphragm," one from the psoas muscle, and the other from the inner aspect of the shoulder, and said samples shall be put into a self-locking tin box, and a duplicate number of the ear tag shall be put into the tin box with the samples. The tin boxes containing the samples are to be taken or sent to the microscopic room for microscopic examination, together with the numbers of all the carcasses from which samples were taken. The inspector or his assistant shall, as soon thereafter as possible, make a microscopic record of the results of all the microscopic examinations.

Sec. 8. Be it further ordained, That all carcasses found by microscopic examination to be affected with trichina, shall be disposed of as condemned carcasses, or they may be rendered into edible lard, at a temperature of not less than 150 degrees Fah., or made into cooked meat products if the temperature is raised to the boiling point a sufficient time to thoroughly cook the interior of the pieces. Any of these methods of disposing of the carcasses must be conducted under the supervision of the inspector or his assistant.

Sec. 9. Be it further ordained, That all meats delivered to the market or anywhere else in the city, shall be delivered in closed wagons, which wagons shall be thoroughly cleansed each day, under the supervision of the inspector.

Sec. 10. Be it further ordained, That the market clerk shall inspect all meat before it is delivered into the market for sale, and see that it is properly tagged and approved by the inspector.

Sec. 11. Be it further ordained, That all animals shall remain at the slaughter house stock yards not less than thirty-six hours prior to the time of slaughter.

Sec. 12. Be it further ordained, That any person, firm or corporation convicted for violating any of the provisions of this ordinance, shall be fined not less than one nor more than one hundred dollars.

The towns and smaller cities should not get the idea that it is necessary to have a large number of inspectors and apparatus in order to conduct a system of meat inspection. In Germany the inspector for the villages and towns is not, as a rule, a veterinarian or a medical man; but a man of average intelligence, who has been taught to recognize the well marked diseases and prominent diseased organs and tissues, and to examine pork for trichina. I would suggest that the examination of the pork for trichina be left to some local physician. It would rarely take more than one-half hour of his time per day. To secure a qualified man to inspect the animals "on foot" and at the slaughter, would be a little more difficult. However, this might be overcome by getting some moderately intelligent man to make some preparation for such work by coming to Auburn to study that special work and by visiting the Union Slaughter House in Montgomery, to see a somewhat extensive and very complete practical application of meat inspection.

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The following works were consulted in the preparation of this Bulletin:

Friedberger and Fröhner's "Pathology and Therapeutics of Domestic Animals."

Diseases of Cattle, by the Bureau of Animal Industry.

Hog Cholera, by the Bureau of Animal Industry.

Swine Plague, by the Bureau of Animal Industry.

Bulletin No. 7, Bovine Tuberculosis, by the Bureau of Animal Industry.

Animal Parasites of Sheep, by the Bureau of Animal Industry.

Texas Fever, by the Bureau of Animal Industry.

Bulletin No. 4, Revision of Cestodes, by the Bureau of Animal Industry.

Nocard's "Animal Tuberculosis."

Neumann's "Parasites and Parasitic Diseases of Domestic Animals."

Walley's "Meat Inspection."

Ostertag's "Handbuch der Fleichbeschau."
Ostertag's "Zeitschrift fur Fleich-und Milch-hygiene."
McFadyean's "Journal of Comparative Pathology and Therapeutics."—Vol. IX, June, 1896.
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" " 37, Missouri " "
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" " 51, Minnesota " "
" " 47, Nebraska " "
" " 32, Delaware " "
" " 67, Alabama " "
" " 65, Cornell University " "
" " 29, Iowa " "
" " 41, Mass. Agr'l College " "
Abbot's "Principles of Bacteriology."
Sternberg's "Bacteriology."
Vaughn-Novy "Ptomaines and Leucomaines."

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The veterinary department of the A. and M. College and experiment station manufactures *tuberculin* and *mallein* These diagnostic agents will be furnished free to graduate veterinarians and medical men who will send us detail reports of all tests made with them. In all cases send for tuberculin just before you are ready to use it and state the number of animals you wish to test, and who is to conduct the test. Full directions for using tuberculin may be found in Bulletin No. 67 of the Alabama Experiment Station.

Reports of, or correspondence on, any diseases that may occur among domestic animals in Alabama should always be directed to the Veterinarian of the A. and M. College and experiment station, Auburn, Ala.