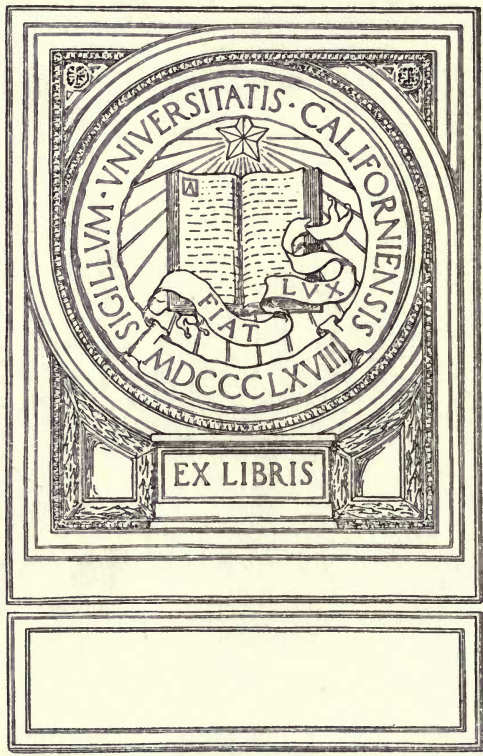


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TEXT-BOOK
OF
MEAT HYGIENE

with special consideration to ante-mortem and
post-mortem inspection of food-
producing animals

BY

MEDICAL COUNSELLOR

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WITH 157 ILLUSTRATIONS AND 8 COLORED PLATES

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GEO. E. HOWARD PRESS, WASHINGTON

1908

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Translators' Preface

The increasing interest manifested by the public concerning all phases of general hygiene has also extended to their food supply, and especially to meat. This is not surprising when it is remembered that meat constitutes one of the most important foods of man.

The importance of controlling the sale of meat, the necessity for which is almost universally recognized, demands a force of thoroughly trained inspectors who are competent to supervise all lines of work which comprise the meat industry. For the training of these experts, veterinary schools have been obliged to afford satisfactory opportunities for the student to familiarize himself with this important branch of sanitary medicine, as it is realized that a continually increasing percentage of their graduates are being called to responsible positions for the purpose of guarding the public against the dangers to which it is constantly exposed from the consumption of unwholesome or diseased meat.

The United States Government, thoroughly aware of the danger to health from consuming meat which is unfit for food, has recently passed an elaborate and comprehensive law for controlling this danger. True, the acts of Congress of 1890, 1891, and 1895 provided for the inspection of meats entering interstate or export commerce, but the annual appropriations had never been sufficient to enable the Government to cover all the establishments slaughtering for interstate trade, although all meats exported were being inspected in a manner satisfactory to foreign governments. While palpable defects in the old law had been repeatedly called to the attention of Congress by the Department of Agriculture, it remained for a sensational press to so exaggerate the conditions as to call immediate attention to the defective features. These articles did not fail to excite public interest, and led the Secretary of Agriculture to inaugurate an investigation of the conditions existing at the Union Stock Yards and Packing Houses at Chicago, Ill., by the appointment of a Departmental Committee which was authorized to make a thorough and complete investigation regarding the meat-inspection work conducted by the Bureau of Animal Industry. The country at this time was being deluged with sensational articles rich in fantasy and reeking with revolting stories calculated to convert the whole world to vegetarianism. These charges were not only against the packing houses, but to a certain extent reflected upon the action of the Government inspectors. The President

thereupon decided it was best to have a report from a committee not interested in the department, and forthwith appointed a commission before the completion of the investigation by the Department of Agriculture. The reports of both these commissions were a unit as to the integrity and efficiency of the Federal meat-inspection force, and agreed that there was urgent need for improvement in the sanitary conditions of the packing houses, for the enlargement of power of the Secretary of Agriculture for the inspection of meat for interstate and foreign commerce, and for the correction of such defects in the existing law as would permit the Government to inspect and supervise from the "hoof to the can" the preparation of all meat-food products. Following the receipt of the above reports a special message was sent to Congress by the President of the United States, calling attention to the need of new and more rigid legislation, and on June 30 1906, Congress passed an eminently satisfactory act, which assures a wholesome and hygienic meat supply to the people, for the enforcement of which a permanent yearly appropriation of three millions of dollars is made, a sum which will permit its efficient and continued enforcement.

The enforcement of this law has created a demand for a concise, though comprehensive, text-book on the subject of meat inspection, which was sounded from numerous sources, and with the publication in 1907 of the second edition of Edelmann's recognized work on Meat Hygiene, we determined to undertake the preparation of an English edition of this valuable text-book. Inasmuch as the original work was applied by the author mainly to the German conditions and the official regulations of Germany, we deemed it advisable to adapt the text-book to the conditions prevailing in this country. Thus such additions and changes were undertaken which were found necessary in order that the work might contain all the information which is applicable to this country. Accordingly the regulations of the Department of Agriculture were inserted, and in the judgment of diseased carcasses special references have been made to the particular regulations which apply to the respective conditions. Other paragraphs have been included which treat of conditions that have attained prominence under the new meat-inspection law. In reproducing this work the translators have endeavored to present the subject in as practicable a form as possible, and always from the view of the practical inspector of meats. Finally, we cannot refrain from expressing our sincere thanks to the eminent author of the work who cheerfully granted to us the privilege of preparing an English edition of his valuable treatise, and we hope that our endeavors to give the work a satisfactory interpretation have been successful.

MOHLER AND EICHHORN.

Washington, D. C.

June 20, 1908.

Preface to the Second Edition

Following the favorable consideration which this text-book on meat hygiene received from the reviewers and the good results obtained from its use in teaching meat inspection to students of veterinary medicine, as well as the assistance it afforded to inspectors of meat in the execution of this work, there seemed to be no reason for undertaking any changes in the outlines of the book or in its division. Therefore this second edition scarcely differs in its general scope from the first.

On the other hand, all the sections of the book were carefully looked over, and were revised in accordance with the results of investigations of the last four years. In various chapters it appeared necessary to revise completely the material, especially regarding the method of distinguishing the meat of the various food animals, the apparatuses for sterilizing conditionally passed meats, the harmless disposition of condemned meat, and, furthermore, the sections on piroplasmosis, sheep-pox, braxy, putrefaction of meat, and meat poisonings. Additions were made with reference to the authorized regulations on the transportation of live stock, specifications regarding the marking of live animals, tables concerning the utilization of various meat-food substances according to König, a comparison of the methods of examination in the inspection of various food animals, the non-contagious foot-and-mouth disease, the pyobacillosis of young hogs, etc. The statistical statements regarding the occurrence of diseases especially important for the inspectors of meats were obtained from the first published Imperial meat-inspection statistics for the year 1904. It may be mentioned in passing that the numerous changes and supplements which the legislation on meat inspection experienced since the publication of the text-book have been carefully considered in the second edition.

Appreciating the importance of good illustrations for the understanding of a text-book, several figures of the first edition have been replaced by better reproductions, and beside twenty-nine new illustrations were inserted. Of the latter several were newly prepared, some were kindly furnished by the interested industrial companies, but the majority were borrowed, with the kind consent of the authors, Hutyra and Marek, from the "Special Pathology and Therapeutics of Domesticated Animals," which also appeared as a publication of Fischer. It is my pleasant duty to express my thanks to all concerned, but especially to the above men-

tioned authors. I also gladly express my obligations to the publishing house, which in a very kindly way satisfied all my wishes relative to issuing the book in a satisfactory form.

In consideration of the numerous additions and improvements which were undertaken in the new adaptation of the book, it was impossible to avoid increasing the size of the book with 53 pages in spite of endeavoring to be as brief as possible and of the extensive use of the small type in the print. May the improved second edition of the text-book on meat hygiene, receive the same favorable welcome as the first edition, which was dedicated to the privy medical counsellor, Prof. Dr. med. h. c. et phil. Ellenberger, in Dresden, and fulfil its purpose to the benefit of the world.

EDELMANN.

Dresden, August, 1907.

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Introduction

Regulation of the diet or hygiene has for its purpose the retaining and strengthening of the health of the human or animal organism, by increasing its internal resistance, and by preventing any noxious effects. In doing this, it is necessary in the first place, to consider the nourishment of the organism. Inasmuch as meat constitutes the principal foodstuff for the human body, the regulation of the diet of man must also extend to meat products. And since recently there has been considerable attention paid to the latter from a hygienic standpoint, justification is had for the use of the words "meat hygiene," by which is understood that part of the regimen which concerns the procurement of wholesome meat foods for man, their value to public health as well as the dangers which threaten the consumers of diseased or unsound meats.

For the prevention of these dangers, there should be in the first place, an expert supervision of the meat-food products of man. Everything which constitutes such a supervision may be comprised in the term of meat inspection or meat examination. By this should be understood the examination of meat and the products made of the same, relative to their proper origin and desirability as food for man.

Inasmuch as these food substances are the products of animals, the examination can only be complete if it extends not alone to all parts of the slaughtered animals, but also to the food-producing animals in life. Accordingly it is more correct to speak of the examination as an ante-mortem and post-mortem inspection.

When in the sense of this inspection the term meat is mentioned, it should not be exclusively applied to the striated muscles of the body, and the tissues in connection therewith (fat, connective tissue, nerves, blood, lymph glands, bones, and cartilages), but rather to all parts of the animal which are suitable for human consumption.

And while the objects and duties of meat inspection are in the first place the prevention of the dangers which threaten human health from noxious meat products, yet at the same time, a well-organized meat inspection also undertakes the task of protecting the meat consumers in an economic relation from frauds and deceptions, by subjecting the meat which is not altogether unobjectionable regarding its origin and consistence to be sold under a compulsory declaration.

In the execution of these main objects, meat inspection may also render important services in veterinary police work by detecting animal plagues, and also by extending a beneficial influence from a general hygienic standpoint to animal and man, by the complete harmless disposition of all products of diseases and their specific causes. In relation to the latter, meat inspection should not be underestimated in its value and importance to general stock raising. It not only discloses to the intelligent owner of stock obscure diseases of food animals, but shows to him also, the means and ways by which such diseases may be eradicated and prevented.

As far as the extension of jurisdiction of meat inspection is concerned, it reaches all the food animals which are customarily found in the respective countries (p. 1), and which produce the principal mass of meat food. And while in the question of inspection, only those food animals are concerned, the meat of which is to be utilized commercially, yet it is of no lesser importance to the public interest that those animals should be subject to inspection which are slaughtered for private purposes. The reasons for this absolute generalization of meat inspection for all animals coming for slaughter, can only be indicated at this time. They lay above all in the importance of meat inspection in general hygiene, which cannot be hindered because of private property.

Furthermore, it is not feasible to control the possibility that meat of animals supposed to be slaughtered for private uses might not serve exclusively for these purposes, but might be brought, in spite of assurances, into the public traffic. There also belongs to a thorough meat inspection the control of the meat products (prepared meat), which are prepared from food animals, as well as the inspection of all other animals which are marketed and served for human food, such as game, poultry, fish, crustaceans, mollusks, reptiles, and amphibians.

I. Origin and Source of Meat Food

Man takes his meat-food diet from almost all classes of animal life, and, therefore, the bromatologic fauna extends from the celenterates to the vertebrates. In general, animals which live on plant food or on the lower animals are furnishing the civilized nations with palatable meat, while the meat of animals which consume higher animals (fish, amphibia, reptiles, birds), are less adapted for human food. The principal meat foods are obtained from the class of mammals, and amongst this class the first place is taken by herbivorous and certain omnivorous animals, while those mammals which are solely carnivorous serve only rarely for human food. Next to the mammals, birds, and then fish supply most of the meat for man. Other foods which are derived from the other classes of animal life play only the part of delicacies, or are consumed only occasionally.

1. Food Animals

Although the animals which are slaughtered, and all those which are killed through the abstraction of blood may be designated as food animals, yet only the slaughterable domesticated mammals are popularly regarded as such, while domestic poultry which serve as human food are in general not considered in the narrow sense under the conception of food animals.

The domesticated mammals which are slaughtered are divided into large stock, hogs, and small stock, while in Austria the latter two classes are classified as "stock for sticking." Depending upon the nutritive condition they may be distinguished as lean stock and fat stock. Besides these designations there is also the pasture stock, which is composed of lean as well as of fattened animals.

To the "large stock" group belong cattle and horses, also the ass and mule. Buffaloes, which are only occasionally slaughtered in Germany, when shipped there from foreign countries, play a more important part as food animals in southern and southeast Europe, the same as reindeer in the northern countries.

Cattle are slaughtered as male animals (bulls, bullocks); as castrated males (ox, steers); and as female animals (cows, heifers).

The designation steer has not the same meaning everywhere. While in some places it is understood that steers are young male animals, in other parts that designation applies to castrated, not full grown male cattle, and in Saxony the word

steer represents only a conception of the state slaughter tax applied to certain animals. For this tax those cattle are designated as steers which have not yet shed the outside middle and the corner teeth.

In the imperial regulations for the slaughter and meat inspection statistics the following designations are made:

- “Steers;” cattle of the male sex which are castrated and have reached two years of age;
- “Bulls;” cattle of the male sex which have reached the age of two years;
- “Cows;” cattle of the female sex which have already calved;
- “Young stock;” cattle after reaching the age of three months when they are:
 - (a) females and have not yet calved,
 - (b) males, or castrated males, which have not yet exceeded the age of two years.
- “Calves;” cattle up to the age of three months, either males, females, or castrated animals.

In horses the different sexes are known as stallions (male), mares (female), geldings (castrated male horses); young horses are called foals or fillies.

The hogs which in Germany furnish most of the meat and which are of the greatest importance from the standpoint of general maintenance, are principally slaughtered as castrated males (barrows, also stags when they are castrated after being used for breeding purposes) and female animals. Besides these, boars (wild boars) and cryptorchids, as well as sucking and breeding sows, and occasionally very young pigs as roasters and suckling pigs are also slaughtered.

Under the term “small stock” come calves, sheep and goats. Of the calves certain types are distinguished through their prominently marked development of the muscles, especially on the chest and legs. Sheep and goats when young are called lambs or kids; the male animals are designated as bucks and rams; when castrated they are known as wethers. In the language of the butcher, however, the meat of all sheep, without consideration of the sex, is called mutton or lamb.

Of the other domesticated animals the following may also be slaughtered and consumed: In Germany dogs are principally slaughtered in large cities or in localities densely populated with the laboring class, and are, as a rule, slaughtered secretly and only for home use. Through the government meat-inspection laws, dogs are subjected to compulsory inspection, and they have been slaughtered and used for food in noteworthy number, especially in Saxony. Cats are also occasionally slaughtered and have been known to be substituted for rabbits.

Rabbits, which are slaughtered in Germany mostly for household use, constitute in France and England quite a considerable commercial product. According to Bentel, the daily consumption of rabbits in Paris amounts to 10,000, and in London to 75,000. In accordance with a publi-

cation of Schlieger, rabbits to the value of 80 to 90 million francs are annually raised in France, and Paris alone annually consumes rabbits valued at 5 to 6 million francs. In France, England, Belgium, and in some parts of Holland rabbits are not a general food of the people, but rabbit meat may be found daily on the tables of the rich. According to Schlieger's calculation a breeding farm in France, which produces 600 rabbits monthly, weighing 3 kg. each, affords an annual clear profit of \$1,250.

In relation to quick meat production the rabbit stands first among meat-producing animals. As a female rabbit may be pregnant eight or ten times annually, giving birth to a litter averaging six young, which reach after four months a weight of 2.5 kg., such a female may accordingly produce inside of a year 150 kg. of meat.

A. Traffic in Food Animals

The need of food animals is preferably supplied through home stock raising, while the importations from foreign countries (page 10) is at present slight, due to the prohibition or considerable restriction of the sanitary police regulations.

The food animals which supply the demand of the butchers in the rural districts and the small cities originate usually at their home place or from the surrounding country, at least if there should be sufficient stock-raising in the vicinity to satisfy the demand. In larger cities and in purely industrial centers the demand of food animals cannot be supplied from the surrounding country, and the shipping of stock to these centers from stock-raising districts becomes a necessity. These shipments seldom occur directly, but as a rule are made from stock-yards, which are the collecting centers for the marketing of food animals (See Chap. XII). These command at present a conspicuous importance in the supply of large cities and extensive territories.

The trading in food animals is principally carried out from a business standpoint, which even applies to the constant small tradings. The buying and selling of a food animal is either conducted according to live weight or by dressed weight or off-hand (so much for each animal).

Each deal is made through the judgment of the quality of the individual food animal. For this purpose, besides the general inspection, the buyer preferably palpates or grasps certain parts of the body which are especially considered on account of the fat deposits at these points.

As a rule, it is applied in cattle to the shoulder, withers, outside surface of the false ribs, hind border and inner surface of the last rib, haunch, rump, flank, base of the tail, scrotal region in steers, and the front of the udder in cows.

In sheep the buyer examines the subcutaneous development of fat, especially on the back, the lumbar region and the base of the tail; he also estimates the weight by lifting the animal from the ground, and by the age.

Calves are judged by their general condition, age, development of meat on the back and leg, also by lifting the animal off the ground.

In hogs the chest-wall, the back, especially the withers, and the abdomen are preferably examined.

Besides the nutritive condition, the following examinations are generally made: General conformation of the food animal, size, age, condition of health, intestinal contents, skin, hair, etc. And from all these conditions the buyer forms a picture as to the value of the animal for slaughter, and above all as to its live weight. On the correct estimate of the latter in connection with pertinent judging of other peculiarities of the animal depends entirely the principle of buying off-hand (by the head).

The buying by live weight is conducted through an estimate of the value of the animal by weight during life and by the advantages and disadvantages which the carcass possesses for its utilization as food. Occasionally a discount is allowed in such trades representing part of the waste from the intestinal content. Most frequently is this the case in the marketing of hogs where 20-22 per cent. of discount is sometimes agreed upon. It is only natural that the price per kilo of the live weight is arranged accordingly.

Rieck established that the losses in weight resulting from transportation of 212 cattle from the time they left the place of feeding until they reached the stock yards amounted to 7.97-8.95 per cent. of their live weight.

In buying by dressed weight, which is practically confined only to stock-yards, a certain price is agreed upon at the time of the deal to be paid in accordance with the weight of the cooled dressed carcass. By dressed weight is generally understood, with the exception of certain regional variations—

- (a) for cattle, the weight of a bled and skinned carcass after removal of the head at the atlanto-occipital joint, feet at the carpus, the outside and inside sexual organs and other viscera with the exception of the kidneys; in other words, the weight of the four quarters;
- (b) for calves and sheep the same conditions as for cattle;
- (c) for hogs the weight of the bled and eviscerated carcass. Only the kidneys with the leaf-lard remain in the animal. The head, however, is weighed in with the carcass, but the tongue, which remains on the pluck (haslets, consisting of the larynx, trachea, heart, lungs, and liver), is not included.

In all species of animals there exists a certain proportion between live and dressed weight, which principally depends on the nutritive condition of the animals. Well-fattened animals naturally produce a higher

dressed weight than those which are in poor condition. The proportion of dressed to live weight is given in the following table, expressed in percentage:

Dressed weight represented in percentage of live weight

Quality	Steers	Bulls	Cows	Calves	Sheep	Hogs
Full flesh, fattened, highest dressed value.....	58-61	58-62	55-60	62-68	48-53	80-85
Young, fleshy, but not fattened, older cattle fattened	53-55	50-56	50-54	58-62	45-48	78-82
Third class	48-52	46-50	48-52	50-56	38-44	70-78
Fourth class	42-46	.....	42-46	40-45	.....	76-80

In specially good animals even a higher dressed weight can be obtained, as, for instance, good, well-developed young bulls may dress over 70 per cent., and the best fattened hogs may even dress out 90 per cent. of their live weight.

Hengst, at the Leipsic stock-yards and abattoirs, established the average weights in a large number of food animals as follows:

Animal species	Live weight		Dressed weight		Average dressed weight in % of the live weight
	No. of the weighed animals	Average weight per head	No. of the weighed animals	Average weight per head	
		<i>kg.</i>		<i>kg.</i>	
Steers.....	9,518	695.81	90,115	374.55	53.83
Bulls.....	4,119	647.93	20,559	365.96	56.48
Cows.....	5,067	560.01	62,689	277.79	49.60
Heifers.....	841	468.55	8,028	253.80	54.17
Calves.....	14,197	69.58	6,653	44.01	63.25
Sheep.....	5,471	53.58	25,281	29.11	54.33
Hogs.....	6,823	107.30	146,205	89.89	83.77

For establishing the dressed weight in stock-yards dealers and butchers have, as a rule, agreed upon certain principles, which are usually carried out in slaughtering the animals.

The amount of foodstuffs in the digestive tract has the most noteworthy effect on the relation between the live and dressed weight in the food animals. This depends on the kind of food, the time of slaughter, and the extent of driving or transportation to which the animal has been subjected after the last feeding. As occasionally this gives rise to deception and fraudulent actions and causes differences between buyer and seller, the knowledge of certain average figures of the weight of the gastro-intestinal canal and its contents is of importance.

With reference to this Wolff makes the following statement: In fasting animals the weight of the gastro-intestinal canal, including its contents, amounted in fat steers to 16.1 per cent.; in medium fat steers, 19.5 per cent.; in medium fat-

tened steers, 24.5 per cent.; in fat calves, 10.6 per cent.; in fat hogs, 7.9 per cent.; in medium fattened hogs, 12.1 per cent.

According to Hintzen's examinations, the relative weight of this material averaged in fasting cows 18.2 per cent.; in fasting calves, 9.2 per cent.; in fasting hogs, 7.6 per cent.

P. Falk ascertained the average weight of the contents of the stomach and intestines in thirty-seven cattle, and found that it represented 16.35 per cent. of the live weight.

Noack, in his investigation of the indigestions of food animals, considered only the weight of the stomachs and their contents, and computed the results in relation to the dressed weights.

The latter are perceptible from the following comparisons:

Species of animals	Number	Dressed weights, limits in kg.	Average weight in kg.	Weight limits of normally and abnormally filled stomachs in kg.	Average weight in kg.	Percentage relation of the average stomach weights to the average dressed weight
Steers.....	10	300-500	400	49-140	94.5	21.1
Cows.....	7	225-375	300	45-120	82.5	27.5
Bulls.....	17	250-600	425	45-105	75.0	17.6
Total cattle.....	34	225-600	412.5	45-140	92.5	22.4
Calves.....	12	25.5- 55.5	40.5	1.5-8.0	4.75	11.7
Sheep.....	17	11.5- 37.0	24.25	3.5-9.5	6.5	26.8
Hogs.....	15	57.0-109.0	83.0	1.5-7.5	4.5	5.4

Against these figures Noack found the weight of stomachs from 11 steers with indigestion between 23 and 42 per cent. of the dressed weight.

With reference to the absolute and relative weights of the principal organs of cattle (heart, lungs, liver, kidneys, and spleen), calculated on the live and dressed weights, see under Chap. II, I, H.

Classification of Food Animals.—In all of the larger stock-yards the average prices which prevail are officially published after the close of the market. These prices generally refer to the live and dressed weight of the various food animals, but at some places only one of the two prices is quoted. The market quotations serve not only as a guide on the condition of the markets, but also afford a comparison of the various markets, and above all they disclose to the stock raiser, from time to time, the market values of food animals.

In order to obtain the most benefit from market quotations, the representatives of the interested parties (stock-yard managers, stock dealers, butchers, stock raisers) established the following uniform scheme for the classification of food animals, which forms at present the basis of market quotations at the larger stock yards:

- Steers:
1. Steers up to 6 years in full flesh, finished as regards to fattening, and of the highest slaughter value.
 2. Young fleshy steers, but not finished in fattening; older fattened steers.
 3. Moderately nourished young steers; well nourished older steers.
 4. Poorly nourished steers of all ages.
- Bulls:
1. Bulls in full flesh of the highest slaughter value.
 2. Moderately nourished younger bulls.
 3. Poorly nourished bulls.
- Heifers and Cows:
1. Heifers in full flesh, finished in fattening and of the highest slaughter value.
 2. Cows up to 7 years in full flesh, finished as regards to fattening and of the highest slaughter value.
 3. Older cows finished in fattening and more poorly developed younger cows and heifers.
 4. Moderately nourished cows and heifers.
 5. Poorly nourished cows and heifers.
- Calves:
1. The finest fattened calves (fattened on milk), and the best suckling calves.
 2. Moderately fattened and good suckling calves.
 3. Poor suckling calves.
 4. Older poorly nourished calves (feeders).
- Sheep:
1. Fattened lambs.
 2. Young fattened wethers.
 3. Old fattened wethers.
 4. Moderately nourished wethers and ewes.
- Hogs:
1. (a) Hogs in full flesh, of fine breeds, and their crossings up to $1\frac{1}{4}$ years old (weight 220-280 lbs.); (b) fattened hogs.
 2. Fleshy hogs.
 3. Poorly developed hogs.
 4. Sows and boars.
 5. Foreign hogs.

B. Transportation of Food Animals

In the transportation of food animals attention must be accorded the animal on account of the benefit it has in the inspection of the meat, since as a result of shipment the condition of the animals, as well as the consistency of the flesh, may be more or less influenced. The transportation may take place by driving, carting, railroad, or by boat.

Transportation by driving affects food animals to a degree corresponding with their being accustomed to outdoor exercise and the temperature of the season. This transportation is conducted with the least effect on horses, sheep, and such cattle which were raised on pasture; more difficulty is met with stabled cattle, calves, and hogs. As a rule the driving of cattle is only employed at the present time for short distances,

and for longer distances only in such cases where the cattle are well accustomed to long drives. As the driving of fattened cattle affects them unfavorably, in accordance with the degree of their fleshiness, they are driven only over very short distances. The voice, sticks, and dogs are employed in driving the animals. While dogs can be scarcely spared in driving sheep, they frequently cause considerable excitement amongst the animals of other species. Sometimes as a means of compulsion to stubborn cattle the tail of the animal is twisted, which, however, may degenerate to a cruelty and produce as a consequence anatomical lesions in the tail (fractures, bruises, etc.).

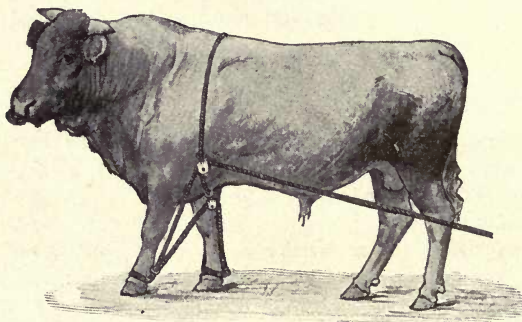


Fig. 1. Bull with casting apparatus (after Dick)

To prevent cattle from running away the so-called "draw-back or pulley" harness is frequently used, the arrangement of which can be seen in Fig. 1.

All animals transported by driving will get more or less excited and tire to a certain extent. Should such excited and tired animals be immediately slaughtered,

they will bleed out incompletely in most instances, and their meat will frequently be of a lesser keeping quality. Accordingly, the transported animals, as a rule, are slaughtered after they have been allowed a period of rest, the length of which must depend on the temperature of the season and the condition and fatigue of the animal resulting from the transportation. Some of the animal and meat inspection regulations prescribe a certain number of hours as a resting period before slaughter of transported animals. Where this is not the case, the veterinary inspector should, in accordance with his findings of the ante-mortem inspection, forbid the slaughter of the animals until they have regained their comfortable state and have entirely recovered from the effects of the transportation.

In transporting by conveyance the vehicles must be suitably constructed for the respective species of animals, and must permit a careful loading and unloading (Fig. 2). Fettering of the animals should be carried out only to the extent of preventing them from jumping out of the wagon. Forcible and painful tying of the legs of calves and sheep is not warranted, especially with thin, cutting strings, and the frequently practiced crowding of animals into a too limited space is also to be condemned. The more the animals are fettered, the more they struggle, and for this reason the advantages of transporting by wagon are limited. In the sum-

merit time the animals should be protected against the heat of the sun, and hogs are advantageously cooled by occasionally pouring cold water over them, or, still better, by transporting them at night.

To-day transportation by rail plays the most important part, and is generally carried out in accordance with appropriate regulations. For this method of transportation a special kind of car is employed, built especially for the transportation of live-stock. They are of prescribed size and are equipped with appropriate ventilation, as well as with contrivances for the feeding and watering of the animals.

A special kind of stock car is the so-called double-deck car, or two-story car, which consists of two divisions, one above the other, and is used for the shipment of sheep and hogs. But the common closed box

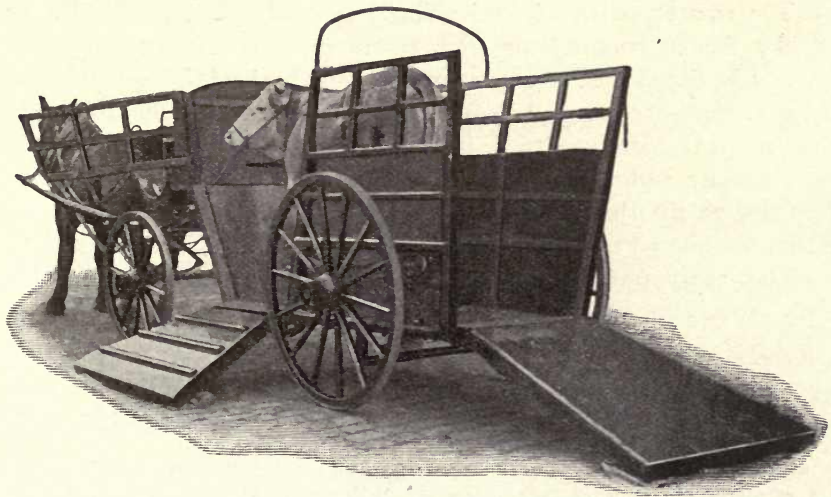


Fig. 2. Wagon for transporting cattle (after Fuchs)

cars are considered preferable by the shippers for the transportation of animals by rail. These, however, frequently do not answer the requirements which must be demanded from a hygienic and humanitarian standpoint.

For the loading and transporting of animals by rail the above-mentioned regulations are in existence, which, however, require modifications and improvement. Cattle, as a rule, are placed crosswise in a fully loaded car; that is, perpendicularly to the long axis of the car. According to Zschocke, adult bulls and steers require for this purpose 66 cm. and cows 57 cm. of the car length. For hogs an average of 0.40 qm. of floor space should be required, for calves 0.31 qm., and for sheep 0.24 qm. per animal.

For the transportation of hogs and small stock it is advisable to divide the cars with cross partitions into several compartments, and in mixed shipments separate

divisions for the different species of animals should be required. Only suckling calves are allowed to be loaded together with their mothers.

The disadvantages and dangers of railroad transportation of food animals depend on various conditions. It is greater for fat animals than for lean ones. The closer they are loaded, the warmer the temperature, the longer the transportation lasts, and the less suitably the cars are arranged, the greater are the disadvantages. Hogs suffer comparatively the most, and deaths from suffocation and paralysis of the heart are not infrequent. Cattle are oftentimes greatly affected by the frequent switching of the cars. They may be thrown down and are then stepped upon by others, and may die as a result of the injuries, or even from suffocation.

A peculiar disease is sometimes observed in cattle as a result of railroad transportation, and is designated as railroad sickness. This affection manifests itself as a severe nervous disorder, which, in a well-developed state, does not appear unlike parturient apoplexy. The termination of the disease is mostly unfavorable, which makes early slaughter of the affected cattle advisable.

The transportation of food animals by boat comes principally into consideration in importations from across the sea, and for this service specially equipped steamers are employed. The loading and unloading of the animals are accompanied sometimes with considerable difficulties, while the transportation itself, if the weather is not stormy, is not followed by any more marked disadvantages than railroad transportation. In regard to the sheltering of the animals on boats, everything said in relation to railroad transportation may be applied here.

The transportation of horses by boat is described by Hörauf in a highly instructive article in the *Berl. Thierarzt. Wochensch.*, No. 40, 1906.

Concerning the above-mentioned period of rest before slaughter, this should be required for animals transported by wagon or boat, and it should be extended in accordance with the condition of the animals. Generally the time will be considerably shorter than in animals transported afoot.

It is readily understood that food animals lose more or less of their live weight as a result of all kinds of transportation. It is impossible, however, to establish definite figures relative to that loss, on account of the great differences in feeding and the conditions of transportation.

[In the United States the transportation of animals is governed by a decree (Public No. 340), enacted by Congress of the United States, and approved June 29, 1906.]

C. Importation of Food Animals from Foreign Countries

The importation of food animals from foreign countries into the territories of the German Empire is regulated by decrees from the Imperial Chancellor as well as by the governments of the allied states.

On account of the changes in the standing of contagious diseases of animals in the states from which importations are made, the regulations

governing the importation are changed from time to time. At present food animals may be imported:

1. From Austria-Hungary cattle and sheep which comply with the required conditions may be imported to a large number of public abattoirs. The cattle have to be kept separated from the domestic cattle and have to be slaughtered inside of a certain time-limit (4 days). Besides, permission is granted to import annually 80,000 hogs for immediate slaughter, 50,000 of them to the boundary abattoirs of Bavaria, namely, Passau and Rossenheim, and 30,000 to the abattoirs of Bodenbach lying on the boundary of Bohemia. The meat of these hogs is permitted to be sold only at certain places. The importation of cattle from Austria-Hungary was fundamentally regulated in the agreement on contagious diseases between the German Empire and Austria-Hungary of January 25, 1905, which went into effect March 1, 1906. Accordingly, the allied states have issued special regulations.

2. Hogs from Russia may be imported weekly in exactly specified numbers into certain abattoirs at Benthien, Kattowitz, Myslowitz, Tarnowitz.

3. Cattle from Denmark may be brought to specified quarantine stations, in which they remain 10 days for the purpose of a tuberculin test. After this time, the cattle which failed to react to the tuberculin test may be shipped for immediate slaughter to the abattoirs which are open for Austro-Hungarian cattle. The reacted cattle cannot be utilized in Germany, but must be again exported.

The result of the post-mortem inspection of the cattle slaughtered must be submitted to the quarantine authorities, and those animals found to be tubercular must be particularly specified. (Proclamation of the Imperial Chancellor of February 21, 1898, in relation to the procedure of imported cattle by the sea route from Denmark and Sweden-Norway.)

4. Cattle from Switzerland accompanied by health certificates.

5. Exceptionally cattle, sheep, goats, and hogs from Luxemburg brought to several public abattoirs of Alsace-Lorraine for immediate slaughter.

The importation of prepared meat in accordance with the imperial meat inspection law when there are no restrictions in the meat inspection law and in the laws on infectious diseases of animals, may be permitted from any country. Regarding the importation of fresh meat, there are no veterinary police prohibitions against the importation of all sorts of fresh meats from Russia, Roumania, Servia, and Bulgaria, also of fresh beef from America. The importation of cattle from North America is prohibited. Sheep and hogs are subjected to a quarantine of 4 weeks.

[The importation of meat and meat products into the United States is subject to Regulation 32, Section 11, of the Rules and Regulations for the enforcement of the "Food and Drug Act," which is determined in the following:

Regulation 32. Imported Food and Drug Products

(Section 11)

(a) Meat and meat-food products imported into the United States shall be accompanied by a certificate of official inspection of a character to satisfy the Secretary of Agriculture that they are not dangerous to health, and each package of such articles shall bear a label which shall identify it as covered by the certificate, which certificate shall accompany or be attached to the invoice on which entry is made.

(b) The certificate shall set forth the official position of the inspector and the character of the inspection.

(c) Meat and meat-food products as well as all other food and drug products of a kind forbidden entry into or forbidden to be sold, or restricted in sale in the country in which made or from which exported, will be refused admission.

(d) Meat and meat-food products which have been inspected and passed through the customs may, if identity is retained, be transported in interstate commerce.]

D. Insurance Methods of Food Animals

As the insurance of food animals is of great importance to the trade in food animals, as well as to the ante-mortem and post-mortem meat inspection, and as the experts on meat inspection have frequently to cooperate in this matter, it seems advisable that the methods of insurance should be at least superficially treated at this time.

The insurance of food animals may be carried out in many various forms. These are distinguished in accordance with their territorial bounds as local, regional, provincial, and continental insurances. Regarding the managements, there are private,

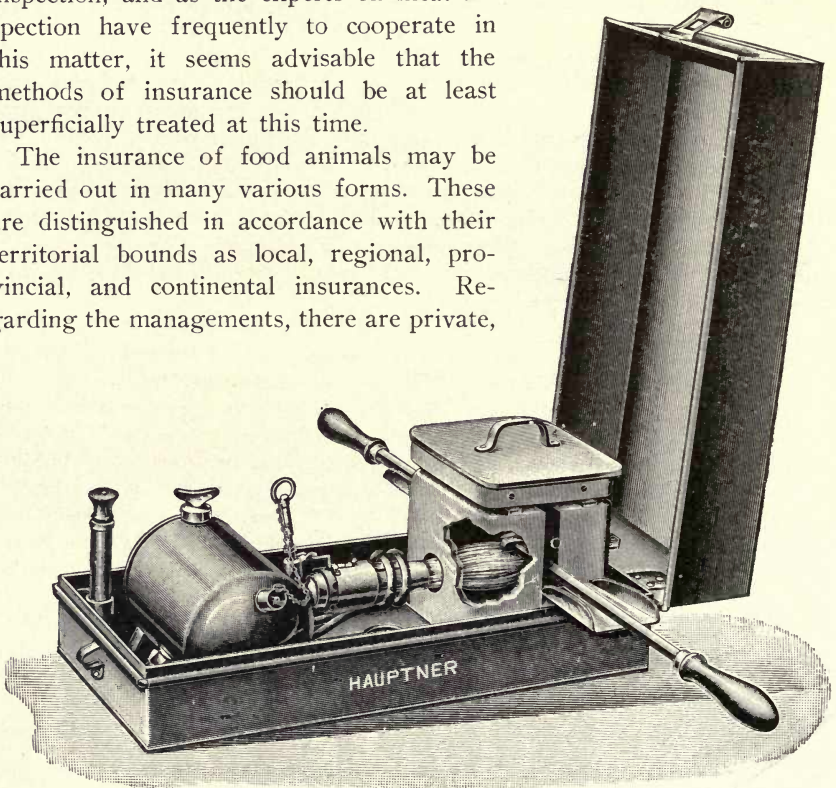


Fig. 3. Large benzine apparatus for heating irons (Hauptner-Ber.in). The flame passes into a box lined with fire-clay, which accommodates two firing irons; they are heated in a few minutes to a red heat. Size of the apparatus, 53x22x18cm, weight, 14.5 kg.

cooperative, community, and state insurances. The participation in the insurance may be voluntary or compulsory; in the same way it may be extended to all the food animals or only to a certain species of them. The

insurance premium is, as a rule, a certain sum decided upon, and is paid for every animal at the place where the animals are marketed or slaughtered; and in either instance it is supposed that the animals are examined by an expert and found in condition for the acceptance of insurance. This is occasionally manifested by a special marking of the live animals, and

Figs. 4 and 5. Anchor ear tags, according to Schumann. The tags, which are also supplied in white or colored tin, can be easily marked or numbered with a steel needle. The tags are also supplied with any kind of marking which may be desired.

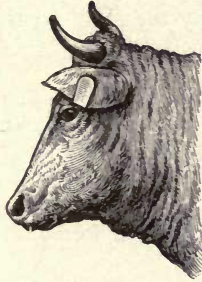


Fig. 4



Fig. 5

for this purpose branding on the horns or claws (Fig. 3), or the use of ear tags, is considered the most appropriate (Fig. 4-7). Such marking may also be applied to small stock. For live hogs the pricking stamps, with or without stains (Fig. 8), are highly satisfactory, or tattooing pinchers, with which markings are applied to the ears (Fig. 9).

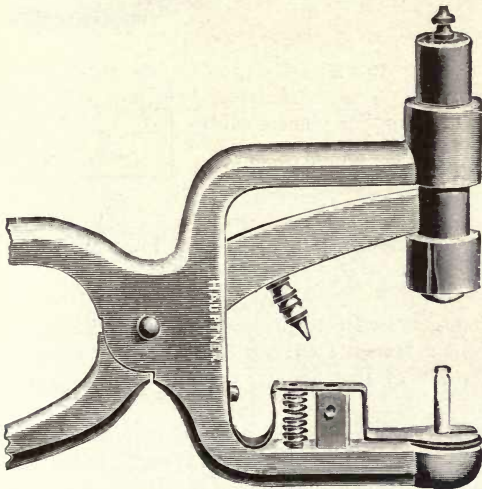


Fig. 6

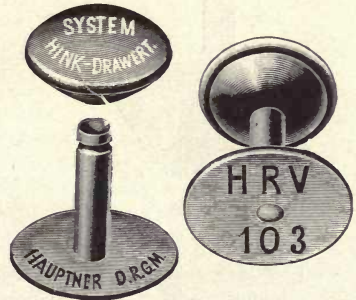


Fig. 7

Fig. 6 and 7. Improved ear tags, according to Hink-Drawert, of the firm of Hauptner-Berlin, with nippers for inserting the tags.

The insurance company pays indemnity, as a rule, only when the entire carcass, or a large part of it, is declared unsuitable for human food, or is only conditionally passed by the veterinary inspector. Then the indemnity is paid, mostly to the full value of the animal, which is determined either from the declared sales price, or after slaughter by the estab-

lishment of the weight and the estimation of the quality of the meat. Besides this many insurance companies remit the expenses which result from the charges for slaughter and other fees in connection with the latter. Other insurance companies allow only a certain proportion of the value of the animal as indemnity. Such insurance measures established by the state and supported by the state treasury, are at the present maintained in the following states:

1. In the Grandduchy of Baden, the townships are authorized by the law of June 26, 1890, and that of 1901, to establish insurance for the cattle stock locally or cooperatively, which numbered at the end of 1899, 185. In case of death $\frac{7}{10}$, and in case of emergency slaughter, $\frac{8}{10}$ of the value is allowed.

2. In the kingdom of Bavaria the law of May 12, 1896, established a public chamber of state stock insurance which forms the central place for the volunteer

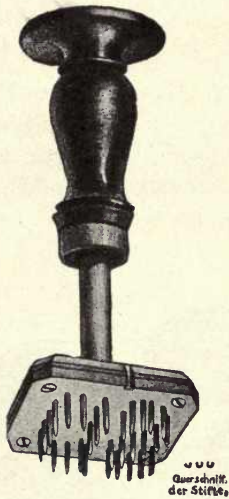


Fig. 8

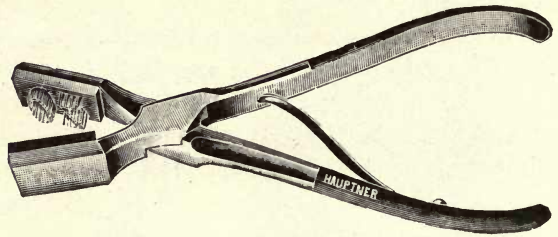


Fig. 9

Fig. 9. Tattooing pincers with two letters and impression, after Hauptner-Berlin.



Fig. 8. Pricking stamp with hollow probe-like pins, according to Siedamgrotzky.

and township stock insurances which are united into the state union. The insurance indemnifies for dead or condemned slaughtered cattle at $\frac{7}{10}$ to $\frac{8}{10}$ of their value. Such insurance included in the fall of 1901 about 1,551 township insurance associations.

3. In the kingdom of Saxony, these regulations have been somewhat modified by the law of April 24, 1906, which went into effect January 1, 1907. There was simultaneously with the introduction of the general animal and meat inspection law of June 1, 1900, a state food animal insurance established through the law of June 2, 1898, with the provisions for execution of July 24, 1899. All cattle and hogs over 3 months of age coming for slaughter, which have been a certain time in the territory of that state are subject to this state insurance. As indemnity for the animal condemned on meat inspection or those passed conditionally $\frac{8}{10}$ of the loss is allowed, which is obtained by deducting the actual value of the slaughtered animal from the market value of the dressed weight, and which is officially established at regular intervals for the various species.

4. In the principality of Schwarzburg-Sonderhausen a state food animal insurance was established October 1, 1900. This applies to cattle, calves, and hogs. The unwholesome meat and that of inferior quality are paid for at their full value.

5. In the principalities of Reuss a state food animal insurance is maintained, based on the laws of March 10, 1903, and March 12, 1903, with regulations of May 15, 1903, which went into effect on July 1, 1903. All cattle and hogs (including calves), which are slaughtered in the principality, and which are sold for the purpose of slaughter, must be insured. The indemnities of the condemned animals amount to the full value, but no settlement is made for losses less than \$1.25.

6. In the Grandduchy of Hessen the law of April 12, 1905, contemplated a state food animal insurance, but lately it is doubtful whether it will go into effect. The insurance is compulsory on all cattle over three months of age, which are slaughtered for commercial purposes, or if the animal had to be immediately slaughtered on account of some injury. The indemnity for carcasses condemned, conditionally passed, or of inferior value, is established by the full value of the carcass from which deductions are made of the actual value of the utilizable parts.

It belongs to the urgent duties of every veterinarian connected with meat inspection to familiarize himself thoroughly regarding the insurance of food animals and their regulations in the territory to which his activity extends, in order that he may not commit errors, but act as an expert adviser to the interested parties.

[There is no food animal insurance carried out at present in the United States, but inasmuch as such splendid results have been obtained in the different countries of Europe by the above-described methods of insurance it is quite probable that in the course of time an insurance will be established which will protect the packers and shippers from the great losses sustained from the transportation and condemnation of food-producing animals.]

E. Conditions of Obligations. (Guarantee)

Regarding the guarantee obligations against certain affections in purchased animals, it is necessary to refer to the citizens' law book, which prescribes the obligations of the seller in regard to some affections. According to Sec. 482, the seller is responsible only for certain deficiencies (principal deficiencies), and only then when they appear inside of a certain time (guarantee limit). The principal defects and guarantee limits for trade in food animals are given below in Sec. 2 of the imperial decree, March 27, 1899.

For the sale of animals which are to be slaughtered and are destined as food for human beings (food animals), the following principal defects are to be considered:

I. In horses, asses, and mules: glanders (farcy) with a time guarantee of 14 days.

II. In cattle: tubercular affections. In cases where they are due to the extension of the disease, half of the dressed weight is condemned or is allowed only conditionally for human food with a time guarantee of 14 days.

III. In sheep; general dropsy with a time guarantee of 14 days; under general dropsy is to be considered a dropsical condition of the meat, brought on by an internal affection or by insufficient nutrition.

IV. In hogs:

1. Tubercular affections as mentioned in No. II, with a time guarantee of 14 days.
2. Trichinosis, with a time guarantee of 14 days.
3. Measles (*cysticercus cellulosæ*), with a time limit of 14 days.

[In the purchase of live stock in the United States, no guarantee, as a rule, accompanies the transaction, with the possible exception of the custom followed in certain localities whereby the stock is bought subject to post-mortem inspection. This method, however, is generally applied only to wagonloads of hogs, and animals which have been tuberculin tested and have reacted to the test. Furthermore, the animals which are condemned or marked as inspected by state inspectors in certain stock yards are also sold subject to the post-mortem examination of the Federal inspector. The practice which formerly obtained with reference to the resale to other packers of animals marked as suspected by a Federal ante-mortem inspector, does not obtain under the new law, as at present all ante-mortem inspections are made by the Government only after the animals have been sold to the packer who wishes the carcasses, and such suspect animals are then killed separately from the regular kill.]

F. Age of Food Animals

In the inspection of animals and meats, strictly speaking, only the age of calves plays an important part, while the age of other food animals is of minor value.

1. The age of calves is of importance, since in the largest part of Germany it is accepted by the public that veal comes on the market in a certain state of development when it has attained the proper maturity for slaughter (See B. A. I. Order 150, Regulat. 13, Sec. 27). And as in general this fitness for slaughter is only reached in calves after a certain age, it is left for the veterinary inspector to decide the age of calves in doubtful cases. For establishing the age in calves the following should be considered.

(a) Calves, according to Pusch, are born with 8 milk incisors and the pre-molar teeth. Should the corner incisors at the time of birth be covered by the mucous membrane, so that their presence can be both seen and felt, they will break through in 2-6 days. While in the beginning the highly reddened gum lays closely on the incisors and almost covers them, after 7-10 days it recedes gradually, so that the shovel form of the incisors becomes more and more apparent. In this way, after two weeks the shovel form appears free in the central and first lateral incisors;

soon this is followed on the second lateral incisors, and finally after 3-4 weeks on the corner teeth. At the age of one month all the crowns of the incisors grow entirely out of the gum, which retains its permanent pale-pinkish red color, and lays against the crowns of the incisors in the form of the characteristic pad.

(b) The stump of the navel cord, which remains on the newly born calf, dries in the first 4-6 days, and separates from the abdominal wall in the second week of life, leaving a moist, sensitive surface, which is soon covered by a scab. In 2-3 weeks the cicatrization of the navel wound takes place, from which the scab falls off generally inside of the 4th-5th week. Exceptions to this rule may occur, and are frequently caused by inflammatory suppurative processes of the navel.

(c) During the first week of life the lumen of the navel vein is found to be still wide open and filled with liquid blood.

(d) The soft, arched pad on the sole of the claws of the newly born calf becomes hard in the first days after birth and wears off in proportion to the amount of moving about that is done by the animal.

(e) The formation of the horns on the frontal bones appears, according to Gerlach, from the third week on in the form of a slight thickening of the skin at the place where the horns appear. By the fifth week the hair becomes scanty at these points, and at the end of the second month the horn cap makes its appearance. After three months a movable horn point may be distinguished, which in heifer calves is 2 cm. long, while in bull calves it is 3 cm. long. The fixed condition of the small horns appears in bull calves after 4 months, and in heifer calves after 5-6 months.

(f) The change in the color of the kidneys, described by Villain and Bascou for establishing the age of calves, is not admissible inasmuch as it is not typical.

(g) Morot has also attempted to connect the ossification of the metacarpal and metatarsal bones with the establishment of the age in calves. In calves up to 5-6 weeks of age the longitudinal halves of these bones separate if they are cut or strongly boiled. The surfaces of separation are rectilinear, but uneven and wrinkled. Each half of the bone shows its special marrow cavity.

In deciding whether the calf is old enough for slaughter the above-mentioned signs to determine the ages of calves may be supplemented by considering the consistency of the meat and fat, which in doubtful cases is the only guide for the inspector.

Regarding the peculiarities of mature veal, see Chap. II; the signs of immaturity are given in Chap. VII, 1.

Although the age of the other animals, as already mentioned, is of minor importance in meat inspection, the following tabulated exhibit

Tabulated comparisons of the eruption and the replacement of the teeth.¹

	Horse ²	Cattle ³			Sheep and goats ⁴	Hog			Dog ⁵	Men
		Early mature breeds	Normal breeds	Late mature breeds		Early mature breeds	Normal breeds	Late mature breeds		
1. Incisors, Eruption of central incisors (I ¹)	Before or in the first 2 weeks after birth	Before birth	Before birth	Before birth	Before or in 1st week after birth	2 weeks....	3-4 weeks... 5 weeks....	From 5-6 weeks (3-4 weeks according to Cornevin and Lesbrye)	6-8 mos.	
Eruption of first lateral incisors (I ²)	At an age 2-4 weeks more sedentary 4-8 weeks	Before birth	Before birth	Before birth	From 8-14 days...	{ Adv. 8 wks Bel. 5 wks	12 weeks... 16 weeks... 8 weeks.... 12 weeks....		7-9 mos.	
Eruption of second lateral incisors of ruminants	Absent.....	Before birth.	Before birth	2-6 days...	From 10-21 days...	Absent.....	Absent....	Absent.....	Absent	
Eruption of the corner incisors (I ³) in horse, hog, dog (I ⁴) and ruminants	At the age of 5-9 months	Before birth.	2-6 days...	2-14 days...	From 3-4 weeks...	Before birth.	Before birth	Before birth	Absent	
Replacement of the central incisors	At the age of 2½-3 years	17 months....	21 months..	25 months..	From 12-16 sometimes 18 months	11 months...	12 months.. 14 months..		8 years	
Replacement of the lateral incisors	At the age of 3½-4 years	22 months...	27 months..	32 months..	From 1½-2 years.	{ Above 16. Bel. 16 mos	18 months.. 20 months.. 17 months.. 18 months..	All 6 incisors at age from 2-5 months mostly at 5 months	9 years	
Replacement of the second lateral incisors	Absent.....	32 months....	36 months..	40 months..	From 2½-3 years.	Absent.....	Absent.....		Absent	
Replacement of corner incisors	At age of 4½-5 years	36 months....	45 months..	52 months..	From 3¾-4 years.	7-8 months...	9 months... 10 months.		Absent	
2. Canine teeth, Eruption of the temporary canines	Are soon present, at latest 6 months after birth. As a rule eruption does not take place	Absent.....	Absent....	Absent.....	Absent.....	Before birth.	Before birth	4 weeks.....	16-20 mos.	
Eruption of the permanent canines	At the age 3½-5 years	Absent.....	Absent....	Absent.....	Absent.....	8½ months...	9 months... 10 months..	4 ½-5 ½ months....	11-13 years	

3. Molar teeth. Eruption of the first molar (P3)	Before or one week after birth	After a few days	14-21 days.	Before or in the first 4 weeks after birth	5 weeks.....	7 weeks....	9 weeks....	From 5-6 wks. Absent (according to Cornelin & Lesbre, P3 after 4-5 wks. & P2 & 1 after 3-4 wks.)
Eruption of the second molar (P2)								
Eruption of the third molar (P1)								
Replacement of first molar (P3)	At the age of 2½ years	24 months..	26 months..	28 months..	13 months..	14-15 mos..	16 months..	From 5-5½ mos. Absent (according to Cornelin & Lesbre, P3 10 years mo. P1, after 5-6 mos.)
Replacement of second molar (P2)	At the age of 2½ years				12 months...	13-14 mos..	15 months..	
Replacement of third molar (P1)	At the age of 3½-4 years	of 28 months...	31 months..	34 months..	12 months...	13-14 mos..	15 months..	11-15 years
Eruption of fourth molar (M1)	At the age of 6-9 months, sometimes up, to 14 months	5 months....	5 months....	5 months..	3 mos. in lower jaw, 5 mos. in upper jaw	4 months....	5 months....	4-5 months.....
Eruption of fifth molar (M2)	At the age of 2½ years	10 months...	10 months..	18 months..	9-12 months.....	9-10 mos..	12-13 mos..	5-6 months.....
Eruption of sixth molar (M3)	At the age of 3½-4½ years	of 24 months...	26 months..	28 months..	1½-2 years	17 months...	18-19 mos..	20-22 mos..
Eruption of the wolf teeth	Uncertain, mostly in first half year of life	Absent.....	Absent.....	Absent.....	Absent.....	4 months....	5 months....	6-7 months.....

(1) Information regarding the eruption and replacement of the teeth was obtained for this table from Deutsche Landwirtschafts Presse, 1899 u. 1900. Cornevin et Lesbre, Traite de l'age des animaux domestiques, Paris, 1894. Rauber, Anatomie des Menschen, Leipzig, 1897, and elsewhere.

(2) In the horse as the incisors of the upper jaw are from 2-8 weeks earlier replaced than those of the lower jaw. In early mature horses the replacing of the teeth occurs generally 2 months earlier than in late mature horses (Frauck-Martin, Anatomie).

(3) Regarding the temporary teeth of calves, see also p. 16.

(4) In the goat the incisors are replaced somewhat earlier than in sheep. It is generally accepted that a goat is as many years old as there are pairs of temporary incisors present. Accordingly, a goat in which the corner incisors are replaced would be four years old. Sometimes in the sheep the second lateral replaced, at 3 years the first laterals appear, at 4 the second laterals, and at 5 all 8 incisors are present.

(5) Sometimes it appears at 4 weeks or even earlier (Nathusius).

(6) According to Cornevin-Lesbre, large breeds of dogs are a few weeks ahead in the replacing of teeth compared to small breeds. Also considerable difference might exist through the influence of the various breeds. The wearing of the teeth is subject to considerable irregularities, depending on the food habits, etc., of the dog.

should furnish some information in regard to the age of food animals as determined by the teeth (Ellenberger and Baum, *Handbuch der Anatomie*).

As the appearance and change of the teeth are influenced in our domesticated animals by breed, precocity and care, it is evident that in determining the age in doubtful cases special works on animal breeding and anatomy should be consulted.

It is a well-known fact to all veterinarians that with the aid of the rings on the horns of the cow, which develop from the influence of pregnancy, an inspector may be able to determine the age up to a certain point. Two, added to the number of rings present on horns of the cow, will generally give her age. This applies to cases in which pregnancy appeared regularly. Irregular distances between the rings are indications of irregular intervals between pregnancies.

For determining the age of slaughtered cattle, certain points of ossification, and especially the cartilaginous extensions of the first 4-5 spines of the dorsal vertebræ, may be advantageously utilized. On the split extensions of the vertebral spines the following changes are manifested with the advancement of age:

- 1 year, cartilaginous extension entirely cartilaginous;
- 2 years, cartilaginous extension interwoven with small single bone centers;
- 3 years, cartilaginous extension diffused with bony islands;
- 4 years, cartilaginous extension more so;
- 5 years, the bony structure exceeds the cartilage;
- 6 years, the cartilaginous extension almost entirely ossified; however, the cartilaginous border can be plainly distinguished between the bony process and the cartilaginous extension;
- 7 years, the cartilaginous border zone still plainly visible;
- 8 years, the cartilaginous border zone only slightly perceptible;
- 9 years, all cartilage disappeared.

The ossified cartilaginous extension is, however, of a lighter color and more compact than the bony substance of the vertebra proper, but sometimes there forms in the bony substance of the former cartilaginous border a narrow red zone. If, therefore, the first spinal extensions in their upper third are uniformly compact, the cow is at least 10 years old. If the age exceeds 12 years, the spinal extensions gradually change into a grayish-yellow compact bony substance.

G. Slaughtering of Animals

The commercial slaughter of animals begins with the killing, which in Germany is generally carried out by bleeding. The latter must be done as thoroughly as possible, since the contents of the blood in the meat influences its keeping qualities. The most thorough bleeding is accomplished when the heart and respiratory functions remain in action as long as possible. As both these functions depend principally on the intactness of the medulla oblongata with the respiratory, cardiac and vaso-motor centers, those methods of killing will prove the most satisfactory in which the medulla oblongata is not injured. From a humanitarian standpoint the withdrawal of blood should always be preceded by stunning the animals, which, as a matter of fact, is carried out in almost all cases with the exception of those slaughtered in accordance with the Jewish rite.

As a result of the stunning the excessive struggling of the animals is prevented, and in consequence the dangers for the butchers from such struggling are also averted.

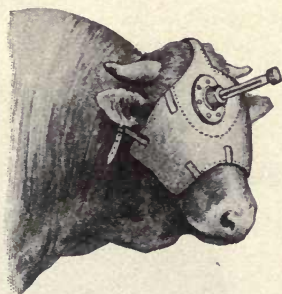
The following killing methods are distinguished as a result of the different methods of stunning:

1. Killing Methods with Stunning

(a) The blow on the head (forehead blow) is carried out with a slaughter ax, heavy wooden club, or hammer. It may be employed on all food animals, and causes, when proficiently applied, an immediate insensibility of the animal.

The action of the blow on the head depends on the position of the brain in the various animals and its greater or lesser protection by the cranium. In the horse, the conditions for stunning with the blow on the head are the most favorable, as the brain is practically only covered by the comparatively thin bone plates formed by the frontal and parietal bones. Therefore, a blow directed at this point will act directly on the brain. Similar conditions obtain in sheep and goats; in these animals, however, it should be remembered that the strong roots of the horn processes of the temporal bone strengthen considerably the cranial roof, and besides the effect of the blow in sheep is also diminished by the wooly covering. The brain in these animals is more easily reached from the base of the head than from the forehead. In cattle, as it is well known, the frontal bone also forms the entire brain covering, which, on account of the strong development of the frontal sinuses, is divided into a lateral and median lamella. The effect of the blow is broken by the frontal sinuses, and the farther the blow strikes from the middle point, the less effective it will prove. The proper point to strike is located where the diagonals from the base of the horns to the opposite orbital arches cross.

These anatomical peculiarities do not interfere in calves, as the undeveloped soft skull does not resist the blow to any marked degree. While the roof of the cranium in hogs is similarly constructed to that in cattle, due to the prominent development of the frontal sinuses, yet these anatomical relations play no special part, as the majority of hogs are slaughtered at a young age, when the roof of the cranium is not very compact. Only in races of hogs with a strongly protruding skull and retreating face is the bony development of the skull very marked, and in these frequently the front part of the head is covered with thick, wooly hair, which considerably diminishes the effect of the blow.



(b) The frontal blow with a slaughter ax or bolt hammer is executed by the use of a short ax, to which is fastened a round, chisel-shaped bolt, and this is driven into the brain. The application of this apparatus, which in general is not to be recommended, requires skill in sure hitting and much strength.

(c) The frontal blow with the application of the so-called slaughter mask. The construction of this apparatus can be seen in Fig. 10, and is employed exclusively on cattle.

The bolt is driven into the brain, causing the animal to collapse immediately. Russling prefers a strong, hollow cylinder to the solid bolt. Other slight changes in the mask have been undertaken occasionally. After the removal of the mask, as a rule a small piece of cane is introduced in the opening of the cranium in order to destroy further the posterior portion of the brain. This is also usually carried out in the use of the previously described apparatus, which, however, is absolutely

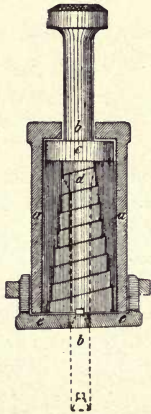


Fig. 11. Vertical section through Kleinschmidt's spring-bolt apparatus : *a*, iron covering ; *b*, bolt ; *c*, groove ; *d*, spring ; *e*, head piece.

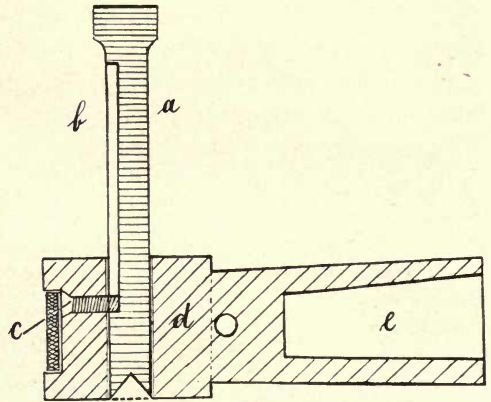


Fig. 12. Vertical section through a bolt apparatus, according to Kögler : *a*, bolt ; *b*, groove ; *c*, screw for the bolt ; *d*, iron middle cylinder ; *e*, eye for opening the wooden handle.

unnecessary when the bolt is driven at the right place into the brain. While the convulsive struggling which results from the introduction of the small piece of cane into the brain has a repulsive effect, there is total absence of consciousness. The statement of Dembo, in which he expressed his doubt regarding the reliability of the slaughter mask, may be considered as disproved through the statistics compiled by Siedamgrotzky.

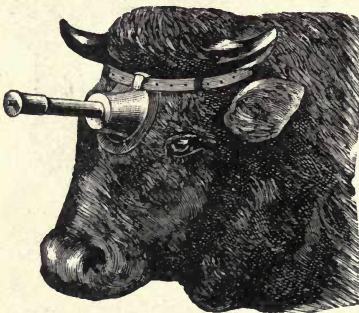


Fig. 13. Head of bull with shooting apparatus attached, according to Staehl-Stoff.

(d) The blow on the forehead with the spring-bolt apparatus designed by Kleinschmidt, or with the bolt apparatus of Kögler, is used for the stunning of hogs and sheep (Fig. 11 and Fig. 12).

(e) Killing of food animals with bullet-shooting apparatus. The oldest instrument belonging to this class was originated by Siegmund. A similar apparatus without the leather mask has been placed on the market for several years by various firms according to Staehl's patent (Fig. 13). Lately, similar instruments

have been made for use on hogs and small stock.

(f) Shooting with the latest shooting-bolt apparatus designed by Flessa, Liebe, Schrader, and further with Behr's bolt pistol, etc., which, by

the pressure of the gases from the powder of an inflammable shell, drives a bolt into the brain in a similar way as the blow-bolt apparatus (Fig. 14). Flessa's bolt-shooting apparatus is very simple, inasmuch as the discharge occurs only on the head of the animal to be killed through the ejection of

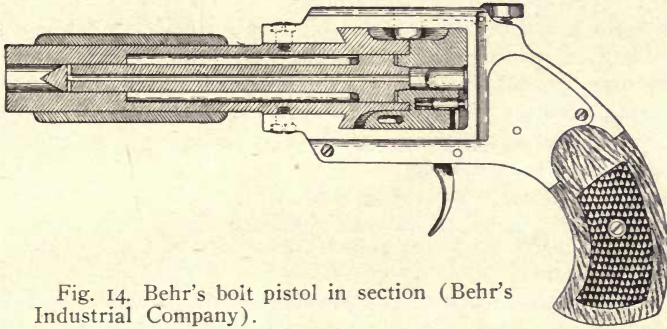


Fig. 14. Behr's bolt pistol in section (Behr's Industrial Company).

the bolt which extends for about 1 cm., whereby the other sharpened end of the bolt causes an explosion of the strongly active copper cap. On account of the slight danger from the bolt-shooting apparatus, they should be preferred to the bullet-shooting apparatuses.

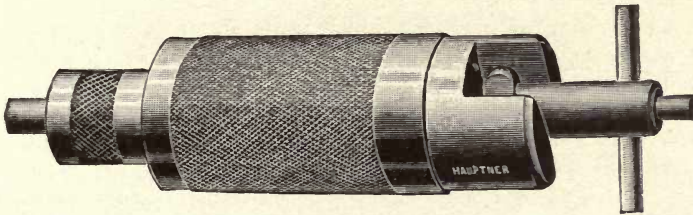


Fig. 15

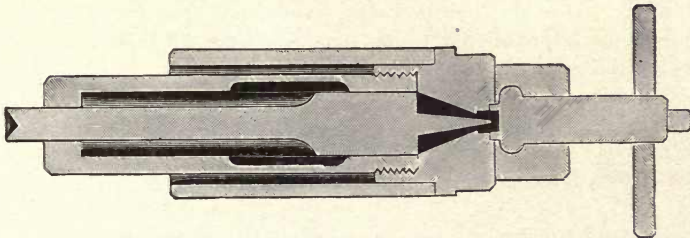


Fig. 16

Fig. 15 and 16. Bolt-shooting apparatus by abattoir director Flessa. Outside view and longitudinal section (Hauptner-Berlin).

(g) The blow on the base of the head is carried out with an ax, cleaver, club, or with the end of a heavy hammer. The stunning results from the contusion of the brain. This method is the simplest for large-horned or aged sheep and goats.

2. Slaughtering Method without Stunning

(a) In pithing, a strong knife is stuck between the atlas and occipital bone and the medulla oblongata is thereby severed or injured. The animals collapse immediately. They are, however, not stunned but only helpless, inasmuch as conscious movement is arrested. Unconsciousness only takes place when, after subsequent bleeding, the resulting cerebral anemia has reached a certain degree. The bleeding of such "pithed" animals is sometimes unsatisfactory, due to the injury of the vasomotor centers, also of the heart and respiratory centers in the medulla oblongata. The pithing, therefore, should be discarded from a humanitarian as well as from a practical standpoint.

The above-mentioned "blow on the base of the head" has the disadvantages of pithing only when the blow has not been sufficiently strong to produce a contusion of the brain.

(b) "Schachten" (from the Hebrew verb "schachat," to draw; to draw the knife to and from), is the oldest slaughtering method, and is applied by the Jews and Mohammedans on cattle and small stock.

For this purpose the animals are secured and thrown, and then follows the cutting of the throat with a very sharp knife with a wide blade. The latter is performed by an especially appointed member of that faith. Death of the animals occurs through the slow loss of blood from the large vessels of the neck. The throwing and securing of large and strong cattle are frequently associated with difficulties and dangers for the butchers, and accompanied generally by considerable cruelty to the animal. Since the middle of the last century much argument has been carried on regarding the advantages and disadvantages of the Jewish method of slaughter from a humanitarian, physiological, and hygienic standpoint, and also as to its authority from a religious consideration, which will not be further discussed here. It should only be mentioned that shectering, without previously stunning the animal, was prohibited in the Kingdom of Saxony and in Switzerland, a regulation which, from the humanitarian standpoint, should receive the fullest approval. Further information may be obtained from the extensive works and publications on this subject.

For diminishing the cruelty in throwing animals, various apparatuses have been constructed, which, however, are only slightly improving the repulsiveness of the Jewish method. The same can be said in relation to the equipment now in use for the stretching of the neck and head before shectering by the so-called headholder.

It should also be mentioned that experiments have been made to kill animals with electricity. (Bockelmann.)

To improve on the securing of hogs for stunning Renger constructed a slaughtering machine, which can be utilized to only a very limited extent.

For acquiring steadiness in taking aim on the part of the butcher apprentices, various apparatuses have been constructed. They are even supplied with an indicator registering the force of the blow, and are maintained by the butchers' associations of larger cities. On these machines the apprentices receive their instruction and practice in striking.

3. Bleeding

Extraction of the blood is accomplished in large stock and hogs by cutting the blood vessels at the entrance of the thoracic cavity; in small stock by sticking in the neck or cutting the throat. The latter is also sometimes employed in cattle, especially when slaughtering them in accordance with the Jewish rite (Schachten). As the preserving qualities of meat depend considerably on thorough bleeding this should be as complete as possible. It depends on the following conditions:

(a) The health of the animal considerably influences thorough bleeding as all severe affections weaken the vitality, which involves the action of the heart, respiration, and muscles, thus influencing the driving out of the blood. Especially is bleeding retarded in febrile conditions of food animals, also in cases of severe indigestion, acute disturbances of the portal circulation, and severe lung and heart affections. As a rule animals so affected bleed out very poorly.

(b) Sufficient rest of the animals before slaughter is also essential to assure a thorough bleeding. Animals that are excited or are thoroughly tired out usually bleed out insufficiently.

(c) Strong and long continued respiratory and heart action, as well as energetic convulsions of the body muscles favor thorough bleeding for reasons that must appear self-explanatory. As these functions are regulated by the central nervous system and especially by the medulla oblongata the thorough bleeding depends to no small degree upon the—

(d) Slaughtering and stunning method, which favorably influences bleeding when the medulla oblongata remains intact.

(e) The performance of sticking or cutting considerably promotes or retards the bleeding. When thoracic bleeding is performed the heart must not be injured, and also bleeding into the thoracic cavity must be prevented (over-sticking), as compression of the heart and lungs takes place through the quick accumulation of blood in the chest cavity.

The anemic state of the arteries and large and medium vein trunks is not the only indication of thorough bleeding, but what may be considered as more important is a certain dryness of the parenchymatous organs and especially of the muscles. Only a few drops of blood can be obtained on pressure of the cut surfaces and only in the smallest veins can there be found traces of blood.

The quantity of blood, which averages $\frac{1}{3}$ of the body weight, naturally cannot be totally abstracted; however, the larger portion of it may be withdrawn. The quantity of the blood depends on the sex, size, and nutritive state, and on the above-mentioned conditions, which may influence the bleeding of the slaughtered animals. The quantity of the withdrawn blood amounts in cattle to 15-25 liters; in horses, 20-30; in hogs, 2-3; in small stock, $1\frac{1}{2}$ liters. In hogs the quantity of blood is considerably diminished with the increase of fat on the animal.

Various experiments have been made regarding the quantity of blood drawn from slaughtered animals. Heissler found the quantity of blood from horses to be 3.93-9 per cent. of their body weights; in cows, 4.02-5.75 per cent.; in calves, 4.40-6.65 per cent.; in sheep, 4.37-7.56 per cent.; in hogs, 1.45-5.74 per cent. According to Goltz the quantity of blood amounted in cattle to 3.1-3.3 per cent. of the body weight; in calves, 4.9-5 per cent; in sheep, 4.1-4.3 per cent. At the same time Goltz established that the method of killing—whether the animal was slaughtered in accordance with the Jewish rite or whether the withdrawal of blood is preceded by stunning—has no influence on the quantity of blood flowing from the animal. The same results were obtained by Falk, who also believes that cows possess a larger quantity of blood than heifers, or even bulls and steers. Fjelstrup determined the quantity of blood by washing out the blood vessels with salt water infusions, according to a special formula.

The blood from animals slaughtered by cutting the throat is as a rule polluted with the vomited contents of the stomach, and therefore cannot be utilized for human food. (B. A. I. Order 150, Regul. 13, Sec. 1.)

4. Further Dressing of Carcasses

Regarding the further course of commercial slaughter the following brief notations may contain some information. [The extent of the dressing and cutting with consideration for the intended post-mortem inspection is established by B. A. I. Order 150, Regulation 12, Sec. 1-3.]

Cattle and horses are partly skinned while on the floor. This is then followed by the removal of the feet in the carpal and tarsal joints, and of the head. (At this time the horns of cattle are chopped off in order to remain on the skin). The abdomen is cut for a short distance along the median line for the removal of the connected masses of fat of the mesentery. After the penis, scrotum, or udder is cut off, the breastbone and the pelvis sawed, the latter in the symphysis, the animal is hoisted with the aid of a beam which is inserted through an opening made between the tendo-Achilles and the metatarsus bone, or by hooks which are inserted into the same openings. The carcass is then further skinned and finally eviscerated, leaving only the kidneys. In the process of evisceration (gutting) the uterus and bladder are first removed, followed by the intestines and mesentery; then the stomach (or stomachs), with the adherent spleen, then the liver and finally the heart, lungs, and trachea. In some places the liver and parts of the diaphragm are removed together with the thoracic viscera (in U. S.). From the head the brain is removed and the tongue is separated from the connection with the lower jaw, in such a way that the buccal and laryngeal cavities become entirely exposed. With hogs, which are subjected to so-called scalding in water at 60°-70° C., the hair and epidermis are loosened, which may then be removed by scraping. After washing and hanging by the flexor pedis tendons of the hind legs, the evisceration takes place. Only the kidneys are left in place, provided they do not come out with the removal of the retroperitoneal layer of fat (leaf lard). Stomach and intestines remain in their natural connection; also the liver, with the thoracic viscera together with the trachea, esophagus, and tongue. In France the bristles of the hog are removed by singeing. [Singeing is followed in U. S. for certain export hogs]. At present this custom appears to be declining, and is gradually being replaced by scalding. As singeing makes the examination of the skin difficult, it should be considered in Germany in accordance with the meat inspection regulation as a procedure to which the hogs should not be subjected without further consideration.

Small stock are skinned after the removal of the feet, partly while lying on a rack and partly when hung up. They are then eviscerated in the same manner as hogs; the kidneys, sometimes the liver and spleen, as well as the thoracic viscera being left in place. The inflation of carcasses of calves and sheep by blowing air into the subcutis with the mouth, bellows, or air-pump, is not so frequently carried out at present as formerly, and this also can be said regarding the inflation of the lungs with air. Meat, which shows changes through the blowing, must be declared as unfit for human consumption. Frequently calves are left with their hides on for reasons of cleanliness in transportation. As a rule, cattle and hogs are split into halves through their vertebral columns immediately after slaughter, while small stock are left intact for the time being. Until the carcasses are cooled no further cutting takes place. At this time each side of beef is transversely cut and divided into a fore and hind quarter, by which procedure the last 3 or 4 ribs are, as a rule, cut off with the hind quarter. The further cutting of the dressed meat depends on the commercial customs, which vary not only in accordance with the various species of animals, but also with different countries and localities. For further particulars on this subject, as well as the commercial designation of the various parts of the dressed carcass, see page 31.

In relation to the further manipulations in the slaughter of animals for Jews it should be briefly mentioned that a certain examination of food animals is made as to their health. In cattle the "Schachter," after the abdomen has been opened, and before the breastbone has been divided, places his arms into the thoracic cavity through an opening in the diaphragm and explores the pleura for adhesions, etc. After the removal of the internal organs from the body their further examination is made principally with the eye, but whether the carcass should be considered as pure and proper food for Israelites (kosher), depends especially upon the palpation of the lungs for abnormalities. Besides there are also certain lesions of the other viscera considered. In case the slaughtered animal cannot be passed for food in accordance with the ritual requirements, it is declared as unclean (trepha). The Kosher meat is marked for the benefit of the consumers with the Hebrew lettering **כשר** and frequently also it is sealed or stamped with the date of the slaughter. As certain large blood vessels, certain strips of fat, tendonous parts, etc., should not be consumed, these parts are removed by the "Schachter," which are designated as "Triebbern" and "Porschen" of the meat. As this would result in considerable cutting if applied to the hind quarters, and consequently would diminish the value of the meat, they are not "porsched," and are, therefore, not eaten by religious Jews. Further particulars of the Jewish ritual slaughter can be found in Goltz's History of Meat Food.

5. Emergency Slaughter

The form of slaughtering which is everywhere designated as emergency slaughter deserves special mention, and, furthermore, requires particular attention from the standpoint of sanitary police.

The emergency slaughter involves those cases of injured and sick animals where the life appears to be more or less threatened, and in order to endeavor to save the meat for human food they are hastily slaughtered. While there are various diseases which occasion an emergency slaughter, yet they may not affect the meat so as to render it unwholesome. Others again are of a doubtful character and have endangered the life and health

of numerous people. This was proven in a long series of epidemics which resulted from meat poisoning, and Bollinger rightly claims that at least $\frac{1}{3}$ of these outbreaks were in connection with emergency slaughter.

The principal causes for emergency slaughter in cattle, as shown by experience and also by the tabulated statistics of A. Maier, are affections of the digestive and sexual organs, and the infectious diseases. In small stock and hogs the latter diseases play the most important part, while in hogs, swine erysipelas is frequently the cause for emergency slaughter.

According to Lydtin's statistics meat produced by emergency slaughter involves a danger which, when compared with the meat obtained by commercial killing, is 80 times greater in cattle, 12 times in calves, 100 times in sheep, 90 times in goats, 211 times in hogs, and 3 times in horses.

Although such statistics sufficiently indicate the sanitary importance of emergency slaughter in general, this is further increased when it is considered that the emergency killings, as Ostertag rightly remarks, "include not always the typical affections, but in many instances diseases of unknown origin (cryptogenetic sepsis)." For these reasons the judging of animals slaughtered in emergency is in many cases connected with difficulties, even for the scientifically trained veterinary inspector, which frequently proves a hard test of his knowledge and conscientiousness. Owing to the dangers of emergency slaughter from a sanitary standpoint, all efforts for years were directed toward the subjection of these animals under all conditions to a veterinary inspection. It is to be regretted that the imperial meat-inspection law shows a flaw on this important point, which could easily prove serious. In accordance with this law the inspection may be omitted if the animals are slaughtered for home consumption, and it frequently happens that many instances of emergency slaughter are carried out on just such occasions. In the above-mentioned law, the limitation is made that inspection may be omitted only in those animals which before or after slaughter show no signs of disease that would render the meat unwholesome. This regulation has, however, only a limited value, as in some cases an important disease might not show striking appearances in the eyes of a layman; then again unconscientious stock owners may either disrespect the requirements of the law altogether, or in case they should be caught they could assert that the symptoms of disease manifested by the animals were not such as to warrant the opinion that the meat in consequence was unfit for consumption. And while the animals slaughtered for home consumption, and therefore uninspected, cannot be commercially utilized, yet the probable affections should be considered which might result from partaking of infected meat by the family and servants. Besides it is a well-known fact that frequently the meat of home-slaughtered animals is openly or indirectly brought to market, or is worked up for this purpose.

For these reasons it would be very desirable if the governments of the allied states should avail themselves of the authority offered them by the law, and should provide compulsory inspections even for home slaughtering, as is the case at present in the Kingdom of Saxony and other states.

By cold slaughtering is understood in butchers' circles those fraudulent manipulations, which aim to utilize carcasses of dead unslaughtered animals, as if they had been slaughtered, by performing the sticking or cutting on post-mortem. The absence of bloody infiltration of the edges of the wound and other manifestations make the detection easy for the expert.

6. Official Regulations Concerning Slaughter

For manifold reasons it would be desirable to have the appendix of the imperial meat-inspection law contain uniform regulations for the slaughter of animals. At present the following decrees are in effect:

In Prussia the ministerial decrees of December 16, 1889, and March 25, 1900, contain detailed specifications regarding the procedure in the slaughter of animals. They also contain the corresponding police regulations which exist in the various parts of the country. In the Government District Koblenz pithing is prohibited by the police regulations of September 23, 1891.

In Bavaria the procedure of the slaughtering of food animals was regulated by the order of the State Ministry of the Interior, February 19, 1890.

In Saxony the decree of the Ministry of the Interior of March 21, 1892, relative to the stunning of food animals prescribes that in the slaughter of all animals with the exception of fowls, stunning must precede bleeding.

By the order of May 23, 1891, in the duchy of Saxony-Meiningen only the "Schachten" is exempted from the decree which prescribes that stunning must precede bleeding.

The following regulations affect the "Schachten," in accordance with the Jewish rite:

In Prussia an order of the Minister of the Interior, Religion and Education, of January 14, 1889, forbids all unnecessary cruelty to animals, and prescribes special regulations for a careful throwing of the animals and safe securing of the head, etc.

In Bavaria a similar decree on this subject was issued by the State Ministry of the Interior, July 12, 1889.

In the Kingdom of Saxony the Schachten is prohibited in accordance with the above decree for that state, if it is not preceded by stunning.

In Baden the regulations regarding the Jewish method of slaughter are contained in the Ministerial decree of March 29, 1888.

In Meiningen a proclamation of May 29, 1891, prescribes the avoidance of unnecessary cruelties to animals in shectering, based upon the above-mentioned decree of Prussia.

In Switzerland the prohibition of Schachten was accepted by the state constitution after submitting the question to general vote, which resulted 187,000 against and 112,000 for the Schachten, and 11½ against and 10½ for in the votes by cantons.

[The slaughtering methods employed for cattle in the United States are preceded, with the exception of those selected for Hebrew consumption, by stunning which is carried out with a long-handled hammer. While there is no doubt that the stunning of the animals with the various above-

described apparatuses has some advantages, yet such methods could not be satisfactorily carried out in the large slaughtering centers of this country, as a large percentage of the food animals are range cattle which have never been accustomed to being handled, and therefore the attachment of an apparatus to them or even approaching them for that purpose would be not only impracticable, but an impossibility in most cases. Besides the construction of the killing pens and the skill of the men employed for this particular work of "knocking," render this method perfectly satisfactory and without any unnecessary cruelty as it occurs only exceptionally that the animal is not completely stunned with a single, well-directed blow.]

H. Utilization of Food Animals

As the utilization of all parts of a slaughtered animal which serves as human food is of the best advantage, it is, therefore, aimed to effect this utilization to the greatest extent possible. All other parts which are not suitable for food are designated as offal. While in ordinary usage most of the edible parts of food animals are erroneously included in the word meat, yet in commerce and trade the term meat, in a narrow sense, includes only the skeletal muscles with all of the organically connected parts (bones, fat, tendons, blood vessels, nerves, lymph glands, etc.), while the fat, the blood, and all viscera utilizable for human food are not considered. All these portions which partly are marketed in their fresh state, partly again worked up, naturally possess great extremes of value.

1. Meat in a Narrow Sense

The principal value of food animals lies in the meat proper,* namely in the striated or skeletal muscles, which, in accordance with their location and their coarse anatomical structure, possess different values as human food. In this valuation the actual nutritive worth of the meat is generally not considered (Chap. II), but more depends on its usefulness and flavor. The latter is principally based upon the firmness and tender character of the muscle fibers, the arrangement and contents of the connective tissue, the deficiency or richness of fat, and the amount of the extractive matter on which depends the taste of the meat. As these relations vary considerably in the different regions of the animal body, the sale value of the meat of certain parts varies likewise. This is also influenced, however, by fondness for certain cuts in different parts of the country. Corresponding with these conditions various meat qualities are

*Regarding the morphology and chemistry of meat, also the peculiarities of the meat of various food animals, see Chap. II.

distinguished in all animals, and the regional limits, valuations, and designations differ considerably in the various countries and territories.

The following attempted division of the quality limitation of meat of food animals is only considered for the principal portions, as they are distinguished by the trade all over Germany, and as they are comprehended regarding their valuations.

[*Meat Cuts in United States.*—In the United States the different meat cuts from the various food animals are sold in accordance with a certain classification, and a considerable variation exists in the market value of the meat from the different parts of the animal. But inasmuch as there is no distinct ratio as to the market value of these various meat cuts, it will be only necessary to name them, indicating also their location on the carcass in the accompanying illustrations:]

(a) *Beef* (Fig. 17)

First Quality: Tenderloin (musculus iliopsoas, invisible on the cut), sirloin (English roast), rump.

Second Quality: Double round (the median part of the round is not visible on the cut), thick flank, best ribs, chuck (only part of the same).

Third Quality: Shoulder, brisket (partly covered by the shoulder), chuck, plate, neck.

Fourth Quality: Short ribs, flank, shank, shin, head, and tail.

[In the United States the usual beef cuts are: *a* Shank, *b* round, *c* rump, *d* sirloin, *e* porterhouse, *f* rib, *o* flank, *m* plate, *h* chuck, *l* brisket, *g* shoulder, *i* neck, *k* shank.]

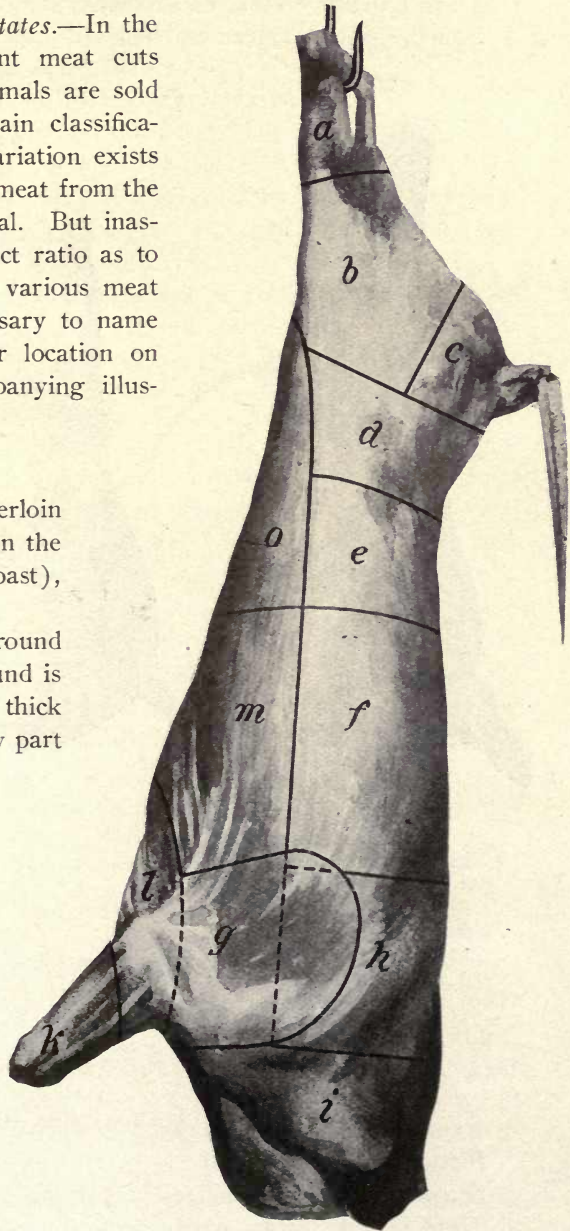


Fig. 17. Side of beef showing the commercial cuts

(b) *Veal* (Fig. 18)

First Quality: Leg (cutlet), loin roast, chops.

Second Quality: Shoulder, chuck, breast (partly covered by the shoulder).

Third Quality: Neck, flank, shank, shin.

Fourth Quality: Head and feet.

Fig. 18



Fig 19

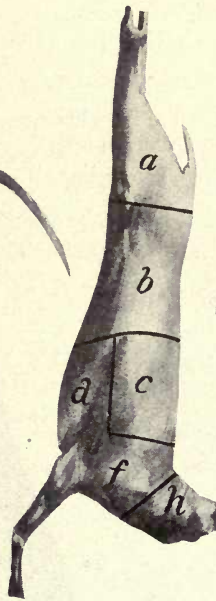


Fig 20

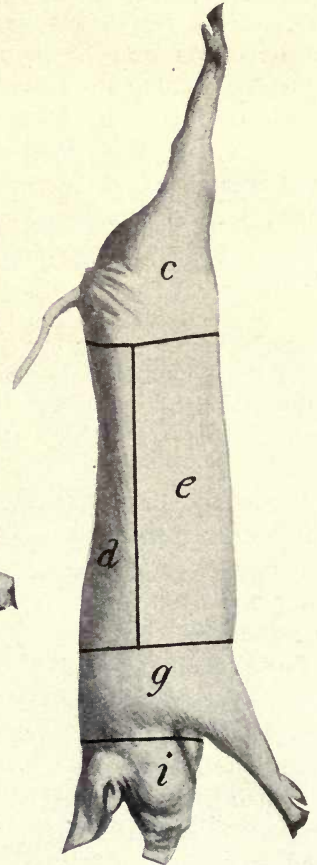


Fig. 18. Side of veal showing the commercial cuts.

Fig. 19. Side of mutton showing the commercial cuts.

Fig. 20. Side of hog showing the commercial cuts.

[In the United States the veal cuts are: *b* Leg, *d* loin, *c* flank, *e* breast, *g* shoulder, *i* neck.]

(c) *Mutton* (Fig. 19)

First Quality: Leg, loin.

Second Quality: Shoulder.

Third Quality: Ribs, partly covered by shoulder; breast, flank, neck.

Fourth Quality: Head.

[In the United States the cuts are: *a* Leg, *b* loin, *c* back and rib, *d* breast, *f* shoulder, *h* neck.]

(d) *Pork* (Fig. 20)

First Quality: Leg (ham), loin (chops, cutlet, roast).

Second Quality: Neck-piece, shoulder (shoulder ham).

Third Quality: Short ribs, belly, shanks.

Fourth Quality: Head with jowl (cheek), snout, feet.

[In the United States the cuts are: *c* Ham *d* loin, *e* belly, *g* shoulder, *i* head.]

In the horse and dog there are, as a rule, no special classes of meat distinguished; nevertheless, in horses certain parts (tenderloin and tongue) command a higher price than others.

The tongue of all animals and the udder of cattle are sold as meat. When meat is not sold in a raw or pickled state, with or without the bones, etc., it is worked up for the various meat products. (See Chap. III.)

2. Fat

The fat which is obtained from food animals in coherent masses is utilized for food purposes either in a raw or rendered state. The term bacon is applied to the deposition of fat in hogs with or without the skin, which lies between the skin and the muscular meat, especially on the back and on the side of the body; it may also be intermixed with thin muscular layers. In commerce, especially in North America, the following varieties of bacon are distinguished, which, however, in accordance with the specific definition above, should not be considered from the meat inspection standpoint, with the exception of fatbacks, as bacon, but they are to be treated in accordance with the disposition of pork meat (See Chaps. IV and V).

1. Short-clear, a side of the hog between the hind shank and the anterior half of the shoulder, from which the bones have been removed.

2. Long-clear, that boneless half of a hog which lies between the hind shank and the head, from which the lean portion of the loin has been cut out.

3. Rib belly, the side of a hog consisting of the hind and lower ribs, which generally are not removed, and of the corresponding lower portion of the belly.

4. Short fat-backs, as the fat which lies on the back and side of the body over the larger muscles and over the ribs; they are generally cut into elongated quadrangular pieces and are very frequently intermixed with the muscular layers.

5. Long fat-backs are short fat-backs, to which the fat lying on the side of the neck is added.

Those pieces of fat and trimmings which are not suitable for sale in the shop are melted for lard, or are conveyed to soap, grease, and other factories, where they find various technical utilization.

Chapter III contains further information on this subject.

3. Blood

It is principally the blood of hogs that is worked up for sausage, while the blood from other animals is used for this purpose only in rare cases.

Albumen was formerly made from blood offal, but its production is now diminishing. Recently efforts have been directed toward utilizing the dried and ground blood for fertilizing and cattle food purposes, since the high nitrogenous contents of the pulverized blood, 12-18 per cent. makes it very adaptable. Small concerns usually dispose of the unused blood with the manure and other offal.

4. Viscera

The heart, liver, lungs, kidneys, spleen, brain, and thymus gland of calves (sweetbread) are sold in their fresh state or they are worked up for sausage or other meat products.

The stomach of hogs is used for sausage coverings, the stomachs of cattle are sold after scalding and removal of the epithelium, as the so-called tripe, or are utilized to a limited extent in ordinary kinds of sausage. Stomach and intestinal canal of calves are consumed as "calf-ruffle." The stomachs of sheep are used either for manufacturing sausage or for food purposes. From the stomach of calves is also obtained the rennet ferment (for manufacturing cheese). The intestinal canals of cattle and hogs serve as sausage coverings after they have been scraped and thoroughly cleaned. In a similar way, but to a limited extent, the small intestines of sheep are employed; otherwise they are utilized for the manufacture of violin strings. The serous membrane of the cæcum of cattle is used as the so-called "goldbeater skins." The bladders of cattle and hogs are utilized for sausage coverings.

It should be remarked in passing that recently from certain organs, especially the thyroids, ovaries, as well as testicles, bone-marrow and adrenal capsules, therapeutic remedies are prepared, which are quite extensively employed in human medicine.

5. Offal

The most important constituent of food animals belonging in this class is the skin, which, with the exception of the hog skin, is worked up into leather.

The latter serves only for this purpose in exceptional cases (boar, old hogs), as it is otherwise sold with the meat, or remains on the bacon, or is mixed in the filling of various kinds of sausage. The same is done

with the skin of the heads of calves, and exceptionally with the skin of the heads of young cattle. Besides, the skin of the head of cattle, especially the lips and the muzzle, as well as the ears, is worked up for food. The utilization of cattle and calf skin for sausage, with the exception of the parts above mentioned, is only permitted under declaration. From the bones, which are not sold with the meat, and which, in well-fattened cattle amount to 15.1 to 15.4 per cent. of the dressed weight the marrow is extracted for various purposes, but that from the lower bones of the legs is especially worked up for Neat's foot oil. Otherwise the offal bones are converted into glue and bone meal in factories, while the long bones are also used for industrial purposes (turnings or coverings). The same applies to the horns of cattle. Tendonous and cartilaginous tissues are utilized in glue factories.

Brushes are made from the better hog bristles, while the poorer qualities are used for minor purposes. Hoofs and claws, as well as inferior horns, are worked into fertilizer.

The genital organs serve as dog food, and other appropriate offal is also beneficially used for this purpose.

The occasionally observed abusive utilization of the sexual organs, especially the testicle and uterus for food purposes, could be remedied by the simplest form of condemning these parts during meat inspection. However, the present meat-inspection regulations give no authority for such action.

The bile, which is collected at some places, is used in the cleaning of clothes, and also for the manufacture of soap.

The contents of the stomachs of ruminants and hogs are also used mixed with blood or molasses, for the preparation of animal food.

II. Morphology and Chemistry of the Principal Tissues and Organs of Food Animals

The morphology and chemical properties of meat and its constituents should be mentioned here only to the extent that it is of importance in the examination of meat and in determining its significance as human food.

1. Meat Proper and Its Constituents

A. Muscles

Of the three kinds of muscles—the striated, non-striated, and heart muscle—only the first, which is bought and consumed as meat proper or muscle meat, comes under consideration here. There is also included the tissues which are in natural connection with the muscle proper (fat, connective, elastic, nerve, bone tissues), and organs (blood and lymph vessels, lymph glands, etc.). According to Friedel the “meat” purchased at the butcher shop contains an average of 83 per cent. meat, 8.4 per cent. bone, 8.6 per cent. fat. The quantitative proportion between the striated muscle and the other constituents of the body varies between 30 and 50 per cent. of the live weight, and in medium fat animals, this is higher than in lean or very fat ones.

The structure of the muscle consists of fibrous tissue, which possesses a peculiar luster and a semi-solid consistence. The firmness of the fiber is different in the various animals, and has an influence on the tastefulness of the meat. The tenderness or toughness, however, does not entirely depend on this, but is more intimately connected with the race, age, nutritive condition of the animal, and the amount of connective tissue present. Relative to the latter, the experiments of K. B. Lehmann, show that the cutaneous muscles are 2.5 times tougher than the tenderloin, the consistency of which is hardly influenced by cooking, but cooking considerably diminishes the toughness of the cutaneous muscles (almost to the consistency of the tenderloin). The toughness of the meat is diminished at least 25 per cent. in a few days through the ripening process, which is due to the formation of acid in the muscles.

The experiments performed by Isaak regarding the toughness of meat are not sufficiently extensive to draw positive conclusions from them.

The color of the muscles varies between a pale red, gray red, and dark red. Pale muscles occur in vertebrates, birds, and certain fish: Almost all the food animals show pale meat in certain ages of life (calves, young pigs), while in rabbits the meat remains pale all through life. Pale meat may also appear in some animals in certain groups of muscles alongside of dark-red muscles (hogs, birds). While the color of the muscles is somewhat influenced by the blood contents, yet it is not produced by the blood. The muscular coloring matter, which is identical with the hemoglobin, is rather bound to the myosin and develops in it. Further, the color of the meat is influenced by age, sex, race, work, feeding, etc. Especially in the ripening of meat a specific aroma is developed, which, as a result of the autolysation, manifests itself both by the odor and taste (M. Müller).

Rigor mortis, which occurs after death, is probably the result of a coagulation of the myosin through the formation of lactic acid in the muscles. It may also be that it is affected by a particular "rigor mortis ferment." It first affects the muscles of the head, and then spreads, in accordance to Nysten's law, backward over the body. The time of the appearance of rigor mortis depends on the muscular activity before death; the stronger the activity of the muscles during life, the sooner rigor mortis sets in. In exhausted animals, rigor mortis, under certain conditions, appears immediately after death, the same as in tetanic muscles. Also the administration of certain medicines, according to Ostertag, favors the early appearance of rigor mortis (veratrin, alcohol, ether, etheric oils). In animals which were affected with severe febrile diseases, rigor mortis either does not manifest itself or only very slightly, being hardly noticeable. High atmospheric temperature favors the appearance of rigor mortis, while cold retards it. The occurrence of rigor mortis is in the same relation to its dissolution: the sooner rigor mortis sets in the quicker the muscles will relax again. Whether the dissolution of rigor mortis results from an increase of acid formation in the muscles, which again affects the solution of the myosin, or whether it is due to other influences, is still the subject of controversy.

Von Fürth, in his experiments of extracting the muscle albumenoid bodies and of their supposed relation to rigor mortis, obtained results which appear to exclude that rigor mortis is affected by an acid precipitation from the muscle albumen; but an attempt to deny that the degree of muscular acidity has no influence on the appearance of rigor mortis, would be too far reaching. In the post-mortem acid formation it certainly concerns lactic acid, as the setting free of inorganic phosphoric acid does not take place. For the utilization of muscles for manufacturing sausage the fact is noteworthy that muscles which still contain the animal heat and in which rigor mortis has not appeared, may absorb up to 70 volume per cent. of water if they have been previously beaten, or if they were torn in shreds (Ostertag).

The reaction of living muscles is slightly alkaline or neutral, and is changed under normal conditions inside 3-6 hours after death to acid, through the formation of lactic acid, formic acid, potassium hypophosphate. The latter causes a swelling and loosening of the connective tissue elements of the meat, and renders the meat tender. By this process the so-called ripening of the meat takes place, the nature and further developments of which is discussed in Chap. VIII. The acid reaction of the muscles becomes changed to an alkaline reaction with the advancement of putrefaction.

An alkaline reaction of completely cooled meat from freshly killed animals always indicates an abnormal condition before slaughter. According to Edelman and Noack this is very frequently met in animals which were slaughtered under manifestations of suffocation or in condition of exhaustion; also in severe febrile diseases, especially septic conditions and pyemia, there may be an alkalinity of the meat resulting. In the latter cases the alkalinity remains permanently, while in the first-mentioned condition an acid reaction sometimes occurs after 48-72 hours. An alkaline reaction of meat is therefore an unsatisfactory indication only when it is lasting, resulting soon in putrefaction of the meat.

The principal chemical constituents of the muscles are the albumenoids and the nitrogenous bodies which are present in the proportion of from 16 to 25 per cent. Calculated on the basis of dry substances, meat contains, according to Salkowski, 77.4 per cent. soluble albumen, 10 per cent. albumen which is soluble in cold water and coagulable through heat, and 12 per cent. albumen soluble in cold water, but uncoagulable (meat bases, lactic acid, albumenose, peptone, salts, especially phosphocarnic acid (Siegfried)). Fat is present between the muscle fibres in the form of globules, to the extent of 1 per cent. water, in an average of 75 per cent. The taste of the meat is dependent upon the extractive bodies, principally osmazon (Landois), and the so-called meat bases: karnin, kreatin, kreatinin, xanthin, sarkin, hypoxanthin, and the muscle salts. The most important salts are potassium phosphate, with magnesium and calcium phosphate and the iron compounds, which amount to 1-1½ per cent. Of the carbohydrates, glycogen generally occurs in muscles in very small and greatly varying quantities, especially in the horse, dog, and fetus.

Of the gases which are present in the muscle substance, carbonic acid is found in 15-18 volume per cent. (Stintzing) while oxygen is absent (Hermann). Besides it is probable that the volatile sulphur compounds first demonstrated by Eber, especially H₂S, play an important part in the changes of the color of the meat after death, and in its preservation (Glage). Finally enzymes (soluble ferments) are also present in the muscle, and these play a principal part in the ripening of meat.

The composition of the meat in various animals and of some of the important meat-food products is tabulated according to König in the following exhibit (See Table, pp. 40-41). As a rule, meat which is rich in fat is always poorer in water, and its content of albumen stands in an inverse relation to the richness of the fat. According to Ignatiew, meat should be valued in accordance with its content of the two albumenoid substances, myosin, and myastromin (Danilewsky). The first is supposed to increase gradually from the muscles of the head toward the tail, while the latter increases in the reverse order.

Of the other chemical qualities of the muscles, their reductive properties are worthy of mention, through which poisons are split into harmless compounds, and coloring matters (bilirubin) are changed into colorless modifications.

B. Connective and Elastic Tissues

The connective tissue which contains a fibrous structure occurs in every part of the body in the most varied forms and connections. Its color is usually white, blueish-white, and if it is rich in elastic fibres it is yellowish. The chemical base of the connective tissue is formed by the albumenoid collagen containing sulphur, which in cooking is changed into gluten (glue). The elastic tissue (ligamentum nuchea, yellow abdominal fascia, etc.), which distinguishes itself by tough fibres and a yellow color, consists chiefly of sulphur free albumenoid elastin, which cannot be converted through heat into gluten.

C. Fat Tissue

The fat tissue, which occurs in closest relation to the connective tissue, is characterized by the depositions of fat cells in the loose connective tissue. It occurs almost all over the body in single or in larger connecting masses. The largest fatty deposits are about the kidneys and heart, in the mesentery (ruffle fat), retroperitoneal fat (leaf lard in hogs), while the subcutaneous fat cushion (bacon of hogs), is in some parts of the body particularly bulky. The fat of cattle is called tallow, that from sheep and goats is termed suet, while that from hogs is called lard. All properties of fat are considerably influenced by the species of animals, age, sex, and nutritive condition. The structure and consistency of fat tissues still retaining the animal heat are transparent, homogenous, or slightly stringy and oily. After the fat stiffens, which depends on its melting point and the surrounding temperature, it becomes dull, greasy, and crumbling.

The color of the fat varies between the purest white (hog, sheep) and a satiated yellow (horse); also gray and grayish-red color tints may be observed (calf).

Table of comparison of the composition and the utilization of various meats and food products, according to König*

No.	Designation	Raw nutritive substances						Utilizable nutritive substances			Nutritive relation† of nitrogenous to nitrogen free substances	
		Water	Nitrogenous substances	Fat	Carbohydrate	Raw fibers	Ash	Nitrogenous substances	Fat	Carbohydrate		
		%	%	%	%	%	%	%	%	%	As 1:	
1	Beef { fat.....	56.20	18.00	25.00	.....	.....	0.80	17.55	23.75	.....	3.4
2		medium fat.....	71.50	20.10	7.40	1.00	19.60	7.03	0.9
3		lean.....	75.00	20.50	2.80	1.20	19.99	2.66	0.3
4	Veal, first quality.....	71.00	19.95	8.00	.....	.....	1.05	19.45	7.60	.....	1.0
5		Goat meat.....	73.80	20.65	4.30	1.25	20.13	4.09	0.5
6	Mutton, first quality.....	55.25	16.85	27.00	.....	.....	0.90	16.43	25.65	.....	4.5
7		Pork, first quality.....	57.40	17.65	24.00	0.95	17.21	22.80	3.3
8	Horse meat.....	74.20	21.50	2.50	0.80	.....	1.00	20.96	2.38	0.76	0.3
9		Blood.....	80.82	18.12	0.18	0.03	0.85	17.67	0.17	0.03	0.03
10	Lung.....	79.89	15.21	2.47	0.56	.....	1.87	13.54	2.30	0.55	0.5
11		Heart.....	71.07	17.55	10.12	0.31	0.95	15.62	9.41	0.31	1.5
12	Kidneys.....	75.55	18.43	4.45	0.35	.....	1.19	16.40	4.14	0.38	0.7
13		Spleen.....	75.47	17.77	4.19	1.01	1.56	15.82	3.90	1.00	0.7
14	Liver.....	71.55	19.92	3.65	3.35	.....	1.55	17.73	3.39	3.30	0.7
15		Udder.....	39.45	10.15	27.93	21.39	1.08	9.03	25.97	21.18	9.5
16	Bone.....	25.00	15.50	17.00	.....	.....	42.50	.....	.....	.....	.....
17	Cattle tallow.....	1.33	0.44	98.15	.....	.....	0.08	0.39	91.28	.....	585.1
18		Lard.....	0.70	0.26	99.04	0.23	95.08	1,033.5
Preserved meats and sausages												
19	Smoked meat from steer.....	47.62	27.10	15.35	.....	.....	10.59	26.42	14.50	.....	1.4
20	Ham, pickled or smoked.....	28.11	24.74	36.45	.....	.....	10.54	24.12	34.68	.....	3.7
21		Bacon, ditto.....	10.21	8.95	72.82	8.02	8.73	69.18	19.8
22	Goose breast.....	41.35	21.45	31.49	1.15	.....	4.56	20.91	29.92	1.14	3.7
23		Beef sausage.....	48.24	20.39	26.99	4.43	19.83	25.64	3.2
24	Cervelat sausage.....	24.18	23.93	45.93	.....	.....	5.96	23.33	43.63	.....	4.7
25		Frankfurter sausage.....	42.80	12.51	39.11	3.09	12.20	37.15	2.47	7.8
26	Blood sausage, best quality.....	49.93	11.81	11.48	25.09	.....	1.69	10.51	10.45	23.84	4.8
27		Liver sausage, medium quality.....	47.80	12.89	25.10	12.00	2.21	11.47	22.84	11.40	5.9
28	Link sausage.....	7.07	16.36	34.00	32.39	0.80	9.48	13.82	31.60	30.67	7.2	
Meat of game and fowl												
29	Rabbit.....	74.16	23.34	1.13	0.19	.....	1.18	22.76	1.07	0.19	0.1
30	Deer.....	75.76	19.11	1.92	0.42	.....	1.13	19.28	1.82	1.41	0.3
31		Chicken, lean.....	76.22	19.72	1.42	1.27	1.37	19.23	1.35	1.26	0.2
32	Chicken, fat.....	70.06	18.49	9.34	1.20	.....	0.91	18.03	8.87	1.19	1.3
33		Turkey, medium fat.....	65.60	24.70	8.50	1.20	24.08	8.07	0.8
34	Duck, wild.....	70.82	22.65	3.11	2.35	.....	1.09	22.08	2.95	2.31	0.4
35		Goose, fat.....	38.02	15.91	45.59	0.48	15.51	43.31	7.0
36	Pigeon.....	75.10	22.14	1.00	0.76	.....	1.00	21.59	0.95	0.75	0.1
Meat of fish												
37	Salmon.....	64.00	21.14	13.53	.....	.....	1.22	20.51	12.31	.....	1.5
38	River eel.....	58.21	12.24	27.48	.....	.....	.....	11.87	25.01	.....	5.2
39		Sea eel.....	72.90	17.96	7.82	17.42	7.12	1.0
40	Herring.....	75.09	15.44	7.63	.....	.....	.....	14.98	6.94	.....	1.2
41		Hallbut.....	75.24	18.53	5.16	17.97	4.70	0.6
42	Carp.....	73.47	16.67	8.73	.....	.....	.....	16.70	7.94	.....	1.2
43		Pike.....	79.63	18.42	0.53	17.87	0.48	0.7
44	Haddock.....	81.50	16.93	0.26	.....	.....	.....	16.42	0.24	.....	0.04
45		Cod fish.....	82.42	15.97	0.31	15.49	0.28	0.04
46	Haddock, dried and smoked.....	17.21	72.37	2.47	.....	.....	.....	70.20	2.25	.....	0.1
47		Frog leg.....	63.64	24.17	0.91	2.98	22.96	0.83	2.89	0.3
48	Giant turtle.....	79.78	18.49	0.53	.....	.....	.....	17.57	0.48	.....	0.1
49		Sole.....	82.67	14.60	0.53	14.16	0.48	0.1
50	Trout.....	77.51	19.18	2.10	.....	.....	.....	18.60	1.91	.....	0.3
51		Salmon trout.....	80.50	17.52	0.74	16.99	0.67	0.1
52	Tench.....	80.09	17.47	0.39	.....	.....	.....	16.95	0.35	.....	0.05
53		Turbot.....	77.69	18.10	2.28	17.56	2.07	0.3
54	Caviar.....	47.86	29.34	13.98	1.30	28.46	13.28	1.27	1.2

Table of comparison of the composition and the utilization of various meats and food products, according to König*—Continued

Meat of invertebrate animals											
No.	Designation	Raw nutritive substances					Utilizable nutritive substances			Nutritive relation† of nitrogenous to nitrogen free substances	
		Water	Nitrogenous substances	Fat	Carbohydrate	Raw fibers	Ash	Nitrogenous substances	Fat		Carbohydrate
55	Oysters, meat juice.....	87.36	5.95	1.15	3.57	.....	2.03	5.77	1.05	3.53	As 1:
56	Common mussel.....	83.61	9.97	1.17	3.57	.....	1.61	9.47	1.06	3.53	1.1
57	Lobster, fresh.....	81.84	14.49	1.84	0.12	.....	1.71	13.77	1.67	0.12	0.6
58	Lobster, preserved.....	77.75	18.13	1.07	0.58	.....	2.47	17.22	0.97	0.57	0.3
59	River crabs, fresh.....	81.22	16.00	0.46	1.01	.....	1.31	15.20	9.42	1.00	0.2
60	River crabs, preserved.....	72.74	13.63	0.36	0.21	.....	13.05	12.95	0.33	0.21	0.1
61	Crab, fresh.....	78.81	15.83	1.32	2.42	.....	1.62	15.04	1.20	2.40	0.1
62	Crab, preserved.....	70.80	25.38	1.00	0.24	.....	2.58	24.11	0.91	0.24	0.3
63	Great snail.....	80.50	16.34	1.38	0.45	.....	1.33	15.52	1.26	0.45	0.1
											0.3

Meat extracts												
No.	Designation	Water	Entire nitrogen	Albuminoses	Pepton + Bases	Aminids	Ammonia	Xanthin basic nitrogen	Fat	Carbohydrates	Ash	Market price per kilogram
64	Liebig's Meat Extract.....	17.70	9.17	6.37	53.87	.....	0.59	0.648	0.21	.....	21.26	Pfg. 15.65
65	Abils Fluid Extract.....	65.80	3.03	6.91	9.26	.....	0.35	0.148	0.35	.....	17.33	5.65
66	Armour's (solid) Extract.....	21.00	9.32	16.12	.....	42.08	.....	0.567	0.58	.....	20.25	15.45
67	Flagg's (solid) Extract.....	21.37	10.01	17.37	.....	41.18	.....	0.687	0.35	.....	19.23	13.50

*König, The Human Foods and Delicacies, etc., 4th Edition, 1904, Bd. II, s. 1467.
 †For utilizable nutritive substances.
 ‡Glycogen.
 §Carbohydrate.

Chemically fats are the richest substances among hydro-carbons. Fresh adipose tissue shows the following composition in one hundred parts, according to E. Schulz and Reinecke:

Species	Nitrogenous substances	Fat	Water
Steer	1.16	88.88	9.96
Sheep	1.64	87.88	10.48
Hog	1.35	92.21	6.44

The fat itself is a mixture of glycerides (ester, derivative of tri-equivalent alcohol) tripalmitin, tristearin, triolein, which, depending upon their predominance, influence the consistency of the fat.

D. Bones and Bone Marrow

In meat inspection the bones come into consideration, principally in regard to their form, for the purpose of recognizing the origin and derivation of the meat. Structural relations, color, and compactness of bones are only rarely of importance in connection with the other properties.

The chemical constituents of bones are bone cartilage (ossein) 30 per cent., inorganic material 70 per cent., and a small quantity of fat. The first consists principally of collagen, which is converted through boiling into glutin. The salts in the dry bone consist of an average of 87.7 per cent. calcium phosphate, 9.1 calcium carbonate, 2 per cent. calcium fluoride, and 1.2 per cent. magnesium phosphate. Heinze reports the following composition for cattle and sheep bones:

	Cattle bones per cent.	Sheep bones per cent.
Calcium carbonate	7.07	7.00
Magnesium phosphate	2.09	1.59
Calcium phosphate	58.30	72.70
Calcium fluoride	1.96	2.17
Organic substance	30.58	26.54

The bone marrow appears as a red and reddish-white substance (fat marrow). The latter consists of about 96 per cent. fat, and contains a firmness in the various animals, which corresponds to the consistence of fat in the respective species. The red bone marrow is semi-solid.

E. Cartilage

From the standpoint of meat inspection cartilage is of only very slight importance. It consists of a collagenous basic substance which is converted through boiling into gelatin.

F. Blood and Blood Vessels

The question regarding the quantity of blood in the body has already been considered on page 25. In thoroughly bled animals, liquid blood is only found in the small veins of the muscles and organs, while coagulated blood may be seen in the heart and in the large veins. The arteries are always empty of blood. Regarding the color, coagulation and microscopical appearance, the blood of healthy animals should not show a deviation from the normal. There is a peculiar odor of the blood, characteristic to each animal species. It results from the volatile fatty acids and appears more pronounced upon the addition of sulphuric acid.

The chemical composition of the blood consists, according to König, of 80.82 per cent. water, 18.12 per cent. nitrogenous substances, 0.18 per cent. fat, 0.03 per cent. nitrogen—free extractive bodies—and 0.85 per cent. ash. On account of the richness of the blood in albumen, it is a very nutritive food.

G. Lymph Glands and Lymph Vessels

Of the lymphatic system the lymph glands, which lately have been designated as lymph nodes, are especially of great importance in meat inspection. Concerning their size it should only be mentioned, that relatively they appear larger in younger animals than in old ones. The same can be applied to the lymph contents of the glands, while, moreover, the intestinal glands are richer in lymph than the body glands. All the lymph vessels of a certain region empty into a certain lymph gland, but the anatomical borders of such a region are not established in the entire body. As far as our present knowledge of the lymphatic system permits us to separate the regions of the various lymph glands, it may be accepted that these are not connected with each other, and that to every part of the body belong one or more distinct lymph glands (corresponding lymph glands). Their size, number, and location are subject to certain deviations.

For the purpose of meat inspection it is best to classify the lymph glands in accordance with their draining regions, into visceral lymph glands, muscular or body lymph glands, and mixed lymph glands. To the latter class belong all those lymph glands which receive their lymph not alone from the viscera, but also from the muscles (muscles, skeleton, etc.).

1. Visceral Lymph Glands

Visceral lymph glands are those which receive their lymph principally from the viscera to which they belong. Those lymph glands, which belong functionally to the various organs or viscera of the body, and which are important in meat inspection, are described in the following:*

(a) *Lymph Glands of the Digestive Apparatus, Including the Abdominal and Pelvic Cavities*

1. *Submaxillary lymph glands.*—*L.* Superficially in the submaxillary space; in cattle at the angle of the lower jaw bone, sometimes present as two small nodes; in hogs, adjacent and to the inside of the submaxillary salivary gland. *A.* Superficial parts of the head, interior nasal passages and buccal cavity. *E.* Superior cervical lymph glands. (Fig. 21b, 22u, 23u.)

**L* Signifies the location of the lymph gland, *A* afferent vessels, and *E* efferent vessels.

2. *Parotid lymph gland*.—*L.* Median surface of the parotid and submaxillary salivary glands. In cattle a special large gland extending

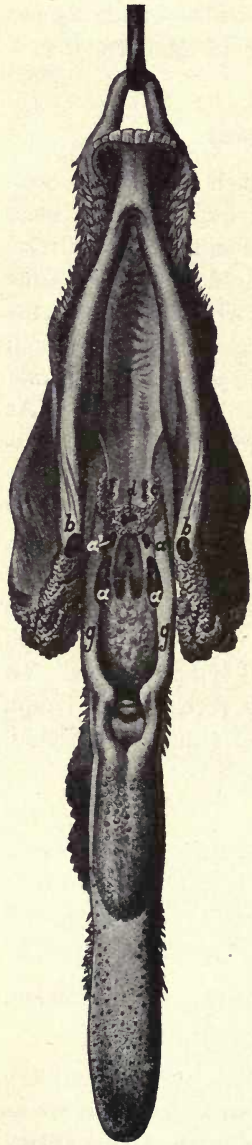


Fig. 21. Head of cow with the tongue cut out, *a*, *a'*, retropharyngeal lymph glands; *b*, submaxillary lymph glands; *c*, tonsils; *d*, posterior nares; *e*, cephalic flexure; *f*, submaxillary salivary gland; *g*, styloid processes of the hyoid bone.

over the maxillary border of the parotid, and partly laying on the masseter muscle. In hogs very numerous, large, and red in color. *A.* Dorsal half of the head, cranial cavity, base of the cranium, tongue, soft palate, esophagus, and larynx. *E.* Superior cervical lymph glands.

3. *Superior cervical lymph glands*.—Partly united with portions of the previous gland to the retropharyngeal lymph glands. *L.* Posterior to the larynx and pharynx near the thyroid gland; in cattle at the base of the cranium, in the superior part of the pharyngeal cavity forming two large bodies. *A.* Inside of the head, together with the cranial, buccal, and tracheal cavities, and the efferent lymph vessels of 1 and 2. *E.* Middle and inferior cervical lymph glands. (Fig. 21*a*, 22*u*, 23*v*).

4. *Middle cervical glands*.—*L.* Middle of the neck, at the side of the trachea, anterior to the carotid artery. *A.* Esophagus and trachea, superior cervical glands. *E.* Inferior cervical lymph glands.

5. *Inferior cervical glands, prepectoral glands*.—*L.* At the entrance of the thorax anterior to the trachea and extending into the thoracic cavity. *A.* Neighboring parts, shoulder, upper arm, and efferent lymph vessels from middle cervical glands (and therefore also from 1 and 3), and also from the prescapular lymph gland. *E.* Thoracic duct, i. e., the great right lymph vein (Fig. 29*b*).

6. *Gastric lymph glands*.—*L.* Small curvature, toward both surfaces of the stomach. In ruminants in the long groove of the rumen and at the attachment of the small mesentery. *A.* Wall of the stomach. *E.* Receptaculum chyli (Fig. 25).

7. *Mesenteric lymph glands*.—*L.* Between the peritoneal folds of the mesentery along the small curvature of the small intestines, between the flexures of the colon and in the mesentery of the

same. In hogs also a group at the superior border of the mesentery. In dogs on the jejunum there is a very long mesenteric lymph gland, the so-called pancreas Aselli. *A.* Wall of large and small intestines. *E.* Receptaculum chyli (Fig. 24).

8. *Anal lymph glands.*—*L.* Two or three lymph glands in the peri-

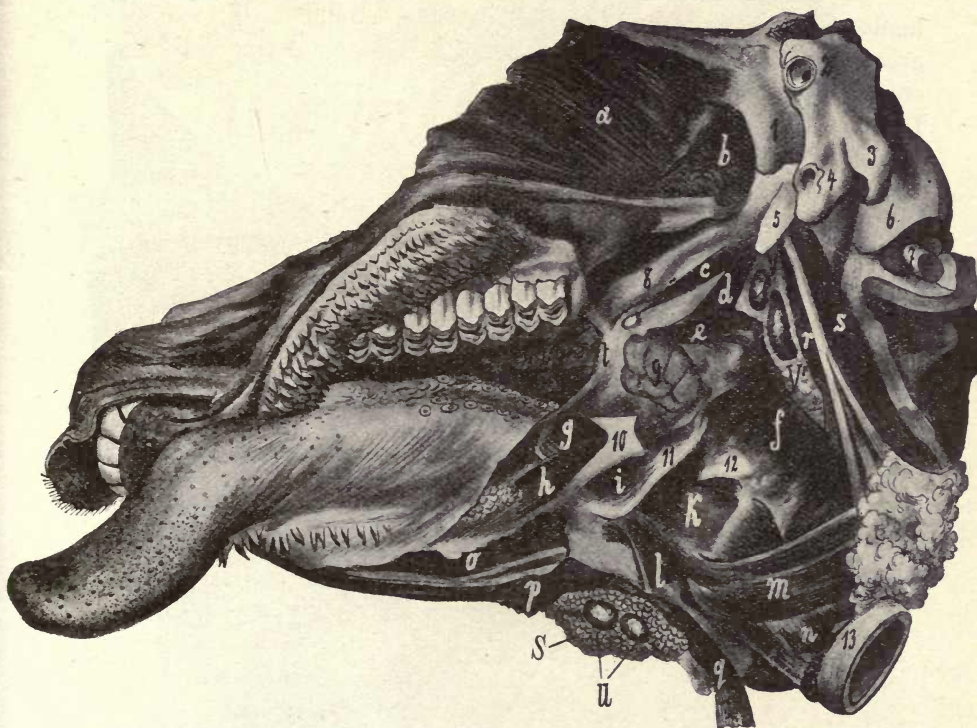


Fig. 22. Head of cow, the right submaxillary and left styloid of the hyoid bone of which are removed. 1. Articular surface of the temporal bone. 2. External auditory meatus. 3. Jugular process of the occipital bone. 4. Petrous bone. 5. Muscular attachment to petrous bone. 6. Occipital condyle. 7. Medulla oblongata. 8. Pterygoid bone. 9. Tonsils. 10. Styloid process of the hyoid bone. 11. Thyroid cornua of the hyoid bone. 12. Cricoid laryngeal cartilage. 13. Ring of the trachea; *a*, masseter muscle; *b*, temporal muscle; *c*, tensor muscle of the palate; *d*, levator muscle of the palate; *e*, pterygopharyngeal muscle; *f*, chondro- crico- thyro-pharyng. muscle; *g*, hyoglossal muscle; *h*, styloglossal muscle; *i*, *M. keratohyoideus brevis*; *k*, *M. hyothyroideus*; *l*, and *m*, *M. omohyoideus*; *n*, *M. sternothyroid*; *o*, *M. myoglossus*; *p*, *M. mylohyoid*.; *q*, *M. sternohyoideus*; *r*, *M. long. capit.*; *s*, *M. rect. capit.*; *t*, arcus palato glossus; *S*, submaxillary salivary gland; *u*, submaxillary lymph gland; *V* retropharyngeal lymph glands.

proctal connective tissue in the vicinity of the levator ani muscle. *A.* Rectum, perineum, and root of the tail. *E.* Sublumbar lymph glands (Fig. 27b).

9. *Hepatic lymph glands*—*Portal lymph glands.*—*L.* In the posterior hepatic fissure (Porta hepatis); in hogs on the portal vein around the

foramen of Winslow, usually conspicuous by their brown color. *A.* Liver tissue. *E.* Receptaculum chyli (Fig. 25k and 26c).

10. *Splenic lymph glands.*—*L.* Hilus of the spleen, between the layers of the gastro-splenic ligament. *A.* Spleen, stomach, and omentum. *E.* Receptaculum chyli.

11. *Sublumbar lymph glands.*—*L.* Side and ventral surface of the lumbar vertebræ, dorsal to the great blood vessels, partially covered by the lumbar muscles. *A.* Dorsal abdominal wall, lumbar vertebræ, internal genital organs. Lymph vessels from the external and internal iliacs, deep inguinal, sacral, and popliteal glands. *E.* Receptaculum chyli (Fig. 27e).

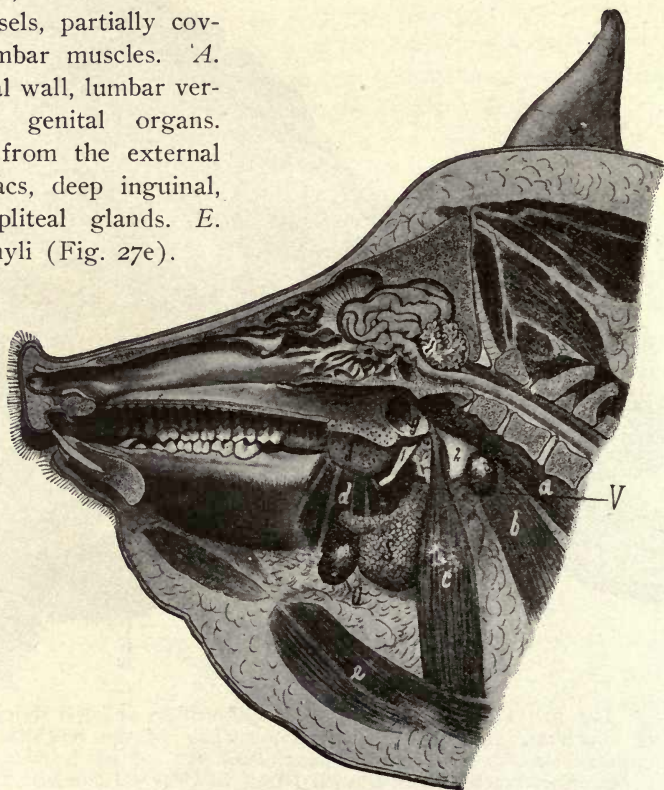


Fig. 23. Right half of a vertical section of a hog's head; 1, cartilaginous nucleus attaching the hyoid to the temporal bone; 2, jugular process of the occipital bone; *a*, *M. longus coli*; *b*, *M. sternocleido mastoid*; *c*, *M. sternocephalic*; *d*, *M. pterygoid. medial*; *e*, *M. sternohyoid*; *f*, soft palate; *g*, post. nares; *S*, submaxillary salivary gland; *u*, submaxillary lymph gland; *V*, retropharyngeal lymph gland.

12. *Sacral lymph glands.*—*L.* Along the ventral border of the sacrum. *A.* Dorsal pelvic wall, rectum, and internal genital organs. *E.* Sublumbar glands (Fig. 27d).

13. *Internal iliac lymph glands.*—*L.* At the angle between the external iliac and the hypogastric arteries, i. e., between the former and the abdominal aorta, on the ventral side of the ileum. *A.* Abdominal and pelvic walls, bones of the pelvis, sacrum, muscles of the croup, rectum,

internal genital organs, external iliac lymph glands. *E.* Sublumbar lymph glands and the receptaculum chyli (Fig. 27c).

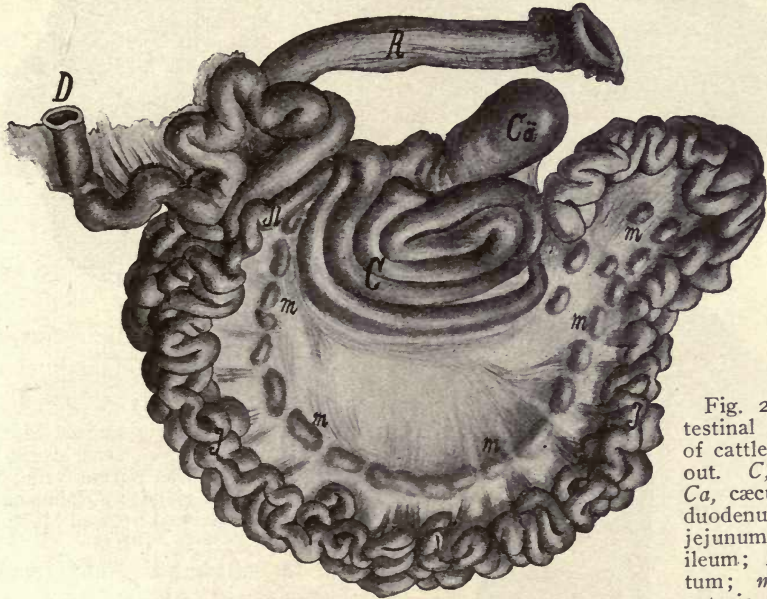


Fig. 24. Intestinal canal of cattle spread out. *C*, colon; *Ca*, caecum; *D*, duodenum; *J*, jejunum; *Il*, ileum; *R*, rectum; *m*, mesenteric lymph glands of the small intestines.

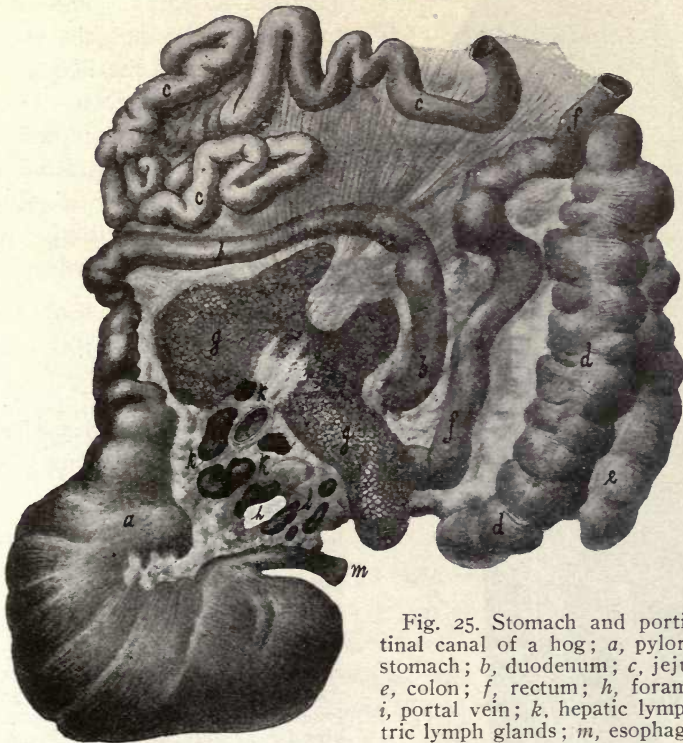


Fig. 25. Stomach and portion of the intestinal canal of a hog; *a*, pyloric portion of the stomach; *b*, duodenum; *c*, jejunum; *d*, caecum; *e*, colon; *f*, rectum; *h*, foramen of Winslow; *i*, portal vein; *k*, hepatic lymph glands; *l*, gastric lymph glands; *m*, esophagus.

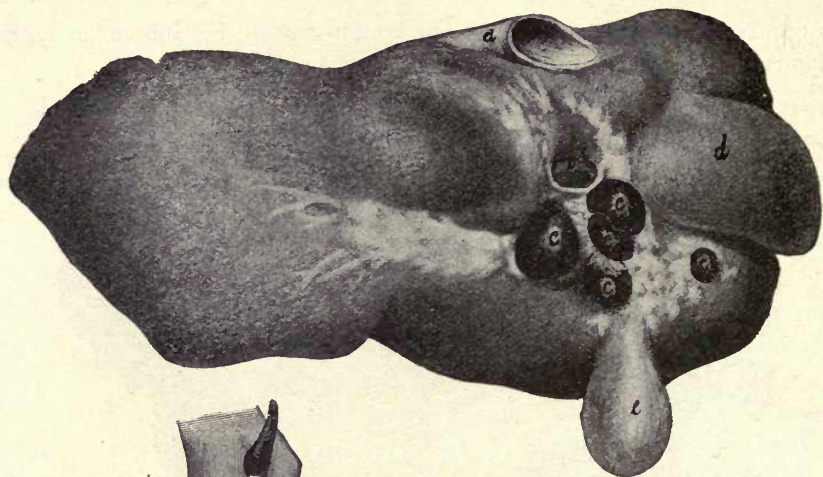


Fig. 26. Gastric surface of the liver of cattle; *a*, vena cava; *b*, entrance of the portal vein; *c*, portal lymph glands; *d*, lobus caudatus (Spigelium); *e*, gall bladder.

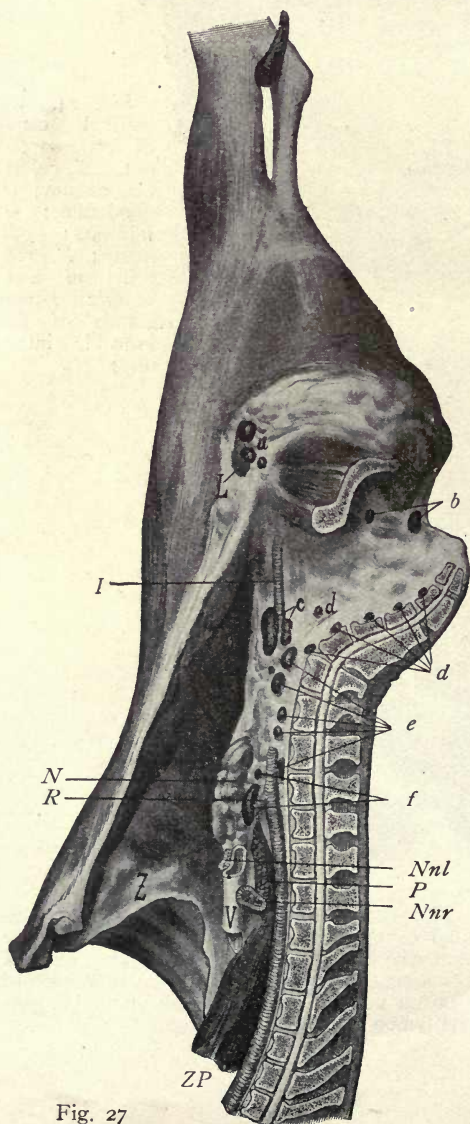


Fig. 27

14. *External iliac lymph glands.*—*L*. Small and detached, in the neighborhood of the angle of the ileum, in the angle between both branches of the circumflex iliac artery. *A*. Abdominal wall, lateral surface of the upper part of the thigh. *E*. Sublumbar lymph glands.

(b) *Lymph Glands of the Respiratory Apparatus, and Thoracic Cavity*

The lymph glands described under A from 1-5 belong also

Fig. 27. Left hind-quarter of a bull, cut very long. *A*, aorta; *V*, vena cava; *Z*, diaphragm; *ZP*, pillars of the diaphragm; *L*, external inguinal canal; *N*, left kidney; *Nnr*, right adrenal capsule; *Nnl*, left adrenal capsule; *P*, pancreas; *R*, renal artery; *I*, external iliac artery. *a*, superficial inguinal lymph gland; *b*, anal lymph gland; *c*, internal iliac gland; *d*, sacral lymph gland; *e*, lumbar glands; *f*, renal lymph gland.

to the respiratory apparatus. As previously stated, they receive lymph from regions belonging in parts to the digestive as well as to the respiratory apparatus.

6. *Bronchial lymph glands*.—*L*. Bifurcation of the trachea, in the lung substance at the branching of the bronchi. In cattle they form a continuous chain with the posterior mediastinal lymph glands; there is one large or several small glands to the left of the arch of the aorta; one on the right, at the branching of the bronchus of the cephalic lobe, or at the root of the lobule of the right lobe, besides a lymph gland of the size of a hazelnut at the base of the division between the cardiac and diaphragmatic lobe of the right lung. In hogs there is generally another lymph gland at the attachment of the mediastinum at the dorsal angle of the bifurcation of the two principal bronchi (middle bronchial lymph gland). *A*. Lungs and lymph vessels from the posterior mediastinal gland. *E*. Thoracic duct and partly to the posterior mediastinal glands (Fig. 28 a, b).

7. *Mediastinal lymph glands*. (a) *Anterior mediastinal glands*. *L*. Numerous in the pre-cardial mediastinal space near the superior vena cava. In cattle several large lymph glands (Fig. 29 a), above the first section of the breastbone, near the entrance of the thorax. *A*. Heart, pericardium, thymus gland, thoracic wall, diaphragm, mediastinum. *E*. Thoracic duct or great right lymph vein.

(b) *Posterior mediastinal lymph glands*.—*L*. In the post-cardial mediastinum, along the esophagus, and posterior aorta. In cattle 8-12 lymph glands are located along the dorsal wall of the esophagus, the posterior node of which is usually strikingly large. *A*. Esophagus, peri-

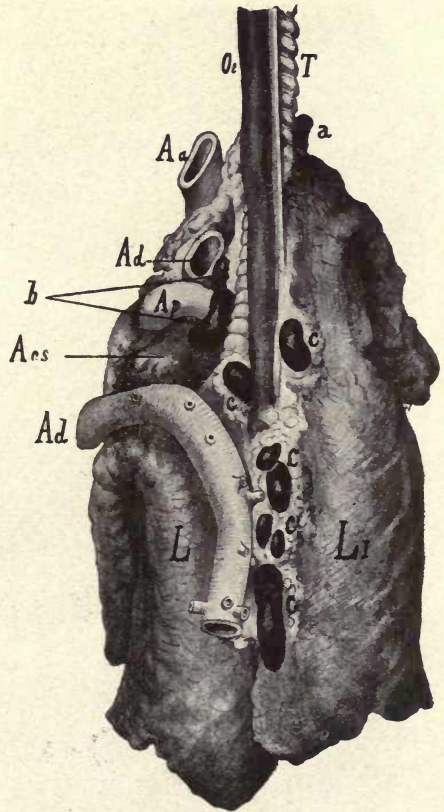


Fig. 28. Lungs and heart of steer, suspended dorsal view. *Aa*, aorta ascendens; *Ad*, aorta descendens cut and flapped over to the left; *Ap*, art. pulmonalis; *Acs*, left cordal atrium; *L*, left, *L'*, right lung; *Oe*, esophagus; *T*, trachea; *a*, right superior bronchial lymph gland; *b*, left bronchial lymph gland; *c*, posterior mediastinal lymph glands.

cardium, diaphragm, mediastinum, parietal surface of the liver. In hogs they are very small or absent (Fig. 28c). *E.* Efferent vessels empty in part into the bronchial glands, in part into the anterior mediastinal glands and in part into the thoracic duct.

8. *Lymph glands of the thoracic wall.*—(a) *Dorsal lymph glands.*—*L.* Small, to the side of the vertebræ, between the consecutive articula-

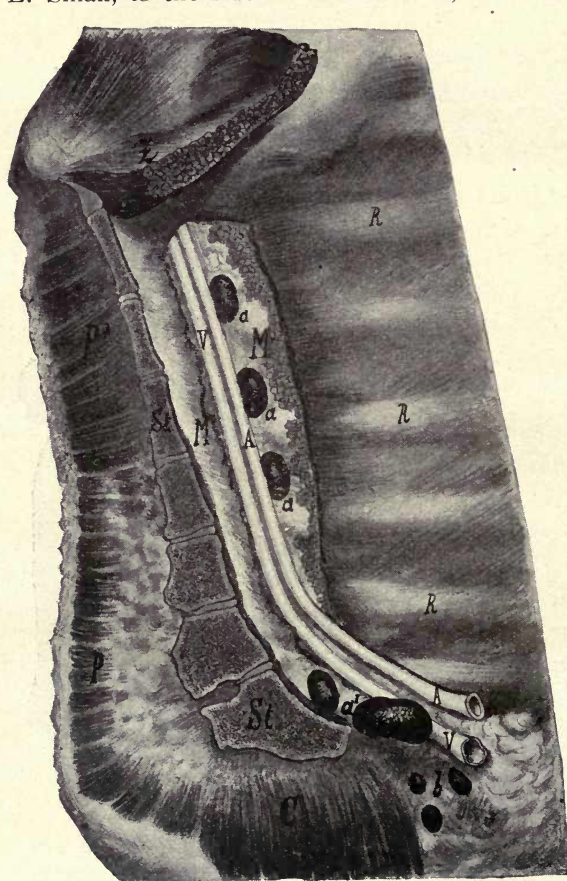


Fig. 29. Portion of the left thoracic wall of heifer. *A*, art. thorac. int.; *V*, vena thorac. int.; *l*, musc. sternocephalic.; *M*, musc. transvers. thorac. cut through. *PP'*, musc. pectoral.; *R*, ribs; *Z*, diaphragm; *a*, inferior thoracic lymph glands; *a'*, anterior mediastinal gland; *b*, inferior cervical or prepectoral lymph glands.

tions of the heads of the ribs, and between the layers of the intercostal muscle. *A.* Dorsal vertebræ, muscles of the same, pleura, diaphragm, and intercostal muscles. *E.* Thoracic duct.

(b) *Inferior thoracic lymph glands.*—*L.* Dorsal surface of the breastbone along the internal thoracic vein, i. e., between the costal cartilage-breastbone articulations. In hogs they are only exceptionally present. *A.* Straight abdominal, thoracic, and intercostal muscles, pleura and diaphragm. *E.* Receptaculum chyli, inferior cervical glands (Fig. 29a).

(c) *Lymph glands of the genito-urinary apparatus.*

(1) *Renal lymph glands.*—*L.* Hilus of the kidneys, at the angle between the aorta and renal artery or posterior vena cava, and renal vein. *A.* Kidneys. *E.* Receptaculum chyli (Fig. 27b).

(2-4) Lymph glands, which have been described under (a), 11-13. *A.* Ureters, bladder, urethra, and genitals inside of the pelvic cavity. *E.* Receptaculum chyli and sublumbar lymph glands.

(5) *Superficial inguinal glands.*—*L.* In male animals these include several lymph nodes, between the abdominal wall and the prepuce and scrotum. In female animals they are located superficially behind the udder. In cows these are the large lymph glands on each side behind and above the udder (supramammary lymph glands). *A.* External genitals, udder, ventral abdominal wall and median surface of the thigh. *E.* Deep inguinal lymph gland (Fig. 27a).

2. Body Lymph Glands

As applied to meat inspection the term muscle or body lymph glands refers to those lymph glands which drain regions in the skeleton and

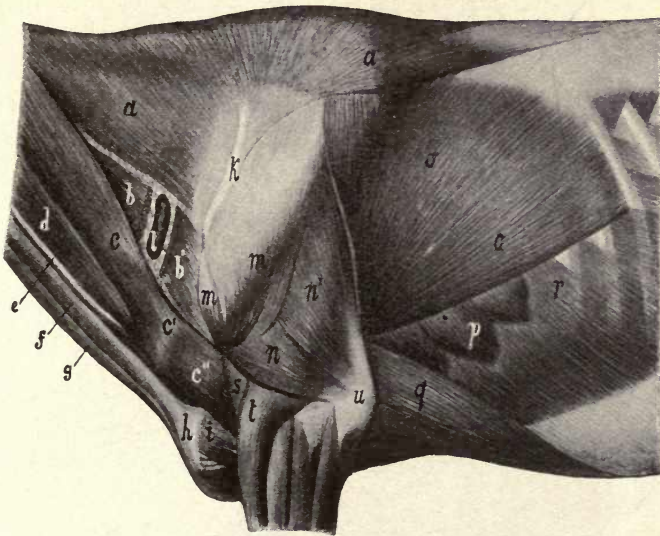


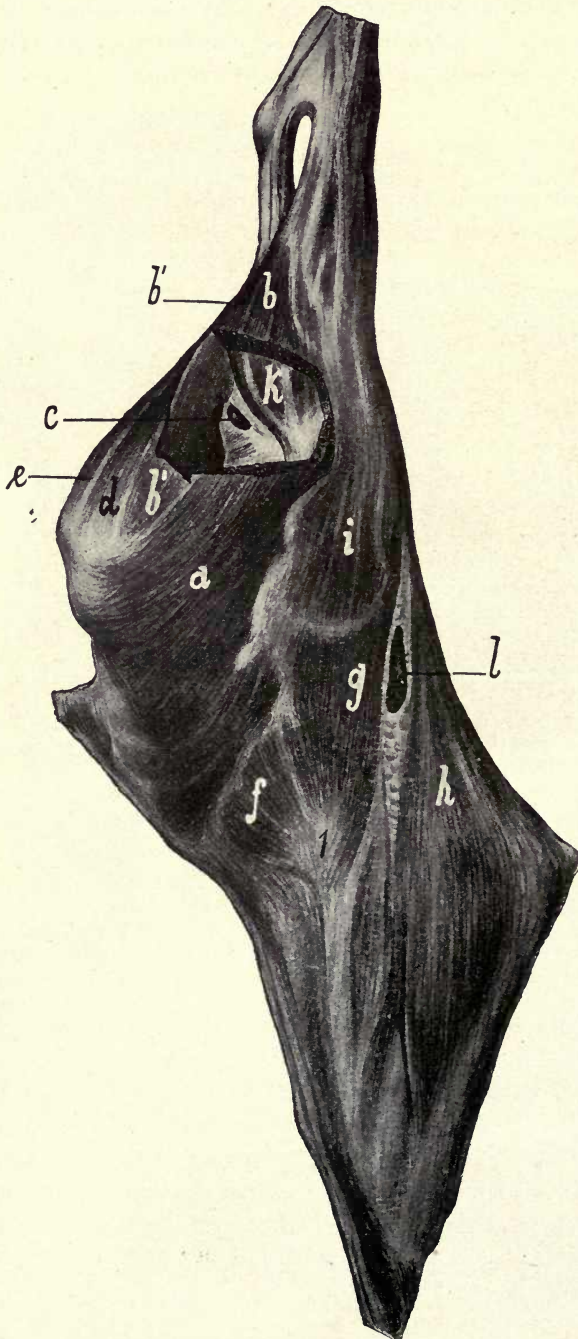
Fig. 30. Left fore-quarter of heifer with exposed prescapular lymph gland, *a, a'* m. trapezius cervical. and thoracic, *b, b'* m. omotransversarius; *c, c', c'', d*, m. brachiocephalicus (of which *d* is the m. cleidomasoideus), *e* jugular vein, *f*, and *g*, m. sternocephalic. (superficial and deep portion). *h*, sternum, *i*, m. pectoral. superficial., *k*, spinal. scapul., *l*, prescapular lymph gland, *m*, pars acromial and *m'* pars scapular, of the m. deltoideus, *n*, caput. lateral. and *n'* caput. long. of the m. triceps brachii, *o*, m. latissim. dorsi, *p*, m. serrat. ventral., *q*, m. pectoral. profund., *r*, m. obliq. ext. abdominal.

muscles, i. e., those tissues which enclose them as well as the bones and skin, but they do not receive lymph from the viscera.

The body lymph glands, which are important in meat inspection, are the following:

1. *Prescapular lymph glands.*—*L.* Anterior border of the shoulder, above the scapulo-humeral articulation, and covered principally by the angularis scapulæ muscle and sometimes by the dorsal border of the mastoido-humeralis muscle. *A.* Neck, shoulder, upper and lower leg. *E.* Inferior cervical lymph glands (Fig. 30l).

2. *Axillary lymph glands.*—*L.* Median surface of the shoulder, dorsal border of the pectoralis minor muscle, posteriorly to the shoulder joint, near the entrance of the lateral thoracic vein into the axillary vein.



They are usually absent in hogs. *A.* Shoulder, upper arm, thoracic wall, and elbow lymph gland. *E.* Inferior cervical lymph glands.

3. *Elbow lymph glands.*—They occur only in the horse. *L.* Median side of the upper arm near the cubital articulation between the biceps brachii muscle, and the median anconeus muscle on the brachial vein. *A.* Foot and lower arm. *E.* Axillary and pre-scapular lymph glands.

4. *Precrural lymph glands.*—*L.* In the tendinous portion of the external abdominal muscle on the free border of the fascia lata muscle in the middle, between the patella and

Fig. 31. Left hind-quarter of steer with exposed precrural and popliteal lymph glands; *a*, *m.* gluteus superficialis, which fuse with *b* and *b'* the *m.* biceps femoris; *c*, popliteal lymph gland; *d*, *m.* semi-tendinosus; *e*, *m.* semi-membranosus; *f*, *m.* gluteus medius; *g*, *m.* tensor fasciae latae; *h*, *m.* cutaneus maximus; *i*, *m.* quadriceps femoris; *l*, precrural or kneefold lymph gland, *l*, lateral angle of the ileum (hip bone).

the external angle of the ileum. In cattle and hogs this gland is a long single one. *A.* Abdominal wall and lateral surface of the posterior limb. *E.* Sublumbar and lateral iliac glands (Figs. 31 and 32f).

5. *Popliteal lymph gland.*—*L.* On the gastrocnemius muscle, between the biceps femoris muscle and the semitendinosus muscle. It is frequently absent in hogs, but there is always present a superficial gland of the size of a small hazelnut in the subcutis of the hollow of the hock about a handbreadth from the point of the hock. *A.* Lower part of leg

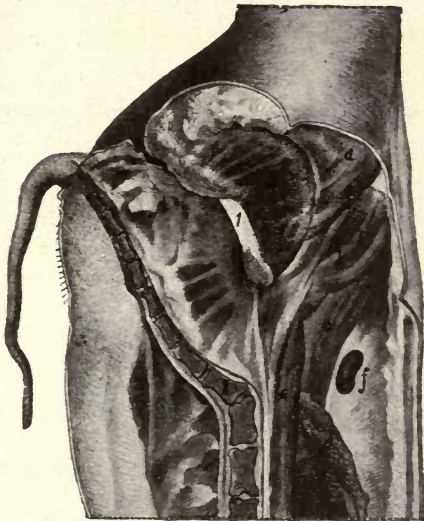


Fig. 32

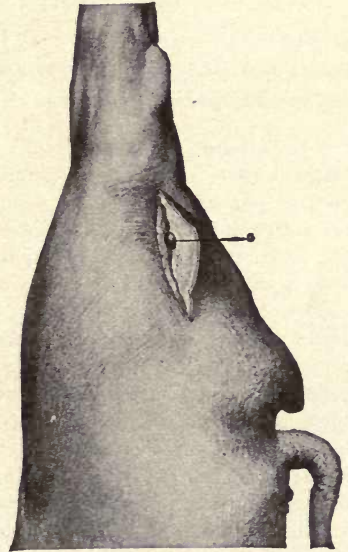


Fig. 33

Fig. 32. Median view of the right hind-quarter of a hog with exposed precrucial lymph gland. 1, pelvic symphysis; 2, first sacral vertebra; *a*, m. gracilis; *b*, m. quadriceps femor.; *c*, m. tensor fascia lat.; *d*, m. obliquus intern. and transversus abdominal.; *e*, m. iliopsoas; *f*, precrucial lymph gland.

Fig. 33. Lateral view of the right hind-quarter of a hog with exposed popliteal lymph gland *a*.

and foot. *E.* Deep inguinal, sublumbar and external ischial lymph glands (Fig. 31 *c* and 33 *a*).

6. *Deep inguinal lymph glands.*—*L.* In the inguinal canal lying above the femoral artery and vein. Only in the horse do they exist as large glands. *A.* Posterior limb with the exception of the external surface of the thigh and muscle thereof; abdominal wall. *E.* Sublumbar lymph glands and receptaculum chyli.

7. *External ischial lymph gland* (Franck).—*L.* In cattle about the size of a walnut on the ventral border of the coccygeus, covered by the broad ligament of the pelvis (Stroh). In hogs it lays usually more super-

ficially. *A.* Pelvic and rump muscles and popliteal lymph gland. *E.* Sacral and sublumbar lymph glands. In ruminants under the skin of the triangle in front of the external angle of the ileum. *A.* Neighboring parts of the skin. *E.* Precrural lymph gland.

In the subcutis there are besides small lymph glands at various parts; they are, however, not constant in their position and they also vary in size.

H. Comparative Anatomy of the Most Important Viscera

Every veterinary inspector should be thoroughly versed concerning the anatomical characteristics of the normal viscera of the domesticated animals, and therefore the principal differential signs of certain viscera will be briefly specified below.

1. *Tongue. Cattle**—Round, large body; mucous membrane frequently shows blackish spots; the filiform papillæ are horny, especially strong along the lateral border; numerous fungiform papillæ mostly arranged in groups and scattered over the entire dorsum; 28-34 circumvallate papillæ, which are arranged in two rows in the form of a V; the foliate papillæ are absent; the epiglottis is frequently attached and appears oval. *Sheep and Goats.*—Similar to cattle; the center of the tip is slightly grooved; the papillæ of the body are comparatively even larger than in cattle and are grouped into compact masses; filiform and fungiform papillæ are also present on the inferior surface; sheep have 18-24, goats have 12 circumvallate papillæ. *Hogs.*—Long and narrow; 2 circumvallate papillæ and numerous fungiform papillæ at the base; long, soft papillæ directed backwards; foliate papillæ have mostly five cross fissures; epiglottis broad, at the free border flatly rounded. *Horses.*—Flat, even, long point; intense toughness of the mucous membrane in the dorsum; fungiform papillæ especially well defined on the lateral surface; 2 circumvallate and 2 foliate papillæ with 3-10 cross furrows; epiglottis leaf-shaped. *Dogs.*—Broad, flat, sharp lateral borders, bright red color; under the mucous membrane on the posterior surface is found the flask-shaped cartilage-like body, the so-called lyssa; long, soft papillæ at the base; 4-6 circumvallate papillæ; foliate papillæ, indistinct, with 5-7 cross fissures; epiglottis rhomboidal.

2. *Stomach.*—The relation of the stomachs of the ruminants do not require special mention. *Hogs.*—Triangular dilation on the left dorsal end; cardiac portion funnel-shaped; the portion covered by esophageal mucous membrane is small; at the elongation of the small curvature lays the cone-shaped pylorus, which contains a sphincter muscle. *Horses.*—Left half of the stomach covered with esophageal mucous membrane, which is sharply separated by a jagged border from the glandular mucous membrane; esophageal orifice is slanting, with sphincter muscle; double pyloric sphincter. *Dogs.*—Left half round, pyloric part shaped like intestines; esophageal orifice conical, single pylorus sphincter; esophageal region absent.

3. *Intestinal Canal.*—In cattle, swine, and goats the colon is spirally coiled upon itself while externally and ventrally to it lays the jejunum on a short mesentery, hanging in numerous convolutions. In hogs the colon forms a convolution the shape of a nine-pin. Regarding the diameter, the colon of cattle, sheep, goats, and dogs differs only slightly from the small intestines; in horses and hogs the colon is con-

* Regarding the weight of the liver, heart, spleen, kidneys, and lungs of cattle see also page 57.

siderably larger than the small intestines. Colon and cecum of the hog and horse have longitudinal muscular bands and are sacculated.

4. *Liver*.—Color is generally reddish-brown; in fat animals and in those of advanced pregnancy it is yellowish-brown. *Cattle*.—Indistinctly three-lobed, Spigelian lobe rounded on the right lobe; falciform ligament absent, and as a rule the ligamentum teres; gall bladder pear-shaped, extending a long distance over the ventral border of the liver, average weight, according to Schmaltz, $\frac{1}{5}$ of the dressed weight; in cattle of over 250 kg., dressed weight, 5-6 kg.; in lighter animals, 3-4½ kg. *Sheep and Goats*.—Covering of the ventral border at the height of the attachment of the round ligament relatively deeper than in cattle, the lobus Spigelii triangular running into a point; the gall bladder appears similar to that in cattle; weight $\frac{1}{3}$ of the dressed weight, from 375-875 g. *Hogs*.—Four lobes besides the lobus quadratus and caudatus; prominent esophageal notch, the gall bladder deep in the right portion of the middle lobe; the head of the gall bladder does not quite reach the ventral border of the liver; the portal vein is at the dorsal border of the liver, more or less surrounded by the liver parenchyma; lateral ligaments are absent; liver lobules are remarkably distinct, due to the rich development of the interlobular connective tissue; weight, $\frac{1}{4}$ of the dressed weight, ½ kg. *Horses*.—Three distinct lobes, the lobus and processus caudatus running into a point (lobus Spigelii), deep esophageal notches; gall bladder absent; average weight, 5 kg., in old horse often only 2.5-3.5 kg. *Dogs*.—From the parietal surface four lobes, and from the visceral 6 lobes are noticeable; deep esophageal notch; the cavity for the gall bladder is formed by the right border of the lobus quadratus, and the left border of the right middle lobe; the head of the gall bladder does not reach the ventral border of the liver.

5. *Pancreas*. *Cattle*.—Light yellow-brown to reddish yellow-brown, free of fat. *Calves and Sheep*.—Similar to cattle; in fattened animals it is lighter in color. *Hogs*.—Grayish-yellow, extensively intermixed with fat. *Horses*.—Reddish-yellow to reddish-gray. *Dogs*.—Pale red.

6. *Spleen*. *Cattle*.—Long and flat, uniformly broad, with rounded edges; in bulls and fattened steers, reddish-brown; in cows, grayish-blue; consistence in bulls and fattened steers quite dense, in the cow loose; the borders of the first are rounded, in the latter, they are sharp. The surfaces in the bulls and steers are arched; in the cow flat; the follicles in the first are larger (up to the size of hemp seeds) than in the latter; weight in animals dressing over 250 kg., 1 kg.; in those dressing below that weight, 0.5-0.75 kg. *Calves*.—Reddish-brown to blueish-violet; borders and surfaces are rounded; consistence soft. *Sheep and Goats*.—Blunt, angular, of the shape of a palm of the hand; reddish-brown; consistence soft to elastic. *Hogs*.—Long tongue-shaped, with the exception of the ends, which are almost uniformly broad; cross-section is triangular; pale red; consistence soft, loose. *Horses*.—Flat, elongated, triangular, and slightly bended in a shape of a scythe; blueish-red, assuming a shade of reddish-brown; the curved anterior border is thinner than the rounded posterior border; weight, $\frac{1}{200}$ of the body weight, 0.5-1.5 kg. *Dogs*.—Tongue-shaped, broad at the ventral extremity; light red; weight, $\frac{1}{500}$ to $\frac{1}{600}$ of the body weight.

7. *Lungs*. *Cattle*.—Left lung has three lobes, cephalic, cardiac, and diaphragmatic; right lung four to five lobes; the division of lobules is more pronounced than in any other food animal; intralobular connective tissue is well developed. *Sheep*.—Structure of lobules very indistinct; in the goat, however, it is more distinct. *Hogs*.—In the left lung, two to three lobes (the cephalic lobe, which is sometimes divided and the principal lobe), the right lung has four lobes. *Horses*.—The left lung has two lobes (cephalic and principal lobes); the right has three; lobular structure not very distinct; the bronchial tube for the cephalic lobe of right lung, which

originates directly from the trachea, and which is present in ruminants and hogs, is absent. *Dogs*.—Left lung has three, right lung has four separate lobes, the notches of which extend up to the principal bronchi; lobular structure is indistinct, frequently anthracosis is seen.

8. *Thyroid gland*. *Cattle*.—Two flat lobes connected by an isthmus which is 1-1.5 cm. broad; structure lobulated, light reddish-brown. *Calves*.—Darker, isthmus stronger. *Sheep*.—On each side a thick brownish-red lobe, with the appearance very much like muscle; isthmus very indistinct. *Hogs*.—Connected, flat, not lobulated, dark-red. *Horses*.—Each side portion roundish, oval, of the size of a prune, reddish brown, isthmus mostly consists only of connective tissue. *Dogs*.—Side lobe large, elongated, isthmus in large dogs very distinct, in smaller dogs only slightly or unobservable.

9. *Thymus gland* (Sweetbread, German kalbsmilch, bries, bröschchen). *Cattle*.—Divided, lobulated, whitish-yellow, first disappears from the neck portion; in the thorax even after 8-9 years it is plainly noticeable. *Calves*.—Reaches up to the larynx; in the first week of life it weighs 100-200 g., after 4-6 weeks, 400-600 g. *Hogs*.—Both cervical lobes reach to the throat, color grayish-yellow. *Horses*.—Disappears at 2-2½ years. *Dogs*.—Flat body, which divides anteriorly and also posteriorly into two lobes; pale-grap; only traces left after 2-3 years.

10. *Heart*.—In all animals reddish-brown; consistence firm. *Cattle*.—In the fibrous ring of the aorta are two heart bones, which in calves are cartilaginous until the fourth week. *Hogs*.—Apex more rounded than in sheep; heart cartilage ossifies in older age, as in the horse. *Dogs*.—Almost round; heart cartilage is absent, or is very small.

11. *Kidneys*. *Cattle*.—Consists of 16-26 lobules, which fuse in the deeper portion, and as there are just as many calices and renal papillæ, there is no true kidney pelvis; reddish-brown; average weight $\frac{3}{100}$ of the body weight, 952 g. *Sheep and Goats*.—Bean-shaped; not lobulated, thick, arched; dark-brown to brown; mutual renal papillæ and pelvis. *Hogs*.—Bean-shaped, not lobulated, flattened; brown to yellow-brown; 10-12 renal papillæ; pelvis with several calices; average weight, $\frac{1}{150}$ of the body weight, 420 g. *Horses*.—Left kidney longer than broad, (bean-shaped); the right is triangular, flat, not lobulated; brown; renal papillæ are fused into a crescent projection; kidney pelvis has two terminal recesses. *Dogs*.—Bean-shaped, thick, only one renal papillæ; reddish-brown; kidney pelvis has two terminal recesses.

12. *Urinary bladder*. *Cattle*.—Very large, almost entirely covered by the peritoneum; the triangular space between the orifices of the ureters and the urethra called the trigone, is very small, hardly perceptible; similar in sheep, goats, hogs, and horses; covered by the peritoneum in the form of a cap; mucous membrane contains noduli lymphatici. *Dogs*.—Roundish, almost entirely covered by peritoneum; ligamentum vesico-umbilicale is present.

13. *Uterus*. *Cattle*.—Two horns; from external appearances a body is apparently present but actually it is only 1-2 cm. long; mucous membrane forms cotyledons. *Sheep and Goats*.—Horns longer, at the extremities round like intestines; mucous membrane forms very small cotyledons, which in pregnancy become cup-shaped (uterine cups); screw-shaped folds in the cervix. *Hogs*.—Horns long, having the appearance of small intestines; body short, 5 cm. long; the cervix proper is absent; mucous membrane on the corresponding place in the form of oblique rolls (pads); mucous membrane in thin folds. *Horses*.—Two horns, very long body (13-15 cm.), prominent cervix with close folds of the mucous membrane arranged lengthwise. *Dogs*.—Long, straight horns, short body, with a strong muscle wall for a cervix.

14. *Ovaries. Cattle.*—Oval, flat, with a large ovulation surface. *Sheep and Goats.*—Roundish, relatively large. *Hogs.*—Roundish, nodular, like a blackberry, more or less enveloped by the ovarian sac. *Horses* —Almost bean-shaped, dense, entirely covered with peritoneum, up to the notches of the ovulation grooves. *Dogs.*—Elongated, has no notches, enveloped by ovarian sac and fat.

15. *Mammæ. Cattle.*—Four quarters, with one teat each, which has only one opening; parenchyma gray to whitish-red. *Sheep.*—Two halves, each has one small teat with one opening. *Goats.*—Two large, loose-hanging halves, each having a strong teat which is turned forward, and has one opening. *Hogs.*—The mammæ extends from the vulva to the sternum, and has 5-6 divisions on each side, each having one teat, which contains one or two openings; the parenchyma is richly intermixed with fat. *Horses.*—Two elongated round halves, each having one flat triangular teat, which has two openings; parenchyma, whitish-red. *Dogs.*—As in the hog, on each side there are 4-5 divisions, each having one teat, the point of which is pierced by 8-12 openings, like a sieve.

Schneider undertook investigations to establish the absolute and relative weight of the heart, lungs, liver, kidneys, and spleen of cattle, the results of which are compiled in the following table :

	Absolute average weight in—				Relative average weight							
					a. To the live weight of the animal				b. To the dressed weight of the carcass			
	Steers	Bulls	Cows	Heifers	Steers	Bulls	Cows	Heifers	Steers	Bulls	Cows	Heifers
	kg.	kg.	kg.	kg.	%	%	%	%	%	%	%	%
Liver.....	7,607	5,947	5,497	4,787	1,038	1,023	1,206	1,156	1,825	1,924	2,531	2,203
Heart.....	3,012	2,592	2,205	1,89	0,414	0,442	0,492	0,457	0,727	0,835	0,997	0,875
Spleen.....	1,155	0,878	0,789	0,744	0,159	0,152	0,171	0,163	0,278	0,285	0,356	0,334
Kidneys.....	0,727	0,613	0,617	0,497	0,1	0,105	0,129	0,115	0,176	0,199	0,278	0,235
Lungs.....	3,93	3,33	2,99	2,657	0,541	0,56	0,653	0,66	0,95	1,056	1,326	1,102

Accordingly the absolute weight of the 5 organs averages the highest in steers, and gradually diminishes from the steers to the heifers. The relative weight averages the smallest in the steers and increases from the steers to the heifers and cows.

2. Peculiarities of the Meat from Various Animals

Meat and fat of all animal species possess certain peculiarities which are more or less influenced by breed, sex, age, feeding, and condition of health of the respective animals, and thus they fluctuate inside of certain limits.

A. Beef

Generally beef shows a saturated red color with a slight tint of brown; it has a firm consistency and its cut surface is shiny. The odor is characteristic and the meat is generally intermingled with fat. The connective tissue is white and soft. After chilling, the fat shows quite a

firm consistence, a white to yellow color, and a peculiar odor. In old cattle the fat assumes a more yellowish color, and is looser in consistency. Intensive yellow coloration of the fat may also be met in pasture-fed cattle. Rich feeding with slop, oil cake, acorn cake, or cotton-seed meal produces a soft loose, yellow fat. The bone marrow is pure white to reddish-yellow, and of a moderately firm consistency. Fattened steers up to six years old have bright, dark brick-red meat, which is moderately coarse in fiber, and which as a result of the intermixing with fat has a marbled shiny appearance on its cut surface. The fat is white to whitish-yellow and firm.

The meat and fat of fattened calves and fattened young cows up to an age of seven years appear similar to that of fattened steers.

The meat of old milch cows shows, as a rule, a lighter coloration and coarser fibers; the connective tissue stands out more prominently and is close in texture or flabby, and contains more moisture. The fat is yellow, even to an intensive lemon-yellow color, and appears less firm and intermixed in smaller amounts with the meat than in the subcutaneous tissues, mesentery, peritoneum, and kidney capsule. The odor of cow meat sometimes reminds one of the odor of cow milk (Baranski).

Young cattle possess a loose, fine-fibered meat of a pale to light brick-red color only slightly intermingled with fat. The fat is white and firm.

In older bulls the meat is dark copper-red in color, coarse fibered, tough, poor in fat and dry. In large masses, and especially where the muscles are covered with a fascia, the meat has a light-blueish hue; the fat is white. The dried surface of the meat of older bulls appears very dark and the butchers designate it as "black." The meat of young fattened bulls differs only slightly from that of fattened steers with the exception of showing coarser fibers.

The disagreeable odor of the bull meat which was observed by Goltz, and which reminds one of the effluvium of the live bull, appears relatively quite rare. The subject of sexual odor of meat is further treated in Chap. VII, 1.

B. Veal

The meat of calves slaughtered at an age from 2-4 weeks is generally pale, gray to grayish-red, has fine, somewhat tough fibers, and is not intermixed with fat. The consistency is from moderately firm to loose. The odor is specific; in calves which have been slaughtered for a long period (old slaughter) it is slightly sour. The fat is reddish-yellow to white-yellow, and pure white, loose, and greasy. The bone marrow is pink-red. Older fattened calves show a darker, redder, tougher meat, which in the so-called "double loined calves or sturgeon calves," is poor in fat and dry.

Veal in general contains more water and gelatin-forming substances; on the other hand it is poorer in muscle-albumen than beef.

Concerning the meat of immature calves see Chap. VII.

C. Mutton

Mutton (sheep meat) distinguishes itself by the firm, dense, fine fibers and its dark-red color. Its consistence is moderately firm. The odor is specific, slightly ammoniacal, sometimes reminding one of the odor of a sheep stable. The muscles are not intermixed with fat. In fattened animals, however, there are rich deposits of fat between the groups of muscles, and especially in the subcutis and the kidney capsule. The fat (suet) is pure white, hard, firm, brittle, and has no odor. The bone marrow is firm and slightly red.

D. Goat Meat

Goat meat is in general paler than sheep meat. The fat and bone marrow simulate that of sheep. The fat is chiefly located in the kidney capsules, while in the subcutis it is only present in small quantities. The muscles also contain only a little fat. The odor of the meat and fat is peculiarly strong, reminding one of the odor of the living goat, and it is especially disagreeable and repulsive in this species. (See Chap. VII, 1.)

E. Pork

In hogs, age, nutritive condition, and the particular body region influence considerably the color of the meat, which appears whitish-gray, pale red, gray-red to dark red. The fibers are fine, the consistence soft to moderately firm, and the odor indefinable. It is considerably intermixed with fat, which also envelopes the larger groups of muscles. The fat is pure white, finely granular, and soft. The marrow of the bone is soft and pink-red.

In boiling pork it becomes whitish-gray and is then much lighter than the meat of all other food animals.

In fattening with corn the fat takes up a yellowish color, and in feeding fish a gray color. Feeding with acorns procures a more oily fat. Feeding fish gives the fat a fishy odor.

In older sows kept for breeding, and stags (boars castrated after they have matured), the meat is dark red, poor in fat, and firm.

The odor of the meat from boars and cryptorchids is more or less repulsive, reminding one of urine. It is frequently perceptible on the fresh meat, but sometimes it appears only in cooking or roasting it. (See Chap. VII, 1.)

F. Horse Meat

Horse meat is conspicuous through its dark-red or even brown color. When exposed to the air it has a blueish luster, and even becomes blackish-red to black. The fibers are very fine, the consistency firm, and fascias are

very prominent. There is no intermixing of fat in the muscles. The odor is peculiar, sweet, and almost repulsive. Fat is soft, oily, and light gold to dark yellow in color, but in well-nourished horses it is whiter and firmer. Bone marrow is wax yellow, greasy, and soft, but becomes stiffened in the air.

G. Dog Meat

Generally the meat of dogs is dark red, firm fibered, and only slightly intermixed with fat, which occurs chiefly between the groups of the muscles and in the subcutis. The consistence of the meat is soft and smeary; the odor is disagreeably repulsive. The color of the fat is white to white-gray, and its consistence oily and greasy.

H. Rabbit Meat

The meat of rabbits distinguishes itself through its pale-red, gray-red, and gray color. The fibers are fine; the fat in the muscles is absent, and the consistence loose. The fat is whitish-yellow, and is principally confined to the body cavities.

J. Poultry Meat

The muscular tissues of fowls are firm, fine-fibered, and without intermixing with fat. The color of the preponderating meat is pale; however, there are also red muscles. Generally the meat of chickens, capons, and turkeys is called white, while that of geese, ducks, and pigeons is considered as dark. The consistency is principally firm and the alkalinity subsists after slaughter for a long time (Postolka and Toscano). Odor and taste vary in accordance with the species and feeding. Fat content of the muscles proper is very small, with the exception of the fattened fowl. The fat is very variable in its consistency, color, and odor; generally, however, it is soft and oily. In chemical composition (page 40), the meat of fowls contains little lime-forming substances, but considerable albumen.

K. Meat of Game

In general the characteristics of the flesh of fowls may be applied to the meat of game, but the color is always darker, shading from red to brownish-red. Odor and taste of the meat are peculiar to each kind of game. Meat of animals which were exhausted in chasing before death, or which were injured by shot and which had to endure a long agony, is said to taste bitter; moreover, the greater contents of blood in the meat of game should be considered. This, however, apparently does not influence its keeping qualities to any extent, although such is the case with the meat of other animals.

Regarding its chemical composition (page 40), what was said about the meat of fowls applies to the meat of game.

L. Fish Meat

The color of fish meat is white; only few fish have red meat (salmon, trout). The structure is peculiar, inasmuch as the entire muscular mass of each side of the fish consists of a single muscle plate (side muscle), which is divided by a long furrow into a dorsal and ventral part. Each side muscle consists of a large number of muscle plates (myomeren), which are separated by thin, connective tissue membranes, and which easily fall apart, especially in boiling. Nothing can be said of importance regarding the odor and taste, which principally depend on the consistency of the fat. The latter, however, is principally influenced by the food of the fish. Fish of prey have a better tasting meat than those which seek their food in the mud. In the same way the season, especially the spawning period, influences the taste of the meat not inconsiderably. According to the examination of Lichtenfelt regarding the periodical changes of the consistence of meat of various kinds of fish, he found that during the spawning period the albumen diminishes in the side body muscles in female animals from 17.5 per cent. to 13.3 per cent., and in males from 17.9-19.0 per cent. to 13-14.3 per cent. In a still larger degree the fat contents of the muscles decrease. The fat, when present, is finely distributed in the meat.

In chemical composition the fish meat contains a larger quantity of water than that of mammals. This, however, is considerably reduced in fish which are rich in fat to the advantage of the fat contents (eel meat 55-60 per cent. of water). Of the nitrogenous constituents, the extractive and glue-forming substances amount to one-third. The supposition that fish meat is not as satiating as other meat appears to be contradicted by Rosenfeld's investigations.

Regarding the poisonous effects of some fish, see Chap. IX, 2.

M. Meat of Crustaceans and Mollusks

In these animals the muscles are white or white-gray. Consistence, odor, and taste vary greatly. There is a remarkably slight amount of fat present. Regarding the chemical composition see page 41.

N. Meat of Reptiles and Amphibians

The meat of frogs and turtles is always of a pale color, usually white, yellowish-gray, yellowish or yellowish-red. Fat content is limited and slight. Regarding the chemical composition, see page 41.

3. Fraudulent Substitutions of Meat and Their Recognition

In the handling of meats and the preparation of meat-food products attempts are sometimes made to substitute meat of a lesser quality for that of higher quality. To prove these fraudulent actions frequently causes the expert considerable trouble, and not infrequently is this altogether impossible, especially in prepared meat-food products.

If there are bones present in the suspected meat, they should be taken for comparison, and further all characteristic peculiarities of the meat and fat, which have been already described for the individual species of animals, should be considered. Relative to the manifold differences in the skeleton, reference should be made to the text-books on comparative anatomy of the domestic animals. For distinguishing the various kinds of meats from a scientific standpoint the

Biological Method

deserves the greatest consideration. The method is based on the formation of precipitins in the blood serums of animals (for instance, rabbits), which received for a certain time intraperitoneally, blood serum of meat juice of other animals (for instance, of horses). If, then, such blood serum (of rabbits) is added to the blood serum or meat-juice of the animal (in this case to horse blood serum), of which the blood serum served in the preparatory treatment of the animal (rabbit), a cloudiness will develop in the latter which results in a precipitate. This reaction appears only with the blood serum or meat-juice of the same kind of animal which was employed for the preparatory treatment, and from which the serum which supplies the precipitating serum originated. The reaction is, therefore, a specific precipitation.

The method was first employed by Uhlenhuth, Wassermann, and Schütze for the recognition of human blood, and later was improved by Jess, Uhlenhuth, Missner and Herbst, Notel, v. Rigler, Gröning, Borschmann, and others for use on meats. The biological method can not only be applied on fresh meat, but also on dried, pickled, and salt meat as well as for distinguishing meat mixtures, bones, and viscera. On the other hand, the method does not prove satisfactory for the differentiation of cooked meats. For distinguishing horse meat from beef the biological method is successful, but whether the application of the same will prove unobjectionable on the meat of other animals, which zoologically are in closer relation, is yet to be determined. The production of the sera and meat extracts and the procedure of the reaction are accompanied by various difficulties and require certain precautions. Therefore the application of the biological method presumes great skill, and is accordingly

adapted only for scientific institutions and for larger meat-inspection bureaus conducted by veterinarians. Owing to the technique and the numerous details to be considered in connection with the test, the reader must be referred to the original works for a full description. Whether Neisser-Sachs' so-called "diverting method" may also be utilized in the differentiation of the various kinds of meat is yet to be determined.

Other differentiating indications between the species which occasionally may appear for comparison are described in the following:

A. Sheep and Goat

In comparing the whole slaughtered carcass, the goat appears to have longer bones, especially in the flank than the sheep. The latter has a round back and a fleshy rounded croup, while the goat manifests a sharp back and a sloping croup. Goats usually have a shorter tail (12 caudal vertebræ) than sheep (18-24 caudal vertebræ); however, they are also short-tailed (12-16 caudal vertebræ) and tailless breeds of sheep (3 caudal vertebræ). The thorax of the goat is flat, that of the sheep is barrel-shaped. On the somewhat sticky surface of the slaughtered goat frequently goat hairs are found adhering; the skin muscles of goats are darker than those of the sheep. The subcutis of goats contains less fat and also the muscles are not enveloped in fat to the extent they are in sheep. The meat has a characteristic odor, especially pronounced in males. Of the skeleton peculiarities it should be mentioned that all bones of the goats in general have a more slender form than sheep bones. In the skull of the goat the external lachrymal notch is absent while it is present in sheep. The spinal processes of the cervical vertebræ are, according to Bützler, long, pointed, and sharp-edged in the goat, while in the sheep they are broad and dull. Sacral vertebræ are at least 4 in the goat, never 3, as occasionally occurs in sheep. The lateral sacral borders of the goat are thin and sharp; in the sheep they are thickened in the form of rolls. Pelvic opening is considerably smaller in the goat than in the sheep. The scapula in the sheep is broad and short; the well-developed spine has in the center a round thickening which is bent backwards in a bow. In goats the scapular spine is flat and straight, the neck of the scapula is distinctly outlined. The tibia in the sheep is strongly turned spirally, and its posterior surface is concave. The bones of the goat are, according to Lohoff, harder and more brittle than the bones of the sheep.

B. Sheep, Goat, and Deer

The conformation of the bones in deer is always more slender and neater than in the sheep or goat. The cervical vertebræ of deer are longer than in sheep and goat compared to the size of the animals. The spinal processes of the dorsal vertebræ of the deer are turned forward, beginning

at the third; on the lumbar vertebræ they are elongated forward in the form of a sharp hook, which in sheep is considerably smaller. In the scapula of the deer the acromion is elongated into a sharp point, which is directed ventrally; it is absent in the sheep and goat, or is considerably smaller. The radio-ulnar arch which forms an oval opening in the sheep and goat is very long in the deer. The lachrymal bone in the deer is also deeply grooved, but its surface appears incomplete. In the deer the subcutaneous layer of fat is not as well developed as in the sheep; the meat is poor in fat and possesses the odor of venison, which is to be distinguished from the odor of sheep.

Smith pointed out the difference between the goat hair and deer hair. In the first the cortical substance in the microscopical picture is as broad as the marrow substance, while deer hair is characterized by the remarkable development of the marrow substance. The cortical layer in deer hair is almost unrecognizable, so that the hair appears to be a cylinder entirely made up of polyhedral cells. The hair of elk and chamois has also a similar structure.

According to the description of Stadies, the kidneys of deer can only be positively distinguished from those of the sheep with the aid of an anatomical fluid injected into the pelvis of the kidneys. The pelvis of the kidney is injected with a solution of celloidin, rosin, and turpentine in alcoholic ether; after the stiffening of the solution the kidney is placed into hydrochloric acid, which in a few days completely destroys the kidney substance. The cast from the pelvis of the deer kidney is small and oval without any bulgings, while that from the pelvis of sheep shows a long stretched runner.

C. Hog and Dog

Besides the manifold differences in the skeleton, which are described in the anatomies, it may be also noted that the color of dog meat is much darker than hog meat, and this difference can be especially observed in the cooked flesh. (See page 59.)

The muscles of dog meat are more smeary and the fat is more oily than in the hog; the odor is entirely different.

D. Rabbit (Hare) and Cat

The following differences in the skeleton are especially to be mentioned: The lateral processes of the lumbar vertebræ which are directed forward terminate in the rabbit (Fig. 34) in two extensions, of which one is directed forward the other backward; in the cat they terminate in a point. The body of the first three lumbar vertebræ in the rabbit contains thorn-shaped ventral processes (Fig. 34 a). The ribs of the rabbit are flat and broad; those of the cat are rounded. On the scapula of the rabbit the acromion turns around posteriorly and terminates in a long point, which is directed backward (Fig. 37). Radius and ulna are completely separated in the cat (Fig. 35); in the Leporides they are united (Fig. 36). On the humerus of the cat is an elongated fissure over the median condyle

of the distal end (Fig. 39). The femur of the rabbit (Fig. 41) contains below the trochanter major, a specially strong smaller trochanter, which is absent in the cat (Fig. 42). Tibia and fibula are complete in the cat (Fig. 43); in the rabbit (Fig. 44), they are only separated in the upper half.

The whole carcass of the cat can be immediately recognized by its head, penis bone, and the tail, and for these reasons, if offered for sale,

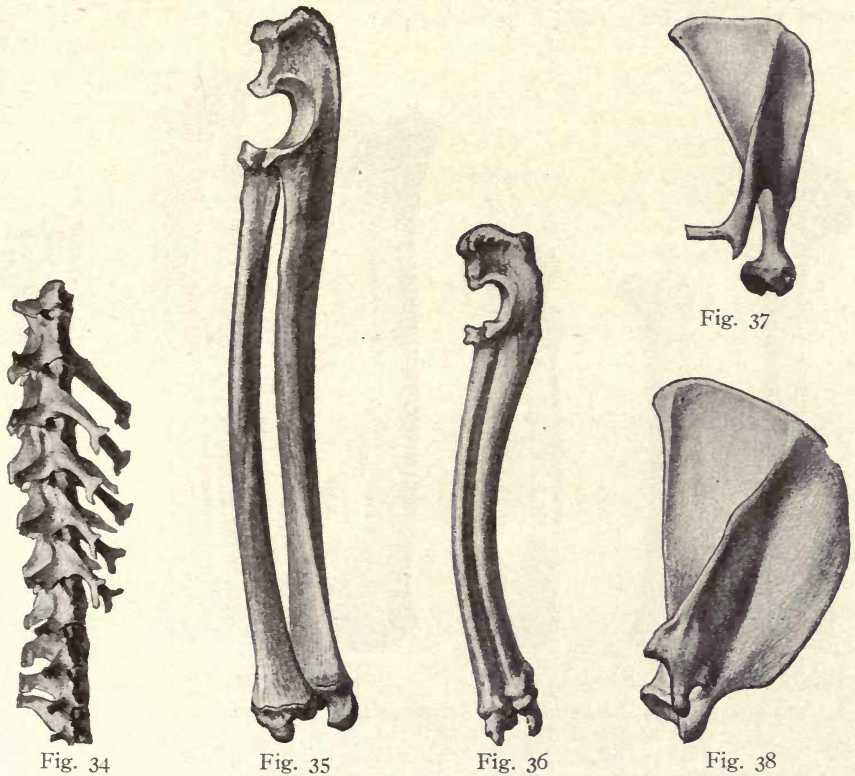


Fig. 34

Fig. 35

Fig. 36

Fig. 37

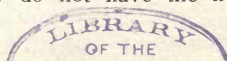
Fig. 38

- Fig. 34. Lumbar vertebræ, a ventral spinal processes.
- Fig. 35. Right forearm of the cat, inside view.
- Fig. 36. Right forearm of the rabbit, inside view.
- Fig. 37. Right scapula of the rabbit.
- Fig. 38. Right scapula of the cat.

these parts are always removed on the slaughtered animal. Rabbits generally have the shot wounds, but these are naturally absent in the slaughtered domesticated rabbits. The meat of the cat is paler than rabbit meat; the fat of the cat appears whitish in contrast to rabbit fat, which is honey-yellow.

E. Hare and Rabbit

The cervical vertebræ in the hare are, according to Lesbre, shorter than those of the rabbit. The spinal processes of the dorsal vertebræ in the rabbit are slightly turned backward, and they do not have the hook-shaped extensions which are



present in the hare. The well-marked bifurcations of the ends of the lateral processes of the lumbar vertebræ in the hare is only perceptible on the first lumbar vertebra of the rabbit. The sacrum of the hare consists of four united vertebræ; the spinal processes are all united. In the rabbit the sacrum is narrower than in the hare. The ribs and scapula are longer in the hare than in the rabbit. The spine of the scapula lays considerably nearer to the anterior border of this bone in the rabbit. The acromion of the hare terminates suddenly at the attachment of the processus hamatus, while in the rabbit it continues for 3-5 mm. in a long point (Fig. 37). Upper arm is larger in the hare than in the rabbit. The radius is longer in the hare than in the rabbit; the middle part is cylindrical in the latter, while in

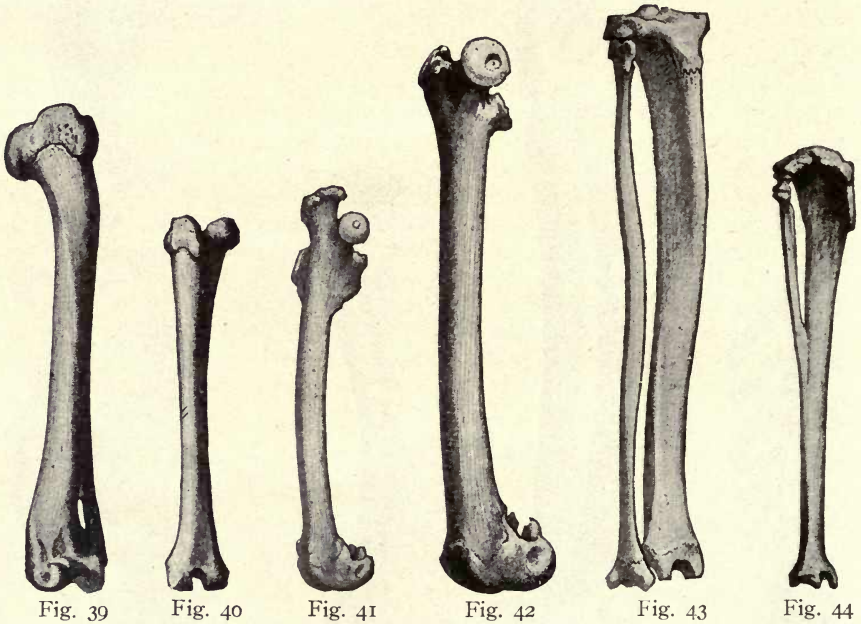


Fig. 39. Right humerus of the cat, front view.
 Fig. 40. Right humerus of the rabbit.
 Fig. 41. Right femur of the rabbit, front and inside view.
 Fig. 42. Right femur of the cat.
 Fig. 43. Right tibia and fibula of the cat, front view.
 Fig. 44. Right tibia and fibula of the rabbit.

the former it is considerably flattened. The ulna of the hare becomes gradually thinner at the distal end, and proceeds almost entirely behind the volar surface of the radius; in the rabbit, on the other hand, it is well developed in the entire length, and lays almost completely on the lateral surface of the radius. With the hind legs there is no perceptible difference noticeable.

F. Cattle and Horses

Regarding the entire quarters, in the horse the length of the extremities and that of the thorax appear in marked contrast to that of cattle, while in the latter, on the other hand, the pelvis is longer than that of the

horse. The characteristics of the meat were discussed on page 57. The numerous osteological differences must be left unconsidered. Seldom is it necessary to pass an opinion on large pieces of meat; it is much more frequently necessary to determine the presence of horse meat which has been prepared for food, especially in sausage. Until a few years ago it was impossible to prove this with any degree of positiveness. However, the work of Niebel can be credited with giving a scientific method for an accurate test for horse meat. Niebel constantly found in horse meat considerable quantities of glycogen (0.373-1.072 per cent.), the smallest amount of which surpasses the quantity found in the meat of other animals.¹

For the demonstration of glycogen Niebel employed Brücke's method with Külz's modification, which is also prescribed with some changes by the regulations of the imperial meat-inspection law for the horse-meat test.

It is certain that superior to the Brücke-Külz's method are those of Pflügler and Pflügler-Nerking, by which Martin has proved that the results gave from 22-25 per cent. higher values than the former. Besides it was found by Frassi, Hefelmann, and Mautz and others, that the glycogen content of the muscles of the horse varies considerably in the various parts of the body; the smallest quantity of glycogen was always found in the muscles of mastication (0.047-0.24 per cent.) while in the back and thigh muscles it was found as high as 10.8 per cent. (in the dry substance free from fat).

Further Niebel found that the glycogen in the horse is converted after a certain time into grape sugar. In such cases he established the contents of the sugar in horse meat by a special method with the aid of Fehling's solution. In this connection it must also be remembered that meat, and especially meat products, contains reductive substances, i. e., creatinin; further that the quantity of carbohydrates is increased in the sausage by the addition of spices, also by starch flour which is sometimes deliberately added to the substance of certain sausages. If there is no addition of carbohydrates made, and it is determined by Niebel's comparative test that the meat or sausage contains at least 1 per cent. carbohydrate, calculated on the basis of the fat² free dry substance, then it is evident that the product contains horse meat. In the horse-meat sausages examined, the confirmed quantity of carbohydrates exceeded 11 times the maximum content of carbohydrates of ordinary sausage.

It is known that the meat of dogs, cats, fetuses, and starved calves contains also a large amount of glycogen. The first two species of animals do not come under consideration in connection with falsification of

¹ This statement of Niebel cannot be sustained, according to Rusche.

² The quantitative glycogen analysis in connection with Niebel's determining method is exact, according to Rusche.

sausage, etc., and with the addition of larger quantities of fetal or starved calf meat the sausages have not the characteristic brown-red color which is given to them by the presence of horse meat. Niebel attaches so much importance to the brown-red color that he considers the presence of horse meat established if, besides the determination of glycogen, the brown-red color of the material is present. While the observations of Niebel have been confirmed by other investigators, nevertheless it has been established by Nerking, Pflüger, and Rusche, that the meat of well-nourished cattle may contain in the fresh state the same quantity of glycogen as horse meat, and Pflüger also determined that meat from horses in poor nutritive condition may occasionally be free from glycogen or have only traces of it. In consequence of these findings and also on account of the high content of glycogen in fetuses and immature calves, it is necessary to employ a supplemental method besides the glycogen test for the positive determination of the presence of horse meat, and for these reasons only the biological test can be accepted as positive.

For the quick determination of horse meat in a meat product, Bräutigam and Edelmann successfully tried and adopted a method for diagnostic purposes, which is based on Niebel's investigations and which depends on the characteristic color reaction of glycogen with iodine as it was first described by Claude Bernard. The method is as follows:

1. A small quantity of the meat (50 g.) to be examined is finely cut and boiled in four times its volume of water for one hour, and the resulting bouillon is treated as described in 4 and 5.

2. To this mass caustic potash dissolved in the same quantity of water is added (3 per cent. of the original quantity of meat) and this is further heated over a water bath until the muscle fibers fall apart.

3. The cooked mass is then boiled down to the weight of the original quantity of meat and filtered.

4. After complete cooling this meat solution is carefully mixed with equal parts of diluted nitric acid, in order to precipitate most of the albuminoids and for decolorization and it is then again filtered.

5. This filtrate (or the bouillon, which was obtained under 1, and which was also acidulated with dilute nitric acid and filtered) is then treated with iodine water, which is carefully poured on the side of the test tube to the filtrate. In this way at the contact of the solutions in the presence of horse meat, a burgundy red zone forms, the width and intensity of which depend on the quantity of horse meat in the examined sample—that is, on the quantity of glycogen in the meat.

This method is successful in proving qualitatively the presence of glycogen even in mixtures which contained only 5 per cent. of horse meat. The color reaction must be distinct, and in order to avoid any possible errors it should be carried out by daylight. The principal requirement in the execution of this test is the absence of starch, and for this reason a small quantity of the meat should be first tested by boiling and the addi-

tion of iodine or Lugol's solution. Should the sample contain starch, then the following modification is to be applied:

1. The glycogen which might be present in the meat product is exclusively extracted by boiling the sample of meat to which the necessary quantity of water has been added in a water bath, which requires several hours.

2. The filtered extract is very carefully reduced on the water bath to one-third of the original quantity of the meat.

3. To this concentrated juice two or three times its volume of concentrated acetic acid is added, which precipitates the starch (frequently only after a few hours).

It has not yet been determined whether the method recommended by Baur and Polenske is suitable for the separation of starch and glycogen through the precipitation with a saturated ammonium sulphate solution.

4. The liquid containing the precipitate is carefully filtered through a double or three-folded filter, and to a small quantity of the filtrate iodine is added for the starch test. Should some starch still be present, the addition of acetic acid must be repeated and the material again filtered.

5. To the solution which does not contain any starch, iodine water may be directly but carefully poured for the glycogen test. But as the extract becomes diluted two or three times its volume through the addition of acetic acid, it becomes advisable in case of negative results:

6. To precipitate the presumptive glycogen by the addition of alcohol to ten or twelve times its volume.

7. The cloudy alcoholic solution is filtered through as small a filter as possible.

8. The traces of glycogen, which might have been retained in the filter, are dissolved with a few drops of hot water, and with water acidified with acetic acid and the solution which thus passes through is then carefully tested with iodine water for glycogen.

The entire procedure of this examination of products containing starch must be carefully executed in every part, owing to the danger of the formation of dextrin, which might be mistaken for glycogen. A chemical separation of dextrin from glycogen has not yet been accomplished. Further information must be obtained from the original works on the subject.

It should be especially emphasized that the method of Edelmann-Bräutigam should be preferably used for diagnostic purposes. In general work this method should be applied for the demonstration of the presence of glycogen in the suspected meat product, and, if necessary, through a quantitative chemical analysis, the quantity of the glycogen should be determined in the product.

The published modification of Edelmann-Bräutigam's method by Courtroy and Coreman cannot be recommended.

Bastien advises the following simplification of Edelmann-Bräutigam's method for determining glycogen in sausages:

20 g. of the sausage to be examined is chopped and boiled for about one hour, until the quantity is reduced to 30 c. c. After cooling, it is filtered and to 10 c. c. of

the filtrate 2-5 drops of iodine water is added. A red-violet coloration proves the presence of horse meat, even if the sausage contains only 5 per cent. of such meat. The coloration disappears quickly, therefore the reagent must be added carefully in order not to obtain a red-brown coloration.

Should the sample of sausage contain starch also, the above-mentioned boiled mass is first decanted, and according to the quantity of starch present, 1 or 2 volumes of acetic acid is added. After 5 minutes it is filtered, and 10 c. c. of the filtrate is taken for the same iodine test as described above.

Lebbien also recommends a new method for the quantitative determination of glycogen, which, however, must first be proved satisfactorily in practice. This method is principally adapted for experts in chemistry.

Hasterlik aimed to utilize the large quantity of iodine which the horse fat contains for a distinguishing sign. The latter amounts in the intermuscular horse fat to 79.71-85.87, compared with 49.74-58.45 in beef fat. In mixtures of these fats or with lard the quantity of the iodine changes to such an extent that the method cannot claim an absolute reliability. The method itself is recently said to have given good satisfaction with meats prepared by cooking.

Bremer does not accept such a high content of iodine in the fat of the horse as Hasterlik, and advises Niebel's method as a supplementary examination.

Nussberger recommends the Zeiss refractometer for the determination of horse fat (Chap. IX).

This method is also prescribed by the regulations of the imperial meat-inspection law.

All these methods should be submitted at first to expert chemists.

G. Cattle and Deer

The muscle fibers of beef are coarser than those of deer, and the bones are also stronger. Deer meat is darker than beef, and is not so mottled with fat. The fat of deer appears much like mutton fat; it is harder and more brittle than beef fat.

H. Cattle and Buffalo

Generally the fresh buffalo is darker (more reddish-brown); the fibers are coarser and looser in the structure than beef. The odor of buffalo meat and fat resembles that of musk, and if boiled in strong acidified (sulphuric acid) water it develops a disagreeable odor similar to that of cattle manure (Puntigam and Halusa). The cutaneous shoulder muscle of buffalo is only 3-5 fingers broad, while that of cattle is considerably broader. The fat of buffalo is strikingly white, and is dryer and less sticky than in cattle. The conformation of the bones of the buffalo is generally finer and the bones are more brittle. The pubic symphysis of the buffalo appears strikingly plain.

III. The Production, Preparation, and Conservation of Meat

In the utilization of meat for human food it undergoes various processes or preparations, and should it not be consumed within a certain period it must be conserved in order that it may be kept.

1. Chopped Meat

The production of chopped meat by means of cutting the flesh with a knife, cleaver, rocking-knife, or meat-grinder is the simplest method of preparation. For this purpose beef and pork are principally used, but veal is likewise utilized to a small extent. The short tendinous meat of the head, leg, and all other parts of the body, which does not find a ready sale in the butcher shop is thus worked up into a more salable product. Naturally fat is also added and chopped up with the meat in larger or smaller quantities.

Chopped meat is consumed either raw, after flavoring with salt, pepper, and onions, especially in northern and middle Germany, or is used for the preparation of meat sausage, meat balls, and various other dishes (German beefsteak, hamburger steak).

In order that the chopped meat should retain the red muscular coloring matter, sulphurous acid and its salt are frequently added, which, however, do not retard all decomposition.

Meyer examined the bacterial contents of chopped meat by sowings on gelatin plates and found 1,695,000 to 12,717,000 bacteria to 1 g. of meat. The number of bacteria was not influenced by the usual additions of preservative salts.

2. Sausage

By sausage is understood a mixture of meat which is placed into a sausage covering. For coverings the intestines are principally employed, the serous membrane being inverted (see page 34); besides the esophagus of cattle, the stomach of hogs and the urinary bladder of various food animals are also used. Lately the so-called artificial parchment is also used as a cover or casing.

The varieties of sausages and their preparations vary considerably in the different countries. This applies especially to those varieties of sausages to which larger quantities of vegetable ingredients are added. The principal ingredients of sausage are always muscle meat and fat, besides

blood, heart, tongue, connective tissue, hog skin, liver, and various other parts of the viscera. In order to make the sausage tasty, spices (salt, saltpeter, sugar, pepper, paprika, caraway, marjoram, garlic, onions, coriander, cinnamon, clove, truffle, sardelle, etc.) are added to the animal ingredients. Many varieties of sausages are prepared for an early (immediate) consumption; in order to increase the keeping qualities of sausage they are either smoked only or they are at first boiled and then smoked.

In accordance with the composition of the filling the following varieties of sausages may be distinguished:

A. Meat Sausages

The meat sausage consists chiefly of chopped beef, pork, or veal. For commercial purposes they are divided into:

1. Fresh sausage and sausage for boiling or scalding, which are sold under various names.
2. Sausages of keeping qualities, which are known as cervelat, summer sausage, etc.

Since fresh sausage or sausage for boiling are destined for early consumption, they do not contain any preservatives, and at most they might be slightly smoked in order to improve the taste. The sausages with keeping qualities, on the other hand, should keep for a longer period. This is accomplished by the reduction of the contents of water in the filling by drying and by smoking. The addition of water to sausage filling of fresh sausage or those for boiling or scalding is usual and positively necessary when the mass is to be filled in the narrow casings. The absorbing power possessed by sausages for water (see page 38) depends on the binding quality of the meat. The higher or lower binding quality of the meat influences the consistence of the sausage mass inside of the covering and therefore the slicing of the sausage as well as the appearance of the cut surface. The quantity of the added water, which amounts to about 24 per cent., according to Hofmann, is of no special importance, since through the hot smoking of boiled sausages and others, not only the added water is lost, but frequently even a portion of the natural content of water of the meat. For this reason, and also on account of the taste of the public demanding juicy, well-stuffed sausages, the addition of water to the filling of this variety of sausages cannot be considered as an adulteration.

The addition of flour to sausage filling, which for a time had assumed considerable proportions, was declared by the butchers to be an absolute necessity, on account of the meat losing its binding qualities through the fattening foods used by the hog raisers. This, however, cannot be confirmed as there are places where the addition of flour is never practiced, yet they produce a splendid meat sausage. If the addition of flour is kept

within a certain limit (about 2 per cent.), it does not necessarily indicate in boiled or scalded sausages a deterioration, as it thickens the juice of the sausage and makes the sausage more palatable. However, the addition of flour is only permissible where the consumers are aware of that practice. In sausage with keeping qualities the addition of any quantity of flour means an adulteration. The supposition that the addition of flour to the sausage filling makes the absorption of a larger quantity of water possible is erroneous, as starch flour absorbs water only in boiling, and boiling water or prepared paste is not employed in the preparation of sausage.

With the addition of mixtures of egg-albumen and tragacanth, the so-called "albumina," it is possible to produce a sausage filling consisting of 35 kg. meat and 50 kg. water, with a content of only 3 per cent. of "albumina." Therefore such an addition must be considered as an adulteration.

Although the coloring of the sausage filling is prohibited for the German Empire (see also B. A. I. Order 150, Reg. 22, Secs. 1 and 2) by the imperial decree of February 16, 1902, it should, however, find brief mention here. The coloring, which was frequently employed in the production of sausages of keeping qualities, was principally practiced to prevent the color of the filling turning gray and especially in order to prevent this occurrence on the cut surfaces. The turning of the color is due to a change of the muscle coloring matter into a colorless modification, which does not necessarily indicate a simultaneous spoiling of the muscle substance. The causes for the sausage turning gray have not yet been satisfactorily established. According to Meyer, this occurs through a loss of salt in the sausage filling, which progresses gradually toward the center by means of osmosis, and naturally may soon affect the cut surface uniformly, thereby turning it gray. It is possible that an insufficient nitrite formation from the saltpeter of the sausage filling might play a part in the change of the color, which, as it has been indicated by K. B. Lehmann and Kalbrenner, changes the hemoglobin into a new red blood coloring derivative (the hemorrhodin). (See also page 96). Glage explains the turning gray of the sausage to the action of the volatile sulphur compound in the meat (N₂S) in combination with oxygen on the muscle coloring matter.

As coloring matter there is employed most frequently cochineal or the carmine which is derived from it. There are also employed numerous preparations with various names (karnit, albon-karnit, rubro-karnit, etc.), but coal-tar preparations as fuchsin, safranin, ponceau, rosalin, and eosin are seldom used.

Through coloring, meat of a lesser value and that which contains only a small amount of muscle coloring matter may be changed into better appearing meat, and the fat in the sausage may also be changed to such an extent that it simulates meat.

The coloring of the casings (sausage cover) is not affected by the above-mentioned prohibition. However, unwholesome stains (for instance korollin) should not be permitted to be used.

[The use of coloring matters in the preparation of sausage is prohibited in the United States. This, however, applies only to the sausage

filling, while for the casings coloring matters which are approved by the Secretary of Agriculture may be used. (See B. A. I. Order 150, Reg. 22, Sec. 2, Par. 1.)]

B. Blood Sausages

The blood sausages are prepared from blood (as a rule, hog blood), mixed with small cubes of cooked fats and lean pork meat, heart, tongue, hog skin, lung, and spices. The meat ingredients, mixed with blood, are filled into casings and the sausages are boiled for the purpose of coagulating the blood. This must be carefully accomplished and the larger the dimensions of the sausage and the more vegetable substance they contain the more attention they require. To insure the keeping qualities of the sausage they are smoked and are sold under the names of red-sausage, black-sausage, tongue-sausage.

C. White Sausages

These varieties of sausages, which are also called soft sausages on account of their consistency, are prepared from boiled and chopped visceral parts, especially from the liver. Besides in these sausages are utilized the lungs, stomachs of ruminants, brains, finely cut pork and veal, with the addition of considerable quantities of rendered or cooked fat in cubes. The addition of the various kinds of spices makes these sausages especially tasteful, and are named accordingly (onion, charlotte, sardell, truffle, and liver sausage, etc.). After cooking they are consumed either in a fresh or smoked state. The light color of the cooked ingredients of the sausage gives the cut surface the gray to whitish color (white sausage).

Similar to these varieties of sausage is the preparation and consistency of most of the commercially known meat pastes (goose liver, fowl, etc.), in which the liver is the principal constituent.

D. Jelly Sausages

They are prepared from those parts of the body which are rich in connective tissue, as skin and head of hogs, head and feet with the skin of calves, the muzzle of cattle, etc., with the addition of fat and lean meat, as well as spices. The cooked or scalded meat and other ingredients are cut and filled, as a rule, into a stomach or bladder of a hog, and the voluminous sausages are then thoroughly boiled. In this process jelly forms inside of the sausage, which after cooling coagulates, and thereby binds the ingredients of the sausage. In order that the binding should be as uniform as possible, and that the sausage should attain the desired firmness and should slice well, it is pressed until completely cooled. The jelly sausage is mostly consumed in the fresh state, but also may be

smoked to increase its keeping qualities. It is known under the names, pressed hogs' head, pressed sack, pressed sausage.

E. Sausages with Larger Quantities of Vegetable Matter

The animal basic substances of these sausages are usually blood with fat or lean pork meat, or a white sausage filling. To these are added, besides various spices, larger quantities of vegetable substances, which are rich in carbohydrates, as groats, bread, boiled rice, rolls, boiled potatoes, corinths, raisins, sugar, etc. The filled sausages for which the stomach or bladder of hogs are frequently used as containers, are cooked and consumed when fresh, or they may be preserved by smoking. This kind of sausage is principally prepared for the household, and, therefore, almost every locality has its own characteristic sausage belonging to this group.

3. Culinary Preparation of the Meat

The culinary preparation should render the meat tasteful and more tender, but it is not necessarily made more digestible.

Considering the digestibility of culinary prepared meat, Popoff established the following scale of values:

If of raw beef, 100 parts are digested, then the digestibility of boiled beef is 83.4 parts; of smoked beef is 71 parts; of smoked and boiled beef is 60 parts.

Different results were obtained by Lebbin, who found that the nutritive value stands the highest in smoked beef; this is followed in a gradual decline by roasted meat, pickled meat, raw chopped meat, soup meat, and broiled meat.

A. H. Chittenden and W. Commins found the following results on the digestibility of the various kind of meats through artificial gastric juice. If the digestibility of beef is placed at 100, then

Veal	= 94.89%	Trout	= 78.45%
Mutton	= 92.15%	Eel	= 71.82%
Lamb	= 87.93%	Haddock	= 82.50%
Fowl (white meat)	= 86.72%	Herring	= 82.34%
Fowl (dark meat)	= 84.42%	Lobster	= 87.81%
Salmon	= 92.29%	Crab	= 67.13%

If under the same condition 100 per cent. of boiled beef would be digested, that of raw beef would amount to 142.38 per cent.

The experiments with artificial gastric juice do not disclose the actual utilization of the meat in the body, especially the nitrogenous substances as the intestinal digestion completes that of the stomach.

The tastefulness and tenderness of meat can be best accomplished in the kitchen, provided it has attained the required ripeness through which the developing lactic acid swells and loosens the connective tissue parts of the muscles. Such loosening may be also obtained by placing the meat into vinegar or milk.

According to Sygoal, Schmidt-Nielson's investigations fish meat also undergoes a ripening process, and especially salted fish should be allowed to go through the process. Fish rich in fat as herring, salmon, trout, mackerel, and others ripe

even when in pickle, while in the salting of haddock and other lean fish the ripening does not take place. The fish muscles contain enzymes the same as those of the mammals, which accomplish the splitting that represents the ripening process. The latter is brought on by autolysis.

On the other hand, according to the investigation of Haldik, freshly slaughtered meat, with a suitable preparation (cooking in small pieces or stewing as gulash in small pieces), is usually just as tasty as ripened meat; however, in roasting it becomes very tough and unpalatable.

A. Boiling

To obtain a good meat broth through the boiling of meat the latter must set on the fire with cold water and boil slowly for 3-4 hours. But should it be desired to obtain boiled meat which is juicy, then the raw meat must be placed in boiling water, and the boiling heat must not be permitted to be reduced to any great extent. In this way there will soon form on the surface of the meat a coagulated layer, which prevents the juices from escaping. In consequence, only traces of muscle albumen pass into the water and they are manifested on the surface of the water in the form of a light coagulated scum. The heat enters the inside of the meat slowly and is indicated by the change of the red muscle coloring matter to the familiar gray color of the meat, the change requiring a temperature of at least 73° C.

The reddening of the meat on the surface in boiling is, according to Kisskalt, the result of the presence of nitrous acid (N_2O_3) in the water in which the boiling takes place. Especially does the superficial reddening of the meat readily occur if fresh meat is boiled in bouillon, which is 12-24 hours old, as in such bouillon N_2O_5 reducing bacteria are remarkably propagated. But the N_2O_5 enters the bouillon either from the water or from the customary soup vegetables which are used in its preparation. It is natural that meat which has been treated with sulphurous salts will also become carmin red on boiling.

The unchanged red color of the salted or pickled meat which remains after boiling, is produced, according to Haldane, through the presence of nitric oxyhemo-chromogen, which is formed as a result of heating from nitric oxyhemo-globin, to which also the unboiled pickled meat owes its redness.

B. Steaming

In steaming or stewing it is best not to allow the meat to come in contact with water, but only steam heat. For this purpose, Papin's steam boiling pot is splendidly adapted. The stewing may also be accomplished by placing the meat in a boiling hot fat gravy, and this is constantly poured over the meat in order to obtain quickly a superficially coagulated layer, in order to retain the juice in the inside of the meat. As a result of this, well-stewed meat is generally more tasteful than boiled meat.

C. Roasting

It is aimed through the roasting of meat with the influence of high temperature (boiling fat), to produce quickly an outside coagulated layer

in order that as much as possible of the juice should be retained in the meat, and which will be replaced by a gradual infiltration of fat. The latter serves also to increase the juiciness and the tastefulness of the roast, while the other peculiarities may be attributed (Stutzer) to the penetration of burning products and to the decomposition of the meat bases (kreatin, sarkin). If it is desired to prepare a so-called English roast the inside of which remains red, the inside temperature should not rise over 63-65° C.

D. Penetration of Meat by High Temperature

As meat is a poor conductor of heat, high temperatures penetrate slowly into it. Bones in the meat increase conduction of heat. Concerning the penetration of heat into meat and meat products, the following investigations were made:

Rupprecht established that in boiling blood sausage the inside temperature of the meat only reached 66° C., in jelly and tongue sausage 62.5°, and in pressed hog's stomach sausage only 58.70° C. The temperature of the inside of boiled ham he established at 65°, and the same for pork, when prepared the usual way cooked with vegetables. In frying meat balls, the inside temperature rises to 58.75°, and in quick frying of sausage only to 28.75° C.

According to Küchenmeister, in boiling larger pieces of meat for ½ an hour a temperature of only 55° C. is reached; even after boiling for several hours it reaches only to 77-80° C.

Leuckart states that in fried sausage and cutlets a temperature of 62.5° and in roast pork 75° C. is obtained, which, however, does not rise over 65° C., if the roast is prepared in the English style.

Wolfhügel and Hüppe established in their extensive experiments the following:

1. Three thermometers inserted into a calf leg of 14.25 kg. after a roasting of 3½ hours at a maximal temperature of 103° C., registered 71, 76, and 89° C.
2. A similar experiment with a smoked ham of 4.5 kg. after 4 hours boiling in salt water with a maximal temperature of 102° C., showed 75, 77, and 78° C.
3. The thermometer registered 93.96 and 98° C. in a fresh piece of veal weighing 3 kg. after three hours of roasting, in which the heat in the roasting oven reached 155° C.
4. A temperature of 91 and 92° C. was obtained in the inside of a piece of beef weighing 3 kg., placed on the fire in boiling water and kept boiling for 2½ hours by which a temperature of 105° C. was reached in the water.
5. In the same size piece of beef, but which was placed in a fire in cold water, the temperature registered 95 and 96° C.

From these experiments it may be observed that the inside temperature of larger pieces of meat (over 3-4 kg.) even in boiling or roasting for several hours never reaches a temperature of 100° C.

In the application of steam under pressure the temperature of the meat rises in a comparatively short time to over 100° C.

E. Losses in Meat in Its Preparation in the Kitchen

Losses in weight. In the culinary preparation the meat loses in the first place water. According to Voit, after boiling 100 g. of fresh meat it gives an average of 57 g. with about 40 per cent. dry substance. Forster established the content

of dry substance in boiled meat at 40-46 per cent; in roast meat at 30-40 per cent. Nothwang found that 100 g. of fresh meat give after boiling 1, 1½ and 2 hours, respectively, 68.9, 59.0, and 54.6 g; in stewing, 68.2, 48.0, and 48.2 g.

In stewing or steaming the loss in weight is generally smaller; it fluctuates between 20-30 per cent.

According to Peters, fish meat loses about 30.18 per cent. of its weight in stewing through the loss of water; from the dry substances only 2 per cent. is lost.

In roasting, the loss of weight depends on the degree of the roasting. 100 g. raw lean meat, according to König, produce 62-85 g. moderately roasted meat; in thorough roasting, however, only 58 g.

According to Grindley and Timothy Mojonier, in the boiling of beef 3.25-12.67 per cent. nitrogenous substances, 0.60-37.40 per cent. fat and 20.04 to 67.39 per cent. mineral constituents pass into the water from the original meat. In heating the meat with fat, on an average 2.15 per cent. nitrogenous substances and 3.07 per cent. ashes are absorbed by the fat, while the meat contains 2.3 times the quantity of fat as before the frying.

Losses in nutritive substances. Still more important are the losses of extractives and phosphoric acid. Nothwang found a loss of the first in boiling and stewing of 50-60 per cent., while of the latter about 35 per cent. In the roasting of meat the losses are somewhat slighter.

In the boiling of pickled meat, which already suffers a loss of extractives and phosphoric acid in the pickling, according to Nothwang, it sustains a further loss of 23.4 per cent. of extractives and 19.05 per cent. of phosphoric acid; and in stewing these losses amount to 20.6 per cent. and 19.3 per cent. The combined losses of pickled meat in boiling and stewing amount to 65.6-67 per cent. in the extractives and 39.50-44.45 per cent. in phosphoric acid.

4. Conserving of the Meat

All meats contain certain preserving qualities which depend on conditions which are in the meat itself, and also on outside influences. To the first belong especially the blood and juice contents of the meat, and the health or disease as well as the exhaustion or rest of the animal before slaughter. The influence of the outside conditions on the meat depends principally on the activity of the putrefactive organisms. They reach the meat from the air or from soiling the meat, entering through the contaminated portions of the surface, through the blood or lymph vessels, the excretory ducts of the glands, the connective tissue spaces, etc., into the inside of the meat.

While all the requirements which favor the biologic conditions for the putrefactive bacteria (moisture, heat, deficiency in oxygen), reduce the preserving qualities of the meat, the latter will be increased, in cases of adverse conditions. And consequently all methods of conserving of meat are directed towards keeping away and diminishing the outside influences for the development of putrefactive bacteria. This purpose is obtained through physical or chemical agents and methods, or with the aid of both.

Deichstetter and Emmerich recommended the use of sterile instruments in the slaughter of animals to as great an extent as is possible, to spray the surface

of the meat with glacial acetic acid, and for dry keeping it should be packed in sterilized sawdust, which has been saturated with sodium chloride; or if it is not to be transported, but allowed to hang, it should be wrapped with cloth saturated in glycerin-acetic acid. The method however is not satisfactory for keeping the meat for a long time in a fresh state. A better method is described by Deichstetter and Emmerich (page 90) which, combined with the previous method, if carefully carried out, enables the keeping of meat for weeks in a fresh state.

A. Physical Conserving Methods

1. Conserving by Extraction of Water

(a) *Drying of Meat*

By this very old and simple method the meat is cut into strips and is dried quickly in the air. In this way the meat becomes so hard and tough that even a later soaking and cooking does not make it perfectly soft. In the meat trade this method is principally employed for the conserving of haddock.

The meat preparation which is made in South America in a similar manner (*chargue dulce*), or by previous salting of the meat (*chargue, tasajo, or jerked beef, Knuth*), is not brought to Europe.

Also the so-called "paprika bacon" may correctly belong here, inasmuch as it represents fresh bacon rubbed with paprika and dried in the air.

(b) *Preparation of Meat Flour*

The meat flour which is prepared and sold in South America under the name "carne pura," or meat powder, is prepared from muscle, which is ground to pulp, then dried, milled to a fine powder, and mixed with a small quantity of salt. The preparation contains about 70 per cent. digestible nitrogen, but has a burned odor and taste. Because of this and its high price it has not found a general market.

2. Conserving by Closing Out the Air

This very old method, especially employed in the household, consists in pouring over the fresh, boiled, or roasted meat, liquid fats which again stiffen, thereby supplying the meat with an air-proof covering. For the wholesale trade in meats this method of preservation is useless.

3. Enclosing in Air-tight Containers

(a) *Sterilization by Boiling*

This method, which was discovered by Appert in 1809, led to the production of canned meat. In this procedure the meat is freed from bones, tendons, and fat, cut into small pieces, and then packed as fresh, pickled, or boiled meat into tin cans to which the covers are tightly soldered. The

cans are boiled for 3-4 hours under steam pressure, whereby the cans become swelled. According to Gröning they are pricked in one place in order that the possible presence of surplus fat may be poured off and that the air might be extracted from the cans in the vacuum apparatus. The drawing in of the walls during this procedure is a positive indication that the cans are tight. After soldering of the small opening, the cans are again heated for a longer period; as a result of the heat the meat will be sterilized. In cooling the cans they must be constantly moved, in order that the liquid ingredients should be uniformly distributed in the can, so that when they have coagulated into a jelly they might hold together firmly the pieces of meat in the container.

In a similar way any kind of meat foods may be preserved with or without the addition of vegetables, and such can preserves form an unsparable proviant for the army maintenance in the field, ships, etc.

The North American corned beef is prepared from pickled meat, which is boiled before pressing it into the can; however, the soldered cans are again subjected to boiling heat. In the same way is prepared the corned mutton and corned pork or corned brawn (pork meat). As the importation of canned meats into Germany has been prohibited since October 1, 1900, the German can preserve industry has experienced a considerable growth.

[The canned-meat industry has assumed extensive proportions in the United States, and as the meat-inspection law of 1906 has control of these meat products a knowledge of the process of their preparation is deemed essential in connection with the supervision of the work.

The preparation of canned meats differs not alone with the different kinds of meats to be preserved, but also the process may differ considerably in the various establishments. The differences, however, affect only some minor details, while the essential points of the process are the same. Inasmuch as the principal canned products are corned beef and potted meats, only the manufacture of these two will be described, all others being more or less similar to the one or the other of the processes.

In canning potted meats the meat is boiled for about 40 minutes, after which it is hashed sufficiently fine, and immediately spread in shallow pans or trays, which are placed in a retort and heated to 82° C. (180° F.) for 20 minutes and then emptied into receptacles from which the meat is conveyed into the stuffing machine. In the handling of the meats all delays should be avoided, and the cans should be filled as rapidly as possible. The tops of the cans, after they leave the stuffer, are cleaned off and the can is then capped. The caps are soldered immediately by passing the cans through an automatic soldering machine, and the vent in the cap is closed by hand soldering shortly after they pass through the machine. At this time the can receives the first inspection. If the can

appears perfectly closed, it is passed directly to the process retort, where it remains for $1\frac{1}{4}$ to $1\frac{1}{2}$ hours (according to the size of the can), under a pressure of seven pounds at 110° C. (233° F.). If inspection, however, shows that the can is imperfectly closed it is repaired before it is placed into the retort.

Small cans are not passed through the vacuum machine before going to the process retort, as they are handled so rapidly that sufficient heat is retained in the product after being placed in the can and capped to establish their own vacuum before the vent in the cap is closed.

By establishing about 22" vacuum on the cans they collapse and distend again from internal pressure, after being placed in the processing retort, which pressure will develop some leaks and imperfections that were not detected on the first inspection. Therefore a second inspection is made as soon as the cans are taken from the processing retort, and any defective cans are repaired and once more passed through the retort. The treatment of cans by passing them through this retort for varying periods at various temperatures, according to the size of the can and the material under treatment, is known in the canning business by the term "processing."

After the cans are sufficiently processed they are passed through a tub of hot lye for the purpose of removing all grease from the outside of the can. From the lye tub the cans pass under a spray of cold water, which causes them to collapse, after which they are removed into the label room. From this time any can showing an imperfect condition is rejected as unfit for food. (B. A. I. Order 150, Reg. 23, sec 2.)

In the canning of corned beef the meat is first boiled for one hour and then placed in the can, which is capped with the vent open. The can is then placed in the vacuum machine, under a 22" vacuum, and the vent soldered, or the vacuum may be also established by leaving the vent open and placing the can in the process retort for 45 minutes at 104.5° C. (220° F.), then removing the can and closing the vent immediately after it ceases blowing. Another method of establishing the vacuum is to seal the can and place it in a vat of boiling water for one hour, then it is removed and punctured with a sharp instrument and sealed as soon as the can stops blowing. If the can contains more than one pound of meat the time in the retort or boiling water is extended, according to the size of the can. If the vacuum has been established by the vacuum machine, the meat is then placed in the process retort for 1 hour and 45 minutes at 8 lb. pressure (111° C.); if the vacuum has been established in the retort, the can is returned to the retort as soon as the vent is closed and remains in the retort for $1\frac{1}{2}$ hours at 7 lb. pressure (110° C.). If again the vacuum has been established by the boiling water method the can is processed by returning to the boiling water for two hours, or by placing

in the retort at 7 lb. pressure for $1\frac{1}{2}$ hours. The processing time given above applies to 1 lb. cans. In larger sizes the procedure is the same only the time is increased about 15 minutes for each additional pound.

In canning roast meat the meat is parboiled only for 30 minutes, and the water method is not used to establish a vacuum; otherwise the method is the same as that for canning corned beef, but a higher temperature is maintained in the retort. After the processing is completed the method is similar to that described above for potted meats.

The following imperfect conditions may occur in the preparation of canned meats:

1. Leaker, a can in which air has gained admittance after the can has been supposedly hermetically closed.

2. Slow leaker, the same as leaker only it develops in the course of time after the completion of the process.

3. Sweller, a can in which the product is undergoing some putrefactive or fermentative change, which was unnoticeable at the time of the canning.

4. Short process can, one which has not had the regular amount of processing for the cooking and sterilizing of the product.

5. Collapsed can, one which has been collapsed by the application of too much vacuum. The condition occurs principally in cans which have not been properly stuffed.

6. Overstuffed can, one which has been strained in packing, by forcing too much of the product into it.

7. Strained can, one which has been overstuffed or strained by over-processing.

8. Do-over can, one which springs a leak after the processing, but before entering the washing machine containing the lye water.]

Judgment

[All the defects of cans which are the result of mechanical imperfections and which are noticed in the course of preparation do not render the meat unwholesome, provided such defects are corrected within 6 hours of the original sterilization. In all other cases the contents of the cans should be considered as unwholesome, and should be condemned in accordance with B. A. I. Order 150 Regulation 23, section 2.]

(b) Replacing the Air with Oil

Of the various methods employed to replace the air in the spaces between pieces of meat in cans, which includes pouring meat-jelly (gelatin), meat-broth, and liquid-fat over the meat, only the use of oil has

attained a practical importance. The latter is particularly employed with fish, which are cooked in oil, packed into tin boxes, and covered with oil (oil sardines).

4. Preserving with Cold

This oldest preserving method is at the same time the simplest, and best for the wholesale industry. Moreover, the quality of the meat is only slightly influenced by the loss of a small amount of the tasty substances; otherwise it ripens and becomes delicate and tender. The preserving action of the cold consists in checking the development of the causes of putrefaction. That numerous bacteria, especially the pathogenic forms, are not destroyed by low temperatures, was proved by the experiments of Forster, Pictet and Young Coleman and Mickendrick, Havemann, and others.

(a) *Laying on Ice*

This simplest application of cold is to be rejected, especially when the meat is placed directly on natural ice, as the pathogenic bacteria which the ice might contain may be transmitted to the meat. Besides, through the melting of the ice, unnecessary moisture is added to the meat, whereby under certain conditions, the buyer would be at a disadvantage regarding the weight of such meat.

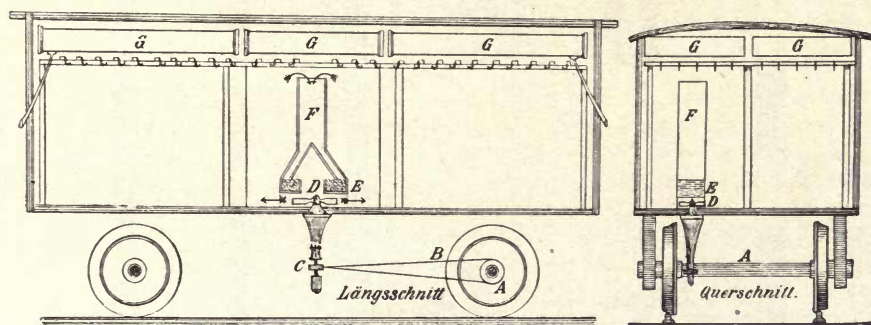


Fig. 45. Refrigerating railroad car for transportation of meat, after Trapp. A, axle; B, belt; C, driving pulley; D, ventilator; E, receptacle for calcium chloride; F, air shaft; G, ice chest.

(b) *Influence of Cold Air*

1. Cooling of Air by Ice

Through the storing of ice and its gradual melting, the surrounding air is cooled. On this principle are based the preserving properties of ice-boxes, ice-cellars, ice-houses. The various constructions of these cannot be treated here. Their qualities depend on the circulation of the air in the meat-keeping rooms, and on their thorough insulation against radiating heat. For larger plants these methods are not satisfactory, inasmuch as

they are dependent on numerous contingencies (deficiency of ice, excessive summer heat, failure of the ventilation arrangements, etc.)

On this principle rests also the transportation of meat in refrigerator cars which are constructed in accordance with various systems (Straschiripka and Tiffany; Anderson, Zimmermann, Acclom, Jaschka, Wickes, Schreiber, Trapp, and others). The construction of the meat transport car patented by abattoir veterinarian Trapp in Strassburg is illustrated and described under Fig. 45.

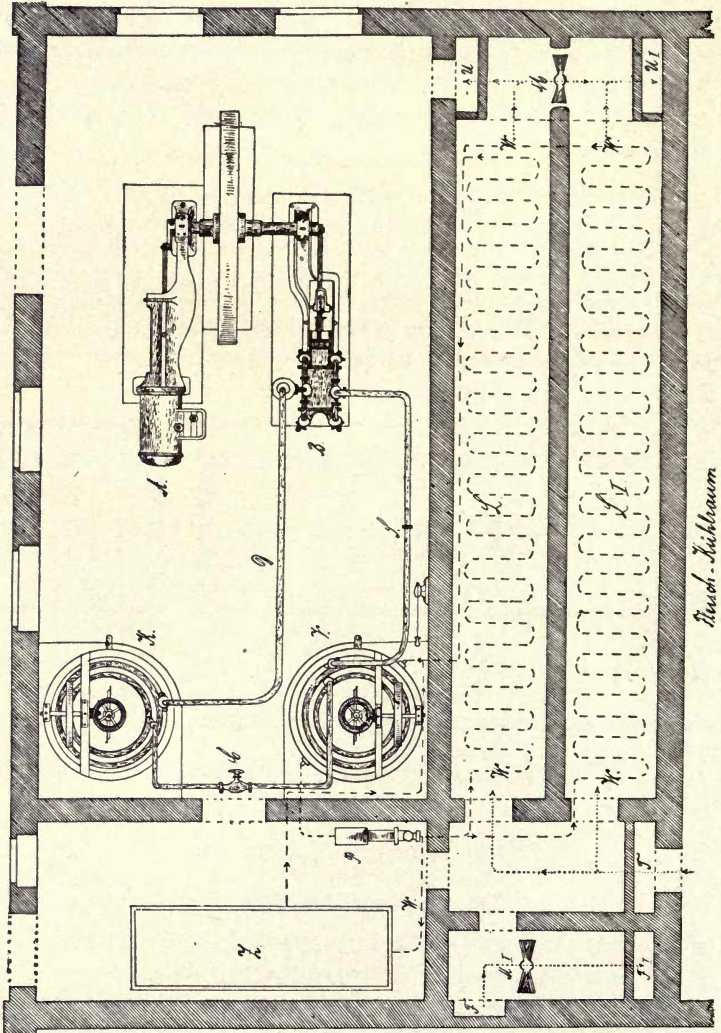


Fig. 46. Schematic sketch of the principal parts of a cold-air refrigerating apparatus

2. Refrigeration Plant Machines

The modern operated refrigeration plant with machine power has for its object the continual maintenance independent of outside influences of a temperature ranging from 4° to 20° C. in the storage room for meat. At the same time it reduces the contents of moisture to at least 70 per cent. of the relative moisture, and provides for a continual renewal of air, which it purifies. For this purpose every refrigeration plant consists of the following three principal parts: The cold generator, the cold transmitter, and the chilling room proper, which in the various systems is differently constructed and arranged.

As refrigeration machines¹ at the present time can be considered only the "cold steam" or "compression" machines, since the "cold air" or "air expansion" machines cannot be utilized in the meat industry.

The refrigeration machines act in accordance with the physical law that the evaporation of liquids consume heat. For this purpose there are principally used carbonic acid, ammonia, and sulphuric acid, which pass in a circle through a system of pipes and are compelled to remain in a portion of the pipe system in a liquid state, as a result of low temperature and pressure, while in the other part of the system they have an opportunity for evaporation. The principal parts of the refrigeration machines are the compressor, condenser, and evaporator. The operation schematically produced according to Fig. 46, is as follows:

In the engine room is a steam engine A, directly connected with the compressor B. From the latter a pressure pipe connection D leads to the condenser K, from which a pipe connection with the regulating valve C leads to the evaporator V. The condenser and evaporator are large cylindrical galvanized-iron containers, in which the mentioned pipes run in numerous spiral windings, which are rinsed with cold and continually renewed water in the condenser, and in the evaporator by a salt or chloride of calcium solution. These solutions are continually kept moving with a stirring apparatus which are also operated by the engine, and which turn around a perpendicular axis inside of the spiral tubing. The spiral piping of the evaporator returns to the compressor as a suction tube S. If, now, one imagines the pipe system D, C, S, filled with one of the mentioned gases, it will, as a result of the pressure of the compressor piston and from the cold water running through the spiral piping of the condenser, change into a liquid state with a constant effort to return to a gaseous condition. The latter occurs in the evaporator into which the gas is admitted and regulated by the valve C, and in which the gas is no longer kept under pressure, but on the contrary suction is applied to it through the pipe S from the compressor. During the evaporation, the gas abstracts heat from the

¹ For extensive descriptions see Lorenz, *New Refrigeration Machines, their Construction, Operation, and Industrial Utilization*, München-Leipzig, 1901, III Auflage; Statefeld, *The Utilization of Refrigeration Machines*, Berlin, 1901; Gottsche, *The Refrigeration Machines*, Hamburg, 1904; also Schwartz, *Construction, Arrangement and Operation of Public Abattoirs and Stock Yards*, Berlin, 1898, II edition, and Schwartz, *Machines for the Operation of Abattoirs*, Berlin, 1901.

spiral pipes which enclose it, and these again from the salt water (salt-chloride of calcium solution) which surrounds them, by which the latter is cooled down to minus 10-12° C. But the evaporated gas passes again as mentioned into the compressor, and makes the described circle over again. The cooled salt water acts further as a transmitter of cold and is pumped by the pump P from the evaporator, is then pressed into the piping W, and is conveyed into the air-cooling chamber L and L', from which it enters the ice-manufacturing tank Z, and thence returned.

In the air-cooling chamber, the salt-water pipes are spread in numerous windings in such a way that the connection of each chamber may be detached from the other; therefore each chamber may be operated separately. The air-cooling chambers are connected by air shafts with the meat cooler proper in such a manner that for instance the air shaft T conveys the air from the cooler into the air-cooling chamber and the air shafts U and U' permit the return of the air from the air-cooling chambers into the meat cooler. In the latter the distribution of the cooled air is accomplished by canals supplied with openings which are attached to the ceiling. In a similar way special canals are present for the air to be drawn away by suction. The moving of the air between the mentioned rooms is accomplished by a ventilator M, which is operated either by electricity or by transmission from the steam engine in such a way that by an alternating opening or closing of valves the air in the meat cooler is ventilated while passing around the pipes of the air-cooling chambers L and L'; at the same time the network of pipes which is cooled down to zero, abstracts from the moving air heat impurities and moisture so that the air is returned to the cooler cooled, purified and dried. That moisture is abstracted from the air is manifested by the ice deposits on the pipes, which gradually gets thicker, and also encloses the impurities which the air contains. The layer of ice around the pipes, however, retards more and more the radiation of cold from the pipe system, and therefore considerably diminishes the cooling action. For this reason, after certain intervals the active pipe system of one of the air-cooling chambers is detached and the other placed into operation, which acts like the first. In the meantime the first thaws out, and may then be again operated when the second has to be detached on account of the thick ice covering. The ice-producing tank Z serves for the production of artificial ice for which purpose galvanized-iron containers are filled with water and hung into the salt water of the tank; the water is permitted to freeze and the containers are then taken out of the salt water. The latter are then dipped into warm water in order to loosen the ice from the sides of the container and the ice is then emptied out. Practical mechanical installations greatly facilitate the necessary work. To supply the meat cooler with fresh air, and to ventilate them when they do not contain anything for cooling, the ventilator M is employed, which transmits the change of air through the air shafts F and F'.

In place of the salt-water piping, which can also be connected with the meat cooler, although this cannot be recommended, may be used certain arrangements for cooling the air, in which artificially moving air is run over the surfaces irrigated by cold salt water or is directed through the salt water. Of the various systems of refrigeration machines those of Linde-Wiesbaden (ammonia), Humboldt-Kalk (ammonia), Riedinger-Augsburg (carbonic acid), Borsig-Tegel near Berlin (sulphurous acid) are the best known.

Regarding the equipment of the meat coolers proper, it is only necessary to mention that they contain racks constructed of iron railings with arrangements for hanging the meat. In abattoirs usually special chill-

rooms and cutting rooms are also constructed, and the first is brought into direct connection with the killing floor, from which the dressed carcass is conveyed without much effort into the cooling rooms the temperature of which is not kept as low as in the coolers proper. For the preservation of fish, game, poultry, etc., special cooling rooms are constructed, the air of which should not be connected with the rooms where fresh meat is kept.

For controlling the temperature and the moisture of air in the cooling room it is recommended that self-registering thermometers and hygrometers be installed, which in some places are required by regulation.

3. Freezing

The freezing of meat is accomplished for preserving meat an unlimited time, as for transatlantic transportation. The equipment for this purpose is the same as those described for the refrigeration plants; the air, however, is cooled below 0° C., and is kept constantly under the freezing temperature.

B. Chemical Preserving Methods

1. Preservation with Salt

On the preservative action of salt is based the oldest method, generally practiced in the household, as well as in the wholesale trade, the salting and pickling of meat. The first indicates a superficial preservation for a shorter time, while with the latter a complete penetration of the meat with salt is obtained, and therefore a lasting preservation. This is based principally on the dehydrating action of the salt and less on its germicidal action.

While superficial salting may be carried out on all kinds of meats, pickling is best adapted for pork meat, especially bacon on account of its high muscular fat content; fine-fibered beef, intermixed with fat (brisket), also produces a good pickled meat. Lean beef as well as veal and mutton get dry and unpalatable from pickling.

Regarding the application of the salt, nothing further need be said. The procedure of pickling depends on the time to be consumed and on the desire for a certain degree of preservation of the meat products. If one desires a hurried pickling (forced pickling) and to abstract from the meat only a little moisture, it is best to place the meat in a salt solution (brine) or to inject this solution into the meat alongside of the bone or into the connective tissue with a special brine syringe supplied with a hollow needle.

In the latter case the salt acts osmotically on the meat, both from the outside and from the inside. The keeping quality of such pickled meat is not very high, on account of the large content of water, and therefore such meat is usually destined for early consumption or it is further preserved by smoking. In slow pickling the surfaces of the smaller cuts of meat are rubbed with salt, and the pieces are

packed into barrels, each layer of meat being thoroughly covered with a layer of salt. The quantity of salt to be used is about 50 g. to 1 kg. of meat. By this process there is also formed a brine, the water content of which originates almost entirely from the meat. The latter, therefore, dries out considerably, and in consequence such meat possesses a better keeping quality. The recently recommended "injection pickling" by Fjelstrup, by injecting the blood-vessels with brine immediately after slaughter, has not yet reached a practical importance.

The changes which meat undergoes through pickling are the following:

(a) Turning gray of the muscles due to change of the muscle coloring matter. To prevent this saltpeter is added to the salt, which is readily reduced to nitrous acid, which changes the hemoglobin into a bright red derivative (hemorrhodin, Lehmann). According to Haldame, through the action of the nitrates on the hemoglobin, in the presence of oxygen and reducing substances, nitricoxyd hemoglobin develops, to which the uncooked pickled meat also owes its red color. Regarding the red color of the pickled meat after cooking, see page 76. The quantity of saltpeter usually added amounts to $1\frac{1}{2}$ -2 g. to each kilo of meat, and there has never yet been found injurious quantities of this cardiac depressant in pickled meat. Glage prefers to use directly small quantities of nitrates in the pickling, or to add alkaline phosphates to the brine to obtain a high red color of the meat. The addition of cane-sugar to the brine or salt mixture increases their powers of checking putrefaction.

(b) The previously mentioned loss of water depends on the method of pickling and the original contents of moisture in the meat; it may amount to 10 or 15 per cent.

(c) The abstraction of nutritive substances, as a result of pickling, is not to be underestimated.

According to Polenske it amounts to:

- In 3 weeks pickling 7.77% N. and 34.72% phosphoric acid anhydride.
- In 3 months pickling 10.08% N. and 54.46% phosphoric acid anhydride.
- In 6 months pickling 13.78% N. and 54.60% phosphoric acid anhydride.

Besides, there occurs a considerable loss of extractive substances (meat bases), and potassium salts to such an extent that pickled meat not only possesses a relatively smaller nutritive value than fresh meat, but it is also, as a rule, harder to digest (compare with page 75). These statements were substantiated by Notiwang, who further established that in boiling and stewing, pickled meat also loses extractive ingredients and phosphoric acid.

(d) The increase of weight of meat in pickling also depends on the method of procedure. In pickling in brine, beef gained 9.4 per cent. after 3 weeks, and after 3 months 13 per cent. of the original weight (Polen-

ske). The absorption of salts after 14 days' pickling of beef at 4 degrees amounted to an average of 8.35 per cent. of saltpeter and 15.69 per cent. of common salt (Kuschel).

The influence of pickling on the meat of diseased animals has formerly been overestimated. Although in accordance with Forster's investigations, cultures of anthrax bacilli under the influence of common salt are destroyed in from 18 to 24 hours, cultures containing spores retain their virulence for months. Tubercle bacilli retained their infectivity for 18 days in pickled pieces of organs, and cultures sprinkled over with common salt remained virulent for 2 months. *Bacillus morbi-ficans bovis* and *bacillus enteritidis* were, according to Stadler, destroyed in concentrated salt solution only after 3 and 4½ weeks. Cultures of the bacillus of swine erysipelas are only slowly killed through salt in substance, but somewhat more quickly by concentrated salt solution. Brine exceeds both the former in its bactericidal action, and it destroys the erysipelas organisms in about 8 days. Still it was possible to demonstrate virulent erysipelas bacilli in the meat affected with erysipelas after being soaked in brine for about 7 weeks. Pickled meat contains even after 4 months, virulent erysipelas bacilli (Stadie). The cultures of pyogenic staphylococci and streptococci acted in the same manner. Animal parasites, if present in the meat (*cysticercus*, *trichinæ*), are positively killed in thorough pickling of the meat.

2. Preservation with Boracic Acid

Although the preservative action of boracic acid (BO_3H_3) and its salt is not great, as they act only in checking the development of bacteria, yet they may prevent infection and decomposition, and keep fresh meat in its natural color. Therefore preservatives containing boracic acid have been used in the meat industry to a considerable extent. For many meat products boracic acid acts to some extent as a substance to increase their weight through an increase of their water contents.

The preservative salts containing borax were placed on the market under various names. The best known are: Barmenit (common salt and sodium chloroborate); [sodium chloroborate is sodiumborate combined with chlorin]; double and triple preserving salt (boracic acid, saltpeter, common salt, Glauber's salt); boroglyceride (a product containing about 60 per cent. glycerine and about 40 per cent. boracic acid).

The injurious effect of boracic acid and its salt on the human system has been argued for many years. In the practice of meat inspection it was decided that the use of boracic acid and its salt in the preservation of meat foods is prohibited in Germany on the ground of the Imperial Decree of February 16, 1902, in connection with the publication of the Imperial Chancellor of February 18, 1902. [Their use is also prohibited in the United States (see B. A. I. Order 150, Regulation 22, section 1).]

3. Preservation with Sulphurous Acid

The salts of sulphurous acid and especially the sulphites, are brought into trade under the name of preservative salts, the acid or primary calcium sulphite (SO_3H_2) Ca, or acid potassium and sodium sulphite (so-called bisulphite) SO_3HK and SO_3HNa , or also neutral sodium sulphite SO_3Na_2 mixed with common salt, Glauber's salt, sugar, etc. As already indicated, sulphurous acid salts are not so much conserving substances for meat as they are for the preservation of muscle

coloring matter. Therefore they were principally employed for the preservation of the fresh meat color on the surface of pieces of meat, and especially for the prevention of chopped (ground) meat from turning gray. The action of the sulphites in preventing putrefaction is only slight, so that putrefaction may develop in meat containing sulphites. But as the initial putrefaction is hidden by the redness of the muscle coloring matter, the use of these preserving salts in connection with the meat trade leads not only to deceptions regarding the freshness of the same, but also to the consumption of meat which might have obtained injurious properties through putrefaction.

The difference of opinions regarding the immediate influence of sulphites on the health of human beings was decided against the sulphites in the German Empire by prohibiting the addition of these substances to meat products in accordance with the Imperial Decree of February 16, 1902, in connection with the publication of the Imperial Chancellor of February 18, 1902. [Sulphites have also been prohibited in the United States in accordance with B. A. I. Order 150, Reg. 22, sect. 1.]

Regarding the test of meat for sulphites see page 342.

4. Other Chemical Conserving Substances

Other chemical conserving substances, such as salicylic acid, sodium silicofluoride, ammonium acetate, sodium acetate, formaldehyde, lactic acid, glycerine and others have been tried in an experimental way for the conservation of meats, but they have not attained any practical importance. Of the above conserving substances the following are prohibited from use in connection with the preparation of meat in the German Empire: Formaldehyde, alkalies and alkaline earth hydroxides and carbonates, fluorhydrogen and its salts, salicylic acid and its combinations, and chlorine acid salts.

[The use of chemical preservatives in the preparation and preservation of meat and meat-food products with the exception of common salt and saltpeter is prohibited in the United States, and the measures governing the same are contained in B. A. I. Order 150, Regulation 22.]

The bactericidal action of acetic acid is utilized in the Deichstetter-Emmerich method (see page 79) for keeping meat fresh. The animal is slaughtered, and cleanliness is observed as much as possible; then the large blood vessels are infused with diluted acetic acid, and the surface of the meat is sprayed with acetic acid. The keeping of the meat has to be carried out as described on page 79. This method which proves an undeniable success if carefully executed, is, however, a failure in large practice, due to the frequent unreliability of persons intrusted with the work.

5. Conservation by Smoking

The preparation of meat products for keeping under the preserving influence of smoke (smoked products, ham, bacon, smoked meat, pickled smoked meat), has been known since the oldest times. Only such meat is adapted for preservation with smoke, however, as contains a comparatively small quantity of water (pickled meat), or is of such consistency that the latter is readily diminished in the smoking and makes an easy penetration of the smoke possible (sausages). There is also meat subjected to smoking not so much for preservation as for its penetration by the burning substances of the smoke to make the meat more palatable.

The application of smoke consists in the development of proper smoke, and this is best accomplished by a slow burning of wood in the form of sawdust. Of the latter hard woods, and especially juniper bush, furnishes the best smoke, while the burning of pine wood is useless for smoking purposes on account of the large amount of turpentine which it contains. The smoking process may be carried out as slow or as forced smoking. In the slow smoking the meat is kept for days and weeks in a room of 20°-25° C., the air of which is impregnated with smoke (smoking room), while in the forced or hot smoking the products (fish, sausages), are exposed only a short time to the smoke at 70°-100° C. Besides there is also a so-called artificial or quick smoking, in which the meat or sausage is dipped into a mixture of pyroligneous acid, water, and juniper oil, or the meat is covered with the same and then dried in an airy place. Also decoctions of shining soot which is formed in the burning of wood with or without the addition of salt is supposed to be employed for applying to meat products. With both methods, however, it is not aimed to conserve the meat preparations, but to impart to them a smoky taste.

The conserving effect of smoking on meat rests upon the previously mentioned extraction of water and the penetration of the meat with gases and fumes of the smoke, which are substances preventing putrefaction. Among these are the tar products and hydrocarbons soluble in water; also acetic acid, creosote, phenol, cresol, carbonic acid, ammonia, etc.

Concerning the action of smoking on microorganisms, the investigations of Beu, Serafini, and Ungaro showed that even pathogenic germs are destroyed in a short time if they are easily reached by the smoke. In the smoking of infected meat it has to be considered, however, that there soon forms on the surface a coagulated layer which makes the penetration of the smoke more difficult. Therefore the germs contained on the inside of large pieces of meat may only with difficulty be destroyed. And this is also influenced by the water content of the meat, inasmuch as the water prevents the penetration of the smoke. The bacilli of hog erysipelas are destroyed in two weeks' continual and intensive smoking of pickled meat, if the pieces do not exceed 2.5 kg. in weight (Stadie).

5. Various Food Preparations Derived from Food Animals

A. Meat Extract

Although the meat extract is not a food but a delicacy of animal origin, still, on account of its extensive consumption, it should be briefly mentioned here. The meat extract of which the principal brand is that discovered by Pettenkofer, and named in honor of Liebig, is almost exclusively prepared in America from lean beef, which is chopped by machine and is boiled with little water under high steam pressure in an apparatus. After the separation of fat, coagulated albumin, and fibrin, the filtered meat broth is concentrated in a vacuum, and is then again boiled down in open kettles which are supplied with stirring apparatuses until a thick pap is formed, which is filled into jars; 30-32 kg. of lean meat gives about 1 kg. of meat extract.

The extracted meat fibers are dried and ground and shipped to Europe as American meat flour, where it is utilized for food purposes, and recently also for the preparation of albumen.

According to Stutzer, meat extract contains about 60 per cent of organic substances, 20 per cent. salt, and 20 per cent. of water. The organic substances consist principally of so-called meat bases—creatin, creatinin, sarkin, xanthin, inosinacid, karnosin, aminoacid (Baur & Barschall) and others, as well as small quantities of phosphocarnic acid and lactic acid. Glycogen is also generally present. The presence of succinic acid in the meat extract cannot be considered as a positive indication of putrefaction. The salts consist of about two-thirds of potassium phosphate.

Due to this composition, the meat extract appears as a spicy delicacy which stimulates the nerves of taste, smell, and digestion.

The liquid meat extracts which are brought into trade as Cibil's, Koch's, Maggi's extracts, contain much less organic substances than Liebig's and Kammerich's meat extract.

[Meat extract is also prepared in the United States to a large extent from the meat broth obtained from the boiling of meats for canning purposes. This is boiled down and concentrated in a vacuum to a desired consistency, and is then drawn off into various sized containers.]

B. Peptones

The efforts of chemistry to convert the albumens of meat into soluble preparations which may be absorbed without any further change in the body by the digestive apparatus lead to the preparation of peptones.

According to Stutzer, there may be distinguished pepsin peptones and pancreatic peptones. The preparation of the latter has ceased at the present time. The first is prepared by subjecting meat to the action of a mixture of pepsin (extract of the mucous membrane of the stomach) and hydrochloric acid in the known physiological dilution; the solution is then filtered, is accurately neutralized with a small quantity of bicarbonate of soda, and finally steamed in vacuum. The peptone thus prepared, contains albumose as the principal ingredient.

The opinions regarding the nutritive value of peptones are very different, and this is readily explainable, as the various trade preparations contain a greatly changing content of true peptones. Thus Stutzer found in a fluid meat peptone preparation, 12-15 per cent. peptone=1.91 per cent. nitrogen; and in another, dry fibrin peptone 81 per cent.=14.56 per cent. nitrogen.

C. Fat and Tallow

The fats of food animals, inasmuch as they are not sold in the raw state, or as prepared meat products (bacon, etc.), are rendered to serve for human food, and the connective tissue constituents of the fat tissue are separated from it in the form of cracklings. The rendered hog fat, under the name of lard, forms as cooking fat, an important trade article, which is principally shipped from America. The freshly rendered beef tallow is also sold directly for food purposes. Larger quantities of it are utilized for the manufacture of oleomargarin (olein), while the superfluous quantities of tallow are chiefly used for industrial purposes.

The lard forms a fine, milk-white homogeneous mass of oleaceous consistence and peculiar agreeable odor and taste. The color of the lard is sometimes artificially improved by the addition of borax, and its water content may be artificially increased by mixing alum or calcium hydrate with the lard.

While such manipulations, as well as adulterations of lard, as a rule, occur only rarely in Germany, they were formerly carried out in America, with all sorts of varieties of fats. The most frequent manipulation is the adulteration with cotton-seed oil. But there are also varieties of lard which do not contain the least portion of hog fat, but are prepared from beef fat, mutton fat, cotton-seed oil, cotton-seed stearin, and other kinds of fats, pignut oil, oil of sesame, palm-seed oil, and cocoanut oil. In the trade the adulterated lard is given the most varied names, as Cottolene, Kotosuet, Refined Lard, Pure Refined Lard, Pure Refined Family Lard, Fairbanks' Lard, Frying Lard, Hamburg City Lard, etc.—on the other hand, the following American lards are unadulterated—Neutral Lard, Leaf Lard, Choice Kettle-rendered Lard (choice lard), and Prime Steam Lard.

[In accordance with the Regulations of April 1, 1908, governing the meat inspection in the United States, all products sold under the trade name of lard must consist of hog fat, as the said regulations provide that the true name must be given to all products, and that false or deceptive names of meat and meat-food products are prohibited. Further, it is provided that the meat-food products which contain substances which are added to adulterate the same must bear a label stating that such substances have been added. (See B. A. I. Order 150, Regulation 18, sections 1-14.)]

According to the German Imperial law of June 15, 1897, regarding the traffic with butter, cheese, lard, and their substitutions, all preparations resembling lard, the fat content of which does not consist of hog fat, must be declared as artificial food fat.

The so-called sausage fat, known principally in the retail trade, is obtained from the skimmings of the sausage broth in which the sausages are cooked. It is a mixed fat containing a considerable amount of water of a gray to grayish-green color, with a spicy sausage taste (principally like marjoram), and which contains small meat particles and unmelted pieces of fat. It spoils very easily.

Under the term *margarin*, formerly also called artificial butter, sweet cream butterine, Holland butter, Holburko, etc., is understood in accordance with the German Imperial law of June 15, 1897, all those preparations which resemble cow butter or butter fat, and which do not entirely originate from milk. Margarin was first prepared by the French chemist, Mège-Mouries, who, in 1869, made public the process of its preparation,

which was practically the same as the present method, with the exception of some slight changes. The fresh beef fat is washed, macerated, and after adding water, potash and stomach mucous membrane, it is heated to about 50° C., causing the liquid fat to accumulate on the surface. The fat—the so-called “Premier jus”—is then taken off, is clarified, and solidified at 25°, by which the tristearin separates in crystals, while the triolein and tripalmitin, which together are also called oleomargarin (in the United States, oleo oil), remain fluid and are separated from the first by pressing. To every 50 kg. of oleomargarin 25 l. of cows' milk and 25 l. of water, with a small quantity of butter coloring, is mixed, and the mass is then churned. Thus the fat mixture so obtained gives, after washing and salting, a fat which tastes like butter. In accordance with the Imperial law, 10 per cent. of sesame oil must be added in order that the margarin itself, as well as possible mixtures with butter, may be easily detected chemically.

If margarin is cleanly prepared from good fat, and is sold under declaration, no objection can be made against it from a hygienic standpoint. According to Jolle's experiments with dogs, margarin is just as profitably utilized in the intestines as butter; and Adolph Mayer, as well as Kienzl, found in the comparative experiments on men only very slight differences in favor of butter. Tubercle bacilli have been found in margarin the same as in butter (Morgenroth).

[The preparation of oleo oil, which is a product of beef fat, comprises an important industry in the largest packing houses of the United States. It is the principal ingredient of butterine. The largest part of oleo oil manufactured in the United States is exported to Europe, principally to Holland and Germany, where it is utilized for the manufacture of butterine. There is at the present time only a comparatively small amount of butterine manufactured in the United States, the demand for that product being somewhat limited.]

In accordance with an act of Congress, butterine must be sold in the United States under declaration, and no coloring is permitted to be used in its preparation, except by the payment of a heavy license.]

D. Caviar and Smoked Salmon

The preservation of fish and crustaceans, which are conserved by salting, smoking, drying, inclosing in air-tight cans, pickling, etc., is of very little importance for the general purpose of the subject under consideration. Only the caviar, which, on account of its high nutritive value, its easy digestibility, and its palatability, forms a widely distributed food and delicacy, and smoked salmon, on account of its various trade preparations, will be briefly considered here.

Caviar is the salted spawn of large varieties of sturgeons. According to Niebel, it is obtained principally in Russia, on the lower courses of the Wolga, Don, in the Ural, Aral sea, and Caspian sea; in Germany, on the East sea, North sea, and on

the lower course of the Elb; in America, in the State of Oregon, and in the Territory of Alaska. It is distinguished as fluid or granular, and pressed caviar. The first, sprinkled with common salt, is passed through a sieve for the separation of the adhering membranes, and is packed into barrels. The pressed caviar consists of eggs of an inferior quality, which are placed into brine, and then pressed out after sufficient absorption has taken place.

Relative to the origin and quality, it is distinguished as Russian, American, and Elb caviar. The eggs of the most valuable—the Russian caviar—are dark gray to black in color, and have an average diameter of 3.55 mm.; besides, they are free of membranes and of added slimy substances. The American and Elb caviar are about the same in quality. The eggs of the former are only 2.5-3 mm. in diameter, are blackish-gray to blackish-yellow, are softer than those of the Russian caviar, and are partly injured. In the Elb caviar, the eggs are still smaller and darker. According to Bischof, there is also sold under the name Elb caviar, a decomposed American caviar, which has been specially preserved.

So-called red caviar is prepared in Russia from the eggs of various fish, and in Germany from the eggs of the pike, carp, and other species.

Regarding the chemical composition of caviar, according to König, see table, page 40. Slightly salted caviar does not contain more than 5 per cent. salt, while strongly salted caviar has up to 10 per cent. salt. According to Raebiger, the following varieties of smoked salmon are placed on the market:

(a) American salmon, which is supposed to originate from the *Oncorhynchus quinnat*. Back and abdominal lines run forward almost parallel. Scales, golden yellow and shiny. Color of flesh, pink to brick-red. The muscles and their surrounding connective tissue ("white veins," in business language) are stronger developed than in the Rhein salmon.

(b) The Rhein, Elb, and Weser salmon have a highly arched back and a body compressed on the sides. Back and abdominal lines approach each other considerably toward the head. Scales are silver white; toward the back they are blackish-brown and ovally elongated. Color of flesh, pinkish-red and with a slight tinge of yellow. They have a heavy cushion of white fat.

(c) The East sea, Wolga and Russian salmon have a long, not as much compressed body, with small round scales. Meat has a typical salmon color, is very rich in fat, and the intramuscular connective tissue is loose as in the American salmon.

(d) The fish known in the trade as sea salmon, is the *Merluccius vulgaris*. Its meat is white and poor in fat.

(e) The Façon salmon is prepared from trimmings which are pressed into parchment hulls. It may be recognized by the absence of the irregularity in the course of the "veins."

IV. Regulations Governing Meat Inspection of the United States Department of Agriculture

B. A. I. ORDER 150

Regulation 1. Scope of Inspection

Section 1. All slaughtering, packing, meat canning, salting, rendering, or similar establishments, except as hereinafter provided, the meat or meat food products of which, in whole or in part, enter into interstate or foreign commerce, shall have inspection under these regulations. The Secretary of Agriculture may exempt from inspection establishments operated by farmers, retail butchers, or retail dealers supplying their customers, but in the absence of such exemption inspection is required.

Section 2. Branch houses of official establishments, when such branch houses are engaged in interstate or foreign commerce and slaughter animals or process meat, shall be considered a part of the parent house, and products received into such branch houses or sent from them shall be subject to these regulations, and inspection shall be maintained therein.

Regulation 2. Organization of Force

Section 1. Paragraph 1. All permanent employees of the Department of Agriculture engaged in the work of meat inspection are appointed upon certification of the Civil Service Commission that they have passed the examination prescribed by that Commission. Promotions in all classes are made on the basis of efficiency, department, and length of service. Such employees include:

Paragraph 2. *Inspectors in Charge.*—These are inspectors assigned by the Bureau of Animal Industry to supervise official work at each official station. Such employees report directly to the Chief of the Bureau of Animal Industry, and are chosen by reason of their fitness for responsibility as determined by their records in the service. At stations where slaughtering is conducted, only veterinary inspectors are placed in charge.

Paragraph 3. *Veterinary Inspectors.*—All applicants examined for these positions must be graduates of recognized veterinary colleges having a course of not less than three years leading to the degree. All final ante-mortem and post-mortem examinations are conducted by veterinarians. At some stations the veterinarians are assisted in making preliminary examinations by trained laymen known as inspectors' assistants.

Paragraph 4. *Traveling Veterinary Inspectors.*—To observe the conditions of sanitation of the establishments at the various stations, note the processes of ante-mortem and post-mortem inspection, confer with and instruct inspectors regarding it, with a view to a uniform system throughout the country, and to report these matters to the Washington office, constitute the principal duties of these employees.

Paragraph 5. *Laboratory Inspectors.*—These employees possess technical training in microscopical and chemical examination of meat food products, and their inspections are conducted in laboratories located at various slaughtering centers. Pathological laboratories are also maintained, to which diseased specimens may be sent when necessary for diagnosis.

Paragraph 6. *Meat Inspectors.*—These employees are laymen, experienced in the curing, canning, packing, or otherwise preparing of meat; they supervise that work and the use of permitted preservatives described in Regulation 22.

Paragraph 7. *Traveling Meat Inspectors.*—These employees perform a service similar to that required of traveling veterinary inspectors, but along the line of the preparation and handling of meat products.

Paragraph 8. *Inspectors' Assistants.*—These employees are laymen, who are first assigned to routine duties and are promoted through examination to higher duties, such as assisting in conducting ante-mortem and post-mortem examinations.

Paragraph 9. *Patrolmen.*—Patrolmen are employed to patrol the establishments at night, to oversee the receipts and shipments of meat, and to observe any operations conducted at night. They consist of veterinarians, inspectors' assistants, or meat inspectors, according to the character of the work where assigned.

Paragraph 10. *Skilled Laborers.*—These employees supervise the marking of meat and meat containers, and perform similar work. They are eligible for promotion only through examination.

Regulation 3. Interpretation and Definition of Words and Terms

Wherever in these regulations the following words, names, or terms are used they shall be construed as follows:

Section 1. *Official Establishment.*—This term shall mean any slaughtering, meat-canning, salting, rendering, or similar establishment at which inspection is maintained under the meat-inspection law approved June 30, 1906 (34 Stat., 674).

Section 2. *Inspectors and Department Employees.*—These terms shall mean, respectively, inspectors and employees of the Bureau of Animal Industry.

Section 3. *"Inspected and Passed."*—This phrase, or any authorized abbreviation thereof, shall mean that the carcasses, parts of carcasses, meat, and meat food products so marked have been inspected and passed for food under these regulations.

Section 4. *Rendered Into Lard or Tallow.*—This phrase shall mean that the carcasses, parts of carcasses, meat, and meat food products so designated are allowed to be made into edible lard or edible tallow.

Section 5. *"U. S. Inspected and Condemned."*—This phrase shall mean that the carcasses, parts of carcasses, meat, and meat food products so marked are unfit for food and shall be destroyed for food purposes.

Section 6. *Carcass.*—This word shall apply to the carcass of an animal that has been killed under these regulations, and shall include all parts which are to be used for food.

Section 7. *Primal Parts of Carcasses.*—This phrase shall mean the usual sections or cuts of the dressed carcass commonly known in the trade, such as sides, quarters, shoulders, hams, backs, bellies, etc., and beef tongues, beef livers, and beef tails, before they have been cut, shredded, or otherwise subdivided preliminary to use in the manufacture of meat food products.

Section 8. *Meat Food Products.*—Paragraph 1. A meat food product, within the meaning of the meat-inspection act and of these regulations, is considered to be any article of food intended for human use which is derived or prepared in whole

or in part from any edible portion of the carcass of cattle, sheep, swine, or goats, if the said edible portion so used is a considerable and definite portion of the finished food.

Paragraph 2. *Mixture*.—A mixture of which meat is an ingredient will not be considered a meat food product unless the meat contained therein is a definite and considerable portion of the said mixture. But where such mixture is prepared in a part of an official establishment, the sanitation of that part of the establishment will be supervised by the Department, and the meat or meat food products will be inspected before it enters the said mixture. The mixture shall not bear the meat-inspection legend or any simulation thereof. If any reference is made to Federal inspection it shall be in the following form: "The meat contained herein has been inspected and passed at an establishment where Federal inspection is maintained." Mixtures, such as mince-meats, soups, etc., which come under this description, and which are not officially labeled, are allowed in interstate and foreign commerce without further inspection, and without certificates, subject to the provisions and requirements of the Food and Drugs Act of June 30, 1906, and the regulations made thereunder.

Section 9. *Medical Meat Products*.—Products, such as meat juice, meat extract, etc., which are intended only for medicinal purposes and are advertised only to the medical profession, are not considered meat food products within the meaning of this order.

Section 10. *Vinegar*.—The word vinegar, as used herein, shall mean cider vinegar, wine vinegar, malt vinegar, sugar vinegar, glucose vinegar, or spirit vinegar.

Regulation 4. Inspection or Exemption

Section 1. The proprietor or operator of each slaughtering, packing, meat-canning, rendering, or similar establishment engaged in the slaughtering of cattle, sheep, swine, or goats, or in the packing, canning, or other preparation of any meat food product for interstate or foreign commerce, shall make application to the Secretary of Agriculture for inspection or for exemption from inspection, except in cases where inspection or exemption is already in effect. In case of change of ownership or change of location of an establishment already having inspection, a new application shall be made. Exemption under the law can be given only to establishments operated by retail butchers and retail dealers. Such application shall be in writing addressed to the Secretary of Agriculture, Washington, D. C., shall state the location of the establishment, and shall be made on blanks which will be furnished by the Chief of the Bureau of Animal Industry upon request.

Section 2. Inspection shall not be begun if an establishment is not in a sanitary condition, nor unless the establishment provides and guarantees to maintain adequate facilities for conducting such inspection.

Section 3. If, in the judgment of the Secretary of Agriculture, the retail butcher or retail dealer who is operating an establishment and engaged in supplying his customers through the medium of interstate or foreign commerce is entitled to exemption from Federal inspection, a numbered certificate of exemption will be furnished to the applicant for use with transportation companies and other companies and persons in securing the movement of his products. If an establishment, including both market and slaughterhouse of such retail butcher or dealer, is not in a sanitary condition, a certificate of exemption will not be issued.

Section 4. Exempted establishments shall be open to the inspectors of the Bureau of Animal Industry, shall be maintained in a clean condition, and shall con-

form to the same regulations as govern official establishments in regard to labeling, dyes, chemicals, and preservatives, and unsound, unwholesome, and unfit meat.

Regulation 5. Official Number

Section 1. Paragraph 1. When inspection is established the Secretary of Agriculture will give the establishment a number, and this number shall be used to mark the meat and meat food products of the establishment as hereafter prescribed.

Paragraph 2. Two or more official establishments under the same ownership or control may use the same establishment number, provided a serial letter is added in each case to designate the establishment and to enable its product to be identified.

Paragraph 3. Persons, firms, or corporations owning subsidiary companies having legal entity may use the names of such companies, provided application has been made for inspection and it has been granted, the inspection legend in such case to bear the official establishment number of the parent firm or corporation.

Paragraph 4. Each official establishment must be separate and distinct from any other establishment or department in which animal products are handled at which inspection is not maintained. When two or more companies prepare their products in the same official establishment they must obtain inspection under the same number. The name of the distributor may appear upon the label.

Regulation 6. Assignment of Inspectors, etc.

Section 1. The Chief of the Bureau of Animal Industry will designate an inspector to take charge of the inspection at each official establishment, and will assign to said inspector such assistants as may be necessary.

Section 2. For the purpose of enforcing the law and regulations all employees of the Bureau of Animal Industry shall have access at all times, by day or night, whether the establishment be operated or not, to every part of the establishment.

Section 3. Each employee of the Bureau of Animal Industry working under these regulations will be furnished with a numbered badge, which he shall wear over the left breast on the outer clothing while in the performance of his official duties, and which shall not be allowed to leave his possession. This official badge shall be sufficient identification to entitle him to admittance at all regular entrances and to all parts of the establishment and premises.

Section 4. Office room, including light and heat, shall be provided by proprietors of establishments, rent free, for the exclusive use, for official purposes, of the inspectors and other employees of the Department assigned thereto. The room or rooms set apart for this purpose must be properly ventilated, conveniently located, and provided with lockers suitable for the protection and storage of such supplies as may be required; all to meet the approval of the inspector in charge.

Regulation 7. All Carcasses and Products Inspected

Section 1. All cattle, sheep, swine, or goats slaughtered at an official establishment, and all meat and meat food products prepared therein, shall be inspected, handled, prepared, and marked as required by these regulations.

Regulation 8. Notice of Daily Operations, etc.

Section 1. The manager of each official establishment shall inform the inspector in charge, or his assistant, when work has been concluded for the day, and of the day and hour when work will be resumed. Under no circumstances shall any

department of an establishment be operated except under the supervision of an employee of the Bureau of Animal Industry. All slaughtering of animals and the preparation of meat and meat food products shall be done within reasonable hours, and with reasonable speed, the facilities of the establishment being considered.

Section 2. Where one inspector is detailed to conduct the work at two or more small establishments where few animals are slaughtered, or where but a small quantity of meat or meat food products is prepared, the inspector in charge may designate the hours for work.

Section 3. No work shall be performed at official establishments during any day on which such work is prohibited by the law of the State or Territory in which the establishment is located. However, the Department will require that it be judicially determined that such work is prohibited by the State law.

Regulation 9. Bribery

Section 1. It is a felony, punishable by fine and imprisonment, for any person, firm, or corporation to give, pay, or offer, directly or indirectly, to any Department employee authorized to perform any duty under these regulations any money or other thing of value with intent to influence said employee in the discharge of his duty under these regulations. It is also a felony, punishable by fine and imprisonment, for any Department employee engaged in the performance of duty under these regulations to receive or accept from any person, firm, or corporation engaged in interstate or foreign commerce any gift, money, or other thing of value given with and purpose or intent whatsoever.

Regulation 10. Sanitation

Section 1. After the receipt of an application for inspection or exemption an examination of the establishment and premises will be made and the requirements for sanitation and the necessary facilities for inspection will be specified.

Section 2. Plans and specifications, in duplicate, of plants for which application for inspection is made, also of new plants and plants to be remodeled, should be submitted to the Secretary of Agriculture.

Section 3. Official establishments and establishments to which certificates of exemption have been issued shall be suitably lighted and ventilated and maintained in a sanitary condition, and shall be provided with efficient drainage, having properly trapped or other approved sewer connections. Rooms in which inspection is carried on shall, by heating or other means, be kept reasonably free from steam and other vapors, in order that proper inspection can be made. All work in such establishments shall be performed in a cleanly and sanitary manner.

Section 4. Ceilings, walls, pillars, partitions, etc., shall be kept in a sanitary condition, and when necessary they shall be washed, scraped, painted, or otherwise treated as required. Where floors or other parts of a building or tables or other parts of the equipment, are so old or in such poor condition that they cannot be readily made sanitary, they shall be removed and replaced by suitable materials. All floors upon which meats are piled during the process of curing shall be so constructed that they can be kept in a clean and sanitary condition, and all meat piled upon floors shall be suitably protected from trucks, etc. Walks and platforms or approaches leading into establishments shall be kept clean to prevent tracking dirt into the same.

Section 5. All trucks, trays, and other receptacles, all chutes, platforms, racks, tables, etc., and all knives, saws, cleavers, and other tools, and all utensils, machinery, and vehicles used in moving, handling, cutting, chopping, mixing, canning, or other processes shall be thoroughly cleaned before using.

Section 6. Managers of establishments must require employees to be cleanly. The aprons, smocks, or other outer clothing worn by employees who handle meat or meat food products shall be of a material that is readily cleansed and made sanitary, and only clean garments shall be worn. Persons who handle meat or meat food products shall be required to keep their hands clean, and they shall be required also to pay particular attention to the cleanliness of their boots or shoes.

Section 7. Persons affected with tuberculosis or any other communicable disease shall not be employed in any of the departments of establishments where carcasses are dressed, meat is handled, or meat food products are prepared; and any employee of such establishment who may be suspected of being so affected shall be reported by the inspector in charge to the manager of the establishment and to the Chief of the Bureau of Animal Industry.

Section 8. All water-closets, toilet rooms, and dressing rooms shall be entirely separated from compartments in which carcasses are dressed or meat or meat food products are cured, stored, packed, handled, or prepared. Where such rooms open into compartments in which meat or meat food products are handled they must, when this is considered necessary, be provided with properly ventilated vestibules and with automatically closing doors. They shall be conveniently located, sufficient in number, ample in size, and fitted with modern lavatory accommodations, including toilet paper, soap, running hot and cold water, towels, etc. They shall be properly lighted, suitably ventilated, and kept in a sanitary condition. Convenient and sanitary urinals shall be provided; and washstands, near at hand, shall also be provided.

Section 9. The rooms or compartments in which meat or meat food products are prepared, cured, stored, packed, or otherwise handled shall be free from odors from toilet rooms, catch basins, casing departments, tank rooms, hide cellars, etc., and shall be kept free from flies and other vermin by screening, or other methods. All rooms or compartments shall be provided with cuspidors of such shape as not readily to be upset and of such material and construction as to be readily disinfected, and employees who expectorate shall be required to use them.

Section 10. The feeding of hogs or other animals on the refuse of slaughterhouses shall not be permitted on the premises of an exempted establishment or an official establishment, and no use incompatible with proper sanitation shall be made of any part of the premises on which such establishment is located. All yards, fences, pens, chutes, alleys, etc., belonging to the premises of such establishments, whether they are used or not, shall be maintained in a sanitary condition, and no nuisance shall be allowed in the establishment or on its premises.

Section 11. Butchers who dress or handle diseased carcasses or parts shall cleanse their hands of all grease and then immerse them in a prescribed disinfectant and rinse them in clear water before dressing or handling healthy carcasses. All butchers' implements used in dressing diseased carcasses shall be sterilized either in boiling water or by immersion in a prescribed disinfectant, followed by rinsing in clear water. Facilities for such cleansing and disinfection, approved by the inspector in charge, shall be provided by the establishment. Separate sanitary trucks, etc., which shall be appropriately and distinctively marked, shall be furnished for handling diseased carcasses and parts. Following the slaughter of any animal affected with an infectious disease, a stop shall be made until the implements have been cleansed and disinfected, unless other clean implements are provided.

Section 12. Inspectors are required to furnish their own implements for use in dissecting, incising, or examining diseased carcasses or unsound parts, and are required to use the same means for disinfecting implements, hands, etc., that are prescribed for employees of the establishment.

Section 13. Due care must be taken to prevent meat and meat food products from falling on the floor; and in the event of their having so fallen, they must be condemned or the soiled portions removed and condemned. When meat or meat food products are being emptied into tanks, some device, such as a metal funnel, must be used.

Section 14. Carcasses shall not be inflated with air from the mouth, and no inflation of carcasses except by mechanical means shall be allowed. Carcasses shall not be dressed with skewers, knives, etc., that have been held in the mouth. Skewers shall be cleaned before being used again. Spitting on whetstones or steels when sharpening knives shall not be allowed.

Section 15. Only good, clean, and wholesome water and ice shall be used in the preparation of carcasses, parts, meat, or meat food products. Whenever there is any doubt regarding the sanitary condition of the water supply, notice shall be sent immediately to the Chief of the Bureau of Animal Industry.

Section 16. Wagons or cars in which meat or meat food products are transported shall be kept in a clean and sanitary condition. The wagons used in transporting loose meat between official establishments shall be so closed and covered that the contents shall be kept clean, and so constructed that they may, when necessary, be locked and sealed with Government seals, which seals shall be affixed and broken only by employees of the Department.

Section 17. Skins and hides from animals condemned for tuberculosis or any other disease infectious to man, but showing no outward appearance of disease, may be removed (except as provided in Regulation 13, section 2 for tanning or other uses in the arts when disinfecting as follows: Each skin and hide must be immersed for not less than five minutes in a 5 per cent. solution of liquor cresolis compositus or a 5 per cent. solution of carbolic acid, or a 1 to 1,000 solution of bichlorid of mercury. The process of skinning and dipping must be conducted entirely in the retaining room, or other specially prepared place, approved by the inspector in charge, for final inspection.

Regulation 11. Ante-mortem Examination and Inspection

Section 1. An ante-mortem examination and inspection shall be made of all cattle, sheep, swine, and goats, about to be slaughtered before they shall be allowed to be killed in an official establishment. Satisfactory facilities for conducting said inspection and for separating and holding apart from passed animals those marked "U. S. Suspect" shall be provided.

Section 2. All animals showing symptoms or suspected of being affected with any disease or condition which, under these regulations, would probably cause their condemnation in whole or in part when slaughtered shall be marked by affixing to the animal a metal tag bearing the words "U. S. Suspect." All such animals, except as hereinafter provided, shall be set apart and slaughtered separately from other animals at an official establishment.

Section 3. Animals which have been tagged for pregnancy or for having recently given birth to young, and which have not been exposed to any infectious or contagious disease, and vaccine animals with unhealed lesions accompanied by fever and which have not been exposed to any other infectious or contagious disease,

are not required to be slaughtered, but before any such animal is removed the tag shall be detached by a Department employee and returned with his report to the inspector in charge.

Section 4. If any pathological condition is suspected in which the question of temperature is important, such as Texas fever, anthrax, pneumonia, blackleg, or septicemia, the exact temperature should be taken. Due consideration, however, must be given to the fact that extremely high temperature may be found in otherwise normal hogs when subjected to exercise or excitement, and a similar condition may obtain to a less degree among other classes of animals.

Section 5. Animals commonly termed "downers," or crippled animals, shall be tagged before slaughter as provided for in Regulation 17, section 1, for the purpose of identification at the time of slaughter, and shall be passed upon in accordance with these regulations.

Regulation 12. Post-mortem Inspection at Time of Slaughter

Section 1. A careful inspection shall be made of all animals at the time of slaughter. The head, tongue, tail, thymus gland, and all viscera, and all parts and blood used in the preparation of meat food or medical products, shall be retained in such manner as to preserve their identity until after post-mortem examination has been completed, in order that they may be identified in case of condemnation of the carcass. Suitable racks or metal receptacles shall be provided for retaining such parts.

Section 2. Carcasses and parts thereof found to be sound, healthful, wholesome, and fit for human food shall be passed and marked as provided in these regulations.

Section 3. Should any lesion of disease or other condition that would render the meat or any organ unfit for food purposes be found on post-mortem examination, the carcass, part, or organ shall be marked immediately with a tag, as provided in Regulation 17, section 3. Carcasses which have been so marked shall not be washed or trimmed unless such washing or trimming is authorized by the inspector.

Regulation 13. Disposal of Diseased Carcasses and Organs

Section 1. *General Statement.*—The carcasses or parts of carcasses of all animals slaughtered at an official establishment and found at time of slaughter or at any subsequent inspection to be affected with any of the diseases or conditions named below shall be disposed of according to the section of this regulation pertaining to the disease or condition. It is to be understood, however, that owing to the fact that it is impracticable to formulate rules covering every case, and to designate at just what stage a process becomes loathsome or a disease noxious, the decision as to the disposal of all carcasses, parts or organs not specifically covered by these regulations shall be left to the veterinary inspector in charge.

Section 2. *Anthrax or Charbon.*—All carcasses showing lesions of anthrax or charbon, regardless of the extent of the disease, and including the hide, hoofs, horns, viscera, fat, blood, and all other portions of the animal, shall be condemned and immediately incinerated. The killing bed upon which the animal was slaughtered shall be disinfected with a 10 per cent. solution of formalin, and all knives, saws, cleavers, and other instruments which have come in contact with the carcass shall be treated as provided in Regulation 10, section 11, before being used upon another carcass.

Section 3. *Blackleg.*—Carcasses of animals showing lesions of blackleg shall be condemned.

Section 4. *Hemorrhagic Septicemia*.—Carcasses of animals affected with hemorrhagic septicemia shall be condemned.

Section 5. *Pyemia and Septicemia*.—Carcasses showing lesions of pyemia or septicemia shall be condemned.

Section 6. *Vaccinia*.—Carcasses of vaccine animals mentioned under Regulation 11, section 3, shall be condemned.

Section 7. *Rabies*.—Carcasses of animals which showed symptoms of rabies before slaughter shall be condemned.

Section 8. *Tetanus*.—Carcasses of animals which showed symptoms of tetanus before slaughter shall be condemned.

Section 9. *Malignant Epizootic Catarrh*.—Carcasses of animals affected with malignant epizootic catarrh and showing generalized inflammation of the mucous membranes shall be condemned.

Section 10. *Hog Cholera and Swine Plague*.—Paragraph 1. Carcasses showing well-marked and progressive lesions of hog cholera or swine plague in more than two of the organs (skin, kidneys, bones, or lymphatic glands) shall be condemned.

Paragraph 2. Provided they are well nourished, carcasses showing slight and limited lesions of these diseases may be passed.

Paragraph 3. Carcasses which reveal lesions more numerous or advanced than those for carcasses to be passed, but not so severe as the lesions described for carcasses to be condemned, may be rendered into lard, provided they are cooked by steam for four hours at a temperature not lower than 220 degrees Fahrenheit, or at a pressure of 4 pounds.

Paragraph 4. In inspecting carcasses showing lesions of hog cholera or swine plague in the skin, bones, kidneys, or lymphatic glands, due consideration shall be given to the extent and severity of the lesions found in the viscera.

Section 11. *Actinomycosis or Lumpy Jaw*.—Paragraph 1. If a carcass affected with actinomycosis or lumpy jaw is in a well-nourished condition and there is no evidence upon post-mortem examination that the disease has extended from a primary area of infection in the head, the carcass may be passed, but the head, including the tongue, shall be condemned.

Paragraph 2. Carcasses of animals showing uncomplicated localized actinomycotic lesions other than, or in addition to, those specified in paragraph 1 of this section may be passed after the injected organs and parts have been removed and condemned.

Paragraph 3. Carcasses of animals showing a generalized actinomycosis shall be condemned.

Section 12. *Caseous Lymphadenitis*.—When the lesions of caseous lymphadenitis are limited to the superficial lymphatic glands or to a few nodules in an organ, involving also the adjacent lymphatic glands, and the carcass is well nourished, the meat may be passed after the affected parts are removed and condemned. If extensive lesions, with or without pleuritic adhesions, are found in the lungs, or if several of the visceral organs contain caseous nodules and the carcass is emaciated, it shall be condemned.

Section 13. *Tuberculosis*.—Paragraph 1. The following principles are declared for guidance in passing on carcasses affected with tuberculosis:

Principle A—Fundamental Thought.—The fundamental thought is that meat should not be used for food if it contains tubercle bacilli, if there is a reasonable possibility that it may contain tubercle bacilli, or if it is impregnated with toxic substances of tuberculosis or associated septic infections.

Principle B—Lesions Localized and not Numerous.—On the other hand, if the lesions are localized and not numerous, if there is no evidence of distribution of tubercle bacilli through the blood, or by other means, to the muscles or to parts that may be eaten with the muscles, and if the animal is well nourished and in good condition, there is no proof, or even reason to suspect, that the flesh is unwholesome.

Principle C—Generalized Tuberculosis.—Evidences of generalized tuberculosis are to be sought in such distribution and number of tuberculous lesions as can be explained only upon the supposition of the entrance of tubercle bacilli in considerable number into the systemic circulation. Significant of such generalization are the presence of numerous uniformly distributed tubercles throughout both lungs, also tubercles in the spleen, kidneys, bones, joints, and sexual glands, and in the lymphatic glands connected with these organs and parts, or in the splenic, renal, prescapular, popliteal, and inguinal glands, when several of these organs and parts are coincidentally affected.

Principle D—Localized Tuberculosis.—By localized tuberculosis is understood tuberculosis limited to a single or several parts or organs of the body without evidence of recent invasion of numerous bacilli into the systemic circulation.

Paragraph 2. *Rules of Disposal of Tuberculous Meat. Entire Carcass Condemned.*—The following rules shall govern the disposal of tuberculous meat:

Rule A.—The entire carcass shall be condemned—

(a) When it was observed before the animal was killed that it was suffering with fever.

(b) When there is a tuberculous or other cachexia, as shown by anemia and emaciation.

(c) When the lesions of tuberculosis are generalized, as shown by their presence not only at the usual seats of primary infection, but also in parts of the carcass or the organs that may be reached by the bacilli of tuberculosis only when they are carried in the systemic circulation. Tuberculous lesions in any two of the following-mentioned organs are to be accepted as evidence of generalization when they occur in addition to local tuberculous lesions in the digestive or respiratory tracts, including the lymphatic glands connected therewith: Spleen, kidney, uterus, udder, ovary, testicle, adrenal gland, brain, or spinal cord or their membranes. Numerous uniformly distributed tubercles throughout both lungs also afford evidence of generalization.

(d) When the lesions of tuberculosis are found in the muscles or intermuscular tissues or bones or joints or in the body lymphatic glands as a result of draining the muscles, bones, or joints.

(e) When the lesions are extensive in one or both body cavities.

(f) When the lesions are multiple, acute, and actively progressive. (Evidence of active progress consists in signs of acute inflammation about the lesions, or liquefaction necrosis, or the presence of young tubercles.)

Rule B—Part of Carcass Condemned.—An organ or a part of a carcass shall be condemned—

(a) When it contains lesions of tuberculosis.

(b) When the lesion is immediately adjacent to the flesh, as in the case of tuberculosis of the parietal pleura or peritoneum, not only the membrane or part affected but also the adjacent thoracic or abdominal wall is to be condemned.

(c) When it has been contaminated by tuberculous material, through contact with the floor, a soiled knife, or otherwise.

(d) All heads showing lesions of tuberculosis shall be condemned.

(e) An organ shall be condemned when the corresponding lymphatic gland is tuberculous.

Rule C—Carcass Passed.—The carcass, if the tuberculous lesions are limited to a single or several parts or organs of the body (except as noted in Rule A), without evidence of recent invasion of tubercle bacilli into the systemic circulation, shall be passed after the parts containing the localized lesions are removed and condemned in accordance with Rule B.

Rule D—Carcass Rendered Into Lard or Tallow.—Carcasses which reveal lesions more numerous than those described for carcasses to be passed (Rule C) but not so severe as the lesions described for carcasses to be condemned (Rule A), may be rendered into lard or tallow if the distribution of the lesions is such that all parts containing tuberculous lesions can be removed. Such carcasses shall be cooked by steam at a temperature not lower than 220 degrees Fahrenheit for not less than four hours.

Section 14. *Texas Fever.*—Carcasses showing lesions to warrant the diagnosis of Texas fever shall be condemned.

Section 15. *Parasitic Ictero-hematuria.*—Carcasses of sheep affected with parasitic ictero-hematuria shall be condemned.

Section 16. *Mange or Scab.*—Carcasses of animals affected with mange or scab, in advanced stages, or showing emaciation or extension of the inflammation to the flesh, shall be condemned. When the disease is slight the carcass may be passed.

Section 17. *Tapeworm Cysts.*—Paragraph 1. Carcasses of animals affected with tapeworm cysts, known as *Cysticercus bovis* and *C. cellulosa*, shall be rendered into lard or tallow, unless the infestation is excessive, in which case the carcass shall be condemned.

Paragraph 2. Carcasses of animals found infested with gid bladderworms (*Cænurus cerebralis*, *Multiceps socialis*) may be passed after condemnation of the infected organ (brain, spinal cord).

Paragraph 3. Carcasses or parts of carcasses found infested with the hydatid cyst (echinococcus) may be passed after condemnation of the infected part or organ.

Section 18. *Infections that May Cause Meat Poisoning.*—All carcasses of animals so infected that consumption of the meat or meat food products thereof may give rise to meat poisoning shall be condemned. This section covers all carcasses showing signs of—

(a) Acute inflammation of the lungs, pleura, pericardium, peritoneum, or meninges.

(b) Septicemia or pyemia, whether puerperal, traumatic, or without any evident cause.

(c) Severe hemorrhagic or gangrenous enteritis or gastritis.

(d) Acute diffuse metritis or mammitis.

(e) Polyarthrits.

(f) Phlebitis of the umbilical veins.

(g) Traumatic pericarditis.

(h) Any other inflammation, abscess, or suppurating sore if associated with acute nephritis, fatty and degenerated liver, swollen soft spleen, marked pulmonary hyperemia, general swelling of lymphatic glands, and diffuse redness of the skin, either singly or in combination.

Immediately after slaughter of any animal so diseased the premises and implements used must be thoroughly disinfected as prescribed elsewhere in these regulations. The part of any carcass coming into contact with the carcass or any part of the carcass of any animal covered by this section, other than those affected with

the diseases mentioned in (a) above, or with the place where such animal was slaughtered, or with the implements used in the slaughter, before thorough disinfection of such place and implements has been accomplished, or with any other contaminated object, shall be condemned; in case the contaminated part is not removed from the carcass within two hours after such contact the whole carcass shall be condemned.

Section 19. *Icterus*.—Carcasses affected with icterus and showing an intense yellow or greenish yellow discoloration after proper cooling shall be condemned. Carcasses which exhibit a yellowish tinge directly after slaughter, but lose this discoloration on chilling, may be passed for food.

Section 20. *Uremia and Sexual Odor*.—Carcasses which give off the odor of urine or a strong sexual odor shall be condemned.

Section 21. *Urticaria, etc.*—Hogs affected with urticaria (diamond skin disease), *Tinea tonsurans*, *Demodex folliculorum*, or erythema may be passed after detaching and condemning the skin, if the carcass is otherwise fit for food.

Section 22. *Melanosis, etc.*—Carcasses of animals showing any disease, such as generalized melanosis, pseudo-leukemia, etc., which affects the system of the animal, shall be condemned.

Section 23. *Tumors, Bruises, Abscesses, Liver Flukes, etc.*—Any organ or part of a carcass which is badly bruised or which is affected by tumors, malignant or benign, abscesses, suppurating sores, or liver flukes shall be condemned; but when the lesions are so extensive as to affect the whole carcass, the whole carcass shall be condemned.

Section 24. *Emaciation and Anemia*.—Carcasses of animals too emaciated or anemic to produce wholesome meat, and carcasses which show a slimy degeneration of the fat or a serous infiltration of the muscles, shall be condemned.

Section 25. *Milk Fever and Railroad Sickness*.—Carcasses of animals showing symptoms of milk fever or railroad sickness at the time of slaughter shall be condemned, as the flesh of such animals is frequently darker in color and more watery than is natural, and the present view of the pathology of at least the first disease suggests auto-intoxication.

Section 26. *Pregnancy and Parturition*.—Carcasses of animals in advanced stages of pregnancy (showing signs of parturition), also carcasses of animals which have within ten days given birth to young, and in which there is no evidence of septic infection, may be rendered into lard or tallow if desired by the manager of the establishment; otherwise they shall be condemned.

Section 27. *Immaturity*.—Carcasses of animals too immature to produce wholesome meat, all unborn and stillborn animals, also carcasses of calves, pigs, kids, and lambs under three weeks of age, shall be condemned.

Section 28. *Diseased Parts*.—In all cases where carcasses showing localized lesions of disease are passed or rendered into lard or tallow, the diseased parts must be removed before the "U. S. Retained" tag is taken from the carcass, and such parts shall be condemned.

Section 29. *Suffocation*.—Hogs which have been allowed to pass into the scalding vat alive or have been suffocated in other ways shall be condemned.

Section 30. *Dead Animals*.—All animals that die in abattoir pens, and those in a dying condition before slaughter, shall be condemned and tagged as provided in Regulation 17, section 2. In conveying to the tank animals which have died in the pens of the establishment, they shall not be allowed to pass through compartments in which food products are prepared. No dead animals shall be brought into an establishment for rendering from outside the premises of said establishment unless permission is first obtained from the Chief of the Bureau of Animal Industry.

Section 31. *Bruised Parts.*—When a portion of a carcass is to be condemned on account of slight bruises, the bruised portion shall be removed immediately and tanked, and the remainder of the carcass shall be marked “Inspected and Passed.” When desired, a retaining room may be provided in one part of the cooler for the retention of such carcasses until after they are chilled, when the bruised portion may be removed.

Section 32. *Portions of Intestines.*—Portions of intestines that show evidence of infestation with esophagostoma or other nodular affections shall be condemned.

Section 33. *Evisceration of Diseased Hogs.*—Hog carcasses found before evisceration has taken place to be affected with an infectious or contagious disease, including tuberculosis, shall not be eviscerated at the regular killing bed or bench, but shall be taken, separate from other carcasses, to the retaining room or other specially prepared place and there opened and examined.

Regulation 14. “Retaining” Rooms

Section 1. Separate compartments, to be known as “retaining rooms,” or other places for final inspection, shall be set apart at all official establishments, and all carcasses and parts marked with a “U. S. Retained” tag shall be held in these rooms pending final inspection. These rooms shall be rat proof, large enough for carcasses to hang separately, furnished with abundant light, and provided with sanitary tables and other necessary apparatus; the floors shall be of cement, asphalt, metal, or brick laid in cement; and shall have proper sewer connections. They shall be provided with facilities for locking, and locks for this purpose will be furnished by the Department. The keys to such locks shall remain in the custody of the inspector or his assistant. In establishments where it is impracticable or undesirable to have refrigeration in the retaining room, rooms may be constructed in the cooler for the reception and chilling of carcasses not affected with infectious diseases, but which require further inspection.

Section 2. Retained carcasses shall be subjected to a final inspection, and immediately after this is completed those found to be wholesome and fit for human food shall be released by the veterinary inspector conducting the inspection, who shall remove the “U. S. Retained” tags, and the carcasses shall be removed from the retaining room and marked “Inspected and Passed,” as provided in Regulation 17, section 5.

Section 3. The floors and walls of all retaining rooms shall be washed with hot water and disinfected after diseased animals are removed and before any “retained” carcasses are again placed therein.

Regulation 15. “Condemned” Rooms

Section 1. In each establishment at which condemned carcasses or meat-food products are held until the day following their condemnation there shall be provided a room entirely separate from all other rooms in the establishment. This room shall be secure, rat proof, and shall be provided with a lock, the key of which shall remain in the custody of a Department employee. This room shall be known as the “condemned room,” and shall be kept locked at all times except when condemned meat or meat food product is being taken into or from the said room under the supervision of a Department employee. The condemned room shall be kept clean.

Section 2. Carcasses or parts of carcasses found on final inspection to be unsound, unhealthful, unwholesome, or otherwise unfit for human food shall be marked "U. S. Inspected and Condemned," as provided in Regulation 17, section 4, and shall be immediately removed from the retaining room to the "condemned room," if such condemned room is provided. In case no condemned room is provided they shall be locked in the retaining room and shall be tanked at or before the close of the day on which they are condemned.

Section 3. Condemned carcasses shall not be allowed to accumulate, but shall be removed from the "condemned room," denatured as provided in Regulation 16, section 3, or tanked within a reasonable time after condemnation.

Section 4. A truck or trucks of sufficient capacity, plainly marked, and which can be locked or sealed, shall, when required by the inspector in charge, be provided for handling condemned meat.

Regulation 16. Tank Rooms, Tanks, and Tanking

Section 1. All tanks and equipment used for rendering and preparing edible product shall be in compartments separate from those used for rendering inedible product, and there shall be no connection by means of pipes or otherwise between the tanks or departments containing inedible product and those containing edible product. This provision must be complied with on or before October 1, 1908.

Section 2. Paragraph 1.—All condemned carcasses, parts of carcasses, and meat-food products shall be tanked as follows:

Paragraph 2. After the lower opening and the draw-off valves of the tank have been securely sealed by an employee of the Department and the condemned carcasses, parts, and meat-food products are placed therein in his presence, the upper opening shall be likewise securely sealed by such employee, whose duty it shall be then to see that a sufficient force of steam (not less than 40 pounds, producing a temperature of 288 degrees Fahrenheit) is turned into the tanks and maintained a sufficient time (not less than six hours) effectually to render the contents unfit for any edible product. Wire and lead seals are provided by the Department for sealing tanks. Proprietors of establishments are required to equip all tanks used for condemned products so that they may be securely sealed in the manner above specified.

Paragraph 3. A sufficient quantity of coloring matter or other substance to be designated by the Department shall be used in connection with the rendering of all condemned carcasses, parts of carcasses, meat, or meat-food products to destroy them effectually for food purposes.

Paragraph 4. The seals of tanks containing condemned meat or the tankage thereof shall be broken only by an employee of the Department, and such employee shall supervise the drawing off of the contents of such tanks and the marking of the tallow and grease as inedible.

Paragraph 5. If an official establishment fails to permit the treatment and tanking of condemned carcasses, parts of carcasses, meat, or meat-food products as required by these regulations, the inspector in charge shall report that fact to the Department, in order that inspection may be withdrawn from such establishment.

Section 3. Any meat or meat-food products condemned at establishments which have no facilities for tanking shall be freely slashed with a knife and then denatured with crude carbolic acid or other prescribed agent, and then removed to an establishment indicated by the inspector in charge and there tanked and rendered under the supervision of an employee of the Department; or such meat or meat-food products may be destroyed by incineration under the supervision of an employee of the Department.

Regulation 17. Tags, Brands, Stamps

Section 1. To each animal inspected under Regulation 11, which shows symptoms or is suspected of being affected with any disease or condition which under these regulations may cause its condemnation in whole or in part on post-mortem inspection there shall be affixed by a Department employee at the time of inspection a numbered metal tag bearing the words "U. S. Suspect," which shall remain upon the animal until final post-mortem inspection, when the carcass shall be marked according to the conditions found, and disposed of as elsewhere provided in these regulations.

Section 2. To the ear of each animal which is found in a dying condition or dead on the premises of an establishment there shall be affixed by a Department employee a numbered tag bearing the words "U. S. Condemned." The ear bearing the tag shall not be removed from the carcass. The number of this tag shall be reported to the inspector in charge by the employee who affixes it. This tag shall accompany the condemned carcass into the tank, and the Department employee who is supervising the tanking shall make a report of the number to the inspector in charge.

Section 3. Upon each carcass, or part or detached organ thereof, inspected under Regulation 12, in which any lesion of disease or other condition is found that might render the meat or any organ unfit for food purposes, and which for that reason would require a subsequent inspection, there shall be placed by a Department employee at the time of inspection a tag, numbered in duplicate, bearing the words "U. S. Retained," and such other marks of identification shall be used as shall be approved by the Chief of the Bureau of Animal Industry. The inspector who attaches this "U. S. Retained" tag shall detach the numbered stub thereof and forward it with his report to the inspector in charge. The other portion shall accompany the carcass to the retaining room.

Section 4. Each carcass, or part or detached organ thereof, which is found on final inspection to be unsound, unhealthful, unwholesome, or otherwise unfit for human food shall be marked conspicuously by a Department employee at the time of inspection with the words "U. S. Inspected and Condemned." The "U. S. Retained" tag shall accompany the carcass into the tank, and the number thereof shall be reported by the employee who supervises the tanking. If, however, upon final inspection the carcass or part thereof is passed, the "U. S. Retained" tag shall be removed and returned to the inspector in charge. A record of the tag showing the serial number, the final disposal of the carcass or part to which it was affixed, the date, and the name of the inspector shall be forwarded with the regular reports to the inspector in charge.

Section 5. Upon all passed carcasses slaughtered under inspection there shall be placed by an employee of the Department, or by an employee of the establishment under the supervision of an employee of the Department, meat-inspection marks bearing the words "Inspected and Passed," or an authorized abbreviation thereof, and such other matter as may be required by the Department. The number of marks, their location on the carcass, and the time they shall be affixed, shall be determined by the Chief of the Bureau of Animal Industry.

Section 6. Paragraph 1.—Each passed primal part or the true container thereof must be marked under the supervision of a Department employee, with the words "Inspected and Passed," or an authorized abbreviation thereof, and the official establishment number, except as provided in paragraphs 2 and 3 of this section and in section 12 of Regulation 25.

Paragraph 2. When primal parts are shipped from one official establishment to another for further processing, it is not obligatory that the inspection legend appear on such primal parts, but the container thereof in the case of a package shall be marked as specified in section 9 of this regulation, and in the case of a car shall be sealed; in such cases the primal parts, after processing, shall show plainly the inspected legend and the number of the official establishment at which the processing was completed.

Paragraph 3. Passed primal parts of pork intended for export need not be marked with the authorized marks of inspection, but all outside containers shall bear the meat-inspection stamp.

Section 7. The inspection legend or an authorized abbreviation thereof may be affixed, under the supervision of a Department employee, to hams, bacon, and similar primal parts with a hot branding iron, and when so affixed will be recognized as the official mark of inspection. When hot branding irons are used to affix trade brands or descriptions, such brand or description must be distinct and apart from the inspection legend.

Section 8. Upon all meat-food products which are suspected on reinspection of being unsound, unhealthful, unwholesome, or otherwise unfit for human food, or upon the containers thereof, there shall be placed by a Department employee at the time of reinspection the "U. S. Retained" tags hereinbefore described. The employee who affixes the tag shall send the numbered stub with his report to the inspector in charge. These tags shall accompany the said meats or meat-food products to the retaining room or other special place for final inspection. When the final inspection is made, if the meat or meat-food product be condemned, the "U. S. Retained" tag shall be stamped "U. S. Inspected and Condemned," and shall accompany the condemned meat or meat-food product to the tank, and the inspector shall report his action to the inspector in charge. If, however, upon final inspection the meat or meat-food product is passed for food, the inspector shall stamp the retained tag "Inspected and Passed" and return the tag with his report to the inspector in charge.

Section 9. When meat products for domestic trade have been inspected and passed, the outside containers of such meat shall bear (in lieu of meat-inspection stamp), a domestic meat label which has been submitted to and approved by the Department, showing the official establishment number and the following legend: "The meat contained herein has been inspected and passed under the provisions of the act of June 30, 1906." The firm name may also appear on the label if desired. The dimensions of the label shall be not less than 4 inches by 2 $\frac{3}{4}$ inches. Outside containers if bearing approved trade labels are not required to be provided with the label above described. Domestic meat labels shall be affixed to packages in the manner prescribed in Regulation 24 for affixing labels to export packages.

Section 10. Each outside container (except cloth wrappings) of export meat or meat-food products shall be marked with a meat-inspection stamp. The cloth wrappings of inspected and passed meat which is so marked shall be marked with an authorized mark of inspection.

Section 11. Upon each container of meat or meat-food products, such as ham, bacon, etc., prepared for export with preservatives under Regulation 22, section 3, paragraph 1, there shall be placed, under the personal supervision of a Department employee, a special stamp for marking such meats, known as the "Preservative" stamp. All outside containers of such meat or meat-food products shall bear the "Preservative" stamp.

Regulation 18. Trade Labels

Section 1. Upon each can, pot, tin, canvas, or other receptacle, or covering containing any meat or meat-food product, which meat or meat-food product does not bear the marks "Inspected and Passed," there shall be securely affixed, under the supervision of a Department employee, a trade label before such meat or meat-food product leaves an official establishment. This trade label shall contain, in plain letters and figures of uniform size, the words "U. S. Inspected and Passed," the number of the official establishment at which the meat or meat-food product is last processed, and the true name of the meat or meat-food product contained in such package. The words "under the act of Congress of June 30, 1906," may be placed upon the label after the words "U. S. Inspected and Passed." An inspector shall not allow trade labels to be affixed until he is satisfied that the contents of the package are sound, healthful, wholesome, and fit for human food, in accordance with the statements on the label.

Section 2. Duplicate copies of each trade label in the form of sketches or proofs shall first be submitted to the Department, and no trade label shall be used until a sketch or proof thereof has been approved. After trade labels are printed from approved proofs or sketches they shall be forwarded in triplicate to the Department for approval and filing.

Section 3. No trade label bearing the words "U. S. Inspected and Passed," or any abbreviation or simulation thereof, shall be used on meat or meat-food products which have not been inspected and passed under these regulations, and no trade label bearing the inspection legend, or any abbreviation or simulation thereof, shall be placed upon meat or meat-food products except under the supervision of an inspector.

Section 4. Tin containers, embossed or lithographed with the label as prescribed in section 1, will be considered as bearing trade labels. On and after October 1, 1908, all sealed tin containers must have the number of the official establishment where packed embossed, lithographed, or printed thereon.

Section 5. The essential features of a trade label are as follows, and shall appear upon each label:

The true name of the product.

The inspection legend.

The establishment number.

Section 6. The inspection legend "U. S. Inspected and Passed," or an authorized abbreviation thereof, and the official establishment number in plain characters of uniform size, which shall be in proper proportion to the general lettering of the label, must be separately and prominently embodied in all trade labels.

Section 7. In the case of meat contained in cartons, or in wrappers of paper, cloth, or other similar substance, the inspection legend and the official establishment number may be embodied in a sticker or seal of proportionate size prominently displayed with the trade label, but not necessarily a part of the trade label, such stickers or seals to be approved by the Department of Agriculture. It is not permissible to affix to meat or meat-food products a detachable device of any kind which bears the inspection legend.

Section 8. While labels to be affixed for foreign shipment may be printed in a foreign language, the same rules shall apply with reference to false labeling and the naming of ingredients as shall apply to goods prepared for domestic use. The inspection legend and the official establishment number must in all cases appear in

English, but if desired they may in addition, literally translated, appear in the language of the country to which the package is destined.

Section 9. Paragraph 1. When an article is prepared by an official establishment for another firm or individual, if the name of the said firm or individual is to appear upon the label the statement must be made that the article was "prepared for" or "manufactured for" the firm or individual. Names of subsidiary companies which have legal entity may be used without the prefix "prepared for" or "manufactured for."

Paragraph 2. When a firm or individual not operating under Federal inspection desires to reship inspected and passed meat that has been processed only under Government inspection and is eligible under these regulations for interstate shipment, he may affix to the package the following statement: "The meat contained herein has been inspected and passed at an establishment where Federal inspection is maintained."

Section 10. No meat or meat-food products shall be sold or offered for sale by any person, firm, or corporation under any false or deceptive name; but the established trade name or names which are usual to such products, which are not false and deceptive and which shall be approved by the Secretary of Agriculture, are permitted.

Section 11. No picture, design, or device, which gives any false indication of origin or quality shall be used upon any label. The law prohibits any statement, design, or device false in any particular regarding the virtues or properties of the materials contained in the package.

Section 12. A meat-food product when composed of more than one ingredient shall not bear a trade label with a name stating or purporting to show that the said meat-food product is a substance which is not the principal ingredient contained therein, even though such name be an established trade name.

Section 13. A meat-food product that contains a substance or substances, including water, added for the purpose of adulteration and which lessens its food value shall bear a label stating that such substance or substances have been added.

Section 14. When any weight is given upon the true container it must be the correct weight, and it must be stated whether this weight is the net weight or the gross weight.

Regulation 19. Reinspection

Section 1. Immediately before shipment and at such other times as may be deemed necessary all carcasses or parts thereof, whether fresh or cured, that have been previously inspected and passed shall be reinspected by the inspector in charge or his assistants, in such manner as shall be prescribed by the Chief of the Bureau of Animal Industry, and if upon any such reinspection any carcass or part thereof is found to have become unsound, unhealthful, unwholesome, or in any way unfit for human food the original mark, stamp, tag, or label shall be destroyed or defaced and the carcass or part shall be condemned.

Section 2. Except as provided in Regulation 20, only carcasses and parts thereof, meat, or meat-food products which have not been processed except under Government supervision, and which can be identified by marks, seals, brands, or labels be identified as having been previously inspected and passed by a Department employee, shall be taken into or allowed to enter an official establishment. All such carcasses, parts, meat, or meat-food products which are brought into one official establishment from another, or which are returned to the establishment from which they issued, shall be identified and reinspected at the time of receipt, and shall be subject to

further reinspection in such manner and at such times as may be deemed necessary. If upon any such reinspection any carcass or part thereof, or meat or meat-food product, is found to have become unsound, unhealthful, unwholesome, or in any way unfit for human food, the original mark, stamp, tag, or label shall be defaced or destroyed, and the carcass, part, meat, or meat-food product shall be condemned.

Section 3. Special docks and receiving rooms shall be designated by the establishment for the receipt and inspection of all meat or meat-food products, and no meat or meat-food products shall be allowed to enter the establishment except in the presence of a Department employee.

Section 4. Unrendered fats from carcasses which have been inspected and passed may be returned and received into official establishments, provided the fats have been handled in a sanitary manner after leaving the establishment, and provided further that upon inspection the fats are found to be clean, sweet, wholesome, and fit for human food. However, the return of such fats to official establishments and the manner in which they shall be handled from the time they leave such establishments until their return thereto shall be governed by such specific instructions as may be issued from time to time by the Chief of the Bureau of Animal Industry.

Section 5. Inedible fats may be received only into the tank room provided for inedible products, and when so received they shall not enter any compartment used for edible products.

Section 6. Paragraph 1. In order to provide for the interstate transportation, from public markets and other places, of portions of inspected and passed carcasses, parts, and meat-food products which, when cut or otherwise removed from a marked carcass, part, or container, do not show the inspection mark and cannot therefore be identified as having been inspected and passed, market inspection may be furnished. Each city in which market inspection is established will be assigned a number, and all products forwarded under such inspection shall bear the inspection legend and the official number assigned to the city.

Paragraph 2. Unmarked portions which are cut from the marked carcass or part, or are removed from the marked container for interstate transportation, shall be marked by a Department employee. Wherever practicable the brand shall be applied to the meat itself; where this cannot be done the true container of the meat or meat-food product shall be marked as required by the Chief of the Bureau of Animal industry.

Paragraph 3. All market stalls or other places which are given market inspection shall be maintained in a sanitary condition and shall also conform to the requirements of the Department governing the use of the drugs, chemicals, dyes, and preservatives.

Regulation 20. Carcasses of Animals Not Inspected Ante-mortem

Section 1.¹ Carcasses of animals which have had no ante-mortem inspection by inspectors of the Bureau of Animal Industry will not, except as hereinafter provided, be admitted into an official establishment. The exception to this rule applies only to carcasses to which the head and all viscera, except the stomach, bladder, and intestines, are held by the natural attachments. Such carcasses, if offered for admission into official establishments, shall be inspected, and if found to be free from disease and otherwise sound, healthful, wholesome, and fit for human food they shall be marked "Inspected and Passed" and admitted. If found to be diseased, unsound, unhealthful, unwholesome, or otherwise unfit for human food, they shall be marked "U. S. Inspected and Condemned," and the proprietor of the establishment shall be required to destroy them for food purposes, as provided in Regulation 16, section 2.

¹ Formerly Regulation 62, B. A. I. Order 137.

Regulation 21. Tank Cars

Section 1. Tank cars carrying edible meat-food products into interstate or foreign commerce shall be provided with proper appliances for sealing and be securely sealed with seals furnished by the Department and affixed by Department employees.

Section 2. When such products for export are transferred from tank cars to other containers on boats, such transfer shall be under Government supervision, and the said containers on boats shall likewise be sealed.

Regulation 22. Dyes, Chemicals, and Preservatives

Section 1. No meat or meat-food products shall contain any substance which lessens its wholesomeness, nor any drug, chemical, dye, or preservative, except as hereinafter provided.

Section 2. Paragraph 1. There may be added to meat or meat-food products common salt, sugar, wood smoke, vinegar, pure spices, and saltpeter. Only such coloring matters as may be designated by the Secretary of Agriculture as being harmless may be used, and these only in such manner as the Secretary of Agriculture may designate.

Paragraph 2. Substances necessary for the preparation, clarification, or refining of meat-food products will be permitted to be used subject to the approval of the Secretary of Agriculture, provided they are eliminated from the meat-food products during the further process of manufacture.

Section 3. Paragraph 1. In accordance with the written direction of the foreign purchaser or his agent, meat or meat-food products prepared for export may contain preservatives of a kind and in proportions which do not conflict with the laws of the foreign country to which they are to be exported; but when such meat or meat-food products are prepared for export under this regulation they shall be prepared in compartments of the establishment separate and apart from those in which meat or meat-food products are prepared for the domestic trade, and such products shall be kept separate. Distinctive export certificates and stamps will be issued for meat or meat-food products of this character, but, if the products are not exported, under no circumstances shall they be allowed to enter domestic trade.

Paragraph 2. The packing of meat which is prepared, as provided in paragraph 1 of this section, with any preservative not permitted by paragraph 1, section 2, may be done in the regular packing room, provided that no other meat is allowed in the packing room during the time of such packing. After such packing is completed the packing room shall be thoroughly cleansed of the preservative before the packing of other meat therein is resumed. A separate compartment constructed of tight partitions, or walls shall be set apart for storing the preservative trays and other appliances used in connection with the packing. The Department will furnish a lock and key for this compartment, and the packing of all meat under this section shall be conducted under the personal supervision of an employee of this Department.

Regulation 23. Preparation of Meat and Meat-food Products

Section 1. All processes used in curing, pickling, rendering, canning, or otherwise preparing meat or meat-food products in official establishments shall be supervised by Department employees. No fixtures or appliances, such as tables, trucks, trays, tanks, vats, machines, implements, cans, or containers of any kind shall be

used unless they are clean and sanitary. All steps in the process of manufacture shall be conducted carefully and with strict cleanliness. All salt pickling fluids, and other solutions or substances used in curing meat must be clean.

Section 2. Canned meat or meat-food products which require sterilization to preserve them must be subjected to this process on the same day that the cans are filled. Defective or leaking cans discovered after the process of sterilization has been completed shall not be repaired or repacked (unless such repairing or repacking is done within six hours of the time of original sterilization), but the contents of such cans shall be removed and condemned.

Section 3. Potato flour shall not be used in the preparation of sausage, nor shall excessive quantities of cereals or water be used.

Section 4. Paragraph 1. The manufacture of all fats into lard, tallow, oils, and stearin at official establishments shall be closely supervised by employees of the Department, who shall see that all portions of carcasses rendered into edible products are clean and wholesome.

Paragraph 2. Heads rendered into edible products shall first be split, cross-sectioned, and thoroughly washed and cleaned.

Paragraph 3. When hogs' feet are used for lard, the hair, hoofs, and the tissues of the interdigital spaces must be removed.

Paragraph 4. All pipes and similar conveyors used in conducting edible fats from one receptacle or container to another shall be of a distinctly different color from the pipes and similar conveyors used in conducting inedible fats from one receptacle or container to another.

Paragraph 5. Blueprints or other accurate diagrams showing all underground pipe lines or other conveyors used to conduct edible and inedible products at official establishments and also those extending from official establishments to other establishments, either official or unofficial, with a description giving the exact location, terminals, and dimensions of such pipes, or other conveyers, and of all gates, valves, or other controlling apparatus, shall be filed with the Department, and a copy of such prints or diagrams shall be filed with the inspector in charge. The prints or diagrams should designate the lines used for conveying edible products and those used for conveying inedible products. If no such underground pipes or conveyers are used for the purposes above indicated, a written statement certifying to this fact and duly signed by the management of each establishment shall be filed with the Department.

Paragraph 6. All containers, such as vats and tierces, in which white grease or other inedible meat products are placed, shall be plainly marked "inedible" in such a manner that they can be readily identified.

Paragraph 7. Final containers, such as tierces, shall be appropriately marked on both ends immediately after filling.

Section 5. The only animal casings that may be used as containers in the manufacture of sausage under these regulations are those from cattle, hogs, sheep, or goats.

Regulation 24. Stamps for Export Packages

Section 1. Paragraph 1. Numbered meat-inspection stamps shall be affixed to packages (except those in cloth wrappings) containing meat or meat-food products to be shipped or otherwise transported in foreign trade.

Paragraph 2. Stamps shall be affixed in the following manner, and when they have been affixed they shall be covered immediately with a coating of transparent varnish or other similar substance:

(a) The stamp may be affixed in a grooved space made by removing a portion of the wood of sufficient size to admit the stamp.

(b) The stamp may be placed on either end of the package, provided that the sides are made to project at least one-eighth of an inch to afford the necessary protection from abrasion.

Section 2. Inedible-product stamps and certificates may, upon request, be issued to accompany shipments for export of casings, bladders, lungs, hoofs, and other similar inedible animal products.

Regulation 25. Transportations¹

Section 1. Upon the application of the exporter the inspector in charge of an establishment is authorized to issue certificates for export shipments of inspected and passed meat or meat-food products. The certificate should be issued at the time the product leaves the establishment; if, however, the certificate is not issued at that time, it can only be issued upon identification and reinspection of the product.

Section 2. These certificates shall be issued in serial numbers and in triplicate form. Each certificate shall show the names of the exporter, and the consignee, the destination, the numbers of the stamps attached to the article to be exported, the shipping marks, the kind of product, and the weight.

Section 3. Only one certificate shall be issued for each consignment unless otherwise directed by the Chief of the Bureau of Animal Industry.

Section 4. Both the original and duplicate certificates shall be delivered by the inspector to the shipper. The copy of certificate provided by law to be delivered to the chief officer of the vessel shall be the duplicate copy and shall be filed with the customs officers at the time of filing the master's manifest or the supplemental manifest.

Section 5. No master of any steam or sailing vessel shall receive for transportation or transport from the United States to Great Britain or Ireland, or any of the countries of continental Europe, or to Argentina or Mexico, any carcass, part of carcass, or meat-food product of cattle, sheep, swine, or goats, except ship stores, unless and until a certificate of inspection covering the same has been issued and delivered as provided in this regulation. The requirement of export certificates is waived for meat and meat-food products to foreign countries, other than those hereinbefore named.

Section 6. When inedible grease, inedible tallow, or inedible stearin derived from cattle, sheep, swine, or goats is offered for export, the collectors of customs, under instructions from the Secretary of Commerce and Labor, will require an affidavit from the exporter that the products to be exported are inedible and are not intended for food purposes.

Section 7.² No person, firm, or corporation shall receive for transportation or transport from one State or Territory or the District of Columbia to another State or Territory or the District of Columbia any carcass, part of carcass, or meat-food product of cattle, sheep, swine, or goats unless and until a certificate is made and furnished in one of the forms prescribed in sections 11, 12, 13, and 14 of this regulation, showing that such meat or meat-food product has been either inspected and

¹ The transportation of meat or meat-food product from one point in a State or Territory to another point in the same State or Territory, when in course of shipment the meat or meat-food product is taken through another State or Territory, is interstate commerce.

² Formerly Regulation 52, B. A. I. Order 137.

passed or exempted from inspection, according to act of Congress of June 30, 1906: *Provided*, That printed certificates in the forms formerly required and now on hand may be used for this purpose. It is necessary, as old stocks of printed certificates are exhausted, that new ones be printed in the new forms.

Section 8.¹ When any shipment of meat or meat-food products covered by these regulations is offered to any common carrier for carriage within the United States as a part of a foreign movement, the same certificate shall be required as if the shipment was destined to a point within the United States.

Section 9.² Paragraph 1. Shipments of inspected and passed meat or meat-food products that are so marked may be diverted from the original destination without a reinspection of the product, if a new certificate showing the changed destination be given to the carrier by the owner or shipper, who may or may not be the original shipper; or in case of a wreck or other extraordinary emergency the carrier may divert such shipments from the original destination without a new shippers' certificate.

Paragraph 2. The Government seals on a car containing inspected and passed meat or meat-food products may be broken by the carrier in case of wreck or other extraordinary emergency, and if necessary the product may be reloaded into another car or the shipment may be diverted from the original destination without another shipper's certificate; but in all such cases the carrier shall immediately report the transaction by telegraph to the Chief of the Bureau of Animal Industry, Washington, D. C. Such report shall include the information indicated below:

- (a) Nature of the emergency.
- (b) Place where seals were broken.
- (c) Original points of shipment and destination.
- (d) Number and initials of the original car.
- (e) Number and initials of the car into which the product is reloaded.
- (f) New destination of the shipment.
- (g) Kind and amount of product.

Section 10.² Reshipments of inspected meat or meat-food products which are sound and wholesome at the time of reshipment may be made without reinspection when the meat or meat-food products, or the containers thereof, are marked "Inspected and Passed," and the meat or meat-food products have not been processed since they were originally shipped under section 11 of this regulation. Also jobbers, wholesalers, or others who do no processing, and who receive "Inspected and Passed" meat or meat-food products, may break bulk, repack, and reship the same into interstate commerce under section 11 of this regulation, if each piece of meat or meat-food product in the unmarked package bears the original authorized mark of Government inspection. Inspection shall be maintained at the establishments of all such jobbers, wholesalers, or others who do any processing.

Section 11.³ When any carcass, part of carcass, or meat-food product of cattle, sheep, swine, or goats, which has been inspected and passed and so marked under these regulations is offered to any common carrier for transportation from one State or Territory or the District of Columbia to another State or Territory or the District of Columbia for interstate shipment only, or for interstate shipment as part of a foreign movement, or for foreign shipment, the person, firm, or corporation offering such carcass, part of carcass, or meat-food product shall make a certificate in the following form and deliver the same to the said common carrier, except as provided in section 12 of this regulation:

¹ Formerly Regulation 52, B. A. I. Order 137.

² Formerly Meat Inspection Rulings 1 A.

³ Formerly Regulation 53, B. A. I. Order 137.

Date.....190...

Name of common carrier.....
 Shipper.....
 Point of shipment.....
 Consignee.....
 Destination.....

I hereby certify that the meat or meat-food products described herein, which are offered for shipment in interstate or foreign commerce, have been inspected and passed according to act of Congress of June 30, 1906, are so marked, and at this date are sound, healthful, wholesome, and fit for human food.

Kind of product	Amount and weight
.....
.....
.....

.....
 (Signature of shipper)

.....
 (Address of shipper)

This certificate may be stamped upon or incorporated in any form which is regularly or ordinarily used in the shipment of meat or meat-food products.

Section 12.¹ Paragraph 1. An official establishment may ship from the said establishment to any other official establishment any meat or meat-food product which has been inspected and passed under these regulations without marking the same "Inspected and Passed," if such shipment be placed in a railroad car which is sealed by an employee of the Bureau of Animal Industry, and provided that not less than 25 per cent. of the contents of each car consists of meat or meat-food products not marked "Inspected and Passed."

Paragraph 2. Wagons so equipped that they can be securely sealed by a Department employee may be considered as true containers.

Paragraph 3. When shipments are made under paragraph 1 of this section the shipper shall make for each car and deliver to the common carrier in duplicate a certificate in the following form:

Date.....190...

Name of common carrier.....
 Establishment number of consignor.....
 Point of shipment.....
 Establishment number of consignee.....
 Destination.....
 Car number and initials.....

I hereby certify that the following-described meat or meat-food products have been inspected and passed according to act of Congress of June 30, 1906. They are

¹ Formerly Regulation 54, B. A. I. Order 137.

not marked "Inspected and Passed," but have been placed in the above car under the supervision of an employee of the Bureau of Animal Industry which was sealed by him with Government seals Nos..... and.....

Kind of product	Amount and weight
.....
.....
.....
.....	
(Signature of shipper)	
.....	
(Address of shipper)	

The duplicate certificate shall be forwarded immediately by the initial carrier to the Chief of the Bureau of Animal Industry, Washington, D. C. Attention is directed to the law which provides a penalty of fine and imprisonment for any unauthorized person who breaks a seal on such cars.

When shipments are made under this section the inspector in charge at point of origin shall duly notify the Chief of the Bureau of Animal Industry and the inspector in charge at point of destination.

Section 13.¹ When any carcass, part of carcass, or meat-food product of cattle, sheep, swine, or goats which has not been inspected under these regulations is offered for shipment from one State or Territory or the District of Columbia to another State or Territory or the District of Columbia by any retail butcher or retail dealer who holds a certificate of exemption issued by the Secretary of Agriculture, the common carrier shall require a certificate to be made in duplicate in the following form by said retail butcher or retail dealer, which certificate shall in all cases show the exemption number designated by the Secretary of Agriculture for said retail butcher or retail dealer:

Date.....190...

Name of common carrier.....

Shipper.....

Point of shipment.....

Consignee.....

Destination.....

Number of exemption certificate.....

I hereby certify that I am a retail butcher or a retail dealer in meat or meat-food products; that the following-described meat or meat-food products are offered for shipment in interstate commerce to a customer, as exempted from inspection according to act of Congress of June 30, 1906, under certificate issued to me by the United States Department of Agriculture, and that at this date they are sound, healthful, wholesome, and fit for human food, and contain no preservative or coloring matter or other substance prohibited by the regulations of the Secretary of Agriculture governing meat inspection.

¹ Formerly Regulation 55, B. A. I. Order 137.

Kind of product	Amount and weight
.....
.....
.....

.....
(Signature of shipper)

.....
(Address of shipper)

The duplicate certificate shall be forwarded immediately by the initial carrier to the Chief of the Bureau of Animal Industry, Washington, D. C. This certificate shall be separate and apart from any waybill, bill of lading, or other form ordinarily used in the shipment of meat.

Section 14.¹ When any cattle, sheep, swine, or goats have been slaughtered by any farmer on the farm, and the carcasses, parts of carcasses, or meat-food products thereof are offered to any common carrier for transportation from one State or Territory or the District of Columbia to another State or Territory or the District of Columbia, the common carrier may so transport such carcasses, parts of carcasses, or meat-food products as long as the same may be identified as of animals slaughtered by any farmer on the farm.

The common carrier shall require a certificate in duplicate in the following form:

Date.....190...

Name of common carrier.....

Shipper.....

Consignee.....

Point of shipment.....

Destination.....

I hereby certify that the following-described uninspected meat or meat-food products are from animals slaughtered by a farmer on the farm, and are offered for transportation in interstate commerce as exempted from inspection according to act of Congress of June 30, 1906, and that at this date they are sound, healthful, wholesome, and fit for human food, and contain no preservative or coloring matter or other substance prohibited by the regulations of the Secretary of Agriculture governing meat inspection.

Kind of product	Amount and weight
.....
.....
.....

.....
(Signature of shipper)

.....
(Address of shipper)

The duplicate certificate shall be forwarded immediately by the initial carrier to the Chief of the Bureau of Animal Industry, Washington, D. C.

¹ Formerly Regulation 56, B. A. I. Order 137.

Section 15.¹ All original certificates delivered to the common carrier, as required by this regulation, shall be filed and retained for one year by the initial carrier, in order that they may be readily checked by this Department in such manner as the Secretary of Agriculture may from time to time prescribe.²

Section 16.³ All waybills, transfer bills, running slips, or conductor's cards accompanying an interstate or foreign shipment of meat or meat-food product must have embodied in, stamped upon, or attached to it a signed statement which shall be evidence to connecting carriers that the proper shipper's certificate as required by sections 11, 12, 13, and 14 of this regulation is on file with the initial carrier, and no connecting carrier shall receive for transportation or transport any interstate or foreign shipment of meat or meat-food product unless the waybill, transfer bill, running slip, or conductor's card accompanying the same includes the aforesaid signed statement in one of the following forms:

When shipment is made under section 11 or 12:

(Name of transportation company)

United States inspected and passed as evidenced by shipper's certificate on file with initial carrier.

(Signed), *Agent.*

When shipment is made under section 13 or 14:

(Name of transportation company.)

Exempted from inspection as evidenced by shipper's certificate on file with initial carrier.

(Signed), *Agent.*

Section 17.⁴ Paragraph 1. When any carcass, part of carcass, or meat-food product of cattle, sheep, swine, or goats loaded on a truck, wagon, cart, or other vehicle, or otherwise prepared for shipment, is offered for transportation or transported by ferry, such ferry being the initial carrier from one State, Territory, or the District of Columbia to another State, Territory, or the District of Columbia, the person, firm, or corporation offering such carcass, part of carcass, or meat-food product shall, except as hereinafter provided by paragraph 5, make a certificate in one of the forms hereinafter indicated and deliver the certificate to said common carrier; and no person, firm, or corporation operating a ferry line as aforesaid shall receive for transportation or transport any carcass, part of carcass, or meat-food product of cattle, sheep, swine, or goats loaded on a truck, wagon, cart, or other vehicle, or in any other manner prepared for transportation, unless a certificate in one of the forms referred to is properly filled out and delivered by the shipper as herein required.

Paragraph 2. When the shipment consists of inspected and passed meat or meat-food products, the form of certificate shown in section 11 of this regulation shall be used.

Paragraph 3. When the shipment is made under exemption and consists of meat or meat-food product which has not been inspected and passed, the form of

¹ Formerly Regulation 57, B. A. I. Order 137.

² Stocks of printed certificates now on hand may be used, but as new supplies are printed they should conform to the forms prescribed.

³ Formerly Regulation 58, B. A. I. Order 137.

⁴ Formerly Regulation 65, B. A. I. Order 137.

certificate shown in section 13 of this regulation shall be used, and a duplicate shall be forwarded immediately by the ferry company to the Chief of the Bureau of Animal Industry, Washington, D. C.

Paragraph 4. When the shipment consists of meat or meat-food products from animals slaughtered by a farmer on the farm and which have not been inspected and passed, the form of certificate shown in section 14 of this regulation shall be used, and a duplicate shall be forwarded immediately by the ferry company to the Chief of the Bureau of Animal Industry, Washington, D. C.

Paragraph 5. When a shipper's certificate for meat or meat-food products has been issued and is on file with the initial carrier and that fact is shown by notation on the billing, the ferry company need not require another certificate.

Section 18.¹ Imported meat or meat-food products which have not been mixed or compounded with or added to domestic meat or meat-food products may be transported by any common carrier from one State or Territory or the District of Columbia into another State or Territory or the District of Columbia if the packages containing them are marked "Inspected under the Food and Drugs Act of June 30, 1906," when received for transportation.

Section 19.² Paragraph 1. Meat or meat-food products which have been inspected and passed and so marked, and which have been transported from the establishments in which they were prepared into the channels of trade, and which are alleged or known to have become unsound, unwholesome, or otherwise unfit for human food, may be transported in interstate commerce only under the following restrictions:

Paragraph 2. Meat or meat-food products inspected and passed and so marked and which are alleged to be unsound, unwholesome, or otherwise unfit for human food may be shipped from one State or Territory or the District of Columbia to any official establishment in the same or a different State or Territory if a written permit in duplicate for such shipment be first obtained from the inspector in charge of the establishment to which the shipment is destined. In all such shipments both the original and duplicate copies of the permits shall be surrendered to the carrier accepting the meat or meat-food product, and the carrier shall require the shipper to furnish three copies of the form of certificate hereinafter given. One of these certificates and the duplicate copy of the permit shall be retained by the carrier; another copy of the certificate, together with the original permit, shall be mailed by the carrier to the Chief of the Bureau of Animal Industry, Washington, D. C., and the third copy of the certificate shall be addressed and mailed by the carrier to the Bureau of Animal Industry inspector in charge at the point to which the shipment is consigned. Upon the arrival of the shipment at the establishment the inspector in charge shall cause a careful inspection to be made of the shipment, to determine whether or not it is unsound, unwholesome, or otherwise unfit for food. Should the meat or meat-food product contained in the shipment prove to be unsound, unwholesome, or otherwise unfit for human food, it shall at once be stamped "U. S. Inspected and Condemned" and be immediately tanked or removed to the condemned room. If the meat or meat-food product contained in the shipment shall prove to be sound, wholesome, and fit for human food, the inspector shall allow the meat or meat-food product to enter the establishment. Meat or meat-food products at an official establishment alleged or known to be unsound, unwholesome, or otherwise unfit for human food shall not be shipped under this paragraph, but must be disposed of at the establishment.

¹ Formerly Regulation 64, B. A. I. Order 137.

² Formerly Regulation 61, B. A. I. Order 137.

Paragraph 3. Meat or meat-food products which have been inspected and passed and are so marked and are alleged to be unsound, unwholesome, or otherwise unfit for human food may be returned from one State or Territory or the District of Columbia to any jobber, wholesaler, or other dealer from whom the said meat or meat-food product was purchased, if a written permit, in duplicate, for such shipment be first obtained from the Chief of the Bureau of Animal Industry. In all such shipments both the original and duplicate copies of the permits shall be surrendered to the carrier accepting the meat or meat-food product, and the carrier shall require the shipper to furnish two copies of the form of certificate hereinafter given. One of these certificates and the duplicate copy of the permit shall be retained by the carrier, and the other copy of the certificate, together with the original permit, shall be mailed by the carrier to the Chief of the Bureau of Animal Industry, Washington, D. C. If the meat or meat-food product which is shipped under this section shall prove to be unsound, unwholesome, or otherwise unfit for human food it may be reshipped in interstate commerce as a food product.

Paragraph 4. The shippers' certificate required by paragraphs 2 and 3 of this section shall be in the following form, and shall in all cases show a description and the weight of the meat or meat-food product:¹

Date.....190...

Name of common carrier.....

Consignor.....

Point of shipment.....

Consignee.....

Destination.....

Number of permit.....

I hereby certify that the following-described meat or meat-food products have been inspected and passed according to the act of Congress of June 30, 1906, and are so marked. It is alleged that the said meat or meat-food products are unsound, unhealthful, unwholesome, and unfit for human food.

Kind of product	Amount and weight
.....
.....
.....

.....
(Signature of shipper)

.....
(Business or occupation of shipper)

.....
(Address of shipper)

As evidence to connecting carriers that the proper shipper's certificate as required by this paragraph is on file with the initial carrier, the waybills, transfer bills, running slips, or conductor's cards accompanying the shipments of meat or meat-food

¹ Attention is directed to the meat-inspection law, which provides a penalty of a fine of \$10,000 and imprisonment for two years for any person who ships for human consumption in interstate or foreign trade any meat or meat-food product which is unsound, unwholesome, or otherwise unfit for human food.

products, made under paragraphs 2 and 3 of this section, must have embodied in, stamped upon, or attached to the same a signed statement in the following form:

(Name of railroad company)

Meat or meat-food product alleged to be unsound, unwholesome, or otherwise unfit for food, as evidenced by shipper's certificate on file with initial carrier.

(Signed) Agent.

Paragraph 5. Uninspected meat or meat-food product, or meat or meat-food product inspected and marked and which is known to have become unsound, unwholesome, or otherwise unfit for human food, or inedible grease or tallow or other fat, may be shipped from one State or Territory or the District of Columbia to another State or Territory or the District of Columbia or to a foreign country for industrial purposes. No such shipment shall be accepted by any carrier unless and until the product which is known to be unsound, unwholesome, or otherwise unfit for food shall have been denatured or otherwise rendered unavailable for food purposes. The carrier shall require the shipper to certify in writing that the meat or meat-food product has been so denatured or otherwise rendered unavailable for food purposes. This certificate of the shipper that the meat or meat-food product has been denatured shall be forwarded by the carrier to the Chief of the Bureau of Animal Industry, Washington, D. C. It is suggested that the shipper's certificate of denaturing required for shipments made under this paragraph be in the following form:

Date.....190...

Name of common carrier.....

Consignor.....

Point of shipment.....

Consignee.....

Destination.....

I hereby certify that the following-described inedible meat or meat-food products have been denatured or otherwise rendered unavailable for food purposes.

Kind of product	Amount and weight
.....
.....
.....

.....
(Signature of shipper)

.....
(Business or occupation of shipper)

.....
(Address of shipper)

As evidence to connecting carriers that the proper shipper's certificate is on file with the initial carrier, the waybills, transfer bills, running slips, or conductor's cards accompanying the shipment of meat or meat-food products under this paragraph must have embodied in, stamped upon, or attached to the same a signed statement in the following form:

(Name of railroad company)

Unsound, unwholesome, or otherwise unfit for food, and denatured or otherwise rendered unavailable for food purposes, as evidenced by shipper's certificate on file with the initial carrier.

(Signed) Agent.

Regulation 26. Counterfeiting, etc.

Section 1. It is a misdemeanor, punishable by fine and imprisonment, for any person, firm, or corporation, or officer, agent, or employee thereof to forge, counterfeit, simulate, or falsely represent, or without proper authority to use, fail to use, or detach, or knowingly or wrongfully to alter, deface, or destroy, or to fail to deface or destroy any of the marks, stamps, tags, labels or other identification devices provided for by law or by these regulations, on any carcasses, parts of carcasses, or the food product, or the containers thereof, or wrongfully to use, deface, or destroy any certificate provided for by law or by these regulations.

Regulation 27. Reports

Section 1. Reports of the work of inspection carried on in every official establishment shall be forwarded to the Department by the inspector in charge, on such blank forms and in such manner as may be specified by the Chief of the Bureau of Animal Industry.

Section 2. The proprietors of official establishments shall furnish daily to the Department employees detailed to the various departments accurate information regarding receipts, shipments, and amounts of products on which to base their daily reports.

Section 3. Reports on sanitation shall be made at stated times by the Department employees in charge of the various departments to the inspector in charge of the station, and by the inspector in charge to the Chief of the Bureau of Animal Industry. If any insanitary conditions are detected by any Department employee, such conditions shall be reported immediately to the inspector in charge, who, after investigation, shall report them to the Chief of the Bureau.

Regulation 28. Appeals

Section 1. When the action of any inspector in condemning any carcass or part thereof, meat, or meat-food product is questioned, appeal may be made to the inspector in charge, and from his decision appeal may be made to the Chief of the Bureau of Animal Industry or to the Secretary of Agriculture, whose decision shall be final.

Regulation 29. Cooperation with Municipal Authorities

Section 1. Inspectors in charge are directed to notify the municipal authorities of the character of inspection, and upon request to advise with such authorities with a view to preventing the entry into the local markets of diseased animals or their products. The details of any proposed cooperative arrangement must be first submitted to and approved by the Chief of the Bureau of Animal Industry.

1. Law Under Which the Foregoing Regulations Are Made

Extract from an act of Congress entitled "An act making appropriations for the Department of Agriculture for the fiscal year ending June thirtieth, nineteen hundred and seven," approved June 30, 1906 (34 Stat., 674).

The Meat-inspection Amendment

That for the purpose of preventing the use in interstate or foreign commerce, as hereinafter provided, of meat and meat-food products which are unsound, unhealthful, unwholesome, or otherwise unfit for human food, the Secretary of Agriculture, at his discretion, may cause to be made, by inspectors appointed for that purpose, an examination and inspection of all cattle, sheep, swine, and goats before they shall be allowed to enter into any slaughtering, packing, meat-canning, rendering, or similar establishment, in which they are to be slaughtered and the meat and meat-food products thereof are to be used in interstate or foreign commerce; and all cattle, swine, sheep, and goats found on such inspection to show symptoms of disease shall be set apart and slaughtered separately from all other cattle, sheep, swine, or goats, and when so slaughtered the carcasses of said cattle, sheep, swine, or goats shall be subject to a careful examination and inspection, all as provided by the rules and regulations to be prescribed by the Secretary of Agriculture as herein provided for.

That for the purposes hereinbefore set forth the Secretary of Agriculture shall cause to be made by inspectors appointed for that purpose, as hereinafter provided, a post-mortem examination and inspection of the carcasses and parts thereof of all cattle, sheep, swine, and goats to be prepared for human consumption at any slaughtering, meat-canning, salting, packing, rendering, or similar establishment in any State, Territory, or the District of Columbia for transportation or sale as articles of interstate or foreign commerce; and the carcasses and parts thereof of all such animals found to be sound, healthful, wholesome, and fit for human food shall be marked, stamped, tagged, or labeled as "Inspected and Passed;" and said inspectors shall label, mark, stamp, or tag as "Inspected and Condemned," all carcasses and parts thereof of animals found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food; and all carcasses and parts thereof thus inspected and condemned shall be destroyed for food purposes by the said establishment in the presence of an inspector, and the Secretary of Agriculture may remove inspectors from any such establishment which fails to so destroy any such condemned carcass or part thereof, and said inspectors, after said first inspection shall, when they deem it necessary, reinspect said carcasses or parts thereof to determine whether since the first inspection the same have become unsound, unhealthful, unwholesome, or in any way unfit for human food, and if any carcass or any part thereof shall, upon examination and inspection subsequent to the first examination and inspection, be found to be unsound, unhealthful, unwholesome, or otherwise unfit for human food, it shall be destroyed for food purposes by the said establishment in the presence of an inspector, and the Secretary of Agriculture may remove inspectors from any establishment which fails to so destroy any such condemned carcass or part thereof.

The foregoing provisions shall apply to all carcasses or parts of carcasses of cattle, sheep, swine, and goats, or the meat or meat products thereof which may be brought into any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, and such examination and inspection shall be had before the said carcasses or parts thereof shall be allowed to enter into any department wherein the same are to be treated and prepared for meat-food products; and the foregoing provisions shall also apply to all such products which, after having been issued from any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, shall be returned to the same or to any similar establishment where such inspection is maintained.

That for the purposes hereinbefore set forth the Secretary of Agriculture shall cause to be made by inspectors appointed for that purpose an examination and inspection of all meat-food products prepared for interstate or foreign commerce in any slaughtering, meat-canning, salting, packing, rendering, or similar establishment, and for the purposes of any examination and inspection said inspectors shall have access at all times, by day or night, whether the establishment be operated or not, to every part of said establishment; and said inspectors shall mark, stamp, tag, or

label as "Inspected and Passed" all such products found to be sound, healthful, and wholesome, and which contain no dyes, chemicals, preservatives, or ingredients which render such meat or meat-food products unsound, unhealthful, unwholesome, or unfit for human food; and said inspectors shall label, mark, stamp, or tag as "Inspected and Condemned" all such products found unsound, unhealthful, and unwholesome, or which contain dyes, chemicals, preservatives, or ingredients which render such meat or meat-food products unsound, unhealthful, unwholesome, or unfit for human food, and all such condemned meat-food products shall be destroyed for food purposes, as hereinbefore provided, and the Secretary of Agriculture may remove inspectors from any establishment which fails to so destroy such condemned meat-food products: *Provided*, That, subject to the rules and regulations of the Secretary of Agriculture, the provisions hereof in regard to preservatives shall not apply to meat-food products for export to any foreign country, and which are prepared or packed according to the specifications or directions of the foreign purchaser, when no substance is used in the preparation or packing thereof in conflict with the laws of the foreign country to which said article is to be exported; but if said article shall be in fact sold or offered for sale for domestic use or consumption, then this proviso shall not exempt said article from the operation of all the other provisions of this act.

That when any meat or meat-food product prepared for interstate or foreign commerce which has been inspected as hereinbefore provided and marked "Inspected and Passed" shall be placed or packed in any can, pot, tin, canvas, or other receptacle or covering in any establishment where inspection under the provisions of this act is maintained, the person, firm, or corporation preparing said product shall cause a label to be attached to said can, pot, tin, canvas, or other receptacle or covering, under the supervision of an inspector, which label shall state that the contents thereof have been "Inspected and Passed" under the provisions of this act; and no inspection and examination of meat or meat-food products deposited or enclosed in cans, tins, pots, canvas, or other receptacle or covering in any establishment where inspection under the provisions of this act is maintained shall be deemed to be complete until such meat or meat-food products have been sealed or inclosed in said can, tin, pot, canvas, or other receptacle or covering under the supervision of an inspector, and no such meat or meat-food products shall be sold or offered for sale by any person, firm, or corporation in interstate or foreign commerce under any false or deceptive name; but established trade name or names which are usual to such products and which are not false and deceptive and which shall be approved by the Secretary of Agriculture are permitted.

The Secretary of Agriculture shall cause to be made, by experts in sanitation or by other competent inspectors, such inspection of all slaughtering, meat-canning, salting, packing, rendering, or similar establishments in which cattle, sheep, swine, and goats are slaughtered and the meat and meat-food products thereof are prepared for interstate or foreign commerce as may be necessary to inform himself concerning the sanitary conditions of the same, and to prescribe the rules and regulations of sanitation under which such establishments shall be maintained; and where the sanitary conditions of any such establishment are such that the meat or meat-food products are rendered unclean, unsound, unhealthful, unwholesome, or otherwise unfit for human food, he shall refuse to allow said meat or meat-food products to be labeled, marked, stamped, or tagged as "Inspected and Passed."

That the Secretary of Agriculture shall cause an examination and inspection of all cattle, sheep, swine, and goats, and the food products thereof, slaughtered and prepared in the establishments hereinbefore described for the purposes of interstate or foreign commerce to be made during the nighttime as well as during the daytime when the slaughtering of said cattle, sheep, swine, and goats, or the preparation of said food products is conducted during the nighttime.

That on and after October first, nineteen hundred and six, no person, firm, or corporation shall transport or offer for transportation, and no carrier of interstate or foreign commerce shall transport or receive for transportation from one State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, or to any place under the jurisdiction of the United States, or to any foreign country, any carcasses or parts thereof, meat, or meat-food products thereof, which have not been inspected, examined, and marked as "Inspected and Passed," in accordance with the terms of this act and with the rules and regulations prescribed by the Secretary of Agriculture: *Provided*, That all meat and meat-food products on hand on October first, nineteen hundred and six, at establishments where inspection has not been maintained, or which have been inspected under existing law,

shall be examined and labeled under such rules and regulations as the Secretary of Agriculture shall prescribe, and then shall be allowed to be sold in interstate or foreign commerce.

That no person, firm, or corporation, or officer, agent, or employee thereof, shall forge, counterfeit, simulate, or falsely represent, or shall without proper authority use, fail to use, or detach, or shall knowingly or wrongfully alter, deface, or destroy, or fail to deface or destroy, any of the marks, stamps, tags, labels, or other identification devices provided for in this act, or in and as directed by the rules and regulations prescribed hereunder by the Secretary of Agriculture, on any carcasses, parts of carcasses, or the food product, or containers thereof, subject to the provisions of this act, or any certificate in relation thereto, authorized or required by this act or by the said rules and regulations of the Secretary of Agriculture.

That the Secretary of Agriculture shall cause to be made a careful inspection of all cattle, sheep, swine, and goats intended and offered for export to foreign countries at such times and places, and in such manner as he may deem proper, to ascertain whether such cattle, sheep, swine, and goats are free from disease.

And for this purpose he may appoint inspectors who shall be authorized to give an official certificate clearly stating the condition in which such cattle, sheep, swine, and goats are found.

And no clearance shall be given to any vessel having on board cattle, sheep, swine, or goats for export to a foreign country until the owner or shipper of such cattle, sheep, swine, or goats has a certificate from the inspector herein authorized to be appointed, stating that the said cattle, sheep, swine, or goats are sound and healthy, or unless the Secretary of Agriculture shall have waived the requirement of such certificate for export to the particular country to which such cattle, sheep, swine, or goats are to be exported.

That the Secretary of Agriculture shall also cause to be made a careful inspection of the carcasses and parts thereof of all cattle, sheep, swine, and goats, the meat of which, fresh, salted, canned, corned, packed, cured, or otherwise prepared, is intended and offered for export to any foreign country, at such times and places and in such manner as he may deem proper.

And for this purpose he may appoint inspectors who shall be authorized to give an official certificate stating the condition in which said cattle, sheep, swine, or goats, and the meat thereof, are found.

And no clearance shall be given to any vessel having on board any fresh, salted, canned, corned, or packed beef, mutton, pork, or goat meat, being the meat of animals killed after the passage of this act, or except as hereinbefore provided for export to and sale in a foreign country from any port in the United States, until the owner or shipper thereof shall obtain from an inspector appointed under the provisions of this act a certificate that the said cattle, sheep, swine, and goats were sound and healthy at the time of inspection, and that their meat is sound and wholesome, unless the Secretary of Agriculture shall have waived the requirements of such certificate for the country to which said cattle, sheep, swine, and goats or meats are to be exported.

That the inspectors provided for herein shall be authorized to give official certificates of the sound and wholesome condition of the cattle, sheep, swine, and goats, their carcasses and products as herein described, and one copy of every certificate granted under the provisions of this act shall be filed in the Department of Agriculture, another copy shall be delivered to the owner or shipper, and when the cattle, sheep, swine, and goats or their carcasses and products are sent abroad, a third copy shall be delivered to the chief officer of the vessel on which the shipment shall be made.

That no person, firm, or corporation engaged in the interstate commerce of meat or meat-food products shall transport or offer for transportation, sell or offer to sell any such meat or meat-food products in any State or Territory or in the District of Columbia or any place under the jurisdiction of the United States, other than in the State or Territory or in the District of Columbia or any place under the jurisdiction of the United States in which the slaughtering, packing, canning, rendering, or other similar establishment owned, leased, operated by said firm, person, or corporation is located unless and until said person, firm, or corporation shall have complied with all of the provisions of this act.

That any person, firm, or corporation, or any officer or agent of any such person, firm, or corporation, who shall violate any of the provisions of this act shall be deemed guilty of a misdemeanor, and shall be punished on conviction thereof by a fine of not exceeding ten thousand dollars or imprisonment for a period not more than two years, or by both such fine and imprisonment, in the discretion of the court

That the Secretary of Agriculture shall appoint from time to time inspectors to make examination and inspection of all cattle, sheep, swine, and goats, the inspection of which is hereby provided for, and of all carcasses and parts thereof, and of all meats and meat-food products thereof, and of the sanitary conditions of all establishments in which such meat and meat-food products hereinbefore described are prepared; and said inspectors shall refuse to stamp, mark, tag, or label any carcass or any part thereof, or meat-food product therefrom, prepared in any establishment hereinbefore mentioned, until the same shall have actually been inspected and found to be sound, healthful, wholesome, and fit for human food, and to contain no dyes, chemicals, preservatives, or ingredients which render such meat-food product unsound, unhealthful, unwholesome, or unfit for human food; and to have been prepared under proper sanitary conditions, hereinbefore provided for; and shall perform such other duties as are provided by this act and by the rules and regulations to be prescribed by said Secretary of Agriculture; and said Secretary of Agriculture shall, from time to time, make such rules and regulations as are necessary for the efficient execution of the provisions of this act, and all inspections and examinations made under this act shall be such and made in such manner as described in the rules and regulations prescribed by said Secretary of Agriculture not inconsistent with the provisions of this act.

That any person, firm, or corporation, or any agent or employee of any person, firm, or corporation, who shall give, pay, or offer, directly or indirectly, to any inspector, deputy inspector, chief inspector, or any other officer or employee of the United States authorized to perform any of the duties prescribed by this act or by the rules and regulations of the Secretary of Agriculture any money or other thing of value, with intent to influence said inspector, deputy inspector, chief inspector, or other officer or employee of the United States in the discharge of any duty herein provided for, shall be deemed guilty of a felony and, upon conviction thereof, shall be punished by a fine not less than five thousand dollars nor more than ten thousand dollars and by imprisonment not less than one year nor more than three years; and any inspector, deputy inspector, chief inspector, or other officer or employee of the United States authorized to perform any of the duties prescribed by this act who shall accept any money, gift, or other thing of value from any person, firm, or corporation, or officers, agents, or employees thereof, given with intent to influence his official action, or who shall receive or accept from any person, firm, or corporation engaged in interstate or foreign commerce any gift, money, or other thing of value given with any purpose or intent whatsoever, shall be deemed guilty of a felony and shall, upon conviction thereof, be summarily discharged from office and shall be punished by a fine not less than one thousand dollars nor more than ten thousand dollars and by imprisonment not less than one year nor more than three years.

That the provisions of this act requiring inspection to be made by the Secretary of Agriculture shall not apply to animals slaughtered by any farmer on the farm and sold and transported as interstate or foreign commerce, nor to retail butchers and retail dealers in meat and meat-food products, supplying their customers: *Provided*, That if any person shall sell or offer for sale or transportation for interstate or foreign commerce any meat or meat-food products which are diseased, unsound, unhealthful, unwholesome, or otherwise unfit for human food, knowing that such meat-food products are intended for human consumption, he shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine not exceeding one thousand dollars or by imprisonment for a period of not exceeding one year, or by both such fine and imprisonment: *Provided also*, That the Secretary of Agriculture is authorized to maintain the inspection in this act provided for at any slaughtering, meat-canning, salting, packing, rendering, or similar establishment notwithstanding this exception, and that the persons operating the same may be retail butchers and retail dealers or farmers; and where the Secretary of Agriculture shall establish such inspection then the provisions of this act shall apply notwithstanding this exception.

That there is permanently appropriated, out of any money in the Treasury not otherwise appropriated, the sum of three million dollars, for the expenses of the inspection of cattle, sheep, swine, and goats, and the meat and meat-food products thereof which enter into interstate or foreign commerce and for all expenses necessary to carry into effect the provisions of this act relating to meat inspection, including rent and the employment of labor in Washington and elsewhere, for each year. And the Secretary of Agriculture shall, in his annual estimates made to Congress, submit a statement in detail, showing the number of persons employed in such inspections and the salary or per diem paid to each, together with the contingent expenses of such inspectors and where they have been and are employed.

V, Organization and Methods of Procedure of the Inspection Force

As the meat-inspection organization in the United States varies somewhat from this organization in Germany, it is deemed essential to incorporate in this text-book the conditions applying to the meat-inspection force in this country, and also to describe the methods of procedure which are required in the execution of the ante-mortem and post-mortem inspection by the Government inspector. Inasmuch as this subject is so thoroughly treated by Dr. A. D. Melvin, Chief of the Bureau of Animal Industry, in his work on the "Federal Meat Inspection Service,"¹ he will be quoted in substance in the following:

1. Personnel of the Inspection Force

The Bureau's employees are both capable and expert. The men in charge of all stations where slaughtering is done, and the men who do the post-mortem work at all stations, are veterinarians. These men must first have successfully completed a three years' course in veterinary medicine at a reputable veterinary college. The Department recognizes only 14 such institutions, excluding several so-called colleges that aspire to cover this field of knowledge. The Civil Service Commission examines these graduates, and about 50 per cent. of those examined make the required grade of 70.

For the relief of those who think that everything necessary to the appointment of a man in this service is a letter written to the Secretary of Agriculture by an influential citizen, it may be stated that the Department makes absolutely no permanent appointments except of men whose names are certified to it by the Civil Service Commission. During a period of six months one so appointed is on probation, and if he fails to measure up to the requirements he is dropped. If at the end of this six months he attains his absolute appointment, he is not at once freed of supervision and clothed with full authority to pass or condemn. The force is large, and he is so placed on it under experienced inspectors that he may learn the law and regulations and the methods of their application. A set of rules, supplemented, of course, by some necessary discretion on the part of the heads of the service, govern his advancement in authority and salary. On the latter men rests the burden of inspection. The Bureau holds them responsible, and they well understand that their promotion depends on efficient and faithful service. They have ample opportunity to become experts in detecting diseased animals, and they do. The Department demands all their time during the working day, and a man must be dull indeed if in the days, months, and years spent amid the swift work of the killing floors he fails to develop a most masterly dexterity in discovering abnormalities in the carcasses that come before him.

¹ Bureau of Animal Industry Circular 125.



The laboratory inspectors constitute another class of employees. They also are selected through civil-service examination in the principles of bacteriology and chemistry, with special application to meats.

A third grade of employee is the inspector's assistant. Being under the direction of the veterinarian, he is not required to be himself regularly educated along this line. He examines live stock, tags animals, stamps carcasses, seals cars, patrols the houses at night, superintends the removal and tanking of condemned carcasses—in short, he does everything he can, where expert pathological knowledge is unnecessary, to relieve and assist the veterinarian.

The meat inspector is a fourth class. He is expert in pickling, salting, smoking, and otherwise curing meat. He likewise enters the service through the civil-service examinations, and his previous experience is taken into account in grading him. By means of the educated senses of sight and smell he can tell when a piece of meat is unfit, and he knows whether it is irretrievably bad or whether it can be utilized. This class of employees condemned 14,000,000 pounds of meat in the fiscal year 1906-7.

The Bureau selects certain of the most experienced veterinary inspectors and meat inspectors, divides the country into districts, and sends these men traveling through them, visiting every station and every plant. Their visits are unannounced, and they submit reports with recommendations to the Washington office. They are able, out of their wider experience, to instruct the inspectors in charge at the various stations, and their reports are of great value to the Department in its efforts to secure a uniform inspection and to learn of insanitary conditions and have them corrected. That the regulations are enforced is capable of demonstration by an examination of the reports of the number of animals condemned. Other safeguards, however, are provided. The law promises to fine not less than \$5,000 and to imprison for at least a year any man who gives anything of value, even a piece of meat, to a Government employee to influence him in the performance of his duties; it is stricter still with such employees, for it holds over them the menace of similar fine and imprisonment if they accept anything of value, no matter what the intent of the donor or the purpose of the gift may be. It is thus dangerous for the packer to bribe, and it is more dangerous still for the employee to accept.

The Bureau places further obstacles in the way of collusion between inspector and owner by frequent changes at the larger stations of employees from house to house, and by changes, less frequent, of employees from station to station. It is working constantly, also, to secure uniformity in the inspection at all stations. It has a very complex system of reports, and its experts scrutinize these with the view of discovering abnormalities in results and making the proper corrections. Again, practically all the operations of slaughtering and preparing meats are open to the world, and are, indeed, in the larger centers, one of the sights to which visitors flock. It is well known that accredited representatives of foreign governments, expert and otherwise, see all the processes of inspection, and more than one has satisfied himself and his government, sometimes to the surprise of both, that inspection is all that it is claimed to be. Publicists also spend days in the stock yards and packing houses, embodying the results of their observations in articles that have recently been of a more favorable tone than they were one or two years ago.

On the whole, it is submitted that no material dishonesty in the inspection can long exist, in view of the above methods and facts, and owing further to the involuntary espionage that each employee undergoes from his fellow-employees, which, while it is not depended upon by the Department, is yet a powerful factor in maintaining a strict integrity in the enforcement of the law.

2. The Performance of Ante-mortem and Post-mortem Inspection

For the carrying on of the ante-mortem and post-mortem inspection, the published regulations of the imperial meat-inspection law prescribe the detailed requirements. Similar instructions for the U. S. Inspector of meats are contained in the regulations of the Federal meat-inspection service, B. A. I. Order, No. 150. It will, therefore, be necessary to discuss here only a few technical and especially important conditions.

A. Action in General

1. Ante-mortem Inspection of Food Animals

The performance of the ante-mortem inspection is regulated by the regulations governing the enforcement of the meat-inspection law, and does not necessitate a further explanation for the veterinary inspector.

Concerning the age of the food animals the most important information has been already given on page 16.

The influence of transportation on the condition of food animals was considered on page 7.

Regarding the diseases which may be observed, reference should be made to Chapter VII.

Concerning the judgment on living food animals see page 158. That under certain conditions the application of slaughter can be permitted only after a period of rest, was already mentioned on page 10. The inspector has also the authority to request that the slaughter should be undertaken at an established hour and in his presence. A reinspection must be made should the slaughter have been delayed for over two days after permission was granted.

[The ante-mortem inspection in the United States is governed by B. A. I. Order 150, Regulation 11, the carrying out of which is described by Dr. A. D. Melvin, in his previously mentioned work, as follows:

As conducted at present, the first step in actual inspection is the examination of the living animal. The law does not absolutely require this, but places it within the discretion of the Secretary. Government inspectors make this examination in the stock yards or in the pens, alleys, etc., of the establishment by which the animals have been bought and in the slaughterhouse of which they are proposed to be slaughtered, and no animals which have not undergone this examination are allowed to enter the slaughterhouse proper. The pens contain from as low as 10 to as high as 200 animals each. The inspector goes into the pen and looks carefully over each animal. When he finds one that to his mind is not perfectly sound and healthy he or his assistant affixes to its ear a numbered metal tag bearing the words "U. S. Suspect." Such animals are segregated and slaughtered separately from other animals, either before or after the regular course of the killing. If the post-mortem examination of an animal does not confirm the suspicions aroused by the appearance

of the live animal, and no lesions of disease are found, the tag is taken off and sent to the office of the inspector in charge of the station, who has already been informed of the number of the tag after it was affixed on suspicion, and the carcass is sent along as edible meat. If lesions are found which warrant condemnation, the carcass is sent to the tank, the tag being removed and taken with a report to the office.]

2. Inspection of the Slaughtered Animals (Meat Inspection)

For the examination of the slaughtered animals exact directions are given in the regulations of the meat-inspection law. The presence of veterinary inspectors at the slaughter is urgently desired in certain diseases (for instance, peritonitis, pleuritis, pericarditis, and certain abscess formations).

Although it is desirable to limit the work of inspection to those hours showing sufficient daylight, this cannot always be accomplished for obvious reasons. For inspection by artificial light an abundant, and, if possible, a white light should be demanded; while in the ambulatory meat-inspection, examinations under oil or plain gas light in the winter time cannot be entirely prevented, yet they should be positively withheld should there be a suspicion of an injurious condition of the entire meat (blood

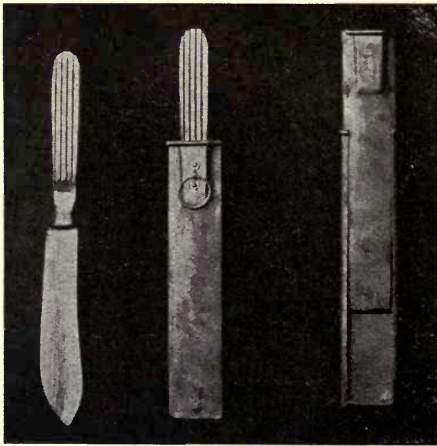


Fig. 47. Post-mortem knife and case made from nickel, after Albrecht, Dresden, Veterinary High School.

poisoning), or even if there are color changes of the meat (jaundice), in which case examinations should be made only by daylight. Before beginning the examination it should be established that not a part of the slaughtered animal is missing and that nothing has been undertaken to change the appearance of certain parts (scalding of the stomachs, mesentery, head, feet, etc.). The separation of the intestines from the mesentery and the emptying of the stomach and the intestinal contents, as well as the cleaning of these parts, cannot be very well prohibited on account of their spoiling, should the

inspector not be present immediately after the conclusion of the slaughter. On the other hand, cutting the mesentery or its further preparation is not permissible.

(a) *Technique of the Inspection*

The inspection of the slaughtered animals in accordance with the above-mentioned instructions consists in the following:

1. Inspection of all organs and parts.
2. Feeling of certain parts, as lungs, liver, spleen, uterus, udder, tongue.

3. Incising of lymph glands, the location of which is given on page 43, in connection with figures 21-33; also muscles, organs with cavities, and suspected or diseased parts. However this should be restrained as much as possible in tuberculosis, suppurations, etc., on account of the danger of spreading the infective substance and the contamination of the meat with this material. Suitable knives, with cases, especially well adapted for the ambulatory inspection, and which can be easily cleansed and disinfected, are illustrated under Figs. 47-49. According to the regulations the knives of the inspectors should be smooth and free from scratches and splits. For the disinfection of knives and their cases boiling in a 2 per cent. soda solution is sufficient.

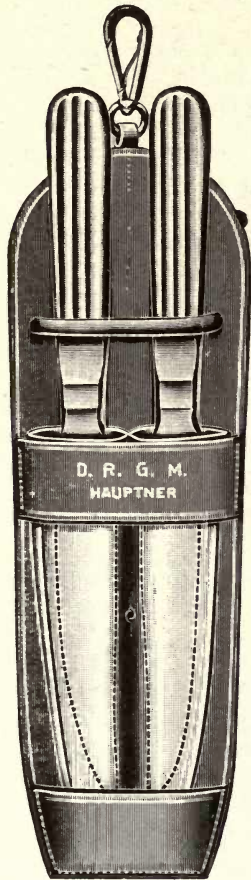


Fig. 48. Case for post-mortem knives after Tempel, of the firm Hauptner-Berlin.

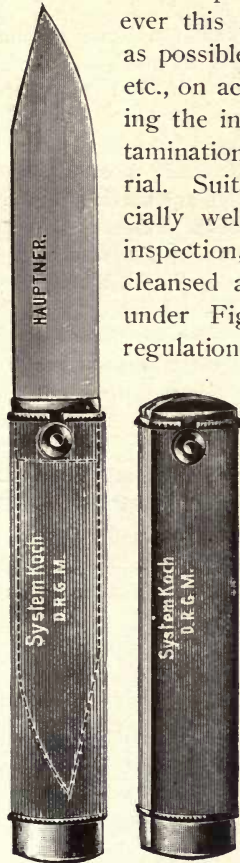


Fig. 49 Post-mortem knife after Koch, of the firm Hauptner-Berlin.

4. Squeezing out the contents of the passages and the cavities or organs (bile ducts of the liver, cut surface of the lungs, etc.). Besides, under special conditions the following additional methods may also be applied:

5. Reaction test of muscles with blue or red litmus paper, which after moistening should be pressed with

a forceps or knife against a fresh cut surface of the muscles. In this work the cuts must be made at various intervals and in muscles lying at various distances apart. (See page 38.)

6. Microscopic examinations of blood, muscles, various tissues, diseased parts, secretions and excretions, parasites, etc.

7. Bacteriological examinations of blood, parenchymatous fluids, etc., in infectious diseases.

8. Bacteriological examinations through the inoculation of culture media, inoculations of test animals, etc.

Directions for the technical procedure prescribed for the veterinary examination of imported meat have already been given, and they may also be applied in the inspection of fresh-slaughtered animals in case of necessity.

A bacteriological meat inspection was first recommended by Basenau for doubtful cases of affections, especially in emergency slaughters, in which an unobjectionable positive result cannot be obtained in any other way. In such an inspection bacterial blood intoxications are included first of all (see Chap. VII, Sec. 6), and a diagnosis even in these cases may prove quite difficult. Basenau himself gives the following directions: "It is practicable to undertake the examination 24 hours after slaughter, as all the meat-poisoning bacteria grow even at a low temperature, thereby increasing their numbers, which facilitates the examination. In this study it is presumed that after slaughter the stomach, intestines, etc., were removed in the usual order. This excludes the possibility that bacteria, which may be found in the inside of the meat have reached that point through post-mortem invasion from the intestines, since, according to our numerous experiences which have recently been confirmed by A. Chillées, microorganisms are not present in the inside of the meat of healthy animals even after a longer time following slaughter. Then from the inside of the meat, which is rich in connective tissue, cover-glass preparations are made and gelatin plates are inoculated. Gelatin plates suffice perfectly for this purpose, if Forster's gelatin with a high melting point is used. At the same time two mice are fed with raw pieces of the meat and two others are fed with meat which has been exposed to 100° C. for one hour.

If there are no microorganisms present in the smear preparations, and if no colonies will develop inside of 24 hours on the plates, then the meat should be released without any further action.

If the presence of bacteria is established as a result of these preparations or plates, then the meat should be temporarily held in a suitable place and the results of the animal experiments, which, when positive, appear in most cases inside of three days, should be taken into consideration for final judgment. Should the mice, which were fed with the raw meat die, while those given the boiled meat remain well, it serves to prove that through the boiling the toxic substances were destroyed. Then, in accordance with present experiences, the meat can be released for consumption without danger to human health, after a sufficient sterilization in the steam apparatus. If there is no sterilizing apparatus present, then the proof of the presence of a larger number of bacteria in the meat would be sufficient for its condemnation. Should the mice fed with the boiled material containing the bacteria succumb, then the meat should be withheld from commerce and permission should only be given for its technical utilization."

As a simplification of Basenau's plating method Ostertag recommends the sowing on slant agar, as agar tubes can be carried easily in a sterile condition.

v. Drigalski recommends surface sowings on alkaline lactose-litmus-agar with particles of the spleen and muscles and besides the inoculation of similar particles into slightly alkaline nutrient bouillon at 22° C. until the following day for the purpose of growing the organism, and then to inoculate new plates from the growth in bouillon. If the growth on the plates shows predominantly blueish, transparent

colonies, this is sufficient to suspect the presence of a specific infection of the concerned animal (bacillus enteritidis, Gartner). For further determinations test inoculations have to be undertaken.

9. Chemical examinations may be necessary for certain purposes (testing for the use of preservative substances).

10. Examination for odor is in many cases requisite. It is especially necessary, even though it is not final, in cases where the boiling test has to be made for the examination of meat for spoiling.

11. The boiling test is frequently of great aid in the examination of the odor and taste of meat.

The same should always be carried out with chilled meat 24 hours after slaughter, as certain odor and taste peculiarities undergo a change in cooled meat. It is also advisable not to place the meat to be examined into boiling water, but by placing it into a covered receptacle with cold water it may be gradually heated to a boiling point, and then from time to time the developing steam should be tested for the odor. The taste of the meat and the meat broth should be determined after the meat is thoroughly boiled through. The boiling test should be especially undertaken with the meat of boars, cryptorchids, male goats, emergency slaughtered animals, when suspicious of an administration of drugs that may give a taste or odor to the meat (also large quantities of iodide of potassium), or inhalation of bad-smelling gases and vapors. Further, there are pronounced changes in the odor of meat when very offensive abscesses are encapsulated in large body cavities, in certain forms of icterus of hogs, in parasitism of calves, etc.

(b) *Procedure of Inspection*

[The procedure of the post-mortem inspection as it is conducted in the United States is described by Doctor Melvin in the following:

At the first exposure of the glands when the head is severed—these being common seats of tubercular infection—a Federal inspector makes an examination for evidences of disease, himself cutting into the glands, if necessary. Another inspector stands at the elbow of the gutter and, as the viscera are revealed, watches with practiced eye for abnormalities, carefully examining and handling the various parts in order that any obscure indication of disease may be discovered. The Bureau requires this inspector to handle the viscera and, if necessary, to cut into them. This is rapid as well as exacting work, and the head and visceral inspectors frequently exchange places, or the visceral inspector is relieved by another, after two hours' work.

When the inspector finds a diseased carcass he attaches to it, by means of a wire and seal, a paper tag with the words "U. S. Retained" on it and numbered to correspond with the number on the stub from which it is taken. He sends the numbered stub to the office with his report. The carcass, with the parts that have been separated, none of which is allowed to lose its identity, is now sent directly to a compartment called the "retaining room." The Government requires this important room to be rat proof, well lighted, to have floors of cement, or of metal or brick laid in cement, and to be provided with facilities for locking. The Government also pro-

vides a special lock for the room, and the keys remain in the custody of the inspector. At convenient periods the retained carcasses undergo in this room at the hands of other inspectors a more leisurely and careful inspection.

This is the final step in the post-mortem examination. The inspectors here have a good deal of personal discretion. Certain definite rules are laid down by the Bureau, but something must be left to the judgment of the inspectors. They must pass upon the question of the extent of the affection and decide whether or not the whole carcass or only parts of it should go to the tank. Not being pushed by the exigencies of the rapid work on the killing beds and the necessity of keeping up with the never-ending stream of carcasses, they are deliberate and careful in making their examinations and in forming their judgment. Carcasses which they decide to be fit for food they permit to be removed and placed with other healthy carcasses, which have been passed on the first inspection. They take off the "U. S. Retained" tag, return it with their report to the office, and stamp it "U. S. Inspected and passed."

When their examination confirms the suspicious indications of the first examination, however, they stamp conspicuously on the carcass, also on the tag, the words "U. S. Inspected and Condemned." The carcass is removed immediately from the retaining room under the eye of a Government employee, and goes either to the tank or, if it is not convenient to tank it immediately, to the condemned-meat room, which, like the retaining room, is provided with a lock, the key of which is kept by a Government employee, and which is opened only by Government employees. As soon as practicable Government men remove the carcass to the tank, keeping a record of the tag numbers, which they forward with their reports to the office. At houses which do not provide a "condemned room," the carcass is sent directly to the tank. About 25 per cent. of the carcasses retained are condemned.

All carcasses, both fit and unfit, having been removed from the retaining room, the floor and walls are washed with hot water and disinfected in order that the room may be clean and free from disease infection for the reception of the next batch of retained carcasses.]

In the performance of meat inspection it is advisable to maintain the following method of procedure in the inspection of the various species of animals:

I. CATTLE.—(a) *The (suitably prepared) head.*—Viewing, cutting the lymph glands (retropharangeal, submaxillary, parotid lymph glands), and tonsils in sections. Viewing and feeling of the tongue, applying extensive cuts to the muscles of mastication on both sides (beginning at the maxillary border and running parallel with the branches of the inferior maxilla.

(b) *Viscera of the Thoracic Cavity*

1. *Lungs.*—Viewing and palpating.—Cutting the lymph glands in sections (right and left bronchial glands, also the mediastinal glands) [the anterior mediastinal glands are hanging, as a rule, near the thoracic entrance on the forequarter], and a cross-section through each lobe of the lungs at about the last third, extending to the larger bronchial tubes. In

cutting the bronchial gland it is also advisable to cut into the principal bronchi (look for evidence of aspiration of the contents of the stomach).

2. *Heart*.—Opening of the pericardium; viewing and opening of both ventricles by a longitudinal cut which should extend through the septum.

(c) *Viscera of the Abdominal and Pelvic Cavity*

1. *Stomach, mesentery, omentum* with small and large intestines. Viewing and cutting their lymph glands.

2. *Liver*.—Viewing of both surfaces, feeling and cutting the lymph glands lying around the portal ring; cross-section through the larger bile ducts on the gastric surface and in the Spigelian lobe.

3. *Spleen*.—Palpation and cutting for the examination of the pulp.

4. *Urinary Bladder*.—Viewing and cutting only if it shows a diseased condition.

5. *Uterus with Vagina and Vulva*.—Viewing and cutting transversely through both horns of the uterus, and also longitudinally, if necessary.

6. *Udder*.—Feeling, viewing, and cutting the organ according to necessity; cutting of the lymph glands, which occasionally remain attached to the hindquarter.

In male cattle, the testicles with the penis and the accessory sexual lymph glands are to be viewed instead of the organs mentioned in 5 and 6.

(d) *The Carcass Proper*

1. In every case viewing of the serous coverings of the large body cavities, the cut surfaces of the accessible meat and bones, the kidneys loosened from their fat envelope, and the surfaces of the meat quarters; in addition the kidney lymph glands should be cut.

2. In suspicious cases, especially in emergency slaughter and in tuberculosis with extension through the systemic circulation, namely, the portal and pulmonary circulation, or the occurrence of extensively softened areas or in pronounced affections of the serous membranes, and of the uterus, the carcass should be cut into:

(a) The body wall lymph glands: inferior cervical lymph glands (including also the anterior mediastinal glands), lymph glands of the superior and inferior thoracic walls, lumbar, internal iliac and external ischiac lymph glands.

(b) The body lymph glands proper; prescapular, axillary, external iliac, popliteal, and superficial inguinal lymph glands.

(2) CALF.—(a) Inspection of the viscera, thoracic and abdominal cavities as in cattle, omitting the cutting of bile ducts, but it is necessary to consider especially the umbilical vein; the kidneys should only be loosened from the fat capsule in suspicious cases.

(b) Special attention should be paid to the navel and to the joints of the carcass, which, as a rule, is only partially skinned. Extensive lymph gland examinations under such conditions as were given for cattle should be carried out in the same manner. An inspection for measles (cutting into the heart and muscles of mastication, examination of the tongue), should only take place in calves over 6 weeks of age, except in suspicious cases; likewise the lymph glands of the head should be only cut in cases of suspicion.

3. SHEEP AND GOAT.—The examination is conducted the same as in calves. The cutting of the heart and the head and pulmonary lymph glands is only undertaken in cases of suspicion. Likewise an inspection of the body lymph glands should be made only under those conditions which apply for cattle.

4. HOG.—Before the inspection, the vertebral column must be split and the abdominal fat (leaf lard) must be separated from the abdominal muscles.

(a) Pluck (haslets): Viewing the tongue and the muscles on its inferior surface, the muscles of the larynx and of the heart and cutting into the latter. Lungs (cross-section through the posterior portion): incising the bronchial lymph glands. Liver: Viewing, palpating, cutting the lymph glands (for the absent mediastinal glands, examine the middle bronchial gland at the bifurcation of the trachea; the portal glands, as a rule, are attached to the mesentery near the pancreas).

(b) Mesentery with stomach, intestines, spleen, omentum, urinary bladder and uterus. Viewing, palpating, cutting the gastric (and if present, the attached portal) lymph glands, also the mesenteric lymph glands of the small and large intestines.

(c) The carcass.

1. In every case view the serous linings of the body cavities, the accessible parts, and cut surfaces of the meat, bones, and surface of the skin; incise the submaxillary and the superior cervical lymph glands.

2. In a suspicious case (under conditions as applied to cattle), incise the superior, middle, and inferior cervical lymph glands, internal iliac and external ischiac lymph glands, the prescapular, external iliac, popliteal and superficial inguinal glands. The external ischiac lymph glands lay as a rule superficially, but they are also frequently detached from the pelvic wall, on the rectum; the lymph glands of the inferior thoracic wall are mostly absent, those of the superior thoracic wall are frequently cut off with portions of the aorta, in the evisceration of the pluck; as a rule, the axillary lymph glands are also absent.

At the request of the owner and if there is no reason for suspicion, the splitting of the vertebral column may be waived and this is also omitted in suckling pigs.

5. HORSE.—The inspection is carried out practically as in cattle, but to make a thorough examination of the nasal mucous membrane, the head must be split longitudinally, and the septum nasi should be taken out in every case.



Fig. 50. Transverse section through the neck of a bull

6. On DOGS the inspection is followed in the same manner as has been described for small stock.

In emergency slaughter the inspection must be carried out with especial care, and particularly where special instructions have been given to the inspectors by the governments of the various allied states. For instance, the Kingdom of Saxony, in 1906, enacted the following:

“In an emergency slaughter the inspector should be especially careful about the presence of all the organs, and should there remain the slightest suspicion after the first inspection as to the wholesomeness of the meat for human consumption he should undertake a second inspection on the slaughtered animal. Especially if there is a suspicion of blood poisoning it is necessary to ascertain whether early changes will appear in connection with the keeping quality, color and odor of the meat; besides a boiling test should also be undertaken with the meat. A repetition of the inspection is always necessary if for an exceptional cause the inspection was made by artificial light. It must be apparent, however, that the second inspection should not be delayed too long,

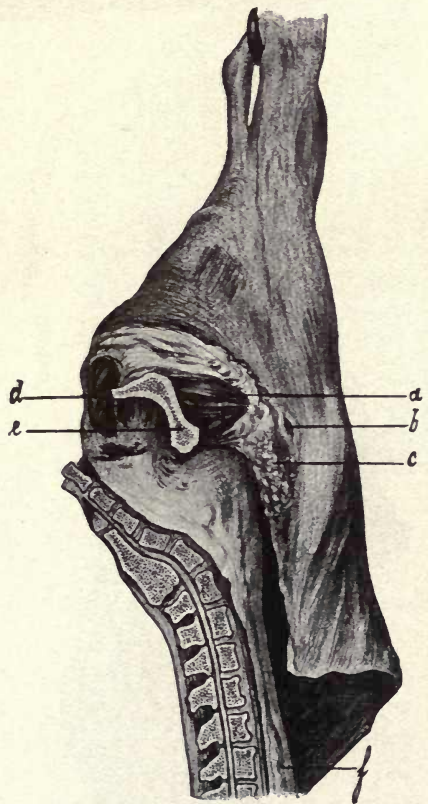


Fig. 51. Median side of the right hind-quarter of a bull; *a*, cut surface of the musc. gracilis; *b*, external inguinal ring; *c*, scrotal fat tissue; *d*, part of the musc. bulbo-cavernosus (represented somewhat enlarged); *e*, tuberculum pubicum; *f*, fat capsule of the kidney.

thus permitting the questionable meat to become affected by putrefactive changes. Therefore in the summer time the second inspection should never be undertaken later than 24 hours after the slaughter."



Fig. 52. Transverse section through the neck of a steer.



Fig. 53. Transverse section through the neck of a cow.

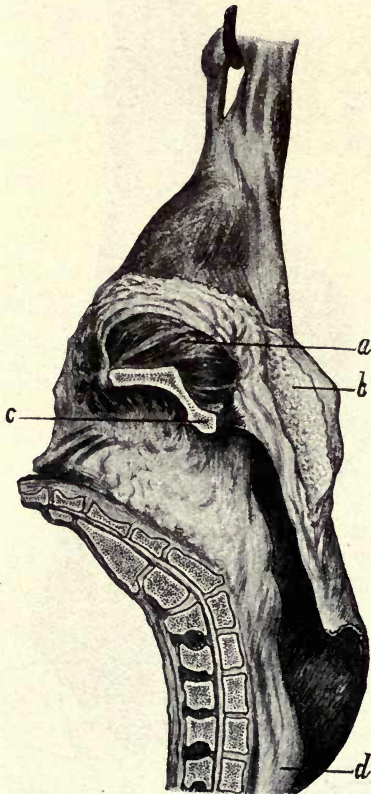


Fig. 54. Median side of a right hind-quarter of a cow; a, cut surface of the musc. gracilis; b, udder; c, tuberculum pubicum; d, fat capsule of the kidney.

(c) Indications of age of the slaughtered animals were mentioned on page 16.

(d) The determination of the sex in the dressed animals may ensue from the following indications:

I CATTLE

The bulls are conspicuous by their strong development of the muscles, especially on the withers (Fig. 50) and shoulders, as well as by their compact development in general. The color of the meat is in general darker (page 57), the quantity of fat is smaller than in steers and cows. On the hind quarters the following is conspicuous (Fig. 51): The opened inguinal canal, the small quantity of scrotal fat, the triangular or irregular rhomboidal-shaped cut section of the gracilis muscles, the place of attachment of which on the ischial portion of the pelvic floor is, as a rule, covered with fasciæ and fat tissue; on the ischial notch there generally remains a large portion of the bulbo-caverno-

sus muscle sometimes with adhering parts of the corpora cavernosa of the penis; the striking angularity of the pelvic floor with the strongly developed tuberculum pubicum, and the slightly developed fat capsule of the kidneys. Sometimes the channel of the penis can be followed in the fat on the inner surface of the thigh and the abdominal wall.

In steers the development of the body is not as compact, and especially the muscles of the neck and withers are not as well developed (Fig. 52); the color of the muscles is also lighter (page 57) than in the bull; the development of the fat is always greater, the inguinal canal is closed and the scrotal region contains a large quantity of fat (cod fat)

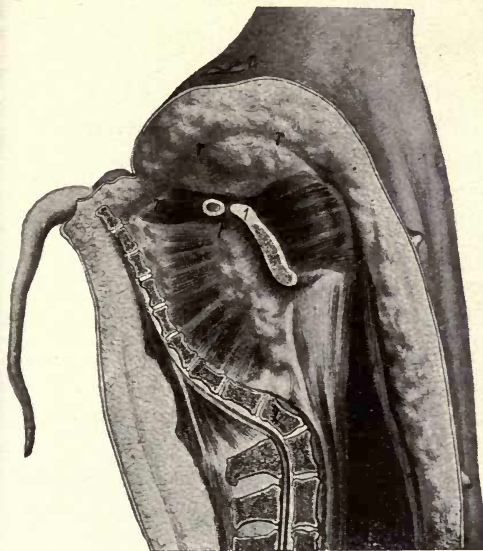


Fig. 55

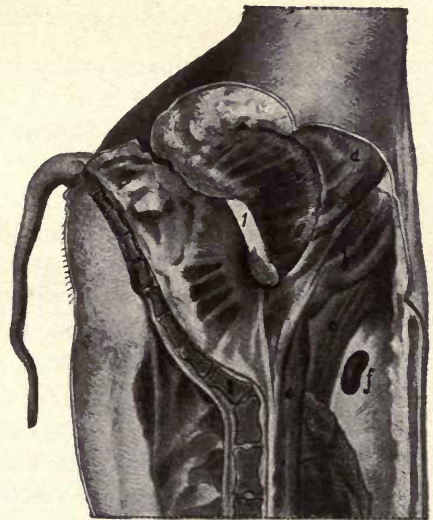


Fig. 56

Fig. 55. Right hind-quarter of a castrated male hog. 1, ischio-pubic symphysis 2, first sacral vertebra; *m*, musc. bulbo-cavernosus enclosing a portion of the corpus cavernosum of the penis; *u*, castration scar; *r*, groove of the penis in the fat tissue.

Fig. 56. Right hind-quarter of a female hog. Here comes into consideration the bean-shaped cross-section of the musc. gracilis laying distally (in the picture above) from the ischio-pubic symphysis.

The cows are characterized by a more slender, finer development of the body; the muscles are not as well developed and their color is lighter (page 57, Fig. 53); the color of the fat is sometimes conspicuously yellow; on the hind quarter the large loose udder is noticeable; after being cut away it leaves a defect in the posterior abdominal region; the cut surface of the gracilis muscle is bean or crescent shaped, and reaches to the ischial notch; the floor of the pelvis appears only slightly angular or arched; the tuberculum pubicum is not well developed (Fig. 54). The

heifers may be distinguished from the cows by their slightly developed milkless udder, which in well fattened animals is considerably intermixed with fat.

2. CALVES

Bull calves are easily recognized by the small testicles, the openings in the inguinal canal, the stump of the penis, etc., and by the ischial notch, while heifer calves are recognized by the presence of the udder as mentioned above.

Calves in the skin. In bull calves the scrotum and the brush (a tuft of long hairs at the orifice of the sheath) are present. In heifer calves the teats, which are present in both sexes, are better developed.

3. SHEEP AND GOATS

The distinguishing of rams from wethers and ewes has to be followed by the same indication as in cattle. In bucks the peculiar sexual odor is conspicuous (Chap. VII, Sect. 1).

4. HOGS

In boars, besides the small quantity of fat deposits there is strikingly noticeable the dark color of the muscles, the thickness of the skin on the neck and shoulders, as well as the strong sexual odor (Chap. VII, 1). If the testicles with the scrotum have been cut out, the large skin defect becomes conspicuous. Besides, the other remaining parts of the penis and the bulbo-cavernosus muscle, the channel of the penis, and the cut surface of the gracilis muscles (Fig. 55) appear in a condition similar to bulls. The opening cut of the abdomen shows in the navel region on both sides, or more to one side a defect as a result of a cutting out of the navel sac. Cryptorchid boars may appear according to the functional ability of the testicles more or less as boars or castrated animals; this also applies to the so-called stags (page 2).

The sexual characteristics of the slaughtered castrated male hogs are in general very much the same as in boars; however, the castration scars (Fig. 55n) are noticeable on the posterior contour of the leg, and also the development of the body resembles very much that of the female hogs.

In female hogs the pelvis appears wider, and the posterior pelvic notch larger than in male animals; the cut surface of the gracilis muscle is bean shaped; on the opening cut of the abdomen the place of the excision of the navel is not present; the development of the udder and teats depends on the number of times the animals have suckled young. In female hogs which have been spayed scars of the operation are visible on the left flank.

5. HORSES

The sex of the dressed horses may be determined by the same characteristics as were described for cattle. In stallions the fat is generally of a lighter color and almost white, in contradistinction to the intensely yellow fat of geldings and mares.

6. Concerning the characteristics of the sexes of slaughtered dogs, nothing particular can be said.

For the judgment of slaughtered animals after inspection is accomplished, the points outlined on page 158 should be considered.

Regarding the stamping of meat after inspection is made, see page 159.

3. Inspection of Imported Meat

(a) *Meat from Foreign Countries*

The inauguration of a general ante-mortem and post-mortem inspection on animals slaughtered within the German Empire makes it naturally essential to subject imported fresh and prepared meats to a careful inspection and strict judgment. For this purpose exact directions were issued in the regulations in connection with the imperial meat-inspection law, which also include the chemical examination of such meat. As the judgment of diseased imported meat sometimes varies from the disposition to be taken of native meat, it is advisable to consider carefully the above-mentioned regulations in every case of condemnation.

The fact that importations into Germany of foreign meat, of contaminated meat, sausages, and other mixtures in air-tight cans or similar containers, have been prohibited since October 1, 1900, was mentioned on page 80.

The relative sizes of imported fresh and prepared pieces of foreign meat were temporarily established up to December 1, 1903, and as there have been no new regulations made to govern these relations, the last established conditions of importations remain in effect until further amendments are issued. The shipment of foreign meats to Germany is limited to certain places of entry, which are named in connection with the inspection stations in the regulations of the Federal Council.

Regarding the designation of imported salted intestines (casings), there are 5 parts distinguished in the intestines of cattle according to Gröning: "Wreath intestines" (small intestines), "cap" (caecum), "butt" (caecum, with the orifice of the ileum and a small portion of the colon), "middle intestines" (colon), and "fat end" (rectum). Every bundle of intestines has, in accordance to its origin from the various countries, a certain length, or it contains a certain number of intestines. A bundle of "wreath" intestines is 24 to 32; a bundle of "middle" intestines is generally 18 m. long. So-called nodular intestines (Chap. VII) [see B. A. I. Order

150, Regulation 13, section 32] are frequently packed separately as inferior in quality. These bundles are longer; and therefore a barrel packed with them contains, as a rule, about 180 bundles, while of the good quality, over 200 bundles are contained in each barrel.

For distinguishing salted horse intestines from cattle intestines, Wentzel points out the following characteristics: The "middle" intestines of cattle run in a straight line, while those of the horse are curved on account of the wall to which the mesentery is attached being shorter than that of the opposite side. Furthermore, the outside surface of the small intestines of the horse (that is, the mucous membrane turned out), cannot be thoroughly and readily separated, as a result of the firmer consistence of the submucosa and the small quantity of fat it contains. Usually on the intestines of the horse larger shreds of the mucous membrane remain attached, which give them a brown appearance. On the small intestines of the horse the place of attachment of the mesentery is conspicuous, but this cannot be noticed on the middle portion of the intestines in cattle. In inflating the small intestines of the horse with air they will arrange themselves in windings, while those of cattle will run straight. If inflated, the walls of the intestines of cattle show an interweaving with fat tissue in all directions, which is absent in the intestines of the horse.

(b) *Domestic Meat*

As a result of uniform regulation of meat-inspection in the entire German Empire, the reinspection of meat shipped from one place to another does not appear any longer necessary as in former times; nevertheless, a control of such introduced meat appears very desirable, especially when the shipments are quite extensive to a certain locality. In order to make this control effective it appears necessary that the meat should originate from regularly inspected food animals, and should comply with all the general requirements which are demanded of marketed meat in the respective localities. Besides, a supervision of shipped meat is also necessary on account of the manifold changes to which it is exposed (putrefaction, spoiling, etc.). The need of inspection for meat shipped to places having public abattoirs and a strict veterinary inspection appears also essential, as otherwise some of the butchers would prefer to slaughter their animals in neighboring towns with less rigid inspection and probably smaller expense. Such procedure would threaten not alone the management of the public abattoirs, but would also considerably diminish their revenues. It was, therefore, determined that the right of the various states in Germany may be further exercised regarding the reinspection of meats shipped to localities in which public abattoirs are maintained and through authorized regulations, such meat would be subject to a compulsory reinspection. An exception was made for the Kingdom of Prussia, by the law of June 28, 1902, in connection with the law of September 23, 1904, whereby the authority of the towns, even if they had public abattoirs, was revoked, so that meat shipped to such localities and which was officially inspected by a veterinarian, need not be subjected to a compulsory reinspection. [See B. A. I. Order 150, Regulation 19, section 1-5.]

In localities to which extensive shipping of meat takes place the establishment of an inspection office appears very essential, the equipment of which should contain everything necessary for a thorough expert inspection of the meat (arrangement for hanging up the meat, inspection tables, good light, microscope, and reagents, stamping apparatus, etc.). Only veterinarians should be employed as experts in such offices, and the time for inspection should be as much as possible restricted to those hours having sufficient daylight, in case there is not a very good artificial light present (electric light, glowing gas light, acetylene light). Where only an inconsiderable quantity of fresh meat is shipped in, it may be inspected on the premises of the consignee, or may be directly brought to the inspector, who, however, should be in all cases a veterinarian. The inspection of prepared meat (meat products) for which there can be no cessation recognized within the Empire, may be undertaken under the same condition by lay meat inspectors.

Regarding the procedure of the inspection of the fresh and prepared meats shipped in from other localities, the directions concerning the technical relations of the veterinary inspection of meat imported from foreign countries may serve as guidance.

Should a chemical examination of such meat be necessary, the directions for the chemical examination of meats and fats give the necessary fundamental information.

An examination for trichina, where such is maintained, should always be undertaken on pork shipped from other localities, if the meat originates from localities which do not conduct regulated trichina examinations; or if the pieces of pork or carcasses are not marked or otherwise designated that the respective animals were examined by an authorized trichina examiner and found free of that affection. The procedure of trichina examination may be carried out in accordance with the directions for the examination of meat for trichina and measles, as given in the regulations to the meat-inspection law.

The judging of imported foreign meat has to be carried out in accordance with the regulations to the meat-inspection law. For native meat such regulations are authorized which exist at the place to which the meat is destined in connection with the state police instructions for those places.

4. Inspection for Trichina

Trichinosis in hogs and dogs, described in Chap. VII, Sect. 5, requires a microscopical examination of the muscles of these animals for the determination of the presence of trichina.

The authorized regulation of this examination—the trichina inspection—is, according to the imperial meat-inspection law, left to the state governments. It has already been made obligatory and inaugurated in North Germany, through state government police regulations; while in states of South Germany it is carried out only exceptionally, and almost exclusively in some of the larger cities.

[Formerly in the United States trichina inspection was maintained only for export pork. This, however, has also been abandoned, as it was found that some of the foreign governments were not giving any attention to our certificates. Quite adequate reasons for not maintaining a trichina examination in the United States are described by Dr. A. D. Melvin in his work on the "Federal Meat Inspection Service" (B. A. I. Circular 125, page 35), which is quoted in the following:

"While the Federal meat inspection in this country is as thorough as a comprehensive law, stringent regulations, and a liberal appropriation of money can make it, and the consumer of meats bearing the stamp "U. S. Inspected and Passed" may in general have the comfortable assurance that he is buying and eating products from healthy animals prepared under clean and sanitary conditions, and the danger of contracting disease from eating these meats is practically eliminated, yet the fact should not be overlooked that there is one disease against which the meat inspection legend does not pretend to be a safeguard. For the detection of most of the diseases affecting meat the human eye needs no assistance. The disease called trichinosis, however, to which hogs are subject, is caused by a parasite so small that the microscope must be employed to detect it. Thorough curing or thorough cooking of the meat kills this parasite. It seems, however, that some European peoples have a habit of eating raw or half-raw pork, and consequently they have suffered from this disease. Very elaborate measures have been taken in some countries to do away with or to lessen the danger. In Germany, for instance, there is an army of inspectors who use the microscope to detect these parasites in pork. These countries some years ago forbade the importation of American pork products unless they had been microscopically inspected. To meet this requirement the Bureau instituted several years ago a system of microscopic inspection of pork intended for shipment to such countries. No microscopic inspection of pork intended for home consumption, however, has ever been made or even contemplated. The Department takes the ground that from the nature of the disease an examination of certain parts of a hog carcass can only minimize and not eliminate the danger.

The parasites, it is true, are usually found, if found at all, in certain parts, as the pillar of the diaphragm, the psoas muscle, the inner aspect of the shoulder, or the base of the tongue. Not finding them in these parts by the usual methods, it may be assumed to be probable that they do not exist in the remainder of the carcass. This is, however, only a probability, as they may exist, and even to such an extent as to produce disease if the flesh is eaten raw. Many cases are on record where twenty, even thirty, examinations were made before trichinæ were found; and out of 6,329 cases of trichinosis in Germany, between 1881 and 1898, a careful inquiry traced 2,042 cases (over 32 per cent) to meat which had been microscopically examined and passed as free from trichinæ. In view of these facts the Department has regarded it as utterly impracticable to inspect hog carcasses for this disease. It has further taken the view that such inspection—which as formerly carried on for exported products would cost about \$3,700,000 a year if all hogs killed at inspected

houses were so examined—would do more harm than good. It would create in the minds of the consumers a feeling of false security, which might lead them to omit the only sure means of escaping danger, namely, to refrain from eating uncooked or uncured pork; and it would thus defeat its very purpose and render the great trouble and expense worse than useless.”]

Trichina Inspection Association.—To facilitate the meat traffic between the governments of Prussia (with the exception of the Hohenzollern country), an agreement was accepted that all meat from hogs which originate inside of the territories

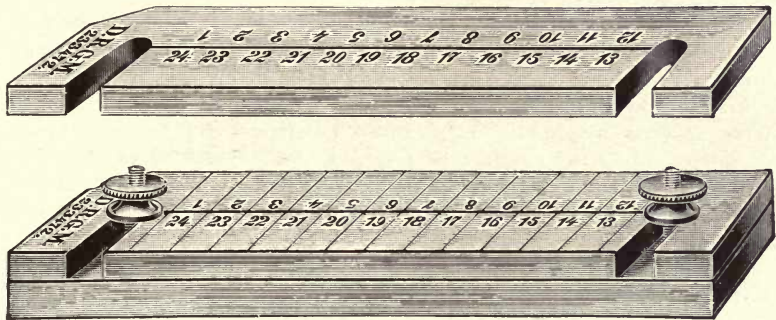


Fig. 57. Compressor, the upper plate of which may be drawn out. Hauptner-Berlin

of the participating states, and which is shipped from one of these states, is considered as inspected for trichinae, as the requirements for inspection is in all of these states based on practically the same foundation.

The execution of trichina inspection on fresh or prepared meats, may be assigned to special trichina examiners, and should be carried out in accordance with the above-mentioned directions of the law. Outside the public abattoirs it is desirable to have the meat and trichina inspection in hogs performed by one and the same person in order that one or the other inspection should not be omitted.



Fig. 58. American compressor (closed)

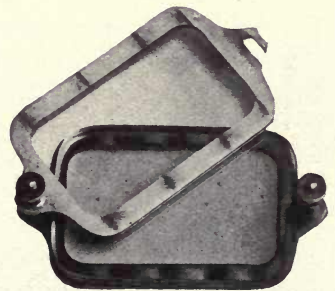


Fig. 59. American compressor (opened)

Regarding the details to be considered in the inspection, it may be referred to the authorized directions as well as to the numerous special publications on trichina inspection.¹

¹ For instance: Johne—*The Trichina Examiner*, 9th edition, Berlin, 1904; Long-Preusse—*Practical Guide for the Trichina Inspection*, 6th edition, Berlin, 1905, and others.

Of the now generally adopted compressors which are used at present in preparing squeeze preparations, Fig. 57 represents an illustration of a compressor divided into 24 parts and which is now generally used; while Figs. 58 and 59 represent a very practical American compressor which does not possess a division into fields, and which is represented in an open and closed condition.

For an easy performance of the microscopical examination of prepared squeeze preparations for trichinæ, there are numerous so-called trichina-microscopes constructed. Projection apparatuses are also employed in larger abattoirs as well as inspection bureaus under the designation of trichina scopes, which serve for a quick purely mechanical search of the preparations. Regarding the importance and execution of these projection trichina inspections, the reader is referred to the publications of Kohler, Bockelmann, Schüller, in the "Zeitschrift für Fleisch-und Milch-hygiene."

That the taking of samples of meat required for the examination of trichinæ should be undertaken by special sample takers is apparent from the official directions. These sample takers, who cannot be dispensed with in the larger abattoirs, must possess the same qualifications as the trichina examiners. The latter, but especially the sample takers, should be required to perform the examination of these samples for measles.

The judging of the results of the examination for trichinæ and measles should not be trusted to the trichina examiners, but it is necessary that they be reexamined by veterinary inspectors. Regarding the disposition of meat found to be infested with trichinæ or measles, see the regulations to the imperial meat-inspection law, as well as Chap. VII, section 5. [See B. A. I. Order 150, Regulation 13, section 17, page 1.]

The samples of muscles which are cut out for the preparations of the slides cannot be considered as unobjectionable food after they have been so used, and they should therefore be treated as meat of inferior quality, which, at larger places, is best utilized in the Freibanks.

5. Legal Means of Redress and Complaints in the Execution of Meat Inspection

Against the decisions of the inspector and the police authorities in matters pertaining to food animal and meat inspection, the owners must be granted an appeal to higher authority. Accordingly in the regulations to the meat-inspection law it is precisely determined regarding the complaints to be made and the legal means of redress by the state governments, which should issue measures that in cases of appeals from the condemnation of an inspector who was not educated as a veterinarian, the opinion of a graduated veterinarian must be required, and in case of condemnations by a veterinarian at least the opinion of one suitable expert must be taken into consideration. As such experts may be considered in a country or in abattoirs which have only one veterinarian, the official veterinarians (district, country, chief bureau veterinarians), while in the larger abattoirs a chief veterinarian or the director of the abattoir constitutes the expert. This should constitute the last instance for appeal, as the appealing to a still higher authority would not correspond to the value of the object, which is also subject to spoiling, and besides the lesions are readily obliterated. [See B. A. I. Order 150, Regulation 28, section 1.]

The time limit for the institution of a complaint should not extend over two hours after the decision of the respective opinion was tendered, owing to the above-mentioned reasons.

The cost incurred by the procedure made necessary by the complaint should be borne by the owner if the opinion of the first inspector is confirmed, while if it is reversed the cost must be paid by the treasury of the respective community. Only by such a procedure and by appropriately high expenses can constant appealing be prevented.

6. Bookkeeping and Certifications of Findings

The necessary bookkeeping required in connection with meat inspection is carried out in accordance with the extent of the inspection and the nature of other local conditions.

Nevertheless, it is required to keep a diary-inspection book for the ante-mortem and post-mortem inspection.

By the resolutions of the Federal Council of May 28, 1903, and May 5, 1904, authority was granted to the state governments to adopt a simplification of the daily bookkeeping in the public abattoirs to such an extent that animals passed on inspection may be entered in a summary; also that the entering of the time of registration, the time of the ante-mortem and post-mortem inspection may be omitted, as well as the condemnation of single parts, when they result from the same cause. The respective animals may be daily entered combined, but must be kept separated according to species. In other cases the designation of further distinguishing signs with the kind and sex of the animals in column 2 of the diary may be omitted. [See B. A. I. Order 150, Regulation 27, sections 1-2.]

At the inspection stations for foreign meats the bookkeeping of meat inspection must be carried out in accordance with the regulations.

If requested the inspector must make out a special certificate (certification of the findings) on the results of the inspection of an animal, for which certain forms are adopted. Regarding the issuance of such certificates of inspected foreign meats, the imperial regulations have no specifications.

7. Statistics of Ante-mortem and Post-mortem Inspection

In order to utilize the results of the inspection, the Federal Council passed resolutions on June 1, 1904, which requires a report from the inspectors on the statistical compilation. According to this the inspectors are directed to prepare for every quarter of the calendar year authentic information (slaughter statistics) of the inspected animals, which should be prepared on a specially printed form, and which is to be transmitted until an established date to the places determined by the state governments. Besides there are also to be submitted annual statistical com-

pilations on the results of the ante-mortem and post-mortem inspection on specially prepared forms, whereby the veterinary and nonveterinary inspectors have to use different forms, which are adapted to the differing duties of these experts. The inspection stations for foreign meat have also to report annually the results of the inspection, and there also have to be prepared until further orders in the abattoirs the findings of tuberculosis in the slaughtered animals, compiled in an annual statistical report.

Regarding the details to be considered by the inspectors in the preparation of the statistics, it must be referred to the special regulations of the various state governments.

The slaughter statistics were prepared for the first time for the 3d quarter of 1904, and the results of the annual inspection were reported for the first time for the year 1904. The compiling of the entire statistical material is carried out by the Imperial Health Department, which also publishes it.

8. Dues for the Ante-mortem and Post-mortem Inspection

For the practice of ante-mortem and post-mortem inspection the experts are allowed a compensation, which is designated as "slaughter dues." The amount is regulated for the inspection of foreign meats by the Federal Council; for all other inspections it is left to the state governments. The amount of the dues should be such, that while it should not be an unreasonable burden for the slaughterer, yet it ought to assure the expert an adequate pay.

An underbidding of the authoritatively adjusted fees by the experts should be condemned and should be severely punished.

The collection of the inspection dues in abattoirs and in places which have special inspection offices (page 156) established for ambulatory inspection, is made through the respective treasuries, or also through the local police authorities; otherwise the fees are, as a rule, directly paid to the inspector. The latter should be restricted as much as possible by the police in consideration of the authority of the inspector as an expert, and by not having to accept his dues directly from the owner it would make the inspector more or less independent of the public. Therefore, it is best for the police authorities, as well as for the inspectors, if the latter are appointed with a fixed salary and the dues for the inspection are collected by the authorities. This must also be followed when the payment of the inspection dues to the inspector is not made.

The dues are also to be payable in cases where the inspector was called, but was unable to perform the duties through no neglect of his.

9. Supervision of the Ante-mortem and Post-mortem Inspection

That the entire system of meat inspection must be placed under supervision, and under a supreme direction of a central office, does not require any further reasoning. According to the regulations the state gov-

ernments are directed to issue suitable regulations to such an extent that a revision should be made of every inspection district at least every two years. In most instances it is best to assign this work to official veterinarians, while the central direction of the office should rest in the hands of higher state veterinarians (state department, district veterinarians).

10. Freibank

By the term Freibank is understood a place (shop) for the selling of meat of inferior quality, not first-class, marketable meat (page 162). The term "bank," in its present application, originates from the old designation of the meat-selling places as "meat banks." At the places so designated, only such meat was sold which possessed all the requirements, and, therefore, it was accepted as "marketable" (suitable for market shop clean, meat of full value). All other meat, which was yet salable, was designated as not marketable (not suitable for market, not shop clean, inferior quality, deficient), and its sale was restricted to a special bank (Freibank), located apart from the other meat shops. At present the Freibank is an indispensable establishment for the meat inspection, the necessity for which need not be further discussed here. The legal permission of the Freibanks was established by the food law of May 14, 1879, and in the regulations based on the same, in the imperial meat-inspection law of June 3, 1900, and also the adopted state legislative as well as the local statutory directions.

The principle of the modern Freibank and of other similar establishments is the selling under declaration—namely, by stating the cause which makes the meat otherwise unmarketable. As a consequence of the "non-marketable" condition of the meat the price of the meat is, as a rule, lower than that of marketable meat. This is, however, not absolutely necessary, and depends on the local conditions of the meat trade. The adjusting of the price of the meat ought to be left to the owners, as an official fixing of the price is not permissible legally. In case the compulsory declaration cannot be sufficiently carried out, meat which is "non-marketable" must be excluded for further trade purposes. Therefore the purchase of such non-marketable meat and its utilization by butchers, manufacturers of meat products, hotel and restaurant and boarding-house keepers, are inadmissible and punishable. In connection with this are carried out the customary limitation of the sale of meat to small quantities in the Freibanks, and the official supervision of the entire Freibank management, which is accomplished in the simplest way and most successfully in places, where only authoritatively appointed, sufficiently compensated, and otherwise independent persons are employed. A supervision of the Freibanks, if possible, by veterinarians, or at least by non-veterinary inspectors, is necessary under all conditions.

The operation of the Freibanks may be advantageously united with the equipments for safe keeping, for boiling and pickling, as well as for the rendering of fat. The location of Freibanks in places which have abattoirs is best established on the premises, as by such arrangements their operation is the simplest and cheapest. For large cities with abattoirs one Freibank only would not prove sufficient, but it would be necessary to establish inside the city limit one or more additional Freibanks. Furthermore, and this applies also to localities without abattoirs, such places should be selected which are inhabited principally by the laboring class, and also not in the immediate vicinity of a regular butcher shop.

Recently it was recommended to establish ambulatory Freibanks also, and special wagons were constructed for this purpose.

For the maintenance of the Freibank the authorities may levy appropriate dues, and the expenses may also be covered by the receipts from the sales.

Similar to a Freibank is to be considered the sale of meat under police supervision which may occur at any place where the meat was declared inferior in quality. This disposition of the non-marketable meat proves very suitable, especially for smaller towns which cannot afford to maintain a permanently equipped Freibank.

Under certain conditions such meat may be immediately disposed of on the premises of the butcher. For readily conceivable reasons it is natural that supervision by the authorities must be especially strict, otherwise all other requirements which constitute the principles of the sales on the Freibank must be carried out.

[The establishment of the Freibanks in various countries of Europe has proven a great success. The strict official supervision of them assures the poor classes a wholesome, palatable, and yet inexpensive meat. Such meat thus advantageously utilized in the Freibanks would otherwise have to be condemned and only its value in by-products would come into consideration, hence the economic importance of this system can be readily recognized.

The establishment of the Freibank in the United States, making a three-class meat system, would afford the same advantages that obtain in the countries where it is now in operation. The system would not create any prejudice amongst that class of people who would patronize it, as there are at the present time a large number of families in this country who have emigrated from the countries where the Freibank system has been in existence for many years, and therefore they are thoroughly familiar with this institution, and would gladly take advantage of the opportunities afforded thereby.

Besides the above-mentioned advantages to be gained from the Freibank, there is one which would have a far-reaching effect toward the eradication of tuberculosis. By the establishment of the Freibank a large percentage of carcasses which are under the present system of meat inspection condemned for tuberculosis would be passed for the Freibank,¹

¹ For detailed information on this subject the reader is referred to Dr. Ch. W. Stiles' work on "The Three-Class (Freibank) Meat System as an Aid in Eradicating Tuberculosis." *Jour. of the American Medical Association*, Nov. 2, 1907, p. 1483.

which would greatly diminish the losses to the stock-raiser, shipper, and packer, and hence the existing feeling of the stock-owners toward the application of the tuberculin test to their herds would be beneficially influenced in that a greater compensation would be obtained for their tuberculous cattle.]

B. Performance of the Ante-mortem and Post-mortem Inspection in the Stock Yards and Abattoirs

Although the purpose of the public abattoirs and stock yards (Chap. XII) is primarily to centralize at one point all the slaughtering of a community, they are of greater importance in the performance of meat inspection because of the inauguration of compulsory slaughter therein. In the public stock yards and abattoirs the inspection of animals, both alive and after slaughter, is not restricted to the animals brought there, but the meat which is shipped from outside into such a community is also inspected. In very large cities, however, it is sometimes necessary to establish special inspection stations inside of the city for the inspection of meat or carcasses which are brought or shipped into the city. In the abattoirs the meat-inspection authorities are in charge of the further disposition of the condemned meat (page 170), the sale of inferior or impaired meat, etc.

In the extensive and varied inspection service in stock yards and abattoirs it is natural that this work can be only carried out in a complete manner by veterinarians. And as they may, at the same time, manage the establishment, conduct the affairs of the food-animal insurance, etc., a requirement to have only veterinarians assigned to the management of public abattoirs would not be unjust. Besides the veterinary director it requires also the services of special veterinarians to carry out the inspection in larger abattoirs, which fact does not need to be further discussed. The performance of certain work in connection with meat inspection may be assigned in stock yards and abattoirs to non-veterinary inspectors or to other appointed experts (trichina examiners), under veterinary supervision and responsibility; however, this should be followed only when it is absolutely necessary. The employment of lay inspectors exclusively for meat-inspection work in stock yards and abattoirs cannot be approved. When lay inspectors are substituted for veterinary experts the arrangement should be such that the inspection should be regularly performed during the prescribed hours. The ante-mortem and post-mortem inspection in stock yards and abattoirs, finally necessitates a personnel for the supervision of the order and the operation of the abattoirs, as well as skilled and conscientious assistants for the discharge of incidental labor and duties in connection with the meat-inspection service.

In large abattoirs the time for inspection extends, as a rule, to all hours of the day, and in several places it is even continued during the night. In small and medium-sized abattoirs it is reasonable to limit the service of inspection to certain hours, adapted to local necessities.

C. The Ambulatory Ante-mortem and Post-mortem Inspection

In all places which do not possess stock yards and abattoirs, meat inspection must be performed on the premises of the slaughtering party, which naturally is far more troublesome, more difficult, and not as thorough as the inspection in public abattoirs. Where the size of the place and other conditions permit, the inspection should be preferably performed by veterinarians, and only in case they cannot be obtained should non-veterinary inspectors be called upon to perform the inspection. The latter will probably never be dispensed with in small towns and in localities which are thinly populated. In ambulatory meat inspection it is always necessary to form inspection districts, which assure the appointed meat inspectors suitable and exclusive spheres of activity. In those localities in which the inspection cannot be performed by an individual expert, inspection stations are frequently established in which the inspections to be made are reported, and the dues paid. Here is also inspected the meat brought or shipped into that locality, and all matters affecting food animals and meat inspection are regulated therein.

Regarding the time of inspection, the distance to be covered by the inspector should always be considered and sufficient notice should be given in order that the inspector may regulate his activity accordingly. If, as in hogs, the post-mortem inspection and examination for trichinæ are not carried out by one and the same inspector, care should be taken that neither of the inspections should remain unperformed.

D. Extraordinary Meat Inspection

By this term is understood special examinations which the experts of meat inspection have to carry out either alone or accompanied by the police authorities, not only of slaughtering places, but also the premises for storing, preparing, and marketing meat. Although veterinary inspectors should always pay attention to the conditions and circumstances of the industrial premises which they may enter in the execution of their office, yet unexpected special examinations must not be dispensed with. In order that any possible objections to these examinations could be met, it is advisable that extraordinary meat inspection should be considered in the local statutory regulations in connection with the general meat inspection. [See B. A. I. Order 150, Regulation 6, section 21.]

This form of inspection should be extended to :

1. Proper condition and equipment of all the rooms used in connection with the operation of the butcher shop, sausage making or preparations of meat products ;
2. Cleanliness of the plants ;
3. The presence of uninspected meat, or
4. Tainted meat ;
5. The use of prohibited preservatives and conserving substances ;
6. Consideration of contingent, special regulations for the meat brought in ;
7. Proper condition of the books pertaining to slaughter, and the meat.

Not too long an interval should elapse between the examinations, and they should be undertaken very frequently during the warmer season.

Such examinations may also extend to the stores which market game, fowl, fish, or products prepared from them, even if these food substances in themselves are not subject to a compulsory inspection.

According to an order of the Royal Bavarian Ministry of the Interior of November 21, 1906, the district veterinarians are directed to spend annually five business days in the controlling of the butcheries, sausage manufactories, meat stores and similar establishments.

This control has to be carried out in accordance with the measures of the prevailing regulations. At the same time it is especially essential to advise the proprietors of the establishments regarding suitable equipment and caretaking of the work and sales rooms, and concerning their proper management.

In Prussia similar regulations exist only in several of the government districts.

For the Kingdom of Saxony there exists an order that the inspectors must report to the police authorities all offenses or irregularities which they may observe in slaughtering or meat-storing establishments, etc.

VI. Decisions of the Veterinary Inspectors and Disposition of the Condemned Meat

All decisions of the veterinary inspectors are based not only upon the imperial meat-inspection law and regulations issued in connection therewith, but also on the state and local police orders which may be authoritatively passed. As the authority for such decisions as the non-veterinary inspectors may make is subject to veterinary supervision, the following representations apply only to the veterinary inspection force:

1. Ante-mortem Inspections

The decision of the inspector may determine the following:

(a) Prohibition of slaughter when the animals show the presence of anthrax, blackleg, rinderpest, rabies, glanders, hemorrhagic septicemia, or if there is a suspicion of any of these enumerated infections.

(b) Deferring the slaughter of the animals which are exhausted or overheated through transportation, and of those calves which are apparently immature. While there are no legislative measures in the regulations for these, such an order is justified from the technical standpoints: besides it is also in the interest of the owners of the animals.

(c) Authorization of slaughter in all other cases.

2. Inspection of the Slaughtered Animals

After the conclusion of the inspection of the slaughtered animal the decision of the inspector may be as follows:

(a) The meat, including the entire carcass (meat with bones, fat, viscera, and all other parts which may be utilized for human food, the skin as well as the blood), is passed for consumption (marketable).

(b) The meat is passed for consumption (marketable) after the removal and condemnation of certain affected parts.

Under this decision is also classified the meat of the so-called "one measles cattle," which after storage for 21 days in cooling or refrigeration room may be passed for consumption without restrictions.

(c) The meat is passed for consumption, but is considerably diminished in its nutritive value (non-marketable, inferior quality), whereby, as a rule, several diseased viscera or more extensive parts of the carcass are removed and condemned.

(d) The fat is passed without restrictions, while the meat is either condemned, conditionally passed, or passed without restriction.

In this group should also be classified the unaffected viscera of measly animals, the meat of which should be either condemned, conditionally passed, of inferior quality, or passed without any restrictions.

(e) Individual quarters are conditionally passed (non-marketable, with subjection to special treatment), or condemned while the other parts are passed (marketable) or sold as of inferior quality after the removal of certain altered organs and parts.

(f) The entire carcass is conditionally passed (non-marketable, with subjection to a special treatment), with the exception of the parts which might have to be condemned.

(g) The fat of the animal is conditionally passed (non-marketable, with subjection to a special treatment), and the other meat including the viscera, is condemned.

(h) The entire carcass is condemned for human consumption.

[While in Germany, as the result of the post-mortem examination, any one of the above-described actions may be taken with the carcass, in the United States only two methods of procedure are followed. The carcasses are either passed for consumption or they are condemned for the

offal tank. Those of the first group are either passed in their entirety or they are passed only for the preparation of lard, in which case the meat cannot be utilized in any form. For instance, in slight lesions of tuberculosis, governed by B. A. I. Order 150, Regulation 13, section 13, rule D. or mild cases of hog cholera and swine plague, Regulation 13, section 10, paragraph 3, or in localized affections, such as bruised parts, fractures, limited lesions in one of the viscera, etc., only the affected parts are condemned, while the carcass may be passed for lard.]

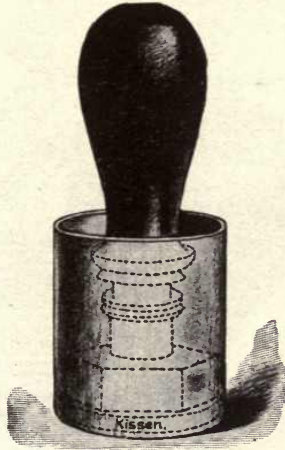


Fig. 60. Jar stamp

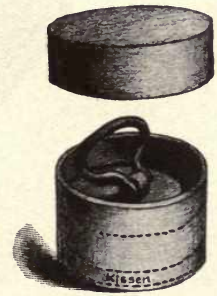


Fig. 61. Box stamp

A. Marking of Meat

The inspected meat should be stamped without delay. [See B. A. I. Order 150, Regulation 17, section 5.] For this marking the ink stamps, which may be cut out of metal and variously constructed, seem to

serve best. Rubber stamps cannot be recommended on account of their lesser durability. For convenient transportation, the box stamp illustrated in Fig. 61 is very well adapted, while for the great amount of stamping in abattoirs and inspection offices a box stamp similar to that of Fig. 60 may be advantageously employed.

For ambulatory meat inspection may be recommended the Garth-Muto stamp, illustrated in Fig. 62, which contains all the necessary forms of stamps conveniently in a case. The stamp consists of a steel handle

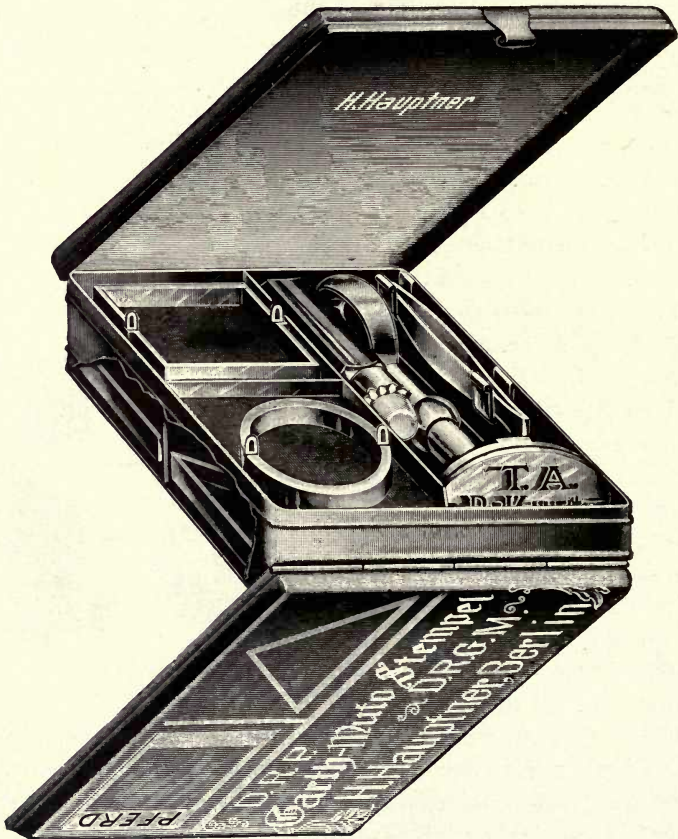


Fig. 62. Garth-Muto stamping outfit (Hauptner-Berlin)

containing a spring, a sliding ring, and five separate steel frames, which can be easily connected or detached from the handle by slight pressure and sliding the ring on the shank of the handle. The case contains besides the stamps a small bottle of stamping ink, a pad, and forceps. Other kinds of stamp constructions were devised by Garth, Liebe, Kühnau, Holländer, Gröning, and others.

As stamping ink for marking of meat of native slaughtered animals there has been prescribed a blue ink which must be harmless, stable, must stick easily, and dry quickly. It should also penetrate into the superficial layers of the meat, and the impressions should not disappear after pickling or smoking.

Branding irons of suitable construction are used for marking and may be heated in charcoal fire, gas flames (bunsen burner), alcohol or benzin apparatuses. The construction of a benzin branding stamp, which the author had constructed from a benzin soldering iron, is illustrated and described under Fig. 63. This simple and cheap stamping apparatus can

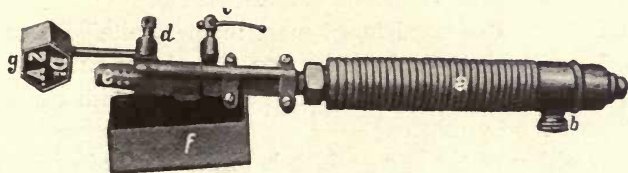


Fig. 63. Benzin branding stamp. a, benzin container, one end of which is closed by a cap screwed on, but to which may be attached a small pumping arrangement for increasing the pressure in the benzin container; b, opening for filling; c, screw for the regulation of the flow of the benzin vapors; d, fastening screw for the stamp; e, heating pipe; f, iron box, which, filled with alcohol, serves for the heating of the apparatus in order to develop the benzin vapors; g, stamp.

be highly recommended, and the burning of the meat with the benzin flame which streams out from the heating tube, thereby heating constantly the stamp, is not to be feared. For the quick heating of several branding stamps the large benzin heating apparatus of the firm of Hauptner, Berlin, illustrated on page 12, may be highly recommended.

[B. A. I. Order 150, Regulation 17, sections 1-11, describes in detail the procedure of marking all of the meat whether passed, retained, or condemned. Doctor Melvin is quoted on this subject as follows:

“The marking is done by means of a metal or rubber stamp and a purple indelible ink, and the words thus stamped are “U. S. Inspected and Passed,” or an abbreviation of these words, with the establishment number. The number is one assigned to the house by the Department at the time inspection is begun. It is registered in the Department records, and besides serving as a convenient means of reference, it provides a sure method of tracing meat about which questions may subsequently arise.

This mark is absolutely necessary under the law to procure the movement of the meats between States. The law forbids carriers to transport from one State to another any meats that are not so marked, except the meats of farmers and of retail butchers and dealers. It may as well be repeated here, in order to emphasize the statement, that the Federal law does not and cannot forbid the carriage of unmarked meats inside a State, so that in the absence of State laws the carriers may, unmolested, carry any kinds of meat from one part of a State to another.”]

B. Disposition of Condemned Meat

If a condemnation is to be made in accordance with the enumerated decisions of paragraphs b-h, of page 158, the inspector should temporarily seize the affected parts or the entire carcass and notify the owner immediately, as well as the police authorities, stating also the cause of the condemnation. The police authorities have to determine the further disposition of the condemned meat, and notify the owner immediately of the course taken.

The details of the method have been determined by the individual state governments, thereby greatly facilitating the work of the inspector after their notification of the police authorities, etc.

[The disposition of condemned meat in the United States is carried out in accordance with B. A. I. Order 150, Regulations 14-16, which contain the instructions as to the course to be followed with condemned carcasses and meat-food products.]

The disposition of the meat which is to be declared of inferior value (non-marketable) and which was described on page 158, under 2c, belongs to the authority of the inspector, providing there are no other provisions made by special state regulations.

1. Meat Passed with Restrictions (passed conditionally)

There are five methods employed to remove the injurious properties of meat belonging to this group: Boiling, steaming in steam boiling apparatus, rendering, pickling, and refrigerating.

(a) The boiling method is well adapted for the destruction of all animal parasites occurring in meat and also of the vegetative forms of the infectious disease-producers, which the meat may contain. For the killing of spores, on the other hand, simple boiling is not sufficiently certain, and for chemical poisons it is, as a rule, entirely ineffective. The satisfactory boiling of meat can be easily recognized by the appearance of a gray or white coloration of the meat, which should affect even the deepest layers.

The simple boiling in open boilers can be easily carried out everywhere, but it has the disadvantage that in the process a comparatively large quantity of the soluble nutritive substances are extracted from the meat.

(b) Steaming of meat, in a steam boiling apparatus, is an innovation due to the united efforts of Hertwig, Duncker, and Rohrbeck, in Berlin, and which has been further improved by numerous veterinarians and technical men. This method has for its purpose to obtain a high temperature in the inside of the affected meat, which is infected with certain diseases, through the application of steam under pressure, thereby rendering

larger quantities of meat suitable for human food with as slight influence as possible on its nutritive value. The apparatus which served at first for this purpose, and which was also installed in numerous abattoirs, is Rohrbeck's steam disinfector. It was originally destined for the disinfection of clothes, but has been equipped for the sterilization of meat.

In the course of years various other steam boiling apparatuses were constructed which gradually forced the Rohrbeck apparatus to the background. Concerning the advantages and disadvantages of these disinfectors, as well as regarding steam boiling itself, time has developed much

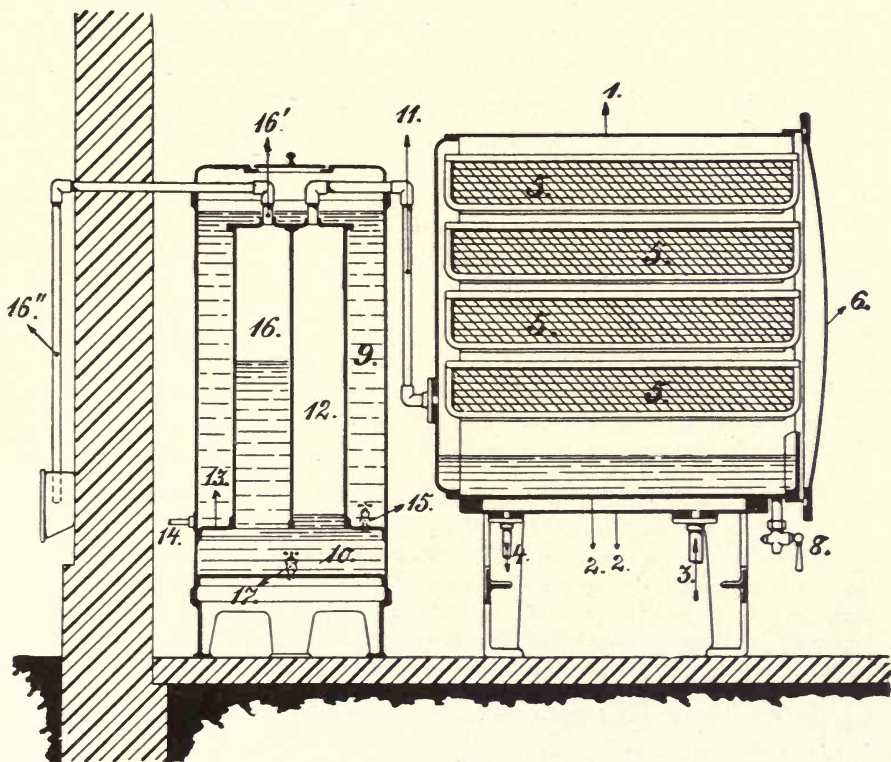


Fig. 64. Meat steamer, according to Engineer Hönnicke in Berlin-Schöneberg. Vertical section.

special literature. At present the following are of foremost interest: Hönnicke's meat steamer and the meat steamer of the firm of Rud. H. Hartmann, of Berlin.

Hönnicke's meat steamer is represented in cross-section in Fig. 64.

The sterilizer proper consists of the body (1) which, on its lower side, is equipped with a double bottom. On this steam double bottom the water for the production of the sterilizing steam is located. A pipe (3) which contains a conveniently placed stop-valve, conducts the steam from the boiler to the double bottom,

which heats the water contained therein. The condensed water which is formed by the heating or boiler steam is drawn off by a pipe (4) into a conveniently located condensed water receiver. The containers or baskets (5) receive the meat. The movable door (6), which is attached to side hinges, is closed hermetically with the aid of clamp screws. In order to draw off the broth conveniently a stop cock (8) is supplied.

At the side of the sterilizer proper stands the condensor, which is connected with the first by a pipe 11, which draws off air, the mixture of steam and air, and steam from the body 1. The pipe opens into a chamber 12 above the bottom 13. The chamber 9 is protected above from the falling dirt by a loose cover. It receives a connection (14) for the supply of fresh water and a tap cock (15) for drawing off hot water. To the lower chamber 10 another chamber 16 is connected, which, through the pipes 16', 16'', connects with the outside. An emptying cock (17) serves for drawing off the condensed water. In the operation of the apparatus the meat is placed into the baskets, the double bottom is filled with water, and the chamber 9 of the condensor is filled with fresh water; chamber 10 must be empty at the commencement of the operation. After this has been completed the door 6 is closed, and the steam valve in pipe 3 is opened, when the apparatus may be left alone. There is no air cock present. At the commencement of the heating of the water to 100° C., before the formation of steam, the air volume is warmed to a certain extent, and expands correspondingly. At this time some of the air has already entered the chambers 11, 12, 10, and 16 from the body 1. At the commencement of the steam formation a steam-air mixture develops, which also reaches the chambers 12 and 10, through the pipe 11, in the proportion of the displacement to which it is subjected by the newly formed steam, to the extent of the heat not absorbed by the meat. From this steam-air mixture the steam contents is now condensed in the chambers 12 and 10, and the air leaves through the pipe 16, while the condensed water accumulates on the bottom of chamber 16. There it gradually rises higher, until it finally closes the lower mouth of chamber 16. The location of this mouth is placed at a selected point so that at the time it gets closed all the air has certainly disappeared from body 1. After the closing of chamber 16, by the condensation, the development of pressure commences, that is, the steam pressure in the sterilizer begins to rise. The maximal height of the pressure may be established by the height of pipe 16. This may be extended as high as it is desired. After the closing of the lower mouth of chamber 16, the water of condensation rises under the expansion which exists in body 1, and effects a counter pressure against the present steam pressure. At a corresponding height the pipe 16 is led either directly to the outside or into the canalization. If the pressure in body 1 should reach such a height that the water in pipe 16 would exceed the highest point, it would then overflow. But this is in practice prevented by other arrangements.

One of these arrangements has already been mentioned in discussing the abstraction of air: the steam condensor. The surplus of steam, which on account of its pressure aims toward the exit of chamber 16 which is closed by water, must pass the cool surfaces of the condensor formed by the chamber 12 and the bottom 13. As soon as the steam from the body passes in here the cool surfaces abstract from the steam a part of its temperature and expansion, with its resulting action on the column of water is diminished and the expelling of water therefore is checked. It should be remembered that at the same time the meat contained in the apparatus continually abstracts heat from the sterilizing steam so that only a small fraction of the steam produced in the double bottom comes into consideration in the con-

densor. To the same extent as the taking up of heat by the meat is reduced, the dropping of juice from the meat into the fluid of the double bottom is likewise reduced. The results of both conditions are that the fluid of the double bottom—that is on the heating surface—gradually becomes poorer in water; on the other hand it becomes continually richer in constituents, among which fat is the most difficult to heat. This increasing concentration of the broth stands in direct opposite relation to the quality of heat absorption of the meat. The consequence of this is that steam production and the quality of heat absorption become proportional to each other, as the steam production diminishes with the loss of water in the broth. Therefore the last described procedure prevents exceeding the desired highest expansion. Hönnicke's meat steamer is also advertised as an apparatus equipped with direct heating arrangements.

The construction of Hartmann's new meat steamer, Franke's system, is

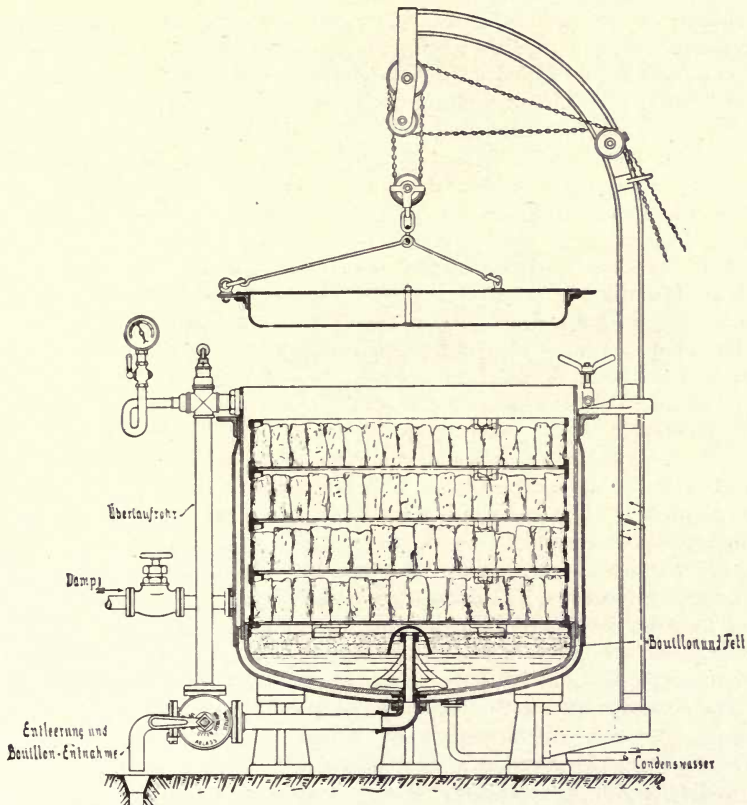


Fig. 65. Hartmann's meat steamer, system Franke, in vertical section

illustrated in Fig. 65. The fundamental idea on which the construction is based, which originated with the deceased veterinarian M. Franke, of the Berlin abattoirs, consists in eliminating from the sterilizing chamber all the air by filling it with water and by placing the meat into the boiling water to prevent a considerable soaking by the formation of a superficial coagulated layer. The discoverer directed his attention in the first place to the very important process of the abstraction of the

air, as it is well known that where air is present no other body can be there at the same time, not even steam, and further, that the air on account of its slight heat conducting qualities prevents the passage of heat from the sterilizing steam into the meat. In this apparatus the abstraction of the air is accomplished in such a manner that the vertical boiler is closed air tight, and is entirely filled with hot water, which afterward, in the course of the process, is displaced from the boiler in the largest part by the developing steam. The abstraction of the air in the apparatus is complete without doubt. The sterilizer consists of a vertical boiler, which rests on 4 legs, and is surrounded by a steam jacket up to its upper angular reinforcement. Above the angle-iron an overflow pipe branches off, which unites by a three-way cock with the emptying pipe of the inside chamber of the jacket, to which the condensation drain pipe is applied at the lowest part. The upper closing of the boiler is accomplished by a cover which is arched toward the inside, the inside surface of which reaches deeper into the cylinder than the height of the mouth of the overflow pipe. The handling of the cover and the perforated meat baskets is accomplished by the aid of a wheel-crane, the block being attached to the side of the apparatus or to one of its legs. After the cylindrical chamber is filled with water to a certain height, which is brought to a boiling temperature through the heating of the steam jacket, the baskets containing the meat are placed into the boiling water, the lowest basket resting on several shelves of angle-iron. Care should be taken that the highest layers of the meat are submerged in the water. The water cools off several degrees while putting in the meat, but is again soon brought to a boiling point by the continual heating of the jacket. After the meat has been boiled for about 5 minutes in the open boiler the cover is placed on and closed steam tight, whereby all the superfluous water is displaced through the overflow pipe and renders the boiler free of air. In keeping open the lower drainage vent the steam jacket remains in operation. The steam developed from the water of the boiler displaces by this time the water up to a height of the bottom drainage stand-pipe. As soon as steam escapes from the delivery-cock, the draining valve is closed, and the remainder of the water is continually evaporated; in this steam the meat is well cooked. On the bottom of the sterilizer the dripping juice forms with the water a bouillon, on the surface of which a layer of fat collects. After a certain time the steam jacket ceases to be operated, and the apparatus is left to itself until the termination of the sterilization. After the opening and removal of the cover, the meat baskets are taken out with the aid of the wheel-crane, the stand-pipe is lifted, and the meat-broth is drained off through the draining valve. The apparatus is also placed on the market in the form of a quadrangular box into which the meat baskets are placed by hand and made to lay alongside each other. The heating surface in this form of apparatus lays on the bottom of the box.

In Franke's apparatus with direct heating, the forged iron boiler hangs by an upper angle-ring in a forged iron casing, which is covered with fire-clay on the inside, representing the covering of the boiler. The casing possesses on the front face a preliminary firing place, the heating fumes of which envelope the boiler directly from all sides and escapes on the back side of the boiler through an upper draft as flue. A mercury safety stand-pipe, besides a safety valve and manometer prevents exceeding the permissible pressure. The overflow pipe which has been already discussed in detail in the description of the apparatus for steam heating, has its continuance in the inside of the boiler up to the lowest surface of the water, beneath the lowest of the two meat baskets. It works in a similar way as was described in its construction for steam heat. To obtain the required pressure for forcing out the water through the overflow pipe, the safety valve is weighted down

by a weight pushed down on its lever until a pressure of 0.05 an atmosphere is obtained, which, after the escape of the water, is again removed. Afterward the fire is drawn out of the box and the sterilization is concluded with the heat contained in the fire-clay lining. This heat suffices to completely convert into steam the water which is contained in the bottom of the boiler. An advantage of this apparatus is its possibility of easy transportation, and it is always in readiness to be put up for immediate operation. The flue has only to be connected with a chimney of the building by making an opening into it.

Another construction of meat steamer has been placed on the market by the firm of Rud. A. Hartmann, under the designation of Hartmann's New Meat Sterilizer, patent of Becker and Ulmann, which is illustrated in Fig. 66, and which is also constructed for direct firing.

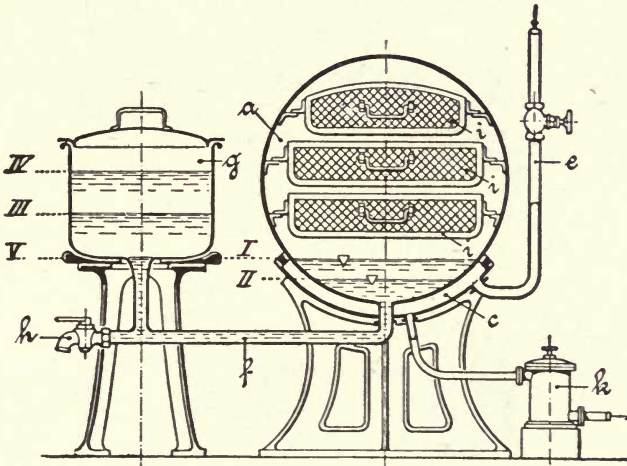


Fig. 66. Hartmann's new meat sterilizer in vertical section. Becker and Ulmann's patent.

The sterilizer consists of a forged iron vertical cylinder *a*, which in front is supplied with an easily moving door, and on the lower part it has a cleating for steam heating *c*. From the deepest point of the inside room a pipe *f* branches off to the receiving tank *g*, which is set up to the side of the sterilizer. The cock *h*, serves for the draining of the entire apparatus. The neatly tinned meat baskets *i*, which are constructed of perforated sheet-iron, are for the purpose of holding the meat to be sterilized, and they can be comfortably slid into the apparatus and also drawn out on ledges which are fastened to the sides of the cylinder. The water which condenses in the steam cleating *c*, is separated by an automatic condensation drawer *k*. A cock serves for the abstraction of air from the inside of the apparatus. Before beginning the operation the boiler is filled with pure water to the level *I*, then the meat is sprinkled with spices, placed into the perforated baskets *i*, shoved into the apparatus and the door closed. Then through the valve *e*, the steam cleating *c* is heated up whereby the water is soon brought to evaporation. An automatic arrangement for the abstraction of air separates the air contained in the apparatus during the development of steam, so that soon the air is sufficiently abstracted from the entire apparatus and is entirely filled up with steam. From this moment on the meat is subjected to the influence of steam at 100° C. The same condenses on the meat, and heats it up, the condensate drips below, and is again converted into steam on the heating surface *c*.

With the increased warming of the meat the consumption of steam decreases. But inasmuch as the steam production on the heating surface *c* remains approximately the same, the result is that more steam is produced than is used up. Through this a slight pressure develops, which presses the water from the sterilizer to the receiving tank *g*. The heating surface *c* is consequently more or less deprived of water, and in the same relation the steam production is diminished. In this way the balancing of the steam production and the heat absorption of the meat is spontaneously accomplished. The pressure in the sterilizer can never rise higher than the corresponding pressure in the receiving tank *g*, and this amounts at maximum to about 500 mm., when the temperature of the steam is fully 100° C. As soon as the temperature penetrates to the inside of the meat and reaches 80° C., the steam is shut off by the closing of valve *e*, and then the apparatus is opened and its contents removed, and the bouillon is drawn off by the cock *h*.

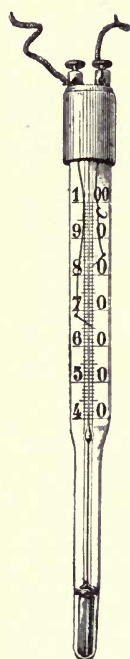


Fig 67

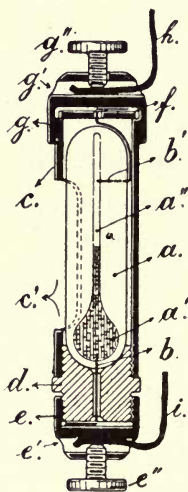


Fig. 68

Fig. 67. Electric mercury contact thermometer.

Fig. 68. Electric signal thermometer, models of Hönnicke-Berlin (Schöneberg).

In order to control the temperature obtained in the steamed meat and for the outside indication for the conclusion of the sterilization, it is advisable to place into one of the pieces of meat an electric contact thermometer, of which a simple construction is represented in Fig. 67. Other similar instruments were constructed by Franke, Hönnicke, and others.

The signal thermometer, Hönnicke's model, is represented in Fig. 68. This instrument contains a mercury signal thermometer, in which the graduations are made as fine as possible, and is combined with a metallic protective casing. The thermometer proper consists of a glass body *a*, with mercury bulb *a'*, and capillary tube *a''*. Into the mercury bulb on the lower part is a platinum wire *b*, melted in, and a similar kind *b'* is applied in the capillary tube *a''* at a corresponding height which should indicate the temperature to be attained by signal. This thermometer is placed into a metallic tube which is provided with a slit *c'*, which is closed below by a perforated winding

stopper *a*, made of insulating material. Through this perforation the platinum wire *b* is inserted and is pressed in with the aid of the perforation *e'* and a contact screw *e''*, which is supplied with a knob. Above, on the casing *c*, rests a metallic plate *f*, through which the platinum wire *b'* is inserted. This is then also pressed in with the aid of the perforation *g'* and a contact screw *g'* which is supplied with a knob *g*. After the mercury column has expanded at the desired temperature to the upper platinum wire, the current circuit closes. The current runs from the current producer through the conduit wire *i* to the ringing apparatus and again to the current producer, whereby the signal is sounded. In employing the signal thermometer, it is inserted with the mercury bulb downwards

perpendicularly into a piece of meat of medium weight. Before the insertion it is advisable to be convinced that not a drop of mercury is torn from the column. If this is the case it is returned to the other portion of the mercury through shaking or by some other method. It is also advisable to observe whether a contact exists by turning the squeeze screw to the right. Both insulated wires leading to the instrument are conducted into the meat steamer of Hönnicke (Fig. 64) simply through the notch in the door. At the place where the wires touch the border of the door either a simple sheet of paper is placed around them or they are covered with a paper husk supplied with the instrument. In closing the door the wires are squeezed between the border and the jam of the door; this, however, does not produce any inconvenience in the tight closing of the door.

The thorough steaming of the meat with the various apparatuses requires, in accordance with the regulations, a temperature of 80° C. in the inside of the pieces of meat for 2-2½ hours. In this process the loss of weight of the meat is considerably less than in cooking under ordinary circumstances, the difference amounting in beef to 25-26 per cent., and in pork to 12-13 per cent. The meat remains very juicy, of a spicy, pleasant taste and odor, reminding one of roasted meat.

The apparatuses are principally utilized in rendering uninjurious the meat of tubercular animals in certain forms of the disease, as well as in trichinous and measly meat. Other various kinds of disinfectors serve for the same purpose as the above-discussed apparatuses, as for instance, the disinfector of Budenberg-Dortmund and the steam cooking and rendering apparatus of Seiffert (W. Boese, Jr., in Breslau).

(c) Regarding the process of melting out fat which is employed for the extraction of fat from diseased animals (tuberculosis, measles) only brief mention will be made.

The cut or mashed fat is rendered in ordinary open kettles, during which the temperature rises to 150° C. Also the described meat steamers of Hönnicke, Hartmann, and others, as well as the cleated boilers with steam running through, are adapted for this purpose. However, the liquid fat must not be drawn off before a temperature of at least 100° C. is registered. The connective tissue residue of the fat tissues is then scooped off and the latter are deprived of fat by pressure as much as possible.

[In the United States carcasses showing lesions which justify the passing of the tissues for lard have to be subjected, according to the B. A. I. Order 150, Regulation 13, section 10, paragraph 3, and section 13, rule D, to a temperature of 220° F. for not less than four hours.]

(d) With the commercial method of pickling, measly meat may also be rendered uninjurious if the pickling is carried out sufficiently long (3-4 weeks) and if the pieces of meat do not exceed over 2 kg. The destroying action of the pickling is very slight on pathogenic bacteria or their products; nevertheless, it may be applied with the meat of hogs which are condemned by the inspectors on account of swine erysipelas, hog cholera, and swine plague.

[Such dispositions are not admissible in the United States with the carcasses affected with the above-mentioned diseases, and the regulations governing the disposition of such affected carcasses will be referred to under the discussion of those diseases.]

(e) The method designated as "thorough chilling" is employed exclusively on slightly measles beef, and serves to keep the meat in a fresh condition. The action of low temperature on the measles does not destroy them, but they lose their power to develop during the time the meat is retained. The employment of this method necessitates well-arranged meat-cooling rooms in all seasons.

The sale of conditionally passed meat which has been rendered fit for human consumption is only permitted after making known this condition, and in accordance with the instructions after it has been satisfactorily marked. The more special measures concerning this marking are left to the state governments. The sale of such meat should always be carried out under the restrictions corresponding to those mentioned on page 153 for the Freibank.

Permission for the conditionally passed meat to be utilized by the owner in his own household is not excluded after the meat has been rendered fit for consumption if the owners are not butchers, meat dealers, hotel or restaurant keepers.

2. Meat of Inferior Quality

The sale and utilization of meat which has been declared of inferior quality (nonmarketable) should be followed under the same conditions as were explained above for the conditionally passed meat.

[The regulations governing the meat inspection in the United States do not contain provisions for passing certain dressed carcasses conditionally. An exception is only made with certain slight cases of tuberculosis and hog cholera, when the carcasses may be passed conditionally for lard. Accordingly, the Freibank system and the sterilization of meat is not practiced in the United States at the present time.]

3. Absolutely Condemned Meat

The harmless disposition of meat condemned as unfit for human consumption has to be affected by a higher degree of heat (cooking or steaming until the maceration of the soft parts, dry distillation, burning) by chemical means until the dissolution of the soft parts or through burying. The products obtained by the first-mentioned method may be utilized in the industrial arts.

Before burying, deep cuts should be made into the meat, and sprinkled over with lime or fine dry sand; or tar, crude oil (carbolic acid, cresol), or alpha-naphthylamin in 5 per cent. solution should be poured over it (dena-

turing). The latter procedure is also recommended when the disposition of the condemned meat cannot take place immediately under the supervision of the inspector. The marking of the condemned meat can be omitted only on single portions of meat, when a harmless disposition of the condemned parts is carried out immediately in the presence of the inspector. Otherwise all condemned organs and parts must be positively marked with a condemned stamp, whereby the condemnation becomes official.

For the temporary retaining of condemned meat, especially in larger abattoirs, special containers should be provided from which removal of condemned parts should be impossible except by the proper authorities. For the collection of such meats a box on a cart frame is illustrated in Fig. 69. The condemned part is

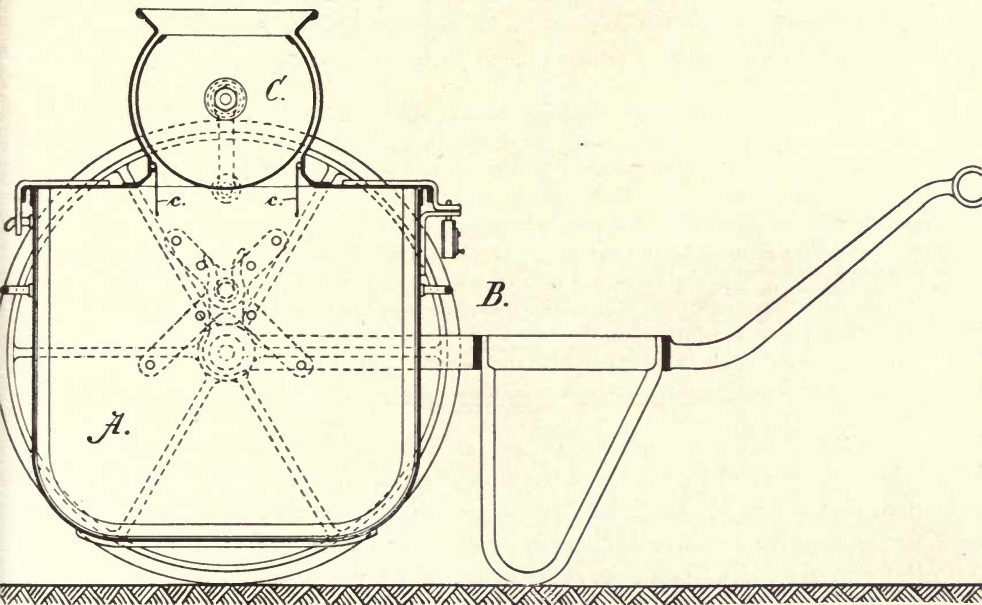


Fig. 69. Collecting box for condemned meat on cart structure, in section. Model of Hönnicke-Berlin (Schöneberg).

thrown into the trough *c*, and the crank is turned around 180° , whereby the piece drops into the box *A*. The taking out of the condemned pieces without the removal of the locked cover with the trough attached to it is impossible, as the trough fills out the opening of the box and besides in turning over the box the trap board immediately covers the split between the trough wall and the box cover.

(a) The simple boiling of the meat in open boilers until the soft parts are falling apart is carried out in old flaying plants in order to obtain the fat, bones and the mass of meat boiled to pieces; the method is less rational and from a hygienic standpoint it is not without objection.

(b) Boiling meat to pieces in a high-pressure steam apparatus includes the advantages of a certain sterilization, together with the gaining of valuable products. The apparatus works with expended water steam, conveying to the meat a temperature up to 150° C., and the meat is broken up to such an extent that the principal constituents may be obtained separately (bones, fat, insoluble albumen, and other substances as well as glue substances).

Of the high-pressure steam apparatuses the following are most extensively in operation:

(A) The simple steam digester (steam barrel) is as a rule, a perpendicularly constructed iron container, supplied with a sifting bottom, which can be closed steam tight on the top by a cover. Below it is equipped with arrangements for the draining of fluids, and it also has a manhole. On various parts of the digester, steam of 2-3 atmospheric pressures may be conveyed to the pieces of meat placed in the apparatus.

After sufficient steaming, the fluids which are collected below the sifting bottom (condensed water, meat-broth, and fat) are drained off, and the firmer masses still intact are removed from the digester. From the latter the bones are utilized under certain conditions for the preparations of bone flour, and from the other parts muscle flour is obtained, after they are first dry-cured and ground up in mills; or the bones are dried and ground with the meat and the product is called "animal body flour," which is advantageously utilized as a fertilizer and food substance. While the fat serves for the manufacture of soap, ointments, etc., the broth, which is a burdensome by-product on account of its great decomposing qualities, can be utilized only to a certain extent at such places where it can be immediately and freshly used as a soil fertilizer.

(B) Similar to the simple digester is the flaying disinfector of Riet-schel and Henneberg, the construction of which is of greater advantage than that of the former. Besides it is equipped with accessory apparatus for an improved method of obtaining the fat and for the condensation of the evaporations. The apparatus is based on the system first employed by veterinarian De La Croix, director of the Antwerp abattoirs for the utilization of the animal parts. The drying and comminuting of the cooked masses are accomplished by special mechanisms.

Similar to the flaying disinfector is the old Hartmann's extraction apparatus.

While in the previously mentioned apparatus the rendering process with the steam in the digesters is only preparatory, since it is necessary to transport the nonliquid masses from the digester to the drying and grinding contrivances, the following rendering methods possess the advantage that the entire process is carried out in one and the same apparatus. The latter is not opened during the rendering and processing, and at the end only the finished products are apparent.

(C) Podewil's system, which has been in use for 23 years, was first to inaugurate horizontally constructed, rotating drums for the steaming of animal parts, and in this way made possible the sterilization, drying, and grinding of the product in a single closed apparatus. The construction characteristics of Podewil's system, which in the course of years experienced various improvements and which is at this time manufactured by the Podewil factories in Augsburg, is illustrated in Fig. 71, in connection with the following description of its operation:

Podewil's rotating drum consists of an inside cylinder, an outside heat cleating and also heatable double bottoms. An accessory receptacle called "hot water-montejus" is also supplied with steam heating arrangements for the heating of the washing fluid which it contains. The liquid conduct pipe *Z*, and the fat drawing pipe *F*, are connected with the drum by hollandic screwing, and are easily taken off.

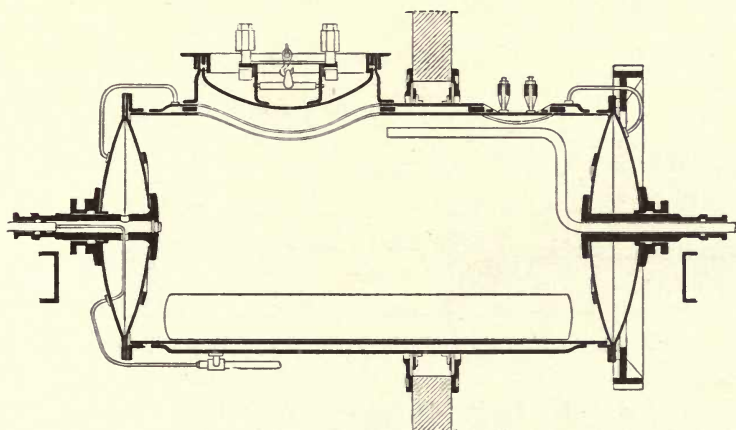


Fig. 70. Section through Podewil drum with specially large manhole.

With the fat conduit is connected a Liebig's cooler *K*, and a gas separator *G*. The steam is conveyed and the condensed water from the heat cleating is led off through one of the hollow bearing plugs of the apparatus, while the steam from the inside of the cylinder is drawn off through the other bearing plug.

For the rendering of large undivided animal carcasses (as for instance in anthrax, glanders) there has been recently constructed Podewil's tympanum with double manhole, Fig. 70, one of which is of such a size that even the large carcasses can be placed undivided into the drum.

Accessory machines are necessary, such as steam boiler, steam engine, or other motors and an air pump with a condensator.

Description of the Operation

The carcass or material is placed through the manhole *M* into the Podewil apparatus; the manhole is then closed steam tight, and the air is removed from the apparatus by the aid of an air pump. At the same time the fluid in the "hot water-

montejus" is heated with boiler steam to 3 atmospheres of pressure. Next a portion of the heated fluid is pressed by the conduit *Z* into the apparatus, and the heat cleating is heated by boiler steam, whereby the inside of the cylinder develops a pressure of 3 atmospheres. This pressure is maintained for about 4 hours, and the apparatus is from time to time rotated. Through the action of the hot fluid, all disease germs are destroyed with a certainty, the carcass is cooked to a pulp, and the fat substances are separated. The remaining quantity of fluid from the "hot water-montejus" is then pressed over into the apparatus; thus the inside of the cylinder is filled to the top, and the material is again washed through and lixiviated. The fat swimming on the surface then flows through the opened cock *F* into the conduit *F*, passes the cooler *K* and gas separator *G*, and is drawn through the drawing pipe *R* in a pure cooled state into fat barrels in a condition for immediate sale.

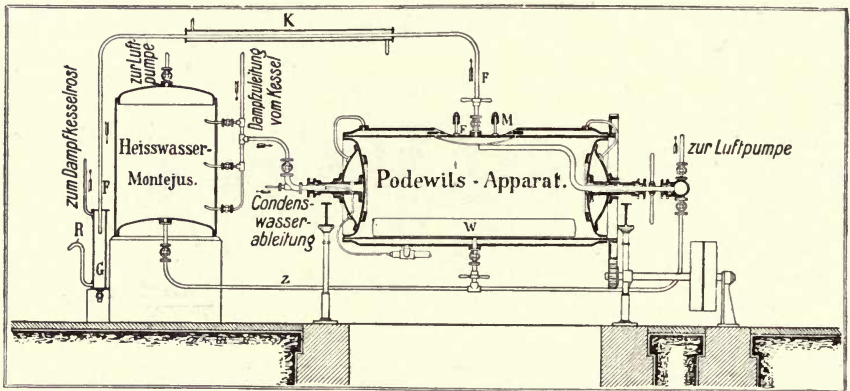


Fig. 71. Section through the apparatus of Podewil's system

The removal of the fat is followed immediately by the drying of the other products in the Podewil apparatus. Previously to this a like quantity of fluid to that which has been taken from the "montejus" is returned in order to be used again in a similar way during the next operation.

The drying and grinding of the carcass material is accomplished by the action of the boiler steam led into the heat cleating, which thoroughly dries the material in about 6 hours, and with the aid of the roller *W*, which lays free in the rotating apparatus, it is converted into a finely ground dry product ready for the market (meat flour). After the manhole *M* is opened and the rotation is continued for about 10 minutes longer, the apparatus empties itself into the carts placed under the opening.

The vapors from the products developed during the drying process inside of the cylinder are sucked out through the curved pipe by the air pump and are then conveyed into a condenser where they are mixed with water and condensed. This condensation water is the only waste water obtained; it is entirely uninjurious, and is drained off as clean water into the sewer or into the sinking hole. The slight quantities of uncondensable gases are conveyed under the fire grate of the steam boiler and are burned there.

The pure hot water condensed in the heat cleating of the apparatus is refed into the steam boiler. The entire process lasts only 10-12 hours.

The utilization of fat and animal flour with the Podewil's method depends naturally on the material to be worked up. In the rendering works of Dresden, by a mixed working of carcasses and meat-inspection condemnations a yearly average of 10 per cent. fat and 20.87 per cent. animal flour was obtained. The latter consisted in the average of 9.64 per cent. nitrogen (60.22 per cent. raw protein) 12.70 per cent. fat, 18.87 per cent. ash (in which 7.19 per cent. phosphoric acid was contained) and 6.91 per cent water. The animal flour on account of the large quantity of nitrogen, fat, and phosphoric acid which it contains makes it a valuable fattening food substance for hogs, cattle, fowls, and fish, the uninjurious effects of which were extensively investigated by Glage.

(D) Rud. A. Hartmann's system of Berlin (Fig. 72) is similar to the above-described system of Podewil. It is distinguished from the latter first of all by the perforated drum, which rotates inside of a double walled, stationary drum, by ren-

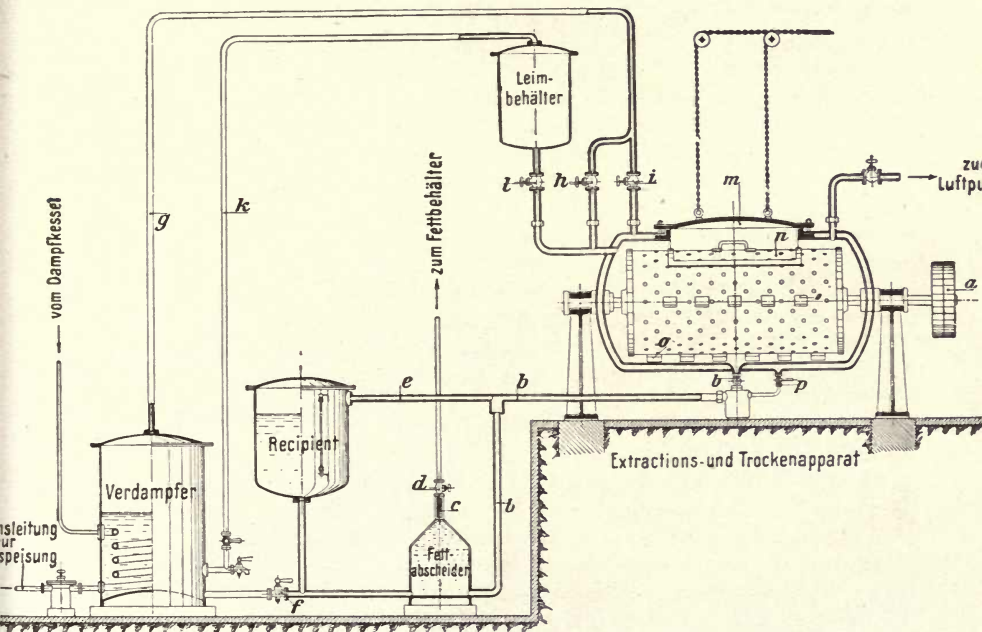


Fig. 72. Model of Hartmann's system of carcass-destruction and utilization apparatus.

dering without the action of direct steam, which is produced in the evaporator by steam from the boiler and is conveyed from the evaporator to the extractor; and also by the continual separation of the fat and glue water during the cooking. The illustration herewith shows the design of the entire system of Hartmann's apparatus, which consists of 5 single containers fed by pipes. The large horizontal cylindrical container is the extraction and drying apparatus proper. This contains in the inside a sieving drum which receives the raw material, and which can be rotated by the engine *a*. Here the carcass material is steamed through, extracted and finally dried to animal flour ready for the market. The fluids extracted from the raw material—fat, glue, and broth, flow through the pipe *b*, into the second container which is the fat separator, in which the fat is separated from the glue broth.

The fat collects in the upper conical part of the container, becomes visible on the indication glass *c*, attached to it, and can be drawn off by opening the valve *d*, which is applied at the highest point to the fat tank, while the defatted glue broth passes spontaneously into the third container, the recipient. The pipe *e* connects the recipient with the extraction apparatus. From the recipient the glue broth is periodically conveyed by the opening of cock *f* into the fourth container to the so-called evaporator in order to be here evaporated with the aid of a coiled heating arrangement to a gelatinous consistence.

The steam developed in this process from the glue broth is not conveyed to special condensation arrangements and precipitated with cold water as in the old apparatuses, but it is returned to the extractor in order to serve as working steam for the cooking and drying process.

For this purpose a pipe *g* leads from the evaporator to the extractor which divides into two branches, of which the one *h* can be closed by a valve and leads to the inside of the apparatus, and therefore to the raw material, while the other *i* can be also closed by a valve, and is led into the cleating which envelops the entire extraction apparatus. This pipe permits the utilization of the steam which develops in the evaporator from the glue broth, according to the desire, either for the steaming or for the drying of the carcass material. The water extracted thereby in the form of steam from the evaporator reaches either the extractor or the cleating and returns again through the cock *b* or cock *p* into the fat separator and the recipient. Accordingly a constant circulation takes place in the apparatus of the water originating from the carcass itself. Therefore the more water is abstracted in the form of steam from the evaporator naturally the more concentrated will become the glue broth, until at the conclusion of the working process the finished thickened glue jelly is obtained in the evaporator. At that time in the extractor the finished dried animal flour is obtained, and in the recipient and in the fat separator remains the distilled meat water; the fat on the other hand has been already drawn off into the fat container during the working process.

The fifth container is placed above the extractor and serves for temporary receiving of the thickened glue broth, in order to convey the same again at the proper time to the extractor, in case it is desired to work up together the extracted meat and bone masses with the glue jelly to a glue-containing animal flour.

The opening in the extractor which can be closed with the cover *m*, is of such a size that the sieving drum may be placed into it and also removed and replaced again in case of repair. Besides the large cover opening (with the exception of the smallest size apparatus) permits also the introduction of undivided carcasses.

The inside of the extractor contains the revolvable sieving drum, which is closed by the removable cover *n*, and on the external circumference it is equipped with stirring arms *o*.

After the conclusion of the extraction, which on an average requires four hours, the sieving drum is made to rotate and at the same time by the heating of the double cleating the drying of the extracted meat and bone masses contained in the extractor is carried out. The material, which by the thorough steaming becomes entirely soft, is ground up in the sieving drum, falls through the sieve holes, and thus reaches into the space between the sieving drum and the heated double cleating. Here it is seized by the stirring arms, is always brought in contact with new surfaces to the heated surface, and at the same time it is ground to a powder. The vapors set free from the drying product are sucked out with the aid of a wet air pump, and precipitated with direct contact with cold water. Other noncondensable gases are conveyed under the furnace and are burned there.

The drying process in the smaller apparatuses of Hartmann is calculated to take about 2 hours while in the larger ones from 3-5 hours. After this time the entire dried product is contained as a pulverized animal flour outside of the sieve drum, and can be emptied from the apparatus by removing the cover and turning the extractor 180°.

The glue steam condensate which develops in the double cleating of the extractor during the drying process, the "distilled meat water," accumulates in the accessory containers, the fat separator and recipient, which are supplied before the commencement of the drying process, and can be drained from them after the conclusion of the working process into the sewer. If there is no sewer then the waste water which in itself is clean and sterile is collected in a special cooling basin, from which it is drained off after cooling into the mill trough.

Recently the firms Hochmuth, in Dresden, as well as Venuleth and Ellenberger, in Darmstadt, and Grove in Charlottenburg, Berlin, constructed apparatuses which are based on the same principle as the two above-described systems. While the last two have not yet been sufficiently tested in practice, the cheap apparatus of Hochmuth has already proven itself very useful in various rendering works.

(E) A sterilization, but not an entirely complete comminution of animal parts, is obtained by Dr. Garth's collecting container and destroying apparatus (Fig. 73), which is constructed in the boiler works of Göhrig and Leuchs A-G., in Darmstadt. Regarding the operation, productiveness, advantages, and defects of the apparatus, information is given in the publications of Garth, Clausen, Resow, and others.

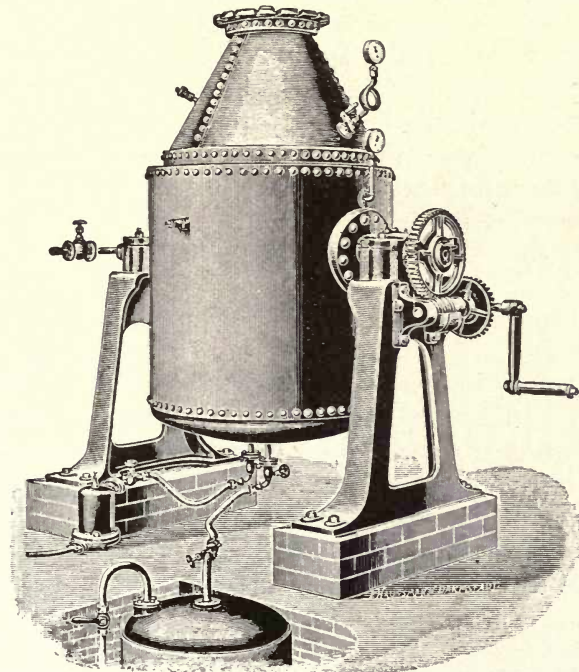


Fig. 73. External view of Dr. Garth's collecting receptacle and destruction apparatus.

When the working up of the product is to take place, the closing head is removed and a cover is tightly screwed on. For about 10-14 hours steam is con-

veyed into the inside of the cleating at 5 atmospheres of pressure. The fluid constituents are drawn off in accordance with necessity into the recipient standing at the side of the apparatus; the fat may be drawn off here. Near the recipient is located a stirring valve to mix the glue water with water from a conduit and lead it into the sewer. During the steaming the container is here and there turned for a thorough mixing of the material, and to offer the steam new points of action.

As end products are obtained fat, glue broth and residues. The latter forms after the cooling a brown, soil-like crumbling mass intermixed with bones and fibers, which, after a further communication, is utilized as food for hogs and fowls.

(c) A chemical destruction of the meat may be obtained in various ways. An older method consists in the treatment of the meat with sulphuric acid and steam. The meat is placed into acid tanks or into wooden containers lined with lead sheets, is poured over with sulphuric acid at 45° B., and then the steam is conducted into the containers. From this a breaking up and loss of fat in the meat takes place. The fat is skimmed off, and the remaining shiny pulpy mass is mixed with bonemeal, lime phosphate, etc., and dried. In the drying quite disagreeable odors develop, so that the method can only find application in fertilizer plants.

Recently Franke has recommended treating condemned meat with a 3 per cent. solution of sodium hydrate (NaOH) for about 24 hours, and afterward to boil it for 2-3 hours with steam or direct fire, until the complete breaking up of the soft parts. In this very inexpensive method, which will likely find more practice in the future, is obtained fat, glue broth, and alkaline albumen. A saponification of the fat does not take place.

(d) The dry distillation of the meat is practically not used as a disposing method.

(e) A burning of small parts may be undertaken at any place in the heating arrangements of the household, and is without a doubt the safest method of disposition. Where steam boilers are present even larger parts and divided carcasses of large animals may be burned. This, however, is not economical, and is also of a disadvantage for the walls of the boiler. To eliminate the last-mentioned disadvantage, various kinds of burning stoves were constructed, of which those of Kori (page 179) prove to be the best.

The illustration, Fig. 74, represents the latest construction of Kori's burning stove, type III, with an upper slime basin. The burning stove consists of a massively built wall body, the surfaces of which, coming in contact with the smoke gases and fire, are constructed of the best fire bricks, while the other wall work consists of brick stones. Besides every stove receives a reinforcement of strong iron U-rails, which are fastened together by strong round irons, both long and crosswise. The operation is carried out in the following way:

The solid offal, condemned meats, etc., are thrown without consideration of their kind, through the opening E T, into the burning chamber V R, and thence to

the cast-iron basin Sch. B II, and from here on the slanting surface of the arching G I, G II. The latter consists of specially constructed perforated fire bricks, which are horizontally continued G III. The coal flame produced in the so-called main fire-box H F reaches in the greatest part directly to the burning chamber V R, and consumes the products which are accumulated there, while a small part reaches through the canal K, directly under the perforated arching G II, drying and igniting the offal lying on it.

In order to make possible the burning in the chamber V R of pulpy and thin liquid material without any other addition, and without disturbing the burning process proper, the stove is extended in its upper part into another small chamber O V R, into which a flat but broad basin Sch. BI is built. This basin can be

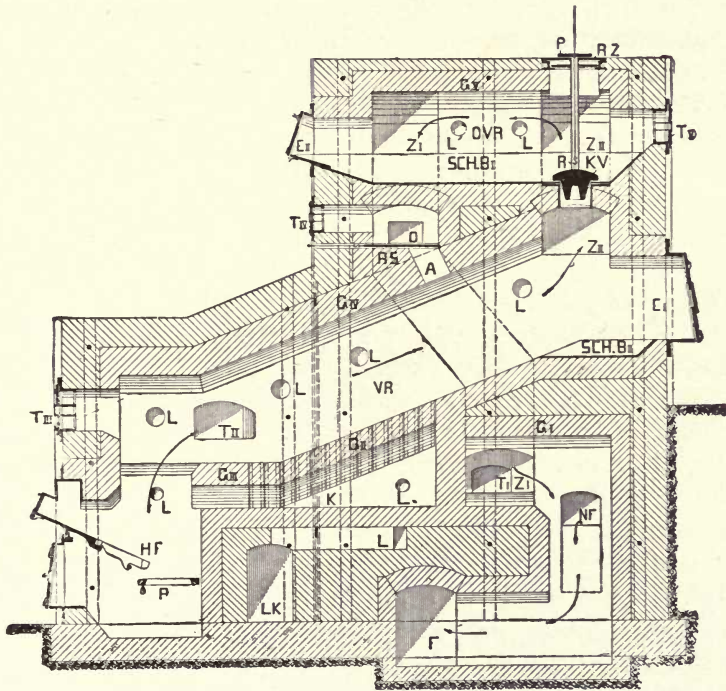


Fig. 74. Longitudinal section through one of Kori's burning ovens, type III

reached from the opening E I, lying on the opposite side to the opening for receiving the materials, and in order to make this accessible, the otherwise sloped back of the stove is made with a platform extension.

The flame from the main place which fills the burning chamber V R, leaves this through the side draft-opening Z II, and reaches the upper burning chamber O V R, in which it passes over the basin Sch. BI, and evaporates the fluids contained therein, thus thickening them. If this is (in about 5 hours) sufficiently accomplished, then with the hoisting of the conical valve K V (in the floor of the basin B), the thickened content flows down or is pushed down into the lower burning chamber V R, where its complete destruction is accomplished in a short time.

The residues remaining in the chamber V R are drawn down at the conclusion of the work, with the aid of a fire hook, to the grading of the main firing, where the complete destruction to a gray ash takes place. When the burning process is well in progress it is advisable to restrict the direct firing, as the meat masses falling from time to time into the fire replace the burning material.

Where it is accessible, the burning stove is connected with the smokestack of the steam boiler. The burning stoves of Kori give good satisfaction everywhere, and work very inexpensively.

(f) The burying of meat is followed principally in flat countries, after the meat has been previously denatured (page 170). The ditch should be laid out so that the surface of the meat may be covered with a layer of earth of at least 1 m. thickness. According to the regulations of the imperial meat-inspection law, trichinous meat is not allowed to be disposed of by burying.

[Condemned carcasses or parts, as well as condemned meat and its products, and the offals of the abattoir are rendered in the United States in tanks, also called digesters. Such tanks are usually installed in abattoirs, and in the larger establishments a large number of such tanks are placed in the so-called tank-house or tank-room. The tanks, which receive the condemned meat, are sealed by a Federal employee, who also supervises the tanking of the condemned material. After the process of rendering is concluded, the seal is broken by the Federal employee and the contents of the tank are also removed under his supervision (see B. A. I. Order 150, Regulation 16, sections 1-3). In the rendering process the regulations prescribe a 40-lb. steam pressure, producing a temperature of 288° F., which should be maintained for not less than six hours. Before tanking the meat is always denatured. Through the rendering process all of the solids are thoroughly disintegrated, forming a pulpy mass. The grease is then drawn off through a conveniently placed draw-off valve, and the product is stored and shipped with the word "inedible" marked on the containers. After the fat is drawn off, the residue of the tank is dumped into a scrap vat in which it is allowed to settle, and the grease is next skimmed off, which is placed again into the tank for the next cooking. Then the residue is placed in a press, usually a hydraulic press being employed, where it is separated from all the moisture and grease, the dry substance being then prepared for fertilizers. In various places the tank water, which contains from 10-15 per cent. solids, is utilized for the preparation of ammonia. The entire rendering process in the tanks requires from 8-10 hours.]

3. Inspection of Meat Imported from Foreign Countries

The decisions of the inspectors, and the treatment of the meat imported from foreign countries after inspection, is accomplished in accordance with the regulations of the imperial meat-inspection law.

The decision may be one of the following :

- (a) Passed and admitted for traffic in the state ;
- (b) Condemned and rejected from importation ;
- (c) Condemned with harmless disposal ;
- (d) Condemned and admitted after rendering it useless.

These decisions may extend in accordance with the conditions in fresh meat, to the entire shipment, to single carcasses, to single affected parts ; and in prepared meat, to the entire shipment, to single packages, or to single pieces of meat.

All final decisions are made by the inspection office in accordance with the opinion of the veterinarian assigned for the inspection to whom the results of the chemical examinations, if such were necessary, should be reported in writing.

Regarding the further treatment of condemned meat, the police authorities have control.

The marking of the meat (page 159) is carried out in accordance with the regulations, with colored or branding stamps on the meat proper, and on the containers of the same.

In condemnations the meat should be temporarily retained, and provided with a suitable identification mark. Of the retention immediate notice should be given to the disposal authorities of the customs and tax office, as well as to the police authorities designating the cause of the condemnation.

The harmless disposal of condemned imported meat has to be carried out under the same conditions as for native meat.

For rendering useless foreign meat which is not permitted for consumption, the regulations give the necessary orders.

Prohibition for importation to Germany applies at the present time to dog meat, prepared horse meat, sausages, and other mixtures from comminuted horse meat, meat in air-tight, closed boxes, or similar containers ; pickled meat, if the weight of a single piece is less than 4 kg. ; fresh beef and veal from Belgium, Russia, Roumania, Servia, Bulgaria, America ; and fresh mutton, goat meat and pork from Russia, Roumania, Servia, and Bulgaria.

VII. Abnormal Conditions and Diseases of Food-producing Animals

1. Noteworthy Peculiarities Within Physiological Limits

A. Fetuses and Dead-born Animals

Unscrupulous butchers sometimes attempt to place on the market as normal veal or to otherwise work up the meat of almost mature fetuses or dead-born animals. If this meat is worked into various preparations it can only be found out, as a rule, by obtaining trustworthy information, and is very difficult to recognize in meat products. At best, the high glycogen content (see page 38) of meat mixtures might furnish a suspicion, as fetal meat contains, relatively, a large amount of this carbohydrate.

Post-mortem Examination.—The undressed carcass of a calf fetus presents the following: Soft claws with untouched convex sole-pads; remains of the umbilical cord hanging from the open navel ring; umbilical vessels open, containing fluid blood; sometimes the throat is cut or is so stuck as to simulate slaughter by bleeding, but the edges of the wound are not infiltrated by blood. The dressed carcass shows the following:

Gaping condition of the umbilical vessels, in which the points of origin of the arteries from the internal pudenda artery should be especially noticed; open urachus; stomach and intestines free of coagulated milk; absence of milk feces; lungs atelectatic if they were not blown up by the butcher; muscles loose, flabby, and watery; so, likewise, is the undeveloped fat tissue, especially around the kidneys, which is jelly-like; bone-marrow is red.

Judgment.—As the consumption of fetal meat would awaken a feeling of repulsion in most cases, such meat should be considered as unfit for human food. [B. A. I. Order 150, Regulation 13, section 27.]

B. Immature Animals

Only calves which are too young come into consideration here, as young pigs, lambs, and kids are consumed when only a few days old. Calves are considered mature or mature for slaughter when the meat and fat have attained a certain development, which, as a rule, is only reached within 8 to 10 days after birth. However, the requirements of

the public relative to this vary greatly. In North Germany, especially in Mecklenburg and Holstein, calves are frequently slaughtered as so-called "fasting calves" when only 3 or 4 days old, and even shortly after birth; but they are allowed to become much older in South Germany, being generally 2 to 3 weeks old. Young pigs (roasting pigs), lambs (Easter lambs) and kids are considered mature for slaughter at an age of about 3 or 4 weeks.

Symptoms and Lesions.—The meat of immature calves is very moist, loose, tender, and tears easily; can be perforated with the fingers, and is grayish-red. The muscular development, as a whole, is but slight, which can be especially noticed on the leg (upper shank). The tissue, which later develops as the fat capsule of the kidneys, is edematous, dirty yellow, or grayish-red, tough, and intermixed with some fat lobules. For characteristic signs of the age, see page 16.

Judgment.—According to the German meat-inspection regulations immature or insufficiently developed calves should be declared of inferior quality.

The same practice should be followed with the immature meat of other animals.

[In the United States the regulations provide that calves, pigs, kids, and lambs under three weeks of age should be condemned. [See B. A. I. Order 150, Regulation 13, section 27.]

C. Emaciated Animals

The meaning of emaciation must not be confused with the designation *leanness*.

Leanness is a physiological condition with perfect health of the individual, and which after slaughter shows no disease, or only insignificant indications of diseased changes. Leanness can be observed in all animals which are in the stage of development; in most of the male breeding animals, in cows which are in a period of strong lactation, and in poorly nourished animals, or in those not properly taken care of.

The meat of lean animals contains a small amount of fat, but is otherwise firm, tense, and as a rule, darker in color than normal, and sometimes the connective tissue appears strongly developed, which causes toughness of the meat.

Emaciation is always the result of disease or old age, and is characterized by a retrogression of the general nutritive condition below the normal. In well-marked cases, and when associated with a pronounced loss of strength, it is designated as cachexia. Emaciation may develop especially fast in febrile diseases. Occasionally anemic and hydremic conditions are associated with emaciation.

Symptoms and Lesions.—On living animals are noted marked projections of prominent portions of the bones, sunken muscles, flabby skin without elasticity and laid in folds with much desquamation, scrubby, dull hair, tired look from sunken eyes, and decided weakness when in motion, with relaxed muscles while standing.

Of the slaughtered animals, the most striking appearance is shown in emaciated hogs, as these animals are generally slaughtered in a fattened condition, with the exception of boars and brood sows, unless the slaughter is necessitated by disease. In general, in all emaciated animals, absence of fat in the subcutis is noted in the first place, which is shrunken away here as in all other places of fat deposit, and is replaced by a loose yellowish or reddish, more moist and even jelly-like tissue. Advanced changes are naturally dependent upon more severe cases, which are especially distinguished by pronounced changes of the kidney fat. The muscular tissues are atrophied, sunken, loose, pale, more moist and very rich in connective tissue elements. Lymph glands and lymphoid tissue are frequently very prominent in young individuals, while the same may be atrophied in older subjects. Bone-marrow is, in advanced cases, poor in fat, red, watery; or, in older animals, even slimy. Sometimes also, signs of atrophy of the liver and spleen are noted.

The *judging* of the meat of emaciated animals depends on the cause of emaciation and upon its degree. In marked substantial changes of the meat, or if complete emaciation is the result of disease, the meat must be considered, according to the regulations, as unfit for human consumption. The same applies to all cases in which the existing original disease would in itself exclude utilization of the meat. In all other cases, the meat represents a food of inferior value, according to the regulations.

[According to B. A. I. Order 150, Regulation 13, section 24, carcasses which show advanced emaciation should be condemned; the association of the emaciation with a disease condition would naturally exclude the carcass for food purposes.]

D. Abnormal Odor and Taste of Meat

1. Sexual Peculiarities

Odor and taste abnormalities of meat, which appear in connection with sexual activity, manifest themselves in the most pronounced form in boars and billy-goats, and next in order, in cryptorchid boars.

Findings.—In old boars immediately after slaughter there is always perceived a specific odor of the meat, which reminds one of the odor of living boars, and which is designated as a urine-like or sexual odor. Although this gradually diminishes through cooling the meat, it becomes again prominently noticeable as soon as the meat is warmed by boiling or roasting.

Therefore it is necessary to undertake a boiling test (page 137) with the meat of every boar 24 hours after slaughter. The odor is most perceptible when the boiled meat begins to cool. In doubtful cases the odor test should be made by several persons. The characteristic repulsive odor is also accompanied by a similar taste.

Besides the disagreeable odor and taste, the meat of boars possesses also a peculiar toughness, and the skin of the back, shoulders, neck, and chest-walls is of a cartilaginous hardness (Schild).

As the boar odor is retained for some time after castration, such recently castrated animals have to be judged the same as those not castrated. (Careful attention should be given to so-called stags).

In larger abattoirs where the ante-mortem and post-mortem inspection is seldom carried out by the same person, it is advisable to practice care in meat inspection, for the butchers, as a rule, remove the testicles with a portion of the scrotum in dressing the animal. In such cases the cutting away of the skin on the inside of the thigh is conspicuous, which, in connection with other sexual peculiarities (thickness of the skin, penis, or its roots at the notch of the pubis, and the marked development of the bulbo-cavernosus muscle), must excite suspicion.

In meat of cryptorchid boars the sexual odor is almost invariably present should the retained testicles possess functional activity. At any rate it is advisable to condemn temporarily every cryptorchid boar, in order to undertake a boiling test with the cooled meat.

Meat of billy-goats has a very pronounced, disagreeable goatish odor and taste, reminding one of the odor of the living animal. The boiling test with the cooled meat is decisive.

Meat of specially strong full-fleshed bulls may, according to Goltz, develop an exceptionally noticeable odor, which is similar to evaporation from the skin of these animals in life, and which also manifests itself after boiling.

Before being chilled the meat of rams has frequently a slight peculiar odor which is quite noticeable, but it cannot be designated as repulsive. For judgment of such meat, see under 3.

2. Influences of Feeding

As a result of extensive feeding with fish, which sometimes occurs near the sea coasts, the meat, and especially the fat of hogs, obtains a fishy odor and taste. Extensive feeding of garbage (food remnants and offal from hotels, institutions, etc.) gives meat an insipid, rancid odor and taste, and besides changes the consistence of the meat and fat.

After feeding fenugreek, meat, according to observations made in France, takes up an odor and taste which resembles that of hog manure, and which may also be manifested in calves given milk from cows fed with this plant.

Ollman observed a rancid odor and a soapy taste of the meat in lambs which were fed with beets in which fermentation had begun to develop.

The flesh of poultry obtains an oily flavor from being fattened with oil seed, oil cake, colza, or hempseed; and a fishy odor and taste from feeding with fish. Turnips are supposed to produce a bitter taste, and pond mussels also cause a very disagreeable flavor to the meat of ducks.

All these odor and taste abnormalities produced by the influence of food are, as a rule, only perceivable after heating the meat. For judgment of the meat, see under 3.

3. Absorption of Odors

The ingestion and administration of odor-producing substances in the body of animals may also cause an abnormal odor and flavor to the meat. These, however, are not always strictly inside the physiological borders, but they may be here mentioned. Of such substances which may be taken up accidentally, or which may be administered as medicines, and especially come into consideration in emergency slaughter, to which attention should be called, are: Ether, anise, asafoetida, baldrian, bezin, camphor, carbolic acid, chloroform, petroleum, tar, and fennel.

It is especially noteworthy that through the inhalations of carbolic acid, chlorine, ether, and chloroform vapors by animals their meat will also absorb the corresponding odor and taste abnormalities. (This may occur from stable and railroad stock-car disinfection.)

These odors may manifest themselves to a high degree in freshly slaughtered animals, but they appear most distinct after boiling or roasting the meat.

Judgment.—Meat which possesses a repulsive odor or flavor in a high degree is, according to the regulations, unfit for human food; that having a fishy odor or taste, and all such meats which possess deviations of these peculiarities to a moderate degree, should be declared of an inferior quality. [According to B. A. I. Order 150, Regulation 13, section 20, carcasses giving off urine or sexual odors should be condemned.]

Regarding deviations in the odor and taste of meat of diseased animals, and those with intestinal parasites, see Chap. VII, Sections 3-7. Regarding post-mortem odor abnormalities, see Chap. VIII.

E. Animals in Advanced Pregnancy

The almost general opinion which exists among butchers that meat of animals in advanced pregnancy is of inferior quality because it contains more moisture, has a looser consistence, and therefore does not keep so well, and is not as suitable for the preparation of sausage, requiring keep-

ing qualities, cannot be in general substantiated. Although there are cases occurring in which the meat, and especially of the hindquarters, possesses the above-mentioned peculiarities, yet these are restricted principally to sows in the last stage of pregnancy.

The *judgment* can, therefore, be applied only from case to case, and has to be directed in accordance with carefully observed objective finding on the animal itself.

[In accordance with Regulation 13, section 26 of B. A. I. Order 150, carcasses of animals in the last stages of pregnancy (showing signs of parturition), also those which have given birth to young within 10 days are passed for lard or tallow, provided there are no signs of septic infection.]

If in the purchase absence of pregnancy was agreed upon, then the buyer is entitled to have indemnification claims on the seller. For this purpose, an authorized certification of the meat inspector is required, specifying the exact weight of the pregnant uterus, and to deduct from the same the weight of a normal uterus, which, in the average, can be calculated in cattle as $1\frac{1}{2}$ kg.; in hogs, 0.75 kg., and in sheep, 60 g.

F. Abnormal Color of the Fat

An intense yellow coloring of the fat appears in old cows as a sign of advanced age. Likewise a change in color of fat occurs, as a rule, through certain influences of feeding. Thus cattle which were principally fattened on the pasture possess an intensely yellow fat. Also in hogs which were extensively fed on corn or cotton-seed meal may be observed a milder yellow coloration of the fat. A more saturated, dirty yellow color is observed in the fat of calves which were nourished on cotton-seed meal or acorn cake. If hogs are fed on fish or garbage the fat manifests a blackish-gray or grayish-yellow coloration.

According to Porcher, the yellow coloration resulting from feeding is dependent upon a pigment, which belongs to the group of "lutein," and which is distinguishable from bilirubin through the sum total of its characteristics.

Lutein is soluble in chloroform, amylalcohol, common alcohol, benzine, turpentine and ether; bilirubin on the other hand, is soluble only in the two first named substances. Lutein has two absorption stripes (green-blue, and blue); bilirubin has none. Solutions of bilirubin in CHCl_3 , shaken with a small quantity of soda solution, lose the pigment rapidly, while the lutein does not. Lutein solutions exposed to the air are soon discolored in contradistinction to that of bilirubin; and lutein solutions do not give the Ehrlich reaction.

Judgment.—Meat and fat of so-called pasture or grass-fed cattle should not be condemned. The same applies to calves, with the above-mentioned yellow coloration of fat. Otherwise, moderate deviations rela-

tive to color, render the meat of a lesser quality. In more marked changes of color the meat, as a rule, shows also abnormalities of odor and taste, and should be judged according to the provisions of the regulations. To mistake the above discolorations for jaundice cannot occur to a careful inspector, as in the yellow coloration resulting from feeding the fat only shows the yellow color, while in icteric animals all connective tissue substances and particularly the serous membranes, manifest a yellow coloration. Relative to further influences on the meat of hogs from feeding upon fish and garbage, see page 185.

[Carcasses showing an intense yellow or greenish-yellow discoloration after proper cooling should be condemned. (B. A. I. Order 150, Regulation 13, section 19.)]

G. Incompletely Bled Animals

Since in the slaughtering of animals it is aimed to abstract from the body as much blood as possible, insufficient bleeding is always somewhat unusual and conspicuous.

Lesions.—There is observed an unusual blood content of the viscera, especially of the liver and intestinal veins, marked fullness of the ventricles of the heart, the subcutaneous veins and those of the muscles, which also contain more moisture. The spongy parts of the bones are richer in blood, as is also the bone-marrow under certain conditions. In accordance with the degree of bleeding, the increased blood content is more or less marked.

In *judgment* it is first of all necessary to decide the cause of insufficient bleeding. If it was the result of disease, then the nature of the disease is the standard for decision.

If insufficient bleeding results as a consequence of long transportation, overexertion, overfeeding, heart stroke, lightning stroke violent brain or spinal-cord injuries, sudden internal bleedings, etc., the meat is, as a rule, to be declared of inferior quality. But there may also be changes present which render the meat entirely unfit for use.

[Carcasses which show indications of incomplete bleeding, which is invariably an evidence of a serious condition of the animal before slaughter, should be condemned.]

H. Exhausted Animals

Although meat of exhausted animals will most frequently have to be judged in accordance with the paragraph above because of insufficient bleeding, still there are instances in which the meat will contain some other peculiarities, as a result of exhaustion. According to Ficker, the exhaustion of animals facilitates considerably

the penetration of bacteria through the intestinal walls. *Bacillus coli* was demonstrated in the kidneys, liver, and mesenteric glands of exhausted dogs, and *B. proteus* in the liver. It produces a similar condition as in the dying animal. This also explains the fact that meat of exhausted food animals spoils soon after slaughter, while it will keep well if animals are rested for several days before being put to death.

Lesions.—The color of the meat is, according to Villain, brown or dark red, frequently even blackish; the odor is repulsive, slightly sour, sometimes similar to ether; the muscle-fibers are dry in cutting; no muscle juice oozes out, and the meat cuts like rubber; hemorrhages and ruptures occur in the muscle-fiber; the spongy part of the bones is dark, the bone-marrow hemorrhagic, and the lymph glands injected. Finally the muscles are supposed to contain 10 times the quantity of kreatin, as in their normal condition.

Judgment.—As a rule, the meat of exhausted animals is unfit for human food, on account of the pronounced repulsive changes.

I. Dead Animals

It sometimes happens that animals are slaughtered after they have died, and that manipulations are undertaken on dead animals to give the appearances of slaughter ("cold slaughter"). Accordingly the meat of dead animals sometimes appears also for inspection.

Lesions.—Absence of signs of a regular slaughter; complete fulness of all the venous vessels, especially noticeable in the liver, intestines, and subcutis; a varied content of blood in the lungs and kidneys (hypostasis); marked fluid content of the subcutis and muscles.

Judgment.—The meat of dead animals is, according to the regulations, unfit for human food.

Whether such meat is objectively unwholesome depends on the cause (disease, accident) which resulted in the death of the animal. Furthermore, meat of dead animals undergoes putrefactive changes very soon (see under H), and as a result may be rendered unwholesome.

The meat of animals which nearly die from injury, stroke of lightning, cardiac, or cerebral apoplexy, suffocation, and from other causes may, in such cases, receive a more liberal decision if some blood could be extracted from the body and the dressing were hastily performed (see above under G).

[According to B. A. I. Order 150, Regulation 13, sections 29 and 30, animals which die in the abattoirs and those in a dying condition should be condemned; the same provision is made for suffocated animals. Besides the regulations also specify that the carcasses of such animals, when conveyed to the tank-room, should not pass through the compartments in which food products are prepared.]

2. General Pathological Changes as Related to Meat Inspection

A. Disturbances of the Circulation

1. Hyperemia

An increased quantity of blood in various parts of the animal body may occur as functional, active, passive, collateral and inflammatory hyperemia, the recognition of which causes no difficulty. However, it should be considered that all changes in organs caused by the quantity of blood in them become, with rare exceptions (local active hyperemia), more or less indistinct after the bleeding of slaughtered animals; on the other hand, after natural death or insufficient bleeding, hyperemia is so pronounced it may serve as a sign for recognition of these last-named conditions. For judgment, see page 192.

Hyperemia should not be confused with hemorrhagic imbibitions, which do not represent an engorgement of blood-vessels, but consist of a red coloration of tissues by the blood-coloring matter, dissolved by blood serum (see septicemia and putrefaction).

Post-mortem Spots (cadaver spots, livid areas, post-mortem hypostasis), are blue discolorations of the skin of dead animals which result from the tendency of blood after death to sink to the dependent tissues, and finally filling the capillaries.

2. Anemia

This condition, which is characterized by a local deficiency of blood (ischemia) in the respective parts, can also be readily detected; and in this connection, the influence of stronger or lesser bleeding should always be taken under consideration. For disposition of such carcasses, see page 192.

Regarding general anemia, see Chap. VII, 4.

3. Hemorrhages

In the occurrence of hemorrhages, it is necessary to distinguish between the escape of blood into the tissues due to tearing of the heart muscle or the walls of the blood-vessels [hemorrhages by rupture (per rhexis) resulting from traumatism, greatly increased blood-pressure or nutritive disturbances of the walls of the blood-vessels], and between hemorrhages without any separation of the continuity of the blood-vessel, from which blood corpuscles and serum escape by diapedesis, through dilated pores of the walls of the vessels. In the first instance, larger hem-

orrhages and blood effusions are produced (extravasations, sugillations, hemorrhagic areas, infarcts, hematomas); in the last instance punctiform, circumscribed hemorrhages are found (petechia and echymosis).

The consistency of the hemorrhages is not affected by the animal being bled to death.

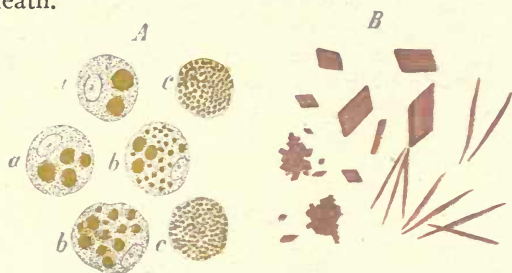


Fig. 75. A, cells containing amorphous blood pigment; a, with a few larger broken down products; b, and c, with numerous small degenerated products of red blood corpuscles B, rhomboid crystals and needles of hematoidin. x 300 diameters (after Ziegler).

For determination of the time of the occurrence of hemorrhages, Drück's publications give the following information:

First the red blood corpuscles swell and commence to clear. As a result of the latter they are distinguished after two days by the appearance of paleness, becoming almost completely transparent; while as a result of the swelling, the bi-concave blood plates gradually adopt a round form. From the fifth day, shrinking takes

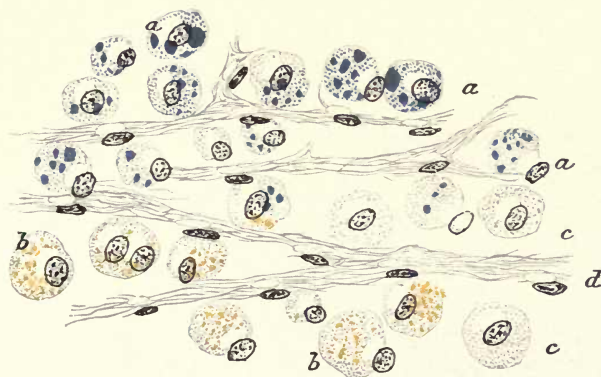


Fig. 76. Cells containing hemosiderin and hematoidin from an old hemorrhagic area in the brain (alk. Berlin blue reaction); a, cells with hemosiderin; b, cells with hematoidin; c, fat granule cells which became cleared; d, new formed connective tissue. x 300 diameters (after Ziegler).

place, with formation of very fine crenations on the periphery of the blood corpuscles. The increased shrinking changes the blood corpuscles up to the 6th to 8th day into either irregular polygonal or star-shaped formations, or into key or cup-shaped bodies. The hemoglobin penetrates the surrounding tissues uniformly, until

the 6th day, to which it confers a brownish tint. At the seventh day hemosiderin (Fig. 76) develops, which contains iron, and soon diffuses through the entire tissue. However, from the 12th day on it is exclusively found in the contracted cells. From the 12th day on the pigment which is at first in solution in the white blood corpuscles becomes granular; and from the 18th to the 25th day it gradually breaks up into finer and finer granules. At the same time the white corpuscles containing granules also break up; so that from the 18th day the first free pigment-granules may be noticed in the tissues. In the latter, about the 60th day, there is a very fine granular pigment exclusively present, which is free of iron. Besides, under certain but entirely unknown conditions, coloring matter crystals may form (hematoidin, a derivative of hemoglobin, containing iron, Fig. 75).

For judgment, see under 5.

4. Transudations

The increased escape of fluid constituents of the blood through the uninjured walls of the vessels, which results inside of the tissue in edema (anasarca, hyposarca) and in the body cavities in effusions, is either the result of changes of the blood (hydremia) or of disturbances of circulation, the recognition of which is very difficult, although the causes are quite significant. While edemas are, as a rule, not changed by slaughter, observation of suspected transudation in the large body cavities requires the personal presence of the inspector at the opening of the carcass.

For judgment, see under 5.

5. Thrombosis and Embolism

Obstructions of blood vessels, as a rule, are recognized in meat inspection only when the obstruction affects large blood vessels, or thrombosis is present in such organs in which a hemorrhagic infarct develops. The infarct usually possesses a wedge-shaped cross-section, and is chiefly conspicuous by its dark red color, which gradually turns to a dim gray and dull yellow. Hemorrhagic infarcts are principally found in organs with terminal arteries (spleen, kidneys, brain, retina), but also in the lungs. If the region of the obstructing blood-vessels does not possess anastomosis with other vessels from which it may receive blood, that region remains free of blood, and dies off. It will develop an anemic, pale infarct, which may be principally observed in the heart, spleen, and kidneys. Later on it results in connective tissue degeneration, and cicatrization of the region cut off from the arterial blood supply.

In the judgment of meat which comes under 1-5 of the above-described local circulatory disturbances, the extent and cause of conditions must be considered, and whether these changes are purely local and appearing independently, or whether they are the accompanying manifestations of a general affection.

In purely local changes, as a rule, only the diseased part of the body, or the entire affected organ is condemned as unfit for human food on account of its altered consistency.

When circulatory disturbances are manifested in numerous parts of the body it is usually indicative of a general affection and should be judged accordingly, but when the circulatory disturbances are not symptomatic of a generally diseased condition and yet appear extensively throughout the body, their significance should be considered under Organic Diseases (page 201).

B. Inflammations

For the purposes of meat inspection it appears most appropriate to consider various inflammations in accordance with the character of their exudates. Accordingly the following forms are distinguished:

1. Serous and catarrhal inflammation.
2. Fibrinous inflammation.
3. Suppurative and ulcerative inflammation.
4. Hemorrhagic inflammation.
5. Croupous inflammation.
6. Diphtheritic inflammation.
7. Gangrenous inflammation.
8. Productive inflammation.

There also belong the variously related and mixed forms (sero-fibrinous inflammation, croupous-diphtheritic inflammation, etc.); also the parenchymatous and interstitial inflammations of glandular organs, which, from a practical standpoint, it is advisable to keep apart.

Regarding lesions found in various forms of inflammations, nothing need be said here, as their manifestations should be familiar to every one who has studied pathology. For the same reason the cause of inflammations will not be treated here.

In *judging* the meat of affected carcasses it is necessary to separate the purely local forms of inflammation from those which appear as accompanying symptoms of general disease. The purely local forms of inflammations are frequently the results of traumatic lesions and are more or less confined to certain areas; accordingly only the inflamed parts, or at most the affected organ, should be condemned as unfit for human food on account of conspicuous changes. This is frequently unnecessary in serous and catarrhal inflammations of the mucous membranes, as the diseased organs are either not used in any form for human food, or in further manipulations of them (intestines, air-passages, urinary and sexual passages) the diseased mucous membranes are removed. That local inflammations may be the starting point of infectious processes is known; and therefore when suspicious of such cases, it is advisable to be careful in making disposition of the meat.

Those general affections which manifest accompanying symptoms of inflammation are usually of an infectious nature (principally the more severe hemorrhagic, croupous, diphtheritic, and parenchymatous inflammations). The judgment of such carcasses depends on the original disease present.

C. Retrogressive Nutritive Disturbances and Infiltration of the Tissues

1. Atrophy

In meat inspection the condition known as atrophy is not of special importance, and comes only into consideration when fat, muscular tissues and certain glands, especially the liver, are affected. While the atrophy of the glandular organs is easily recognized by the decrease in size and the firmer consistency nevertheless the atrophy of the muscles and of the fat tissues is, as a rule, only noticed in an advanced state. As a result of atrophy of parenchyma cells, the connective tissue elements stand out more prominently in the atrophied organ; and this condition is sometimes wrongly considered as an increase of connective tissue (induration).

For judgment, see page 199.

2. Cloudy Swelling

Cloudy swelling (parenchymatous degeneration, granular infiltration) is of the highest diagnostic importance in meat inspection. It occurs in large glandular organs and in muscles, and is characterized by a slight enlargement of the organ, with a cloudy, dull, lusterless appearance, especially of the cut surface, together with the projection and diffused appearance of the latter. The normal color is changed into grayish color tints, the lightness of which corresponds with the severity of the changes. The

consistence of the organ is friable, which as a result of a diminution in blood and moisture may increase to a brittleness. In a pronounced case the organs appear as if they were boiled.

Cloudy swelling is to be considered as a disorganization of the protoplasm, which ensues under the absorption of fluids, and leads to a partial separation of the solid and fluid parts (Ziegler).

Microscopical examination reveals an accumulation of fine, slightly refractory granules in the protoplasm of the swollen cells, the connection of which appears also somewhat loosened. The albuminous granules, which are insoluble in alkalis and ether, but are soluble in acetic acid, cause the cells to have a cloudy appearance, as if they had been covered with dust



Fig. 77 Cloudy swelling of liver cells as a result a septicemia. $\times 350$ diameters (after Ziegler).

(Fig. 77). The nucleus may also be swollen and its structure degenerated.

Cloudy swelling is frequently the precursor of degeneration (see below).

For judgment, see page 199.

3. Fatty Infiltration

Fatty infiltration, which frequently occurs in various organs of fattened food animals, does not represent in meat inspection an abnormal condition, and is here only mentioned in contradistinction to fatty degeneration, which is described below.

By physiological infiltration is understood a deposit of fat globules in the cells, the normal structure of which remains otherwise intact. The fat enters the cells, according to Rievel in dissolved form, is split up, and is then again synthetically built up within the cells (granular fat synthesis of Arnold). This condition appears principally in those tissues which normally serve for storing fat (connective tissue).

It also occurs to a great extent in primitive muscular fibers, in various epithelial cells, and especially in liver cells. To this form of infiltration belongs the so-called fatty liver in highly fattened animals, in advanced pregnancy, in sucking animals, and in diseased conditions where there is an insufficient oxidation of blood.

Fatty liver is characterized by its lighter yellowish-brown color, slight swelling, rounded edges, cloudiness, fatty luster of the cut surface, but with no structural abnormalities (the lobules are not obliterated). The consistence is soft. Microscopically, there is found a rich accumulation of fat in the interlobular tissue, and the swollen fat globules have a tendency to run together, to form large droplets in the cell protoplasm (Fig. 78 a, b).

For judgment, see page 199.

4. Fatty Degeneration

Fatty degeneration, which, according to Rievel, would be more correctly designated as pathological or degenerative fatty infiltration, represents occasionally an advanced development of cloudy swelling; but it may also occur without this preliminary process. It affects both epithelial cells (liver and kidney), connective tissue substances (heart and skeleton muscles, connective tissue fibers), and consists in an accumulation of fat in the cells, the structure of which is more or less injured. Fat, however,

does not originate from breaking up of the cell albumen, as it was formerly supposed; but it is conveyed as such to the cells. The entire procedure might be traced to respiratory causes.

Fatty degenerated organs are characterized by a yellowish color, which may be uniform or spotted, with slight fatty luster of the cut surface, obliterated structural relations, and flabby, doughy consistence. A swelling of organs in the majority of cases does not take place. Microscopically, there is found a disintegration of cell connections, and sometimes crumbling and breaking down of the cell into a fatty detritus, which

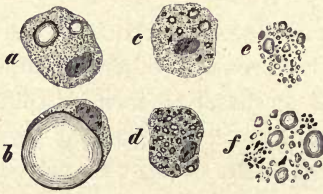


Fig. 78. Liver cells containing fat; *a* and *b*, fatty infiltration; *c*, *d*, *e*, fatty degeneration; $\times 400$ diameters (after Ziegler).



Fig. 79. Fatty degeneration of the heart muscle. $\times 350$ diameters (after Ziegler).

consists of granules and fat globules (Figs. 78 and 79). The latter remain unchanged by the action of acetic acid; while they are dissolved by ether and chloroform.

For judgment see page 199.

5. Various Degenerations

Mucoid degeneration (mucin-metamorphosis) is rarely observed in food animals. It affects fat tissues, which are transformed into a yellow transparent jelly-like mass (Ostertag).

Hyaline or glassy degeneration of the muscles also occurs infrequently, and is always associated with severe general affections. It was observed by Frattner to affect the heart muscles in the malignant form of foot and mouth disease.

Amyloid degenerations have been observed in various organs, especially in fowls.

For judgment, see page 199.

6. Necrosis. Caseation. Gangrene.

The easily recognized necrosis or necrobiosis of the organs or tissues occurs principally as a local affection, and would accordingly be of little

importance in meat inspection if the necrotic parts did not readily become centers for colonization and multiplication of saprophytic and pathogenic micro-organisms. In such cases in the surrounding tissues of the necrotic parts an inflammation always develops, and not infrequently in connection with this a uniformly diseased condition follows in the affected animal.

Caseation is designated as necrobiotic coagulation necrosis, in which the broken-down tissue has a caseous appearance. Tuberculous change of the tissues is the typical form. In cellular tissue, caseation may be frequently observed between the cells as a "fibrinoid mass," or even as typical thready fibrin (Fig. 80).

Gangrene, which results from necrosis as a result of breaking down of diseased tissues through the influence of saprophytes, is characterized by a softening of those tissues under the formation of gases, with an offensive odor. Therefore everything said about necrosis, and especially concerning the danger of a resulting uniform affection, also applies to gangrene; as a matter of fact the development of putrid intoxications or septic infections is quite frequent in connection with gangrene. (See Chap. VII, 6.)

For judgment, see page 199.

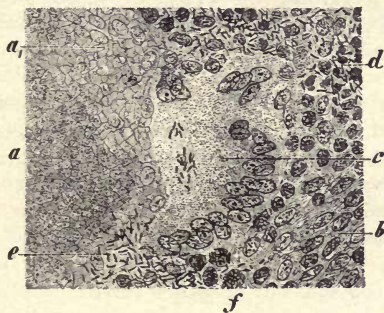


Fig. 80. Tissue from a partially caseated tubercular focus with bacilli (alk. fuchsin-aniline blue); *a*, granular, *a'*, cheesy masses; *b*, fibrous cellular tissue; *c*, partly necrotic giant cells with bacilli; *d*, bacilli in the cellular tissue; *e*, bacilli in necrotic tissue; *f*, bacilli enclosed in cells. x 200 diameters (after Ziegler).

7. Suppuration

While suppuration is a product of inflammation and as such has been already mentioned, it deserves special attention as a frequently occurring disintegration of tissues in food animals.

Although suppuration may be produced by chemical substances (mercury, turpentine, petroleum, creolin, digitoxin, bacterial proteins), still, from a practical standpoint, all cases of suppuration must be considered of infectious origin, occasioned by various pus-forming organisms (staphylococcus pyogenes aureus albus and citreus; streptococcus pyogenes; str. equi; bacillus pyogenes suis; bac. pyogenes bovis; bac.

pyogenes foetidus; bac. liquifaciens bovis; bac. pyelonephritis, and others). Also various other bacilli and bacteria (for instance, actinomyces fungi; botryococcus ascoformans) may act as pus-producing organisms.

Regarding the origin of suppurations, Kreutzer expresses himself as follows: "Pus-forming bacteria irritate the tissues by their large masses, and also through proteins contained in their bodies attract leucocytes (chemotactic action) and produce by this cell-infiltration a true inflammation. Toxins and ferments produced by pus-forming bacteria cause a breaking down of leucocytes, through a chemical action, which makes their return migration impossible—disturb and prevent fibrin-formation, and peptonize all albumen of the tissues." In the horse the most frequent pus-producing organism, according to Kreutzer, is staph. pyogenes aureus and albus; and in cattle streptococcus pyogenes predominates; but in most instances various pus-forming organisms are present at the same time. In the pus of sheep, staph. pyogenes is chiefly present, while in hogs, dogs, and cats it is staphylococcus pyogenes aureus.

Suppuration remains localized as a rule, in the form of suppurative catarrh (pyorrhoea), ulceration, suppurative exudate (empyema) or suppuration inside of the tissues (abscess); or it may be generalized throughout the circulation, and develops into pyemia. (See Chap. VII, section 6.) The local abscesses may become encapsulated, and heal by drying up and calcification.

For judgment, see under 9.

8. Calcification

Deposits of lime salts are found in food animals, either as diffused calcifications in various tissues (cartilage, fat tissues), or as circumscribed areas of calcifications, which partly appear as end-products of retrogressive tissue metamorphosis (calcified deposits within the muscles, calcified abscesses); and also deposits enclosing dead parasites. Circumscribed calcifications are also designated by the unsuitable name of concrements (page 203).

Concrements proper, which occur as so-called intestinal, urinary, biliary, and renal calculi, and which are occasionally found in animals, are of no importance in meat inspection.

For judgment, see under 9.

9. Pathological Pigment Formation

Abnormal pigmentation occurs principally in cattle and in calves; also in sheep and hogs (Lenke, Feuereissen) as melanosis maculosa; or less frequently as melanosis diffusa, which may be confined to single organs

(lungs, pleura, liver, meninges, various parts of the subcutis, muscular aponeurosis), or may be generalized. In the latter form all connective tissues may be intermixed with black-colored spots. The melano-sarcomata belong to the multiple tumor-formations.

The condition described by Virchow as ochronosis—a brown to blackish coloration of the cartilage, tendons, and capsules of the joints—is brought on by imbibition of the basic substance with coloring similar to that of melanin. It occurs in cattle, calves, and hogs. (Mosselmann, Brouvier, Lachmann, Hélrout, Bail, and others.)

The condition described by Goltz as xanthosis, and which is of comparatively rare occurrence, consists of a liver-brown discoloration of the muscles; according to Roth and Resow, a designation of "brown atrophy" would apply more correctly to this condition. It is always associated with changes of the supra-renal capsules.

The hematogenous pigment formations (changing of the blood coloring-matter in extravasations, etc., page 191), and the symptomatic discoloration of tissues (icterus) cannot be considered here.

In *judging* cases of atrophic degeneration and infiltration of tissues (pages 194-199), it should be decided in the first place, whether the processes are purely localized or whether they represent symptoms of general affections.

As localized cases are considered, all those conditions of atrophy, fatty infiltration, necrosis, suppuration, calcification and pigment-formation in which either the affection is slight and the localized diseased parts are removable, or the affected organ itself is considered as unwholesome and must be condemned as unfit for human food.

Fatty infiltration, however, gives no cause for condemnation unless at the same time conspicuous changes in the consistence (pulpy softening) of such organs confer upon them the character of a spoiled condition.

In necrosis and gangrene the meat should be carefully examined for evidence of septicemia; and in fresh suppurations a similar examination regarding pyemic manifestations should be made.

General muscular atrophy should be judged according to the principles of emaciation (page 183).

Pigment formation may appear wide-spread throughout the entire body (melanosis), thereby rendering the animal unfit for human food. In local pigmentations, judgment should be made in accordance with the regulations.

The occurrence of cloudy swelling, fatty, mucoid, hyaline, and amyloid degenerations points usually to severe generalized affections, and judging should be in accordance with the nature of the disease.

Circumscribed calcifications—so-called lime concrements—have to be judged according to their etiology, especially if they appear in multiples, and are more or less extensive (see muscle concrements, page 203).

[The judgment of the conditions described above is carried out by the United States meat-inspection force on similar lines to those provided by the German regulations.]

D. Hypertrophy, Hyperplasia, Metaplasia

The hypertrophy of an organ through enlargement of the elementary constituents (hypertrophy), or through increase of these constituents (hyperplasia), has no importance in meat inspection, as in this condition the macroscopical composition does not appear changed.

The condition designated as metaplasia, represents transformation of already developed tissues into other tissues, without intervention of organisms or connective tissues; it occurs in food animals as bone-formation in scars (castration scars), in the belly-fat and mesentery of hogs, etc., and is of no importance to meat inspection.

Judgment.—Hyperthrophic and hyperplastic organs give no cause for condemnation. Metaplastic tissues, however, should be condemned inasmuch as they represent foreign bodies in the affected tissues. [The same disposition is observed by the United States meat-inspection force.]

E. Tumors

Nonmalignant tumors appear principally localized, and confined as solitary or isolated new formations on one and the same part of the body.

In malignant tumors (sarcoma and carcinoma) an affection of the corresponding lymph glands is invariably associated, and sometimes there is extensive metastasis, which may result in generalized sarcomatosis and carcinomatosis, without the accompaniment of cachectic conditions in the lower animals.

Judgment.—Nonmalignant tumors are usually easily removed, and after their removal they have no influence on the wholesomeness of the part of the body from which they were excised.

Regarding malignant tumors, transmissibility of sarcomas and carcinomas to man by the ingestion of meat is probably to be excluded; at any rate it is not yet proven. In most cases the affected organ, together with its lymph glands is involved by malignant tumors to such an extent that it becomes unfit for human food, and should therefore be condemned.

Where tumors are numerous, a decision is made from the extent of the lesions and the nutritive state of the carcass as to whether it should be passed for food, declared of an inferior quality, or be condemned. The latter should always be pronounced if metastasis occurs on numerous parts of the skeleton, body, or in the lymph glands; or if secondary changes (watery condition, flabbiness, etc.) are observed in the muscles.

Regarding so-called granulomata or infectious growths (new formations in tuberculosis, actinomycosis, botryomycosis, and glanders), note the chapter on infectious diseases.

[According to B. A. I. Order 150, Regulation 13, section 23, any organ or part of carcass which is affected by malignant or benign tumors shall be condemned, but when the lesions are so extensive as to affect the whole carcass, the whole carcass shall be condemned.]

F. Malformations

Various malformations which occur in food animals are only of importance in meat inspection should they conspicuously change the appearance or structure of that respective part of the body. When marked structural changes are present, or if there be a repulsive appearance of the malformed part, it should be declared as unfit for human food; in milder cases only partial condemnation may be necessary.

3. The Principal Affections of Tissues and Organs

In the following section, only those pathologic-anatomical changes of tissues and organs will be discussed which possess a certain importance in meat inspection, and which have not been sufficiently described in the previous chapters.

In *judging* these tissues and organic diseases in meat inspection, it should be understood that they usually cause purely localized changes, which require only removal of the diseased tissues or the respective organs, for only exceptionally do they affect the full value of the entire carcass. Therefore the judging of the diseases described below, which should be chiefly carried out according to the regulations, will not be further mentioned under the various processes, and will be specified only in such places where they have to be considered from an additional point of view.

A. Skeleton Muscles

1. *Hemorrhages* may appear in muscles as local and multiple hemorrhages. The first occur from local traumatic influences which result in a tearing of the muscular fibers and their blood-vessels. Multiple hemorrhages are sometimes due to toxic or infectious causes; more frequently, however, they are of mechanical origin.

Multiple hemorrhages in muscles of fattened hogs belong to hemorrhages of mechanical origin (*fragmentatio hemorrhagica carnis*, Kitt). They result from tearing of the muscle fibers and capillaries in consequence of exertions, to which the fatty infiltrated muscular fibers are not equal on account of not being used to work. They are found as irregular, isolated spots, of sizes ranging from a pin's head to twice the size of a pea, in at least 8 per cent. of all the slaughtered hogs, and principally in the muscles of the diaphragm; next in frequency they occur in the abdomi-

nal, psoas, and pelvic muscles. In rare cases they may also be found in all the skeleton muscles. Occasionally multiple hemorrhages may also occur in all species of food animals; for instance, they were described in cattle, by Clausen.

Multiple hemorrhages of toxic and infectious origin are accompanying symptoms of phosphorous poisoning, tetanus, and anthrax, as well as septic and pyemic diseases. Besides these, there are always present ecchymoses on the serous membranes and other characteristic lesions of the respective general diseases. The judgment of meat showing these hemorrhages should, therefore, be carried out according to the nature of the condition which produced them.

2. *Inflammatory processes* of the muscles are principally of traumatic origin, and are locally confined. Inflammatory changes which are scattered and not of traumatic origin (polymyositis) appear as symptoms of severe general affections, and result frequently in muscle degenerations.

Whether the so-called "chicken-meat appearance," which has been several times observed in calves and young cattle, represents always an interstitial myositis (Stoss, Bayersdörfer, or whether the condition might be the result of deficiency of muscle coloring matter, is not yet definitely established. The latter is probably also the case in iridescence of the muscles, which is occasionally observed on the longissimus dorsi muscle of hogs. More frequently, iridescence occurs on boiled, pickled, or smoked meat (see Chap. IX).

3. *Degenerations, cloudy swelling, or granular degeneration* of the muscle fibers occur in severe intoxications and in febrile infectious diseases. The macroscopical appearance of the degenerated muscle shows a flabby, mellow, pale, gray, and cloudy condition; microscopically, the muscle fibers show fine granular, dust-like, albuminous precipitation, which disappears upon addition of acetic acid (see page 194).

In fatty degeneration the muscles appear still softer, yellowish, or mottled, with yellow stripes. Microscopically, strong refractory bodies (fat globules) are found, which, under certain conditions, may cover the cross striations, and do not disappear upon addition of acetic acid (see Fig. 79).

Regarding fatty infiltration, which should not be confused with fatty degeneration, see page 195.

Hyaline or glassy degeneration is observed in hemaglobinemia, morbus maculosus, acute muscular rheumatism, and in parturient paresis (Zschokke).

Macroscopically, hyaline degeneration is only recognizable when it affects numerous muscle fibers. In such cases, the muscles appear cloudy, dull, pale, like the meat of fish. Microscopically, the necrotic and so-called contractile substances appear homogeneous, glassy, and disintegrated into flakes.

The nature of hyaline degeneration of muscles observed in isolated cases in young cattle and calves, and producing a white or colored appearance, is not yet clear.

The peculiar changes which were recently described as specific muscle degenerations (Ostertag), and which were formerly designated as muscle actinomycosis (Duncker), also appear to be hyaline degeneration, according to David. This specific degeneration develops also without a general diseased condition (Fig. 83).

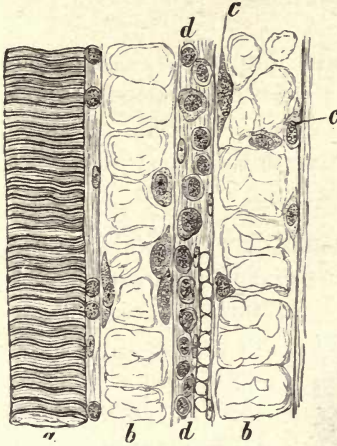


Fig. 81. Amyloid degeneration; *a*, transversely striated normal fibers; *b*, degenerated fibers; *c*, enlarged muscle nuclei; *d*, connective tissue infiltrated with cells. x 250 diameters (after Ziegler).

4. *Lime concretions* are often found in the muscles of hogs, and may occur in large numbers. Frequently they may be recognized by the naked eye as small, elongated, or round, gray or grayish-white points and dots. They are most frequently met with in muscles of the diaphragm and abdomen. These concretions are indicative of either the end-products of retrogressive metamorphosis of the tissues, or calcification of dead parasites. The latter is occasionally confirmed by microscopical examination, which, however, does not disclose the nature of the concretions in numerous cases. Glage

demonstrated *cysticercus tenuicollis* as the cause of lime concretions occurring in sheep.

Tumors occurring in the muscles, embolic affections, metaplasia, and parasites are discussed elsewhere.

Blastomycosis of the muscles of cattle, described by Ostertag, is very rare. All the muscles are studded with fibrinous nodules in sizes ranging from a lentil to that of a walnut, the centers of which contain punctiform, yellowish, cloudy colonies.

Judgment of the above affections of the muscles, see page 201. Occasionally, especially in the presence of lime concretion, the meat must be considered of inferior quality.



Fig. 82. Lime concretions in the muscles of hog. x 40 diameters.

B. Connective Tissue

1. *Hemorrhages*.—Regarding the etiology and anatomy of hemorrhages which occur in connective tissue, the same remarks apply which were stated above relative to hemorrhages of the muscles; and also on page 190, concerning hemorrhages in general.

2. *Imbibition* with blood coloring-matter only occurs in general affections (intoxications and infectious diseases), where the blood becomes wax-colored, or where through action of water post mortem, the blood contained in the meat transmits coloring matter to the fluids of the tissues (for instance, meat exposed to the rain).

But as meat from well-bled animals should only contain traces of blood, therefore only an insignificant local bloody imbibition can develop through the influence of water. Accordingly the larger bloody imbibitions are always suspicious.

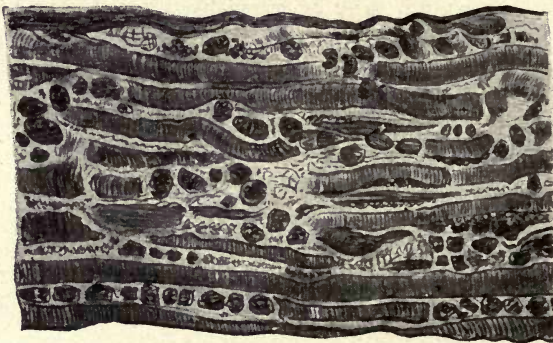


Fig. 83. Specific degeneration of the muscle of hog, x 35 diameter. (After Duncker.)

3. *Inflammatory and breaking-down processes* in connective tissue (hyperemia, edema, phlegmon, suppurations, etc.) appear under known pathological-anatomical manifestations.

Large and extensive edemas may be the symptoms of severe general affections (hydreemia, cachexia). In suppuration and putrefaction of the connective tissues, pyemia and septicemia should be remembered.

4. *Emphysema*.—The presence of air in the subcutaneous tissue and the intermuscular connective tissue may be artificially produced by inflating the carcasses of calves and sheep (page 27), through forcing air into the subcutis.

[This practice in this country is confined to Louisiana and Eastern Texas to meet the demands of the French people.]

Furthermore, emphysema may result from injuries of the air-passages and lungs, as well as through escape of gas from the intestines, in cases where adhesions of the intestines to the abdominal wall are present causing perforation to take place. In such cases the collection of gas in

the connective tissue becomes conspicuous by its disagreeable odor. The latter is also noticeable, when emphysema is the result of gangrenous decompositions, black-leg, septicemia, etc. Also injuries to the skin, which allow the subcutaneous tissues to come in contact with the outside air, may result in emphysema at such places where the skin is easily displaced (extremities).

The other pathological changes in connective tissue are either of no importance in meat inspection or are discussed in other parts; such as parasitic affections, tumors, and embolic processes.

Regarding the judgment of such changes in the connective tissue, see page 201. Inflated meat, according to the regulations, is to be declared unfit for human food.

C. Fat Tissue

In general, the fat tissue is rarely affected by diseased changes; occasionally, however, the following characteristics may be present:

1. *A sclerotic condition* of the fat tissues (lipoma) occurs occasionally in the kidney fat of cattle and in hog leaf lard (especially in hogs from Bakony-Hungary). The fat tissue in these places appears in larger or smaller nodules, opaque, firm, almost like skin (called fat-stones by butchers). Microscopically, there is found a hyperplasia of connective tissue structures at the expense of the number of fat cells.

2. *Black pigmentation* appears occasionally in the belly-fat of fat black-haired hogs, very probably the result of hemorrhages (Ostertag). They appear as numerous black irregularly-formed spots, frequently branched in the shape of trees or like veins. Besides a deposit of coloring matter (melanosis diffusa) may be frequently observed on the belly-fat of hogs, which gives to the bacon a bluish-black appearance, with fine dotted lines, and at some places a brownish tint (Glage, Feueressen). A green coloration of fat tissue and muscles near the intestinal tract, on the breast-bone, carpal joint, hips, and abdomen was found by Beel in cattle which were constantly pastured. In boiling the discolored meat of these regions an impregnated "grass odor" appeared.

3. *Multiple fat necrosis* has been repeatedly observed in the retro-peritoneal fat tissue on the fat of the mesentery, and on the omentum in the form of numerous yellow-white opaque colonies, up to the size of a ten-cent piece (Ostertag). It may be that this affection, which is usually of no consequence in meat inspection, is associated with a diseased condition of the pancreas (page 209).

The judgment of the diseased changes of the fat tissue is indicated on page 201.

D. Bone Tissue

The various diseased conditions involving the bones do not require a special discussion at this time, since they mostly occur as purely local changes, are readily intelligible as to their pathologic-anatomical nature, and are of little importance in meat inspection. But inasmuch as diseases

of bone-tissue and bone-marrow may also occur in association with general affections, as in rhachitis, osteomalacia, osteomyelitis, pyemia, leukemia, or from a parasitic cause (tuberculosis, actinomycosis, botryomycosis, glanders, echinococci) they are mentioned in course of the description of these respective diseases. Regarding pigmentation of bone-tissue, see page 199.

Although *presternal calcification* (Ostertag) does not belong directly to affections of the bones, nevertheless discussion of that condition is best

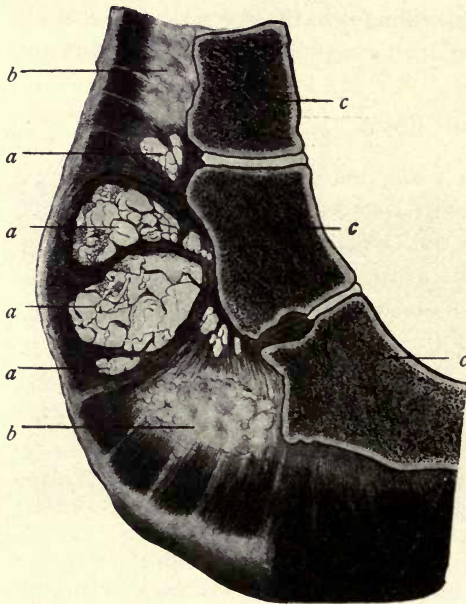


Fig. 84. Cross section through the point of the breast of cattle with presternal calcification; a, lime deposit; b, normal cushion of the sternum; c, sternal bones.

given at this place. Occasionally there is found in cattle in the presternal fat-cushion, knobby, irregularly shaped formations with calcified contents of sizes ranging from that of a nut to as large as a man's fist. Occasionally these formations extend into the sternum as a result of pressure. In a superficial examination these calcifications might be mistaken for tubercular lesions, but they are, without a doubt, of traumatic origin. They can be distinguished from tubercular processes by their appearance of plaster-Paris like masses, which are pure white in color. (Fig. 84.)

For the judgment of bone affections see page 201.

E. Cartilaginous Tissue

The pathological changes of the cartilaginous tissues have no significance for the inspector of meats.

F. The Other Meat Components

Diseases of other components of meat in the narrow sense, namely those of the nervous system, the lymph and blood vessels and lymph glands will be discussed later.

G. Digestive Apparatus

Traumatic inflammation of the rumen.—Through the pricking of the rumen by sharp foreign bodies taken up with food, a chronic inflammation develops of a suppurative or sclerotic nature, which results in thickening

of the wall of that organ; and also, as a rule, in plastic or suppurative inflammation of the serous covering. Besides, adhesion of the rumen to neighboring organs may also develop, which generally involves the diaphragm first. Through strong contraction of the muscles of the rumen, sharp foreign bodies are pushed forward and principally in the direction of the diaphragm. In their course around the tissues these foreign bodies form fibrous tissue, fistulous tracts and abscesses, with greenish-yellow pus. The abscess may develop between the stomach, liver, and diaphragm, and may become the size of a man's head.

After perforation of the diaphragm, these foreign bodies not infrequently strike the pericardium, which is only about 3-4 cm. from it, resulting in pericarditis.

Regarding septic peritonitis or pleuritis, which develops from perforation of suppurative material into the abdominal and thoracic cavities, see Chap. VII, section 6, A, 12-13.

2. *Peptic Ulcers*.—Round or peptic ulcers are occasionally found in the abomasum of calves in the form of sharply-defined erosions in the mucous membrane, with slightly rounded edges. The ulcers are not necessarily always round; they may extend into the muscular coat of the stomach; and occasionally only the serous membrane of the thickness of paper is left intact. Similar ulcers may also occur in the duodenum. The inspector's attention is usually called to the presence of these affections in the abomasum, by peritonitis, which corresponds with the location of the ulcers; or a perforation of the ulcer may occur shortly before death of the animal, as during transportation for slaughter, etc., and in such cases the contents of the stomach are found in the abdominal cavity.

Should the ulcer, through an early perforation, produce septic peritonitis, the meat should be condemned as unfit for human food. In late perforations care should be taken in the judgment, on account of a repulsive sour odor which the meat may possess (boiling test). Otherwise, peptic ulcers are of no importance to the veterinary inspector of meats.

[If peritonitis develops in consequence of a peptic ulcer the carcass should be condemned according to B. A. I. Order 150, Regulation 13, section 18, a.]

3. *Diffused lymphadenia* of the mucous membrane of the abomasum is sometimes observed in cattle. On the rigid stomach-wall the mucous membrane appears sometimes to the thickness of 5 cm., fatty, grayish-white, and glassy in places.

4. The rarely occurring *diphtheritic inflammation* of the abomasum of cattle is, according to Ledschbor, due to a long filamentous bacterium, which resembles very much the bacillus necrophorus.

5. *Multiple hemorrhages* in the intestinal wall have been occasionally observed in cattle and hogs; in the latter it is usually associated with multiple hemorrhages of the muscles (page 201). The origin of these hemorrhages is not yet sufficiently explained. It may be that the small hemorrhages are of purely mechanical origin (severe coughing, asphyxia); larger ones on the other hand, may have other causes, such as septic and other acute infections, which however may be excluded from cases mentioned here. To point out this fact is the only reason for mentioning these larger hemorrhages.

6. Regarding characteristic changes of the intestines in hog cholera, see Chap. VII, Sec. 6, B. No. 3.

7. *Changes of the liver*, which were formerly called angiomas, were recently designated as teleangiectasis by Jaeger; this condition commonly occurs in older animals, most frequently in a multiple and spotted form in cows (hemangioma cavernosum hepatis, Kitt).

Even externally can be seen under the serous membrane of the liver deepened, irregularly formed, purple-red to bluish-black spots, in greatly varying sizes, sometimes confined to single sections of the liver, but may also affect the entire organ. On the cut surface the spots appear contracted, of a reddish tinge and spongy consistence (blood sponges), and are sharply separated from the otherwise normal liver parenchyma.

According to Jaeger, the anatomical foundation of the teleangiectatic degeneration in the liver of cattle results primarily from a breaking down of liver cells in groups, leaving the bordering capillary endothelium intact. Thus the unaffected capillary blood circulation extends under its own blood pressure toward the margin of the altered parenchyma, forming sinuses, and finally cavernous spaces. There are no satisfactory explanations concerning the cause of this degeneration (illustration on Plate II, Fig. 2).

8. *Chronic interstitial hepatitis* may occur in various stages in all food animals. In the early stages the liver appears greatly enlarged, grayish-brown in color, firm and dense (hypertrophic cirrhosis), while later it becomes smaller and harder, through the cicatricial contraction of the interstitial newly-formed connective tissue. Portions of the parenchyma become obliterated, while intact parts of the latter protrude so that the surface and the section of the liver appear granular (atrophic cirrhosis, cirrhotic granular atrophy, hob-nail liver).

According to Tschauer, cirrhosis of the liver in hogs appears to be produced occasionally by feeding alcoholic food-stuffs which are in the act of fermentation (swill). Cirrhosis of the liver in horses is of importance in diagnosis of so-called "Schweinsberger disease." The cirrhotic connective tissue proliferation in the liver of cattle having distomatosis is, according to Jaeger, due to the irritating toxic products of metabolism from distomas in the bile ducts.

9. *Multiple liver necrosis* is observed principally in cattle (necrosis nodosa, Kitt), but it occurs also in calves, sheep, hogs (hog cholera),

horses, and dogs. Through the liver, which is frequently enlarged, icteric, of an olive-brown to a red-brown color, are disseminated embolic, pale-brown or grayish-yellow sharply circumscribed foci or nodules in large numbers. They are without luster, brittle, compact, and surrounded in the early stages by a red zone, but later by a connective tissue capsule. Occasionally in later stages the necrotic masses are transformed into a greenish, flaky, pus-like fluid. The causative factor of these changes is the bacillus necrophorus, which is conveyed to the liver by the portal or umbilical vessels and obtains lodgment in that organ.

10. *Calcareo-fibrous nodules* are quite frequently found in the liver of the horse (chalicosis nodosa). They are disseminated in all parts of the liver tissue, as sharply circumscribed yellow to yellowish-brown formations, of sizes ranging from a pin's head to that of a millet seed, and are parasitic in origin.

11. *A peculiar nodular formation* in a calf's liver is described by Langer. He found in that organ sharply circumscribed foci situated under the capsule of the liver, which were of a grayish-white to an orange-red color, and of varying sizes up to a millet seed. Langer considers the foci as the remains of an infectious disease, which is produced by a bacillus first isolated by Bugge, and which he termed bacillus nodulifacius bovis, a new species of the para-typhoid group. Manifestation of a general disease was not observed in the affected calves.

12. *Fatty necrosis of the pancreas* is observed in old, very fat hogs. The greatly hypertrophied fat tissue enveloping the pancreas shows numerous dull grayish-yellow or grayish nodular areas, which are dry, hard, or cheesy. The glandular tissue proper appears intact, and therefore no disturbances in the general condition of the animals can be observed. The nature of the necrosis is still unknown (see also page 205, under C. 3).

Regarding the judgment for the above-mentioned diseases of the digestive apparatus, see page 201.

H. Peritoneum

1. *Mesenteric emphysema (intestinal emphysema Jaeger) of the hog*.—On the small intestines and its mesentery are found not infrequently single or grape-like clusters of air-containing cysts of sizes ranging from a pin head to a grape, which sometimes hang on pedicles. The walls of the cysts appear transparent, or are colored red, by hemorrhages. Sometimes the air-cysts accompany the course of the mesenteric vessels in the form of a rose wreath; occasionally cysts are also found in the muscular coat of the intestines and in the lymph glands. The origin of this pneumatosis which was investigated by Schmutzer and Heydemann is, according to Jaeger, caused by the bacterium coli lymphaticum aërogenes, which belongs to the coli group and penetrates the intestinal wall, where it produces gas as a result of its great fermenting qualities; it only secondarily extends to the mesentery in severe cases.

2. *Hypophrenic Abscesses*.—Abscess formations which may develop at any part of the peritoneum are of the greatest interest in meat inspection, and those suppurations which not infrequently develop between the diaphragm, liver, and kidneys of cattle may often reach a considerable size, and are encapsulated. In the process of removing the abdominal viscera, these abscesses are frequently cut open, resulting in a soiling of the viscera and the parietal serous membrane of the body cavities with the contained pus. In such cases the serous membranes should be removed as well as the superficial layer of the meat which has been contaminated. Regarding other results from these abscesses, see page 299.

3. Regarding *peritonitis* as a result of heavy infestation by *cysticercus tenuicollis*, see page 232.

4. *Multiple calcifications* in the form of flat elevations (Ostertag) of sizes ranging from a pin head to that of a lentil, occur comparatively rarely on the peritoneum in cattle, and must not be mistaken for tuberculosis.

For the judging of the diseases of the peritoneum, see page 201.

J. Genito-urinary Apparatus

1. *The white-spotted kidney of calves* (nephritis fibro-plastica or maculosa alba) occurs more frequently than is really observed, as the recognition of these changes is frequently made difficult by the perirenal

kidney fat. Even on the surface of the kidney may be seen slightly projecting whitish-gray spots, which are distributed over numerous lobules, from the size of a millet seed to that of a bean and even a hazelnut. On section the white spots appear as wedge-shaped or circular, juicy, shining areas, which extend through the cortex, reaching to the medullary or tubular layer. In the medullary substance the grayish-white extensions appear less frequently. The parenchyma of the kidney is generally unchanged; occasionally a slightly reddened zone is found around the white areas; or less frequently single punctiform hemorrhages are seen in the parenchyma, which, however, are probably coincident.



Fig. 85. Kidney of calf with fibroplastic nephritis

extend through the cortex, reaching to the medullary or tubular layer. In the medullary substance the grayish-white extensions appear less frequently. The parenchyma of the kidney is generally unchanged; occasionally a slightly reddened zone is found around the white areas; or less frequently single punctiform hemorrhages are seen in the parenchyma, which, however, are probably coincident.

The nature of these spotted changes in the kidney is, according to Rieck, Kitt, Kabitz, and others, infectious emboli, while Vaerst considers the white areas as embryonic nodular remains of the blastemic state.

De Blicke considers the process as an acute, hematogenous, toxic, parenchymatous-and interstitial nephritis, a diffused focal nephritis, the cause of which is

unknown. Against this, however, Gillebeau emphasizes the fact that the inflammatory origin of the spotted kidney is neither histologically nor clinically understood, but that even De Blicck's findings speak for the blastemic theory.

At any rate, this change in the kidney is without a noticeable influence on the general condition of the calves; besides, its harmless nature is also confirmed by complete disappearance of the spots inside of the first year of life.

The appearance of the above-described changes in a diffused extension over the entire cortical layer of the kidney, which is designated by Kitt as nephritis alba, or fibroplastica diffusa, is quite rare. These white spots are confluent to such an extent that the entire cortical layer appears to be of a whitish color. In the medullary layer there is always a hyperemia in such cases with hemorrhages, and edematous infiltration of parts adjacent to the pelvis of the kidney.

2. From *purulent nephritis*, which, as a rule, occurs as a hematogenous, embolic, focal nephritis, but which may also develop gradually, should be distinguished the bacterial (diphtheritic) pyelonephritis, which is a special form. It appears occasionally in cattle on one or both sides, and is probably of hematogenous origin (Bollinger, Ernst) and of a cryptogenetic nature.

The kidney is prominently enlarged, and its surface is either spotted with gray or totally gray in color. Moreover the kidney is enveloped in a fat capsule which has undergone a serous infiltration. On section a collection of slimy pus with a strongly smelling urinous odor is noted in the distended pelvis of the kidney and in the dilated calices, the walls of which are considerably thickened. The papillæ of the kidney show a diphtheritic deposit, and pin-shaped, radiating, yellowish-gray streaks of various breadths extend from the center toward the cortex. In the same, and also in normally appearing parts of the kidney, may be found small, suppurative, softening foci. With progression of the lesion the kidney tissue degenerates more and more, until finally the enormously enlarged kidney may only represent a thin-walled cyst filled with pus (pyonephrosis). Besides, the urethra also appears dilated and filled with pus in advanced cases, on one or both sides.

The bacillus renalis bovis is accepted as the cause of pyelonephritis in cattle, but mixed infections also occur, so that according to Kitt, Cadéac, Lucet, and Ernst, the affection may be considered as polybacterial, similar to other suppurative processes.

In *judgment* of pyelonephritis, there is to be considered the general condition, the nutritive state, and whether there are other suppurations in the body.

Unilateral pyelonephritis appears generally as a purely local affection; if bilateral, retention of urine has to be suspected, and the meat should be tested by boiling for odor of urine. The result of the latter, and also other changes which might be present, determine whether the meat should be declared of inferior quality or be condemned as totally unfit for human food.

[In cases of bilateral pyelonephritis causing a retention of urine, the carcass should be condemned according to Regulation 13, section 20, of B. A. I. Order 150.]

3. *Cystic and bladder kidneys* not infrequently appear in hogs, cattle, and occasionally also in calves. The first are limited to single small or larger sections of the kidney from which the flow of the urine is prevented, while in the latter the entire kidney represents a cyst filled with urine (hydronephrosis).

When the latter is found affecting both sides, greater attention is required in the judgment of the meat, as not only meat in the surrounding parts may be watery, but such may also occur at distant parts of the body. Besides this edematous condition, the meat might possess a urinous odor. The boiling test should determine the extent of this condition, and in accordance with the objective finding of the meat it should be passed or declared of inferior quality or condemned.

[Frequently only one kidney is found cystic, in which case the carcass is passed for food; while if the affection is bilateral, causing an edematous condition of the meat in various parts of the body, or if the meat possesses a urinous odor, the carcass should be condemned (B. A. I. Order 150, Regulation 13, section 20)].

4. *The inflammations of the uterus* are for the inspector of prominent interest on account of their relations to septicemia (Chap. VII, page 296). All acute inflammations of the uterus, following parturition, or as a result of fetal and placental decomposition, should be considered suspicious.

5. *Catarrh of the uterus* may result in hydrometra and pyometra, due to accumulations of muco-purulent secretions in that organ. Chronic catarrh (leucorrhœa) may occasionally be followed by great emaciation, thus giving sufficient cause to declare the meat of inferior quality. Otherwise, the suppurative contents of the uterus is of no consequence if there are no pyemic or septicemic manifestations present.

[In acute cases of diffused nephritis, the carcasses should be condemned (B. A. I. Order 150, Regulation 13 section 18, d)].

6. *The infectious vaginal catarrh of cattle* (colpitis follicularis infectiosa, vaginitis granularis infectiosa bovis, Raebiger), of which the causes are probably spe-

cific streptococci (*streptococcus vaginitis bovis*, Ostertag), is accompanied by a nodular formation in the inflamed mucous membrane. It is of no importance for the veterinary inspector.

Regarding the diseases of the urinary and sexual apparatus, see page 201.

K. Udder

1. *Catarrh of the udder* is only mentioned as it has been mistaken for tuberculosis of the udder. The enlarged quarters of the udder are harder; from the teats of the diseased quarters may be squeezed out a thick ropy secretion, which is intermixed with pus; the mammary lymph glands are uniformly swollen, but they are not lumpy and hard. On the cut surface the milk-ducts are found to be dilated and filled with the above-mentioned secretion; their walls are thickened, and occasionally the mucous membrane shows firm fibrous nodules, which, on superficial observation, resemble tuberculous nodules. The interparenchymatous connective tissue is increased; the lobules of the glands are, however, apparently unchanged.

In the course of catarrh of the udder some of the milk-ducts may become obstructed and dilated, so that cysts will develop, which on touch are lumpy (milk nodes) and are filled with a curdy content.

2. Of the various inflammations of the udder, there will be mentioned here only *gangrenous and septic mastitis* (Chap. VII, page 318), on account of the associated severe general affection, according to which the judgment should be made.

A catarrhal form of mastitis, which leads to agalactia, and which is called in Switzerland "yellow galt," is caused by a particular streptococcus. Dammann and Freese described an infectious inflammation of the udder in sheep which is produced by a rod-shaped bacteria.

3. Regarding the characteristic changes in color of cows' udders on boiling, see Chap. VIII.

For judgment of the disease of the udder, compare with page 201.

[According to B. A. I. Order 150, Regulation 13, section 18, d, carcasses which are affected with acute diffused mammitis should be condemned.]

L. Respiratory Apparatus

1. *Subpleural hemorrhages of the lung*, which are very frequently seen in food animals, originate at the time of slaughter, and are to be considered as hemorrhages from suffocation. They are punctiform, sharply defined, light red in color, and are disseminated over the entire lung. These hemorrhages are absolutely of no importance for the inspector, and should not be mistaken for ecchymosis of septic origin.

2. Of *inflammations of the lungs* especially to be noted are specific pneumonias, which characterize contagious pleuro-pneumonia in cattle and swine-plague (see pages 304 and 309).

3. *Calcareo-fibrous nodules* in the lungs are very frequently found in horses (*chalicosis nodularis*). They occur irregularly scattered in the parenchyma of the lung, and are usually very numerous, firm, readily peel, in sizes from a pin head to that of a hemp seed, and are rarely as large as a pea.

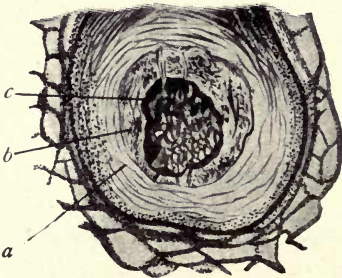


Fig. 86. Calcareo-fibrous nodule from the lung of a horse; *a*, connective capsule; *b*, slightly, and *c*, markedly calcified center (after Kitt).

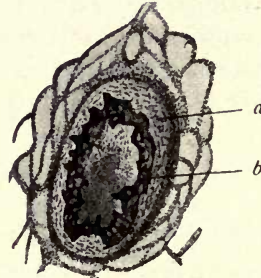


Fig. 87. Calcareo-fibrous nodules from the lung of a horse; *a*, connective tissue capsule; *b*, calcified zone (after Kitt).

Their color is white or whitish-gray, and young nodules appear glassy. There is no red zone surrounding them. The origin of these nodules, which occasionally appear at the same time in the liver (page 208), might be traced back to embolic invasion of animal parasites (Olt, Künnemann, Schütz, Grips).

In differentiating the calcareo-fibrous nodules from those of glanders, it is to be considered that in the first place the red zone is absent; furthermore, they are of uniform size and consistence, possess pronounced inclination toward calcification, while all manifestations of glanders are absent. Though a normal condition of the bronchial glands might have some weight in comparison with glanders, there are instances where calcareo-fibrous nodules may also appear in the lymph glands. Besides, the histological structure of the nodules determines the nature of the affection, which is reproduced in the preceding illustrations (Figs. 86 and 87), in comparison with the structure of glanders nodules Chap. VII, page 282.

For the judgment of diseases of the respiratory apparatus, see page 201.

4. *Anthracosis* of the lungs occurs in horses and cattle, as well as in dogs, in which about 60 per cent. may be affected with it (Feuereissen).

5. *Pollution of the lungs* with blood and contents of the stomach may follow the slaughter of all food animals, as a result of inhaling these substances. Most frequently it occurs in animals which have been "shacted," but is found also in sheep (Müller), cattle, and hogs. While blood can be readily recognized by the irregularly red-colored sections of the lungs, the aspiration of food can be only determined by cutting into the lung in the posterior third of the main lobe. Such

a procedure is necessary in examination for the presence of scalding water in the lungs of hogs. To determine the extensiveness of the aspiration of food, it is recommended that during the act of cutting the bronchial lymph glands to sever at the same time the principal bronchus of each side; as otherwise the aspirated food, which does not extend into the small bronchi, cannot be seen.

In the *judgment* of these pollutions of the lungs, their extent should determine the disposition of them. If the aspiration of blood is only slight, and the amount of food and scalding water limited to the trachea and large bronchi, the lungs may be passed after a thorough cleansing. In pronounced aspirations of blood the lungs should be declared of inferior quality. In the presence of food contents or scalding water in the deeper sections of bronchial tubes the lungs should be condemned as unfit for human food.

[Lungs containing aspirated substances, either solids or liquids, are condemned in the United States.]

M. Pleura

1. *Petechia of the pleura* may be present in perfectly healthy food animals, as suffocation hemorrhages resulting from slaughter (page 213), and should not be confused with hemorrhages of septic origin.

2. *False neuromas* in the course of intercostal nerves are not infrequently observed in cattle. They are new formations of myofibromatous nature, of sizes ranging from that of a pea to a hazelnut—seldom larger—which develop from the nerve sheaths.

3. Relative to *melanotic pigmentation* of the pleura, especially in calves, see page 200.

4. Regarding *secondary inflammation* of the pleura in contagious pleuropneumonia of cattle, swine plague, and rinderpest, see these respective diseases.

Judgment, see page 201.

N. Circulatory Apparatus

1. *Petechina on the peri-epi- and endocardium* of food animals are mostly the result of asphyxiation at the time of slaughter, especially if they are present in connection with the above-described hemorrhages of the pleura and with those of the lung mentioned on page 213; but they may also result from sepsis or other acute infectious diseases. Hemorrhages occur frequently on the auriculo-ventricular valves.

Reddened patches at the level of the columnæ carnæ are of systolic origin and disappear at diastole; they indicate a systolic pause of the heart.

2. *Pericarditis* is most frequently observed as the result of traumatism in cattle, due to the pressing forward of sharp foreign bodies in the rumen. The degree and the form of such traumatic pericarditis may vary extraordinarily; and the judgment, therefore, is influenced by the

severity as well as possible complications from disturbances in circulation, and from fever. In febrile conditions it has to be always remembered that traumatic pericarditis may be of septic nature; however, it must also be recognized that a pericardial content with offensive odor is not sufficient for the determination of a diagnosis of sepsis (Chap. VII, page 296).

Besides, pericarditis of serous and sero-fibrinous form may be observed in hogs as an accompanying symptom of swine plague (Chap. VII, page 304).

Recovered forms of pericarditis appear not infrequently as "villous hearts" in cattle and in hogs.

3. *Endocarditis* is observed most frequently in hogs as a verrucose valvular form, and occurs principally as a result of swine erysipelas infection. Ulcerous and diphtheritic endocarditis may be of toxic or pyemic origin.

4. *Cystic formations* (hematoma and lymph cysts) on the auriculo-ventricular valves were found frequently by Klaeger and Glage in calves and hogs; and not infrequently by Fischer in cattle.

5. *Phlebectasis* is found in older food animals as nodular dilations of the veins in parts rich in blood-vessels, principally in the mesenterics.

6. The formation of *multiple infarcts* in the spleen as a result of endocarditis, was first indicated by Ostertag. The splenic infarcts appear like wedge-shaped or round growths, at first dark red, later yellowish and white in color. After the resorption of the necrotic infarct areas there usually follows considerable shrinking of the spleen. The latter also follows rotation of the spleen.

7. *Rotation of the spleen* is a rarely occurring condition to which Glage has called attention. The splenic tumor which develops as a result of the torsion of the blood vessels is distinguishable by absence of a softening of the pulp.

Regarding the judgment of these diseases of the circulatory apparatus, see page 201.

[Carcasses affected with acute pericarditis should be condemned, according to B. A. I. Order 150, Regulation 13, section 18a. For judgment of other lesions of the heart appearing in association with various general affections, see these respective diseases.]

O. Skin

1. *Reddening of the skin* is only important from the standpoint of differential diagnosis in hogs, especially in connection with the presence of infectious diseases of these animals (swine erysipelas, etc.).

2. Regarding *granular eruptions* (schrotausschlag) of hogs, see Chap. VII, page 225.

3. The name of "*sooty mange*" is applied to a pustular exanthema of young pigs, which leads to the formation of pitch-like scabs (pitch mange), and occurs

as an accompanying symptom of general chronic affections. The latter, and also the condition of the animal, determine the disposition of the meat.

P. Central Nervous System

Of diseases of the central nervous system there will only be mentioned infectious cerebro-spinal meningitis of horses (meningitis cerebrospinalis enzootica), as it frequently occasions emergency slaughter. It is generally without influence upon the utilization of the meat, but in cases of delayed slaughter incomplete bleeding may be present. If the disease is of long standing, and is associated with marked decubitis or other injuries, as well as traumatic pneumonia, a certain amount of caution is advisable.

4. Diseases of the Blood and Constitutional Diseases

A. Anemia (Oligemia)

Anemia appears in food animals as symptomatic or as so-called pernicious anemia.

1. Symptomatic Anemia

Symptomatic anemias are expressions of various disturbances in the vegetative functions of the body, and as etiological factors internal parasites, chronic intestinal or pulmonary affections, chronic cachexia, and tuberculosis play the most important part.

Symptoms and Lesions.—During life paleness of the mucous membrane in advanced cases, dulness, loss of appetite, and emaciation point to anemia; while in the slaughtered animal it is observed only in advanced cases by emaciation and slight coagulation of the blood, as well as by the pale appearance of the muscles. The presence of certain organic affections indicates the cause of the disease.

Microscopical examination of the blood may show considerable decrease of red blood corpuscles (Shaper).

The *judgment* depends on the primary affection which may be present and on the nutritive condition of the carcass. As a rule, this meat may be passed for human food, and only in advanced cases should it be declared of inferior quality.

[According to B. A. I. Order 150, Regulation 13, section 24, carcasses of animals which are too anemic to produce wholesome meat should be condemned. Advanced cases of anemia are usually associated with pronounced emaciation.]

2. Pernicious Anemia

The essential primary, pernicious or progressive anemia is a disease which has not yet been sufficiently explained; but nevertheless, it is of

infectious or toxic nature, almost entirely confined to horses. The disease runs an acute or chronic course.

Symptoms and Lesions.—During life, in acute cases there is intermittent high fever, with greatly increased frequency in pulse, and rapid emaciation without any indications of a local affection. The red blood corpuscles show conspicuous changes in form, which is designated as poikilocytosis; besides, there are macro- and microcytes present. In chronic disease the manifestations are the same as in symptomatic anemia. In slaughtered animals the acute cases show a cloudy swelling and fatty degeneration of the visceral parenchyma and muscles, with hemorrhages in most of the organs, especially under the serous membranes, spleen tumor, cellular infiltration of the bone-marrow, hemoglobin infarcts of the kidneys, without any particular conspicuous affection of the organs. In a more chronic type pathological changes are similar to those of symptomatic anemia; only the bone-marrow is greatly changed, appearing like raspberry jelly, or as the bone-marrow of the embryonic state.

Judgment.—On account of great emaciation and pronounced changes in the muscles and viscera, the meat should be considered badly spoiled, and, consequently, unfit for human consumption. It has not yet been proven that this meat is injurious to health.

B. Hydremia

The watery condition of the blood of food animals, which occurs most frequently in sheep and cattle, develops as a result of insufficient assimilation of nutritive substances, or from over-abundant partaking of food containing a large amount of water. In the first instance it produces chronic disturbances of the blood-producing organs as in anemia, with which disease hydremia is usually associated. Swill and sugar-beets are foods containing especially large amounts of water. The symptoms in living animals depend on the extent of the affection. Edema of dependent portions of the body (neck, brisket, abdomen, legs) is rarely absent, even in the earliest stages; at the same time symptoms of anemia are apparent. In slaughtered animals well pronounced changes of the blood, such as noticeable thinness, and slight coagulability, are only found in advanced cases. Furthermore, there is an edematous appearance of the subcutaneous and intermuscular connective tissue and transudates in the body cavities. The muscles are relaxed, and rigor mortis is not well marked; only in very advanced cases (cachexia) are they discolored and grayish-red. In these cases there is also pronounced atrophy and gelatinous infiltration of the fat tissue.

Judgment.—In advanced hydremia the meat should be condemned as unfit for human food, on account of its repulsive changes, and its marked emaciation.

In less severe cases the slaughtered animals are allowed to hang for 24 hours; since, according to experience, a large portion of the transudates and edema of the connective tissue disappear by dripping and evaporation and through its resorption by the muscle substance.

Therefore in the cutting of the carcass it becomes evident whether there still remains a distinct watery condition of the muscles in the deeper parts. If this cannot be noticed the carcass is released; while, if visible, the meat should be sold after the removal of the watery tissues, as inferior quality under declaration. In mild cases deterioration occurs very rarely from the hanging of the carcasses.

[In case hydremia is associated with emaciation or if the carcass manifests edema of the muscles and connective tissue, in consequence of that condition, the carcass should be condemned, according to B. A. I. Order 150, Regulation 13, section 24.]

C. Leukemia

In food animals cases of true leukemia are more infrequent than pseudo-leukemia, which, however, should be distinguished from the former, etiologically and anatomically.

To what extent these diseases are of an infectious nature remains to be explained.

1. True Leukemia

This disease, which depends on a marked and continuing increase of white corpuscles (leucocytes and lymphocytes), takes its origin from a hyperplasia of the lymphadenoid tissue—namely the spleen, lymph glands, bone-marrow, and also from the intestinal wall and other organs. The blood in this condition may contain a large increase of lymphocytes (leukemia lymphatica). On the other hand, the leukemia may be due to a migration of leucocytes from the marrow of the bone, resulting in amyelogenous leukemia. Accordingly the clinical and anatomical picture of the disease likewise varies.

Symptoms and Lesions.—In living animals the suspicion of leukemia is only attracted, as a rule, in the lymphatic form, owing to enlargement of most of the accessible lymph glands. Besides there is a dulness of the animal, and a paleness of the mucous membranes. Examination of the blood establishes the correct diagnosis. The slaughtered animal shows slightly coagulable pale blood, the serum of which may be of a milky or pus-like consistence; the coagulum in the heart and large blood-vessels is similar in appearance. There is also hyperplasia of the spleen and of the lymph glands, which may reach enormous proportions; at the same time

the lymph glands are frequently very soft and moist. The bone-marrow has either undergone a lymphadenoid change to a raspberry jelly consistence, or it is like pus. Leukemic infiltrations or tumors may be present in any of the organs; also hemorrhages in the kidneys, serous and mucous membranes, as well as in the muscles. The latter are considerably paler than normal, gray, flabby, and permeated with hemorrhages. The characteristic microscopical appearance of the blood cannot be discussed here.

Judgment.—On account of the severe and pronounced changes present the meat should be condemned as unfit for human food.

[Carcasses affected with leukemia, which is invariably associated with a general swelling of the lymphatic glands, should be condemned, according to B. A. I. Order 150, Regulation 13, section 18 h.]

2. Pseudo-leukemia

This disease manifests the same clinical aspect in its course as true leukemia. The pseudo-leukemia (Hodgkin's disease) is principally distinguished from the latter through the fact that the numerical proportion between the leucocytes and erythrocytes of the blood is not disturbed. Pseudo-leukemic conditions occur occasionally in cattle and hogs, but rarely to such a degree that the general condition of the animal appears greatly disturbed.

The anatomical lesions do not differ from those of leukemia; Haffner found lymphoid areas in the entire muscular system of a cow, in the form of grayish spots. Regarding the judgment, carcasses showing pseudo-leukemia should be treated like those with true leukemia.

D. Rhachitis

Rhachitis, which appears most frequently in young hogs, depends on an insufficient calcification of the periosteal tissues, and on the irregular ossification of the cartilage, whereby excessive proliferation of cartilaginous and periosteal tissue takes place (Kitt).

The clinical findings that are of interest here are the enlargements of the bones, especially on the epiphyses and cartilages of the ribs, the bending of the extremities, and of the vertebral column, as well as the enlargements of the nose and superior and inferior maxillary bones (snuffle disease), which may be observed in hogs. The manifestations in the slaughtered animal correspond to the clinical findings and to the stage of the disease. In advanced cases lesions of severe nutritive disturbances and of cachexia may be present in the meat.

Judgment.—In the beginning of rhachitis, accompanied by good nutritive conditions, there is no ground for condemnation. When the

disease is of medium degree with pronounced changes of the bones in addition to those affecting the bones of the head, the meat is considered of inferior quality. Condemnation becomes necessary in very rare cases with cachectic changes of the muscles, and considerable emaciation.

[Carcasses affected with rhachitis in an advanced degree should be condemned, according to B. A. I. Order 150, Regulation 13, section 22.]

E. Osteomalacia

This brittle condition of the bones, with liquid marrow called osteospathyrosis, is a softening of the bones of mature animals, as a result of a diminution of the lime contents and a partial transformation of the bone into an osteoid mass (Kitt). Klimmer and Schmidt designate this disease, which occurs most frequently in cattle, as a halisteresis ossium, and consider rhachitis and osteomalacia as identical in their nature.

Symptoms and Lesions.—Of the clinical manifestations, the most marked is the occurrence of bone fractures (fractures of ribs and pelvis), without any corresponding cause being apparent. With this condition are also associated nutritive disturbances, swellings of the joints, and painful gait; later emaciation, hardened skin, and cachexia. The slaughtered animals show hyperemia of the diseased bones, thinning of the hard outer part; softening of the bone substances, and even its transformation into a fibrous tissue; transformation of the marrow of the bones into a dark-yellow to dark-red jelly-like mass; bone fractures; peeling off of the periosteum, and the wearing away of the joint. Although pronounced changes of the meat appear usually only in cachexic conditions, occasionally they may be observed earlier, according to Klimmer and Schmidt. On account of physical changes of the walls of the blood-vessels, marked serous infiltrations of the bordering tissues develop, the muscles become flabby, watery, and, as a rule, darker and softer; their reaction is generally alkaline. The fat tissue appears atrophied in the later stages. The preservative quality of the meat is poor.

Judgment.—According to the observations of Klimmer and Schmidt, animals affected with osteomalacia ought only rarely to be passed without restriction. They recommend judging meat, finally, 24 hours after slaughter. Then if emaciation and slight changes in the meat are present, the animal should be declared of inferior quality. If pronounced changes, and especially cachectic conditions are noticeable, the judgment must be made for total condemnation.

[Carcasses showing pronounced changes of osteomalacia should be condemned, according to B. A. I. Order 150 Regulation 13, section 22.]

F. Sarcomatosis and carcinomatosis, which also belong here, have been mentioned on page 200.

G. Cholemia, uremia, and hemoglobinemia, which frequently are classified with affections of the blood, will be discussed with auto-intoxications (Chap. VII, 7). Hemoglobinemia will also be referred to, under diseases of invasion (page 254).

5. Diseases of Invasion

The diseases of food animals caused by animal parasites—the diseases of invasion—are either of purely local nature (diseases of organs), or they appear on various parts of the body, and may, therefore, be designated as general parasitic affections. According to their importance in meat inspection, the animal parasites of food-producing animals may be classified in the following three groups:

(a) *Parasites which are not injurious to man.*—To this class belong all parasites represented on pages 222-234 (with the exception of pentastomum tænioides), and those protozoa which excite general parasitic affections.

(b) *Parasites which only indirectly may become injurious to man.*—Echinococci and pentastomes.

(c) *Parasites which are transmissible to man by the ingestion of meat.*—Measles and trichinæ.

A. Parasitic Diseases of Organs

The parasites of organs described below may all be united in as far as the judgment in meat inspection is concerned. As has been stated, they are not transmissible to man. The organs invaded by the parasites should be condemned as unfit for human food in all those cases where the parasites are not removed in the commercial preparations of the parts (intestines), or if the organ in all of its portions contains parasites, or their presence gives to the organ a repulsive appearance. If the latter are confined, or the parasites invade only single sections of an organ, then only the changed parts should be condemned.

1. Parasites of the Skin

(a) *Hypoderma Larvæ*

The larvæ of the *Hypoderma bovis* (œstrus bovis) gad-fly, develop in the subcutis of cattle.

Development.—The gad-fly deposits its sticky eggs on the skin of cattle, where they undergo the first process of development, and through licking are brought into the mouth. Very soon (June), according to Koorevaar, transparent larvæ, 2-4 mm. long, are found in the wall of the esophagus, from whence they migrate partly to

the subcutis, but usually toward the vertebral canal (Hinrichsen, Ruser, Koorevaar), in order to further develop in the dural fat tissue, and later to proceed to the subcutis. There they grow until the ninth month after the invasion to the length of 28 mm. and 12-15 mm. in breadth. They are backish-brown, roller-shaped larvæ, which begin in April to migrate to the outside by breaking through the skin, in order that they may change into pupæ in the ground.

Lesions.—"Warbles," or "gad boils" are flat, nodular elevations of the skin, especially along the back, from which, under certain conditions, larvæ surrounded by pus may be squeezed out. After the skin is removed, dirty, greenish-yellow, suppurative areas are found in the subcutis, with edematous infiltration of the surrounding parts, extending even into the muscles. The latter may also be found invaded by dirty, greenish larval passages.

1. *Psoroptes ovis* (sucking mite, Fig. 88) produces the skin eruption organs, see the above.

(b) *Scabies Mites*

1. *Psoroptes ovis* (sucking mite, Fig. 88) produces the skin eruption designated as sheep scabies, which affects the woolly parts of the body, and begins mostly at the sacral region.

Symptoms and Lesions.—Loosening of the wool, which extends over the surface of the body in various places, leaving vesicles and pustules on the skin; later scabs with sticking together of the wool, thickening of the skin, formation of folds and fissures, itching, especially when warm. In extensive affections emaciation, anemia, and cachexia are present.

Cases of psoroptic scabies of sheep and horses, as well as sarcoptic scabies of horses, must be reported to the police authorities, according to the Imperial law on Infectious Diseases.

[The movement of scabies cattle and sheep in the United States is restricted by the existing regulations which prohibit the shipment of affected and exposed animals unless they are destined for immediate slaughter.]

2. *Sarcoptes equi* (*S. scabiei communis*) produces scabies of horses, which commences with slight granular elevations and papules on the thickly-haired protected portions of the skin, and progressing leads to serous exudates, scabs, and scab formations. In advanced cases hairless spots, thickened skin, pustules and flat swellings may develop; also emaciation may appear. Itching is generally well marked.

3. *Demodex phylloides* (*demodex folliculorum suis*)—the hair-follicle mite of hogs—produces nodules and pustules of sizes frequently ranging from a millet seed to that of a hazelnut. This not infrequent acne eruption appears on the snout, neck, pectoral region, abdomen, the inner sur-

face of the thighs and flanks, and is manifested by grayish or yellowish-gray pustules, as well as by being sharply defined from the neighboring parts (Ostertag).

4. *Demodex folliculorum canis* causes the demodex mange, which occurs frequently in dogs, where it invariably appears locally on the face, the pectoral region, and on the paws, but may also extend over the entire

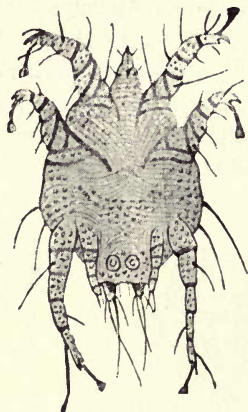


Fig. 88

Fig. 88. Male of dermatocoptes communis, viewed from the abdominal side. x 50 diameters. (After Ziegler).

Fig. 89. Sarcoptes scabiei v equi. Above to the left, male; below, dorsal view of female; above to the right, female; below, ventral side of male. x 75 diameters. (After Hutyr-Marek).

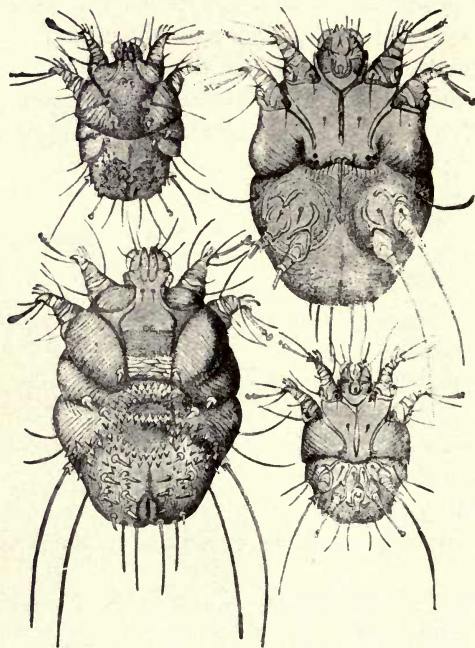


Fig. 89

skin and result in emaciation. Characteristic lesions are the red and bluish-red papules and pustules, from which a sero-purulent bloody fluid may be squeezed out.

5. *Sarcoptes canis* produces sarcoptic mange, frequently affecting dogs. It appears principally on the head, but is found on other parts of the body; also it is manifested as red spots, later by nodules and vesicles with exudates and scab formations, loss of hair and emaciation in extensive cases.

The other forms of scabies in food animals are: The dermatocoptes and dermatophagus scabies of horses and cattle; the sarcoptes and dermatophagus scabies in sheep and goats and the sarcoptes scabies of hogs. With the exception of the dermatocoptes scabies of the horse, they are of no importance in meat inspection or to veterinary police supervision.

[According to B. A. I. Order 150, Regulation 13, section 16, carcasses showing advanced lesions of scabies associated with emaciation, or if the inflammation extends to the flesh, should be condemned. In mild cases the carcasses are passed for food.]

On calves there are occasionally found immense numbers of lice (haematopines); and in order to prevent their crawling on the meat, it is advisable to have the skin removed immediately after slaughter.

(c) *Coccida*

Coccidium fuscum, which was discovered by Olt, is the cause of coccidiosis cutis, spiradenitis coccidiosa, in the granular eruptions of hogs. These protozoa, the classification of which as coccidia is disputed by Lühe, penetrate into the sweat glands and produce chronic inflammation in the same with a damming up of the secretion.

Lesions.—On various parts of the skin pale bluish-gray, lead-gray, or yellowish-brown nodules develop, of sizes ranging from a pin-head to the double size of a pea. They are semi solid, lying very superficially in the skin, contain a cloudy, watery or bloody smeary mass, and sometimes rolled-up hair.

A disturbance in the general health is not connected with this eruption.

2. Parasites of the Respiratory Apparatus

(a) *Æstrus Larvæ*

The larvæ of the gad-fly of sheep (*æstrus ovis*) invade the nose and sinuses of the sheep.

Development.—The fly deposits eggs or already partially developed larvæ on or into the openings of the nose of sheep, from whence they migrate into the nasal, frontal, and maxillary sinuses as well as into the cones of the horns, and there develop within nine months into yellowish-brown larvæ, 20 to 30 mm. in length. They are expelled to the outside by sneezing, blowing, shaking (shaking disease), and burrow into the ground where they change into a chrysalis stage.

Symptoms and Lesions.—Catarrh of the respective mucous membranes, mucopurulent nasal discharges, shaking, sneezing, brain irritations; swelling of the mucous membrane with hemorrhages and loss of substance; finally the presence of larvæ which are enveloped in pus and mucus and which may become fetid.

(b) *Pentastomes*

The *Pentastomum tænioides*, which resemble the tapeworm, infests the nasal cavities and sinuses of dogs and men, and produces only slight catarrhal disturbances. These parasites, which belong to the arachnoidæ, are from 15-20 mm. long (male), and 80-90 mm. long (female).

For the veterinary inspector the only parasite that is of importance on account of its larval condition is the *Pentastomum denticulatum*. This develops from the eggs of the *P. tænioides*, which reach the outside with the nasal mucus, and are then taken up by herbivorous animals. There the embryos are set free in the digestive apparatus, and reach either actively or passively the mesenteric glands, liver, lungs, or peritoneum, where they become encapsulated and form cysts.

(c) *Parasites of the Lungs*

1. *Strongylus paradoxus*.—This strange palisade worm occurs very frequently in the lungs of both domesticated and wild hogs, but according to Müller, only in young animals. The males are 16-20 mm. and the females 40 mm. long, and they live in the trachea and bronchi, where they produce only slight catarrhal disturbances. Lungs affected at the places invaded by a large number of these worms have elevated, flat, dense areas, with a mother-of-pearl luster.

As the latter indications may be absent in spite of the presence of the parasites, it is advisable to cut into every hog lung posteriorly. If worms can be squeezed out of the cut surface, another cut is then made a few centimeters anteriorly, and if parasites are also found there the center of the lung may then be considered infested.

2. *Strongylus filaria*, the thread worm of the lung, lives in the bronchi of sheep, goats, deer, and roe, where it produces catarrh and pneumonia. In sheep it occasionally occurs in such immense numbers and extensiveness that entire flocks become infested with it, and a large number of sheep succumb from pneumonia and cachexia (lung-worm plague). The findings are similar to those for the previously described parasite. The males are 25 and the females 84 mm. long.

3. *Strongylus ovis pulmonalis* (lung hair-worm), 10-30 mm. long, lives as reddish-brown parasites in sheep, goats, deer, and chamois. It produces in the lungs small yellowish or greenish-gray hard nodules or wedge-shaped areas. In cutting into these places caseous, gray, crumbling masses are found, which contain eggs, embryos, and dead parasites.

4. *Strongylus micrurus* is found comparatively seldom in the lungs of cattle and calves. It also occurs in deer, roe, and horses. The 30-40 mm. long male and 60-80 mm. long female parasite are recognized through the mother-of-pearl luster of the hard lobuli, and occur preferably

at the base of the lung, where the parasites are lodged in the dilated bronchi. Occasionally dead parasites may be found in greenish-colored nodules (Ostertag).

5. *Strongylus commutatus* occurs rarely in the lungs of sheep and goats, but more frequently in hares and rabbits. The 30 to 70 mm. long worm produces in the lung tissue proper inflammatory areas of sizes from that of a hemp seed to a hazelnut, which have a yellow caseous content. Occasionally the parasite produces enzootic losses in rabbits.

According to Schlegel, the *Strongylus commutatus* is comparatively frequent in sheep, and is also the most harmful lung-worm of this species. It is supposed to be always present in the dark-brown to black or violet-red nodules of the lungs of sheep.

3. Parasites of the Digestive Apparatus

(a) *Gastros Larvæ*

1. The larvæ of *Gastrophilus equi* the stomach bot of the horse, live as 18-20 mm. long, roll-shaped, yellowish, meat-colored bodies on the cardiac portion of the mucosa of the horse's stomach. Occasionally they also occur in the dog (Fig. 90).

The gad-fly lays eggs 1 mm. long on the hair of the horse, where, within 3-5 days, the worms slip out of the eggs. They are then licked off, reach the stomach, burrow themselves into the mucous membrane, and are developed after 9-10 months into full-grown larvæ, which are ejected with the feces.

2. The larvæ of the *Gastrophilus hæmorrhoidalis* of the horse are more slender than the former, and of a lighter red color.

3. Larvæ of the *Gastrophilus duodenalis* occur in the pyloric portion of the stomach of the horse. They are whitish-yellow in color, and measure 13-15 mm. in length.

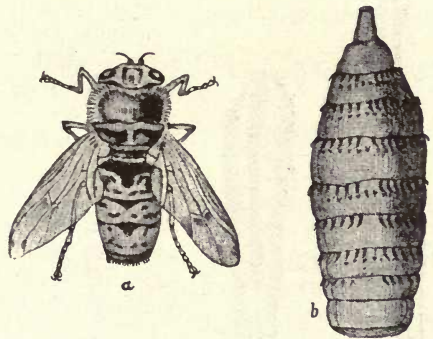


Fig. 90. *Gastrophilus equi*, a, male fly; b, larva (after Ziegler).

(b) *Round Worms*

1. *Strongylus contortus*, the contorted palisade worm, lives in the abomasum of sheep and goats; seldom in young cattle. The reddish-white worms are 16-20 mm. long. The blood-sucking parasite produces, through heavy infestations, anemia and cachexia. If they appear extensively in a flock of sheep, it is spoken of as stomach-worm epizootic of sheep.

2. *Strongylus Ostertagi* (*S. convolutus*), conglomerated palisade worm, lives frequently in the abomasum of cattle, sheep, and goats. The location of the 7-13 mm. long worms, which lie under the epithelia of the mucous membranes, are indicated as round elevated spots the size of lentils, and with a central opening. The presence of large numbers of these parasites may result in emaciation.

Strongylus convolutus as well as various other strongylidæ, according to Schnyder, are the cause of chronic diarrhea in cattle in Switzerland, which is designated as "kalkbrandigkeit."

3. *Strongylus rubidus* was the cause of a severe affection in hogs, observed by Oppermann, consisting of a diphtheritic or chronic inflammatory affection of the gastric mucous membrane, which resulted in severe anemia to the sucking mother pig.

4. *Trichocephalus affinis*, which generally occurs only in cattle, sheep, and goats, was found by Meyer in large masses in the large intestines of a hog. *T. crenatus* was also found by Haase (Heine).

5. *Oxyuris curvula* Rud., and *Oxyuris mastigodes*, Nitsche, occur in the large intestines of the horse, according to Jerke.

6. *Sclerostomum quadridentatum* (Sticker), *edentatum* (Looss) and *bidentatum* (Sticker), formerly known as *strongylus armatus*, inhabit the large intestines of horses, and their embryos produce aneurisms (of the abdominal blood vessels).

7. *Spiroptera sanguinolenta*, the blood-sucking, coiled-tail parasite which lives in minute cavities under the mucous membrane of the esophagus and stomach of dogs.

8. *Ascaris megaloccephala*, the large-headed stomach-worm which is most frequently found in the small intestines of horses, and

9. *Ascaris lumbricoides* of cattle and hogs. In cases of heavy infestations of ascarides in the intestines of calves and sheep there will be noticed an abnormally stale, sourish odor and flavor of the meat (Morat, Laubion, Leibender, Vallisnieri, Mathis).

10. Larvæ of *Ankylostomum radiatum* (Schneider) (= *Dochmius*, *Strongylus*, *Uncinaria*), which infest the small intestine and cecum of European cattle and sheep, are, according to Scheben, the cause of helminthiasis nodularis intestinalis, also called nodular disease of the intestines. In the intestines of American cattle and of American and Australian sheep, the *Ankylostomum* Ströse and *Oesophagostomum* Curtice are present as the cause of the formation of intestinal nodules.

11. *Gnathostoma hispidum* (*Cheiranthus hispidus*), the three-colored stomach-worm, lives on the blood from the mucous membrane of the stomach of hogs. This parasite, which is 2 to 3 cm. long, has a spherical head which is separated by a deep furrow from the remainder of the body.

12. *Echinorhynchus gigas*, the giant worm, is from 7 to 9 cm. (males), and 30 to 40 cm. (females) long, and inhabits the small intestine of hogs. At the

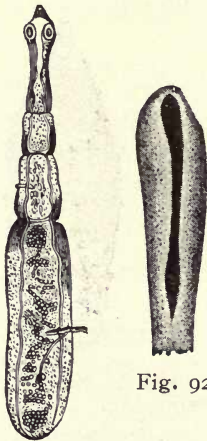


Fig. 91

Fig. 91. Full-grown tania echinococcus, x 12 diameters (after Ziegler).

Fig. 92. Head of the bothriocephalus latus (Bremser) enlarged (after Heller).

Fig. 92

point of attachment it produces a circumscribed inflammatory nodule and small abscesses which may then be easily mistaken for a tuberculous nodule.

For the discussion of trichinae in the intestines, see page 245.

(c) Flat Worms

1. *Tænia* (*Moniezia*) *expansa* produces the most important and frequent tapeworm disease of sheep, and in young animals causes emaciation, diarrhea, cachetic anemia, followed by death. It also occurs in cattle and is from 2 to 6 m. in length.

Recently there have been various distinct species separated from the principal species, *Tænia expansa*. The cysticercus stage of this parasite lives probably in the so-called sheep tick (*Melophagus ovinus*).

Of the remaining flat worms found in food-producing animals may be mentioned the following:

2. *T. denticulata* of cattle and sheep, cysticercus unknown, 25-80 cm., sometimes 150 cm. long.

3. *T. (Anoplocephala) perfoliata* of horses, 3-5 cm. long.

4. *T. (Anoplocephala) plicata* of horses, 10-25 cm. long.

5. *T. (Anoplocephala) mamillana* of horses, 1-3 cm. long.

In dogs are found:

6. *T. marginata*, 1½-2 m. long, which is the adult of cysticercus *tenuicollis* of sheep, hogs, and cattle.

7. *T. serrata*, ½-1 m. long, which is the adult of cysticercus *pisiformis* of hares.

8. *T. cœnurus*, 40-60 cm. long, which is the adult of *cœnurus cerebralis* of sheep.

9. *T. cucumerina* (*Dipylidium caninum*) 10-40 cm. long. Its cysticercus stage is in the dog louse (*Trichodectes canis latus*), and in the dog flea (*Pulex serraticipes*).

10. *T. echinococcus*, 3-4 mm. long, which has its origin from either the *Echinococcus unilocularis* or *E. multilocularis* (page 235) of ruminants and hogs (Fig. 91).

11. *Bithriocephalus latus*, the larval stages of which are found in the muscles of pike, perch, eel, pout, grayling, and trout (Fig. 92).

Recent investigations (Vaulleuard) appear to establish the fact that heavy parasitic infestations occasion the production of toxin-like poisonous products in the intestines.

(d) Flukes

1. *Distomum hepaticum* s. *Fasciola hepatica* L., the large distoma, occurs in the bile ducts of the liver of cattle, sheep, goats, hogs (very rarely), and deer. Distoma or their remains may occasionally be found in the lungs, spleen, heart, subcutis, muscles, and beneath the serous membranes.

This leaf-shaped worm is 20-40 mm. long and 12-15 mm. broad at its widest portion. Its color is muddy-yellow to greenish-brown. It has an oral and ventral sucker and its cuticula bears scale-like thorns (Fig. 93).

The invasion of the distoma occurs in the larval state (Cercaria), which develops in small water snails (*Limnæus minutus* and *L. pereger*) and is ingested with food or water. In the intestines the Cercaria burst their cyst-wall and wander through the ductus choledochus into the liver; some may also reach this destination upon penetrating an intestinal vein, whereupon they are transmitted by the portal circulation. They develop in the bile ducts of the liver, become sexually mature, and with the bile enter the intestinal canal, to be discharged with the feces.

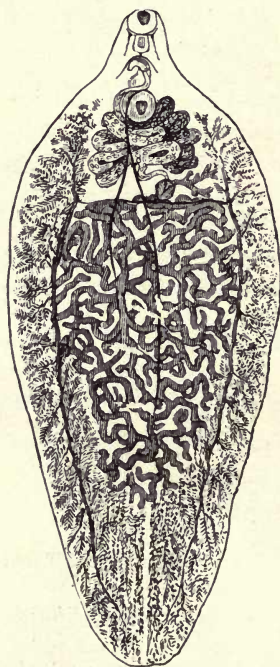


Fig. 93. *Distomum hepaticum* with male and female sexual organs (after Leuckart). $\times 3.2$ diameters.

The lesions in the liver depend on the intensity and duration of invasion. If the latter is recent (3 weeks) and heavy, symptoms of acute inflammation of the liver may be observed. Occasionally hemorrhages of the liver may also occur. Later, we find changes in the bile ducts ranging from simple catarrh of the mucous membrane of the bile ducts to a chronic hyperplastic inflammation of their walls with considerable hypertrophy and calcareous incrustations. Either synchronously or following this there may develop a chronic interstitial hepatitis with indurations and contractions (hypertrophic cirrhosis of the liver). In the majority of cases the liver tissue itself remains unchanged. Occasionally one may find suppurative cysts, in which living or dead flukes reside, in the parenchyma of the liver communicating with the bile ducts.

Jaeger attributes the action of the distomes on the tissue of the liver to their toxic products of metabolism.

While the general condition of other animals is not visibly disturbed by invasion of the liver fluke, as a rule a severe and extensive occurrence of the disease in sheep (liver fluke pest or rot) occasions serious losses by producing digestive disturbances, icterus, anemia, and cachexia.

Examination.—Expression of the bile ducts, incisions into the liver, so as to strike the main ducts; for instance, on the stomach surface of the liver of cattle, to the left of the porta and at the base of the Lobus Spigelii.

2. *Distomum lanceolatum* s. *Fasciola lanceolata*, the lancet-shaped fluke occurs most commonly in the liver of sheep, more rarely in cattle, hogs, rabbits, hares, and also in man.

The worm attains a length of only 4-9 mm., and a width of 1-2.5 mm. (Fig. 94). Its anterior portion is quite motile, and stained black in parts. Its invasion occurs in a manner similar to the preceding.

This liver fluke may also infest whole herds and produce numerous deaths, as Roemer observed in goats.

Findings and examination.—The parasite occasions only slight catarrhal changes in the bile ducts, and its presence is frequently not discernible at the surface of the liver. They are, therefore, found only on incision of the bile ducts where they are frequently present in large numbers.

The *judgment* of distomatosis depends on the number of flukes and the probable changes in the liver. If the latter are absent, or restricted to the large bile ducts and the distomes confined to these, they may be entirely removed by careful dissection of the bile ducts, and the remaining tissue of the liver utilized. If, however, the flukes are also present in the smaller bile passages, or if severe indurative or suppurative processes are present, the whole organ is then confiscated and destroyed.

[According to B. A. I. Order 150, Regulation 13, section 23, if the liver shows an infestation with flukes, it should be condemned.]

3. *Paramphistomum conicum*, nine-pin-shaped fluke (Endloch), occurs as a 4-12 mm. long, 1-3 mm. thick, reddish-white worm on the mucosa of the first and second stomachs of cattle, sheep, goats, deer, and buffalo. It is rare in Germany and of no importance whatever.

(e) Protozoa

1. *Coccidium zurnii* is of interest, as it causes the red diarrhea of cattle (Dysentery hemorrhagica coccidiosa Hess). The oval or spherical unicellular coccidia belong to the Sporozoa and inhabit the epithelium of the intestinal mucosa, producing severe inflammatory processes.

The symptoms in the living animal may be summarized as a usually acute diarrhea, mixed with blood and accompanied by a general febrile condition. In the slaughtered animal is found severe inflammation of the intestines, with blood-red intestinal contents.

In the *judgment* of such cattle the meat cannot be considered as dangerous to health, yet on account of the existing severe general disturbance its value is impaired. In very severe cases where the animals are greatly emaciated, the meat will sometimes be found unfit for human food.

2. The *Coccidium oviforme* (Fig. 95) inhabits the epithelium of the bile ducts of the rabbit liver, and produces abscess-like nodules and cysts.

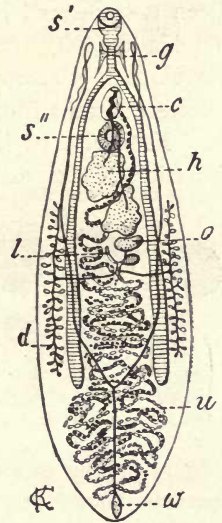


Fig. 94. *Distomum lanceolatum* (after Hertwig) *s'*, oral sucker and entrance to the fork-shaped intestine. *s''*, ventral sucker; *h*, testicle with vasa deferentia; *c*, cirrus; *u*, uterus; *o*, ovarium; *l*, canal of Laurer and yolk gland; *d*, shell glands; *w*, excretory vessel; *g*, ganglion. x 8 diameters.

3. *Coccidium perforans*, which is also parasitic in the intestinal epithelia of rabbits, produces profuse diarrhea. It is said to occur also in the intestinal epithelia of sheep and calves.

4. *Coccidium fuscum* occasions the shot-like skin eruptions (Schrottausschlag) of the hog.

4. Parasites of the Pleura and Peritoneum

(a) *Cysticercus tenuicollis*

The slender-necked bladder worm is a frequent parasite of hogs and ruminants, particularly of sheep. It is frequently found on and beneath the serous membranes, especially of the omentum, mesentery, and liver in the form of flabby bladders, or vesicles, filled with serous fluid, ranging from a pea to a man's fist in size. Occasionally the *Cysticercus tenuicollis* has been encountered in the lung tissue of the hog. In a fully grown state the bladders are connected by a long, thin neck, with a scolex, from which develops the *Tænia marginata* of the dog, after a change of host. The scolex contains four suckers and a double crown of 32-40 hooks.

Extensive peritonitis is sometimes produced in hogs in cases of heavy invasion of the parasites beneath the folds of the abdominal serosa, result-



Fig. 95. Coccidiæ in the various stages of development, from the bile duct of a rabbit's liver, *a, b*, small granular, young forms; *c, d*, larger forms with dark stained border granules; *e, f, g, h*, oval, encapsulated forms, the protoplasm of which fills up a portion of the capsule. (After Ziegler, x 400 diameters).

ing in extensive adhesions of the abdominal organs. The dead cysticerci may be found in large numbers among the peritoneal folds as spherical, nodular or more flattened formations, ranging in size from millet seeds to hazelnuts, and composed of whitish to yellowish-brown caseous material with a membranoid envelope (the thickened serosa).

Usually the nature of the nodules is easily ascertained macroscopically by making smears of the contents of the larger and softer caseous nodules, which should contain portions of the cysticercus membrane; and microscopically by the presence of hooks and calcareous bodies.

The calcareous concretions occasionally encountered in the musculature of sheep may, according to the observations of Glage, be produced by the invasion of slender-necked cysticerci.

Relatively quite young animals may harbor the parasite, as the development of the thin-necked bladder worm from the tapeworm ova occurs within 5-6 weeks. At this stage they lie, as a rule, beneath the serous membrane. In further development the bladder worms increase the protrusion of the serosa more and more, but always remain covered by it. In young animals which have recently ingested

numerous tapeworm ova, one occasionally encounters serpentine paths in the liver, filled with dark-red, brownish or greenish masses, which indicate the course traversed by the bladder-worm embryos. Should the parasites remain within the interior of the organs, especially the liver, they barely attain the size of a pea, and rapidly undergo cheesy and calcareous degeneration.

Differential Diagnosis.—Although the slender-necked bladder worms never occur between the muscle fibers as matured parasites, they have, nevertheless, been confounded with true measles, when found as pea-sized vesicles in places where the serosa lie directly in contact with the musculature (diaphragm, pillars of the diaphragm, abdominal, intercostal, and sternal muscles). Such errors do not occur when one—

1. Examines the favorite site of true measles (*C. cellulosa* or *C. bovis*), where the thin-necked measles never occur (tongue, larynx, heart musculature). If no measles are found there it is quite likely that the doubtful structure is not a true measles.

2. Examines the scolex of the doubtful bladder worms microscopically, carefully noting the number and shape of the hooks.

To avoid mistaking the caseous or calcified thin-necked bladder worms for tubercular areas it is essential to bear in mind the characteristic structure of the latter, and to ascertain the absence of infection of the lymphatic glands of the organ under consideration.

(b) *Cysticercus Pisiformis*

The pea-shaped bladder worm (the larval stage of the *Tania serrata* of the dog), is quite common in the lungs and liver, and especially prevalent in the serous lining of the thoracic and abdominal cavities of rabbits and hares. Sometimes they occur epizootically, and it is then spoken of as rabbit venery; and in some cases it is at times held to be tuberculosis, as caseation and calcification of the cysts occur within the organs.

On Echinococci of serous membranes, see page 237.

(c) *Other Parasites*

Filaria equina, a round worm 6-15 cm. long, has been found free in the abdominal cavity of horses; and *Strongylus armatus* (Kitt) has been found in the same animal. Migrating liver flukes may also find their way into the serous cavities and become attached to serous membranes.

5. Parasites in the Brain

Cœnurus cerebralis.—Cerebral bladder-worm cysts, filled with serous fluid, in sizes from that of a pea to as large as a hen's egg, occur in the brains of sheep, more rarely in cattle, and produce the so-called gid or staggers.

On the inner wall of the cysts are situated large numbers of millet-seed-sized whitish granules, the scolices, from which the *Tænia cœnurus* of the dog is developed.

The development of cœnurus cysts lasts for two to two and a half months. The embryos, which have been set free from the ova in the digestive tract, are largely disseminated embolically. As early as 8-14 days after invasion there are found bluish-white cysts on the surface of the brain, these cysts having a diameter of 1-3 mm. and showing sulphur-yellow streaks. Similar streaks, indicating the path of the wandering onchospheres, may be also found in other organs, in which there are later observed spherical, encapsulated areas with greenish pus-like contents (cestodal-tuberculosis, pseudo-tuberculosis verminosa). These areas are transformed by calcification into fibrous-calciform nodules (chalicosis nodularis).

Occasionally there are seen cœnurus cysts (*C. serialis*) in the abdominal cavity and muscles of hares and rabbits.

Other parasites occurring in the central nervous system, such as *Cysticercus cellulosæ*, and *Æstrus larvæ* are mentioned elsewhere.

Regarding the judgment of parasitic organ affections, see page 222.

B. Parasitic General Diseases

1. *Pentastomum Denticulatum*

The denticulate pentastome is the larval stage of the tapeworm-like five-mouth parasite (*Pentastomum s. Linguatula tenioides*), considered under parasites of the respiratory system (page 225), and inhabits the intestines, lymphatic glands, and the under surface of the serous membranes of cattle, sheep, goats, hogs, deer, rabbit, and hare.

Development.—The young larvæ escape from the ova ingested into the intestinal tract with food, pierce the intestinal wall, and enter the various organs actively or embolically, being most common in the liver, mesenteric, inguinal and iliac lymphatic glands, also in lung, spleen, pleura and peritoneum. They become encysted, undergo various changes, and 6-7 months after invasion one finds the mature larva, *P. denticulatum*. It either dies or wanders actively through the peritoneal or pleural cavities into the intestines or bronchi, in order to reach the beginning of the respiratory apparatus and thus escape.

The larval invasion and its results produce millet-seed-sized white nodules, which lead one to suspect tuberculosis. In the lymphatic glands especially on the periphery, are formed irregular, millet-seed to hazel-nut sized areas of yellowish or greenish-gray color (Plate II, Fig. 4). The parasites occur within this caseous or mortar-like substance as whitish, flat larvæ, narrower posteriorly, of 6-8 mm. length, and an anterior width of 1.2 to 2 mm. The segmented body, covered with teeth-like thorns, is supplied with two pairs of hooks on either side of the mouth (Fig. 96). The latter are permanent and may be demonstrated microscopically when the pentastoma larvæ die and decompose.

Recognition or identification and false interpretation.—The recognition of the larval site is not difficult if the places in question and the lymphatic glands are cut open. They may be mistaken for tubercular areas if it is not recalled that—

1. Tubercular areas do not occur in the peripheral zone of the lymphatic glands only, but also in their interior.

2. Tubercular areas caseate from the center and are surrounded by a gray peripheral layer, whereas pentastomum areas possess a uniform caseous consistency.

3. Caseous tubercular areas are yellow, while caseated pentastomum areas give a greenish color (Plate II, Fig. 4).

4. In beginning calcification, tuberculous areas retain their yellow color; the pentastomum areas on the contrary turn gray, and

5. In pentastomum areas the larvæ or their hooks are easily demonstrated.

Judgment.—Direct transmission of the pentastoma larvæ to man, through eating meat, is most improbable. The portions of meat showing a heavy infestation with *P. denticulatum* are not to be considered dangerous to health, but at the most are to be designated as greatly impaired in value. If these parasites obtain a heavy invasion the parts or organs are to be removed as unfit for use, while isolated areas in valuable organs (liver) may be excised.

[In the United States organs infested with *P. denticulatum* are condemned.]

The indirect harmfulness of the pentastoma larvæ for man is shown by its relation to *P. tenioides* of man and dog; and for this reason special care should be exercised to prevent dogs from eating organs infested with *P. Denticulatum*.

Especially conscientious examination is required in pentastomatosis of body lymph glands to avoid mistaking it for tuberculosis.

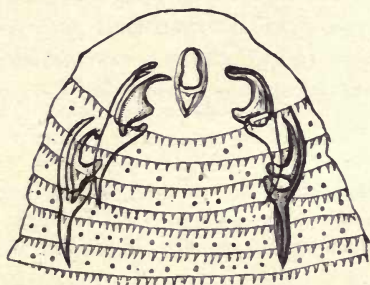


Fig. 96. Head of *Pentastomum denticulatum*, x 40 diam. (according to Ziegler).

2. Echinococci

Echinococci are bladder worms whose scolices are not situated immediately or directly on the inner surface of the cyst walls, but are surrounded by separate capsules (proliferous vesicles or daughter cysts), which are attached to the enveloping membrane by a pedicle, or exist free within the serous fluid which fills the cysts.

Echinococci (*Echinococcus polymorphus*) occur in all animals used for slaughter; most commonly, however, in sheep, hogs, and cattle. They form the asexual stage of *Tænia echinococcus*, the three-segmented tapeworm of the dog (page 229), and occur in two forms as—

- (a) *Echinococcus polymorphus s. unilocularis s. simplex*, and
- (b) *Echinococcus multilocularis s. alveolaris*.

The development of echinococci results from the ova or onchospheres of the *Tænia echinococcus* after having reached the alimentary tract; and, according to recent observations by Mangold, Mueller, v. Linstow, Posselt, this tænia exists in the dog in two varieties, which externally, however, appear very similar. The dissemination of the embryos from the intestines is mainly through the portal circulation, which accounts for the fact that the liver is the most common site of infesta-

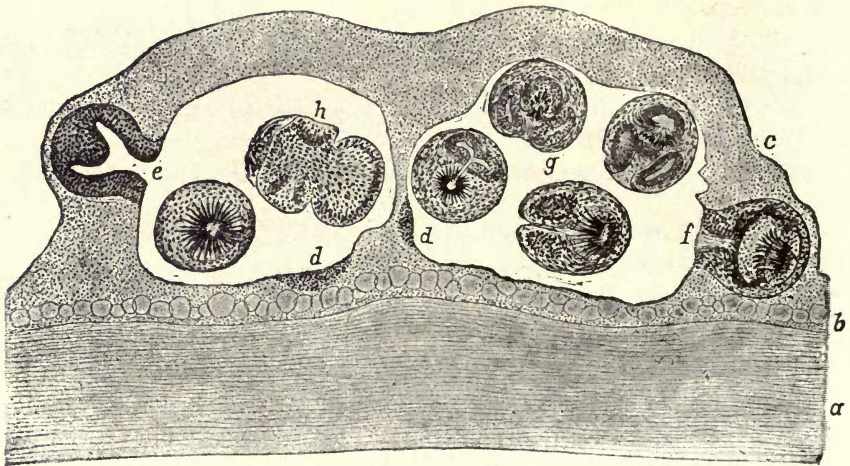


Fig. 97. Wall of an echinococcus cyst with brood capsules and scolices; a, chitin membrane (cuticula); b, layer of parenchyma with cystic cells; c, daughter cysts; d, e, f, g, h, scolices in various stages of development (according to Ziegler). \times 100 diameters.

tion with developing echinococcus cysts. According to Leuckart the development is comparatively slow. White nodules of about one millimeter in size may be seen four weeks after invasion, and after four more weeks the cystic nodules have only attained a size of 1.5-2.5 mm., with a central cavity containing fluid. Only at the age of five months have they attained 15-20 mm. in size, and the first proligerous or daughter cysts with scolices are then formed.

The echinococci degenerate easily and undergo caseation or calcification. The initial stage of this degeneration is a softening and fatty change of the parenchyma layer, and a transformation of the partly transudated echinococcic fluid into a sticky honey-like mass. In sheep the cyst wall may become cartilaginous, or it may even calcify. The scolices of the echinococci die as a result of the processes of degeneration.

(a) *Echinococcus polymorphus s. unilocularis s. simplex*

The simple echinococcus cyst may be the size of a pea or as large as a child's head, transparent or opaque, light-gray to pure white, appearing in all animals that are slaughtered, especially in sheep, hogs, and cattle. They are mainly found in the liver and lung, but they may also be present in all other organs of the body, even in the heart, bones, udder, brain, muscles. Of the organs infested with echinococci, the liver particularly may increase enormously in size and weight.

The unilocular echinococci are constantly enclosed by a connective tissue capsule (organic membrane of Ostertag), resulting from the reaction of the immediately surrounding structures, and separating the parasite from the neighboring tissues of the organ.

The true wall of the echinococcic cysts is composed of a laminated cuticula and a parenchymatous layer in which calcareous bodies may be found. Should the parenchymatous layer remain smooth upon its inner surface the echinococcus will be found to contain only fluid, and is then called *E. cysticus sterilis*; this is the most common form in slaughter animals. If proligerous vesicles (Fig. 98) develop from the parenchymatous layer, there is formed the *E. fertilis*, which is found most fre-

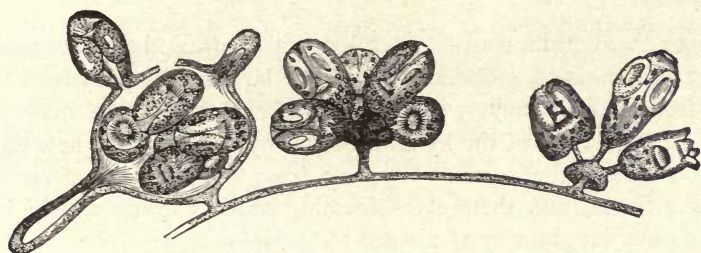


Fig. 98. Closed and ruptured brood capsules with scolices in their connection with the parenchymatous layer of the cystic wall (according to Leuckart). x 40 diameters.

quently in hogs and sheep. A formation of the so-called daughter cysts, which have the same structure as the mother cyst, may result out of portions of the parenchymatous layer which have remained between the layers of the cuticula (M. Braun). Originating in the substance of the cuticle, they distend the wall of the mother cyst, either outwardly (*E. granulosus*) or inwardly (*E. hydatidosus*). In the latter case the daughter cysts may rupture the innermost layers of the wall of the mother cyst, be set free, and fall into the mother cyst. The early growing forms of the echinococci, according to Leuckart, appear as whitish bodies the size of sago seed, which, under the microscope, show a structureless enveloping membrane of granular formation within.

(b) *Echinococcus multilocularis s. alveolaris*

The many-chambered hydatid occurs as a tumor-like growth (Fig. 99) in the liver and lungs, especially in cattle. It has been found

occasionally in the spleen and kidneys and other organs in sheep, also in hogs, and in the latter species of animals it has been found in a form which differs from that in cattle, and is more like the alveolar echinococcus found in man (Ostertag). The multilocular echinococcus is composed of numerous small cysts or vesicles imbedded in a connective tissue network. The latter is delicate and thin in small echinococcus cysts, but in growing attains considerable thickness in the large forms. According to size and age, the individual vesicles of the multilocular echinococci are either soft



Fig. 99. Section through liver of cow with *Echinococcus multilocularis*

and elastic, with thin walls and filled with serous fluid, or gelatinous, caseated and calcified. The centers of the larger echinococci are usually of the latter consistency, while the peripheral layers are made of the former. The growth of the hydatid occurs by formation of new daughter cysts from the mother cysts, emerging from within, being freed by the connective tissue, and themselves forming mother cysts which, in their turn, send out daughter cysts toward the periphery.

In other respects the single vesicle of the alveolar echinococcus is similar to the structure of the simple echinococcus; but, according to v. Linstow, *E. alveolaris* has less hooks than *E. cysticus* (26 as compared with 36). That both are not identical biologically, and that two different varieties of echinococcus develop from these has been mentioned on page 229.

The alveolar echinococcus found in the pleura of hogs by Ostertag gave the impression of a miliary pearl disease. The numerous millet-seed-shaped nodules were grayish-yellow, of firm consistency, and enclosed fresh and caseated hydatids containing scolices.

The recognition of echinococci is not difficult as soon as they have become visible on the surface of the organs and have not degenerated. When deeply located within the organs, palpation of the latter will enable the perception of large cysts; smaller ones, however, can only be ascertained upon section. The alveolar echinococcus and caseated or calcified simple echinococci may be mistaken for tuberculosis, if we fail to observe in echinococcus disease that—

1. The lymph glands belonging to the organ are free of the infection.
2. In the caseous or calcareous masses are contained delicate membranous remnants, the hull or enveloping membrane of the proligerous vesicles, or the remnants of the main membrane of the mother cyst.
3. The cuticula of the echinococcus wall shows microscopically a banded or striped structure (Fig. 97).
4. The caseated or calcified contents of unilocular cysts are easily removed from the surrounding smooth-walled connective-tissue capsule.

In the *judgment* of echinococci it must be remembered that they are not transmissible to man through ingestion. The parasites themselves, however, are to be looked upon as objectionable formations, and whenever they are found in small numbers in any organ they should be carefully excised, while the organ infested is to be cut in layers. When present in great numbers the organ becomes unfit for food, and is to be condemned.

[According to B. A. I. Order 150, Regulation 13, section 17, paragraph 3, the presence of an organ found infested with echinococcus cysts does not affect the wholesomeness of the meat, and the carcass may be passed for food after condemnation of the infested part or organ.]

The importance of the echinococcus cyst to man lies in the easy transmission of the ova of *Tænia echinococcus* of the dog to man. This is proven by the fact that echinococcus disease in man is proportional to that of domestic animals in those localities in which the animal echinococci are not carefully removed, thus allowing dogs to gain access to the tissues containing echinococci. The echinococcus cysts in man formed from the *Tænia echinococcus* of the dog are developed in the same way as in animals and almost in every case lead to severe disturbance of health and may even prove fatal. For this reason the careful removal of all echinococci through meat inspection is of the greatest sanitary value and importance.

3. Measles

The true measles of food-producing animals are the larval stages of two varieties of tapeworms in man. We have for consideration, therefore, two corresponding forms of measles:

- (a) *Cysticercus cellulosæ*, the pork measles.
- (b) *Cysticercus bovis*, the beef measles.

The transition stage of a third tapeworm of man, found in the flesh of fish, namely, that of *Bothriocephalus latus*, will be considered in Chapter IX.

The larval stages of the *Bothriocephalus liguloides*, which occur in man in Japan, according to Miyake, need not be considered here. The same is true of the hydatids of *Tænia krabbei*, which Rusche reported in reindeer meat. The tapeworm in question is parasitic in dogs. The hydatids are somewhat smaller than hog measles, their scolex having 26-39 hooks of various sizes.

Generalities and Development.—The measles develop from the tapeworm eggs which have gained access to the stomach of the respective host where they are freed from their covering. Either actively or passively the developing embryos gain access to all parts of the body, and form in the connective tissue of the body, especially in the striated musculature the so-called measles. These appear as round or oval, transparent, colorless to grayish-white vesicles, ranging in size from a millet-seed to a double-pea, and filled with a serous fluid. An invagination of the cyst wall, the site of the future tapeworm, shows the scolex as a whitish translucent spot. The measles are separated from the surrounding tissues by the so-called bladder worm capsule, a delicate, connective tissue membrane, formed by the reaction of the cellular tissue. In microscopic examination of a cyst whose scolex has been extruded by gentle pressure between two glass plates, we observe four suckers, and sometimes crowns of hooks on the spherical or pear-shaped head (scolex). In the so-called neck we find numerous calcareous bodies and a cross-striation pointing to the future segments. The development of measles in animals follows ingestion of tapeworm ova, whose onchospheres (embryos), supplied with hooks, are largely carried from the intestines to the widely divergent portions of the body (connective tissue of the body) by the blood stream. The measles, especially those of cattle, may at any stage of their development undergo degeneration—hypertrophy of the sac surrounding the measles, coagulation necrosis, caseation, suppuration, calcification, and usually lose their capacity for further development, which is decided by the intactness of the scolex. If the latter cannot be demonstrated, or is easily crushed, the measles are no doubt dead. The viability of measles is limited, temperatures of 45-50° C. causing them to die; a strong salt solution will also kill them in a short while. The measles survive the death of their host for several weeks. The fact that meat is spoiled does not necessarily mean death of the hydatids.

Intrauterine infection of the fetus with embryos of measles, as some observations from practice would indicate, is not yet proven.

(a) *Cysticercus Cellulosæ*

The measles of pork is the asexual transition or larval stage of the hermit tapeworm (*Tænia solium*) of man. The bluish-white cysts of pork measles and the surrounding bladders are very thin; through them the invaginated scolex may be distinctly seen. The latter has four suckers and a rostellum with double crown, of 22-28 hooks (Fig. 100), which are absent in beef measles.

Occurrence—Locality.—The pork measles are found particularly in the connective tissues of domestic and wild hogs; rarely they are observed

in sheep, goat, dog, bear, cat, deer, buck, monkey, and man. The favorite site is the intermuscular tissue of the heart, tongue, larynx, abdomen, diaphragm, flanks, masticatory, neck, sternum, intercostal muscles, and adductors of the hind legs. When infestation is heavy they may be found in all muscles of the body, in the panniculus adiposus and in the brain; very rarely in the lung and liver. In case of marked invasion the musculature is aqueous and discolored a grayish-red. When a heavy invasion occurs the measles may be recognized beneath the mucosa of the tongue in the living animal.

Frequency.—The number of measly hogs has been decreasing steadily in Germany, thanks to meat inspection. The number of measly hogs is in general much larger in East Germany than in the west and south.

According to the government meat inspection statistics of the year 1904, measles were found in 0.25 per cent. of all slaughtered hogs in the German Empire. Infection is much more common in hogs in Russia and Austro-Hungary; Prettnier, of Prag, found measles in 3.44 per cent. of the hogs in Austro-Hungary.

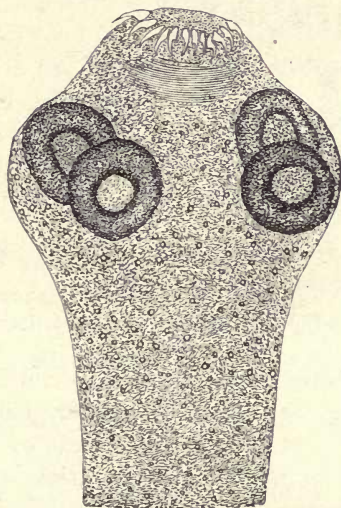


Fig. 100. Scolex of the hog measles. Squeeze preparation. x 50 diameters.

The detection of measles is not difficult by careful examination of the above-mentioned favorite sites. The tongue muscles are always to be separated, and the heart should be laid open with a cut exposing both chambers and dividing wall. In doubtful cases a microscopic examination is to be made. This will ascertain the presence or absence of the hooks and their number, etc. The latter remain intact even in caseous or calcified measles.

In order to avoid error, one must bear in mind the thin-necked bladder worm (*Cysticercus tenuicollis*), whose characteristics were described on page 232. From a differential diagnostic point of view, the following indications are especially to be observed:

1. The thin-necked bladder worm is never situated intermuscularly; if present it will be found on the muscles which are covered with serous membranes (abdominal, diaphragmatic, intercostal and sternal muscles).

2. In the isolated specimen of *Cysticercus tenuicollis* attention is called to the thin neck and the presence of more than 28 hooks (32-40) on the scolex.

3. The hooks of *Cysticercus tenuicollis* are more sickle-shaped; those of *Cysticercus cellulosæ* shaped more scythe-like (Fig. 102). Some of the smaller hooks of the former possess, in addition, a cleft or bifurcated basal process, which is not found in *Cysticercus cellulosæ* (Schwarz). (Fig. 101.)



Fig. 101

Fig. 101. Hooks of the hog measles

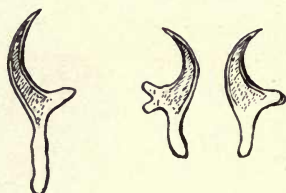


Fig. 102

Fig. 102. Hooks of the *Cysticercus tenuicollis*

Even small echinococci may most exceptionally occur in the musculature in cases of unusually heavy infestation, but by bearing the characteristic signs of this parasite in mind, no difficulty should be encountered in recognizing it.

In order to differentiate

between caseous and calcified measles, there come in question—

1. Embolic suppurations in the muscles.

2. Calcareous areas of degeneration.

3. Calcified parasites (trichinæ, echinococci, thin-necked bladder worms).

These occurrences in the musculature not only seldom occur, but present such definite characteristic appearances in the area affected that a careful examination will prevent mistaking them for measles.

Judgment.—Measly pork in a raw or improperly cooked condition is harmful to man, inasmuch as the hermit tapeworm develops in man from the measles. This parasite, 2-3.5 m. in length, is injurious to man—

1. By causing disturbances of digestion and nervous symptoms, which may be present more or less markedly according to the individual susceptibility of the patient.

2. By removal of foodstuffs (nutrition).

3. By the danger of autoinfection with measles.

The latter is effected by uncleanness in defecation, or through antiperistalsis in which the ova or mature segments of the tapeworm may gain entrance into the stomach of the affected individual and reproduce in this way the same measles development as occurs in the regular way of change of host in the hog. But the development of this species in the human body is of especial gravity and danger, as it frequently appears in the cerebrum, spinal cord, and eyes, producing severe disturbance of health and even death.

[According to B. A. I. Order 150, Regulation 13, section 17, paragraph 1, carcasses affected with *Cysticercus cellulosæ* may be passed for lard unless the infestation is excessive, in which case the carcass is condemned.]

Regulations.—As already stated on page 240, measles may be made harmless by high temperature and strong salt solutions. For this reason measly pork may be utilized for food, provided the infestation is not too heavy. Meat is considered strongly measly or heavily infested when the measles are present alive or dead in large numbers in areas as large as the palm of the hand, on section of muscles in the favorite location of the measles. This is the case, as a rule, when in the majority of the cut surfaces there is found more than one measles in each section.

Heavily infested measly meat possesses characteristics which incur a general disgust and makes the meat unfit for food. The same is true when the meat, without being heavily infested with measles, is aqueous or discolored.

Anent the utility of measly meat, the true musculature, the meat in a restricted sense, is to be considered separate from the fat and the viscera. Measles rarely occur in the fat and in the viscera, nor are either of these used for food in the raw state. Special regulations, therefore, apply to these.

Lightly infested measly meat (*Cysticercus cellulosæ*) may be made harmless by the following methods:

1. *Thorough Boiling.*—Inasmuch as a temperature over 49° C. destroys measles, thoroughly boiled pork which assumes a grayish-white color throughout even in the thickest portions, and in which the juice emanating on section is no longer red, is to be considered harmless.

2. *Pickling—Salting.*—If pork has been thoroughly salted for 2 to 3 weeks the measles will be destroyed with certainty.

3. *Freezing—Refrigeration.*—After large pieces of pork have been kept for four days at a temperature 8-10° C. below zero the measles contained therein will be found dead. This method has, however, not been accepted or incorporated into the legal regulations.

The method of killing beef measles, described on page 245, that is, by sufficiently long preservation of the meat, cannot be employed in pork measles, as they have been found viable 42 days after the death of the host (Ostertag).

For inspection regulations, see page 246.

(b) *Cysticercus Inermis s. Bovis*

The beef measles is the asexual intermediate or larval stage of the tapeworm *Tenia saginata s. T. Mediocanellata s. T. inermis* of man. The usually oval, grayish-white vesicles contain the scolex which may be seen within the cyst. The scolex contains four suckers, but no crown of hooks. Numerous calcareous (small) bodies may be seen microscopically in the neck of the scolex. The size (diameter) of the measles varies, according to Kaepfel, between 5 and 19 mm. in length and 3-8.5 mm. in width.

Ostertag was the first to establish the fact that numerous measles may become completely disintegrated and be absorbed later. This explains the excess of infestation in younger cattle.

Processes of degeneration are much more common in beef measles than in pork measles, and may appear at any stage of development. Measles of the viscera, masticatory muscle and tongue muscle are most suscep-

tible to degeneration and the processes of caseation are frequently recognized by their green color. If the scolex has also been destroyed in these regressive metamorphoses, and is not demonstrable microscopically, the measles are without doubt dead.



Fig. 103. Scolex of the cattle measles. x 50 diameters.

Occurrence—Prevalence. — Beef measles occur relatively seldom in suckling calves, more frequently in older calves and heaves in the intermuscular connective tissue, usually in small numbers. Sites of predilection are the inner (*M. pterygoid. medial. et lateral.*) and outer (*M. masseter*) muscles of mastication, heart and tongue muscles. Next in order are the muscles of the diaphragm, diaphragmatic pillars, esophagus, larynx, thorax, intercostals, and rump muscles; and, in fact, they are found in all the muscles of the body, but their distribution is very irregular. We may suddenly come upon nests of measles in the center of a

large uninfested area. In severe or heavy invasion the lungs, liver, brain, lymphatic glands and fatty tissue are also affected, but measles have been found in these organs or regions in isolated numbers, in even very slight infestation.

Frequency.—According to the Government meat-inspection statistics for the year 1904, measles occurred in the German Empire in 3.2 of every 1,000 head of cattle slaughtered, as follows: 5.13 steers, 6.03 bulls, 1.67 cows, 3.21 young heaves, and 0.024 calves.

C. bovis does not occur in reindeer meat, but the armed measles of *Tania krabbei* are found there, as has been mentioned on page 239.

In order to detect beef measles it is absolutely necessary to make several cuts into the inner and outer muscles of mastication, to inspect carefully the tongue musculature, also to inspect carefully the heart externally and internally after laying open the chambers and cutting through the dividing wall. It is understood that all other surfaces as well as cut surfaces of the remaining muscles be inspected for beef measles. The

discovery of doubtful formations and degenerated measles requires a microscopical examination.

Regarding the likelihood of mistaking beef measles for similar structures, we would refer to the points presented on page 241 in connection with pork measles. The special morphologic characteristics of beef measles are always to be borne in mind.

Judgment.—Raw, measly beef is to be viewed as injurious to man, as the 4-6 meter long *Tænia saginata* is developed in man from the ingested beef measles. The effect of infestation in man is the same as that of infestation with *Tænia solium*, as mentioned on page 242, with the exception of the danger of autoinfection, which has not been observed in the hosts of *Tænia saginata*.

Legal regulations for inspection of slaughter animals infested with measles injurious to health

Finding	Judging of the meat		Dog
	Beef	Hogs, sheep, goats	
1. Heavy infestation with measles. (Measles occur, alive or dead, in a large number of the prescribed muscle sections or the meat is aqueous or discolored without regard to the grade of measles infestation.)	The whole body is unfit for food with the following exceptions: Fat, liver, spleen, kidneys, stomach and intestines, are fit for food when careful examination has shown them to be free of measles; otherwise the fat is to be used under certain conditions, and the other organs are unfit for food.	Liver, spleen, kidneys, stomach, and intestines, are unfit for food. The fat is considered admissible, provisionally.	Measles in dogs always render the entire carcass unfit for food.
2. Slight infestation with measles. (All cases of finding live measles with exception of heavy infestation with measles, etc., as under 1, and of one-measled infestation as under 3.)	The entire animal body may be utilized with certain restrictions. The fat, liver, spleen, kidneys, stomach and intestines are fit for food if found free of measles upon careful inspection	Liver, spleen, kidneys, stomach, and intestines Fat is always fit, conditionally.	
3. One measled. (a) Only one measles (live) has been found, even after examination of the animal body upon section into pieces of about 2.5 kg.	The meat is to be excised at the site where the measles is situated and this portion is unfit for food. The fat, liver, spleen, kidneys, stomach, and intestines are to be considered fit for food without cutting them into sections if upon proper inspection they have been found free of measles. Nor is thorough cooling required. The other meat is impaired in value.	Liver, spleen, kidneys, stomach, and intestines The other meat, inclusive of the fat, is impaired in value.	
(b) On prescribed examination for measles only one live measles has been found, and the meat has been kept in the cooling or refrigerating room for 21 days.	As under 3a. The other meat is fit for food without restrictions.		

Regulations.—As the beef measles is much more easily killed than the pork measles, measly beef may be made fit for human food, provided it is only slightly infested (the infestation is not heavy) (see page 243), by boiling thoroughly, or salting, or freezing, or preserving it for sufficient length of time (cooling it thoroughly). The first three methods have already been discussed under pork measles, page 243. The admission of so-called one-measled beeves (einfinnigen Rinder) as human food, without previous destruction of the measles, is a regulation in favor of commercial interest against which weighty sanitary considerations will not prevail.

As concerns thorough cooling of the meat and its effect on the vitality of the measles under proper preservation of the meat, numerous experiments have shown that the beef measles survives its host 18-20 days at the outside.

If, therefore, slightly infected beef be kept in the prescribed manner (refrigerating rooms) for at least three weeks, it may be admitted to the trade in the raw state without incurring any risk of infestation.

[The regulation to B. A. I. Order 150, applying to the infestation of pork with *Cysticercus cellulosæ*, which was quoted on page 242, applies also to infestation of beef with *Cysticercus bovis*.]

4. Trichinosis

Trichinosis is due to *Trichina spiralis*, a roundworm inhabiting the muscles (muscle trichina), which is, however, not a sexually mature individual, but the asexual larval state of the intestinal trichina whose habitat is in the intestines.

Generalities and Development.—The intestinal trichina is a roundworm belonging to the family Trichotrachelidæ, according to Schneider, of the Holomyariæ, existing in both sexes, and found in the adult state in the small intestines of man and various mammals. The males attain a length of 1.5 mm., are 0.04 mm. thick, and possess two caudal appendages (sexual spicules). The females are 3-4 mm. long and 0.06 mm. thick.

Characteristic of the morphology of the trichina is its pointed anterior and the blunt posterior extremity of the body, as well as of the internal organs, the so-called "cell body," a row of large nucleated cells which lay in the anterior half of the body around the esophagus.

The trichina occurs in carnivorous and omnivorous animals, of which the following deserve special mention: Domestic and wild hog, dog, rat, fox, badger, marten, polecat, bear, cat; it may be transmitted to a number

of other mammals by feeding, but cannot be transmitted to birds or cold-blooded animals. Muscle trichinæ do not develop in birds, but intestinal trichinæ may occur.

The actual main host of the trichina, no doubt, is the rat; and these animals readily transmit the infestation to each other. Animals which prey on, or occasionally eat rats, may become infested from them (hog, dog, cat, bear, marten, polecat), and the trichina contained in their meat can again reinfest the rats. Trichina may also be transmitted through the ingestion of feces of animals which have eaten trichinous meat, but not from the fact that intestinal trichinæ are thus transmitted, but because the feces contained undigested trichinosed meat (Ostertag).

Development of the Trichinæ.—Upon the ingestion of meat containing trichinæ, the latter are freed through digestion of the parasitic sacs and their surrounding capsules and develop to sexually mature worms in the intestinal tract. While the males die shortly after impregnating the female and are digested and discharged with the feces, the females penetrate into the glands of Lieberkühn of the intestinal mucous membrane, with their anterior extremity, and deposit their young. During the six to seven weeks of life each female gives birth to 1,500 to 2,000, according to Braun even 8,000 to 10,000, embryos of 0.1 mm. in length, which are carried into the blood by the intestinal lymph stream. The blood carries them to all parts of the body, and in this way they gain access to the striated muscular tissues in which they locate exclusively, the heart excepted. Trichina embryos in other tissues and organs of the body die. In the further development of trichina embryos in the striated muscles, they emerge from the capillaries partly by diaporesis, partly by boring through the wall, and enter the sarcolemma sheath. As early as the 7th to 8th day after ingestion of trichinosed meat there may be found the first wandering embryos in the musculature. The embryos which wander within the muscle sheath to the bony or tendonous

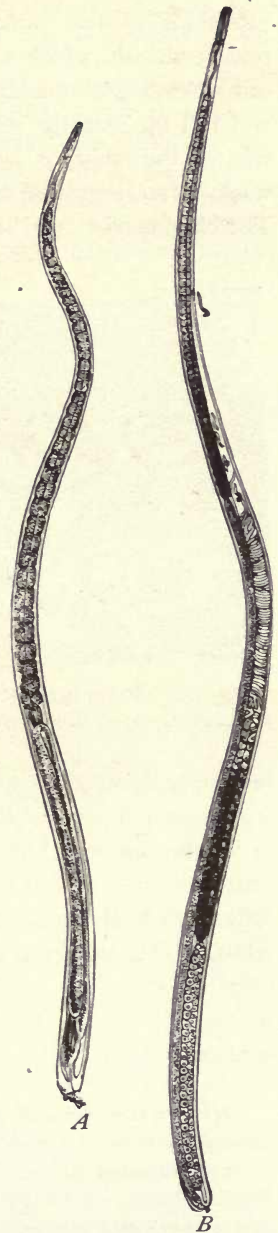


Fig. 104. Adult trichinæ. A, male; B, female (after Leuckart). $\times 120$ diameters.

insertions of the muscle fibers destroy the contractile contents of the muscle sheath, which lose their striation and at first assume a homogeneous, then a granular appearance. Finally the embryos become quiescent and roll up, spirally, within the sarcolemma. This terminates the migration of the embryos, which have attained a length of 1 mm., and three weeks after ingestion of trichinosed meat have become muscle trichinæ. The characteristics of the muscle trichina, which has no sexual apparatus,

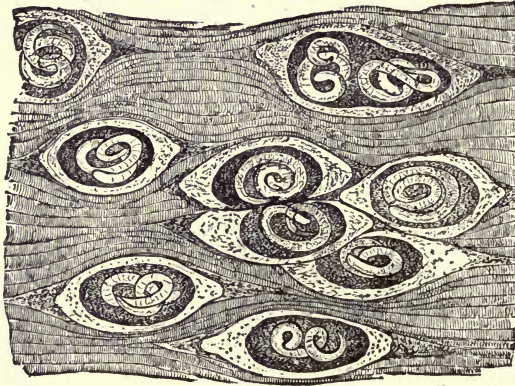


Fig. 105. Encapsulated muscle trichinæ (after Leuckart). x 60 diameters.

is the anterior pointed and the posterior blunt (body) extremity, the cell-body, and its situation within the muscle sheath. The encystment of the muscle trichina soon begins, forming capsules of a lemon-shaped form, whose longitudinal axis corresponds to that of the muscle fibers. The first signs of the capsules may be observed during the 5th week following infestation; and 9 to 12 weeks thereafter one will

find fully developed capsules everywhere. The capsule itself is structureless, homogeneous, shiny, possesses a double contour, and is transparent in the beginning. Fat cells form at the poles of the capsules within the muscle sheath, and at the end of three months lime salts also appear. The latter gradually encrust the entire capsule and sometimes the trichina itself. The calcification of the capsule may be complete at the ninth month, but usually takes 18 months. Muscle trichinæ may remain active within the capsule for many years (they have been found alive for 31 years in man).

Historical.—The first one to name trichina was Owen, who gave a more detailed account in 1835 of a worm which had been found in the same year by Paget, of London, encysted in the musculature of man. The muscle trichina was found in hogs by Leidy, of Philadelphia, in 1847. In 1850 Herbst, of Göttingen, made the first experiments at transmission of trichina; he infected a badger with the encapsulated trichina of a dog, and with the meat of the former infected two dogs. The importance of trichina to man was recognized in 1869, by Zenker, of Dresden, who found sexually mature trichinæ in the intestines of a girl who had died from typhoid; and also found recent unencapsulated muscle trichinæ in the musculature. He was enabled to prove that the girl had eaten of pork which had been found by

him to be heavily infested with trichinæ. In view of this discovery some of the most important observers studied the trichina, and the life cycle of this worm was established by Leuckart, Virchow, Fiedler, Haubner, et al. The biological condition of the trichina received further attention later by Heitzmann, Cerfontaine, Geisse, Askanazy, Chatin, Graham, Stäubli, etc.

The great danger of trichina to man was demonstrated scientifically for the first time in the epidemics of trichinosis at Hettstedt (1863), when 160 persons became infested and 28 died, and at Hedersleben (1865), where 337 cases occurred with 101 deaths. In the years following numerous observations of small and large epidemics were made in the most widely divergent portions of Central and North Germany.

The distribution of trichinæ in the musculature is not uniform. They are found in greatest numbers in the diaphragmatic pillars and the diaphragmatic muscles, which Heitzmann explains by the arrest of the embryos at the moment of muscular contraction, as this causes a transitory contraction or narrowing of the capillary diameter. In view of the constant activity of the respiratory muscles, this heavy infestation of trichinæ should not be surprising. Next in order of frequency of invasion are the tongue, laryngeal muscles, lumbar, masticatory and abdominal muscles. Specimens for examination should therefore be taken from the above-stated muscles of the hog. If careful microscopic examination of the diaphragmatic pillar, diaphragmatic, laryngeal, and tongue muscles has failed to reveal any trichinæ, it may be assumed that the remaining musculature does not harbor any parasites either; should isolated specimens occur in the remaining musculature, the ingestion of this meat is never followed by any deleterious results. Trichinæ do not occur in fat; sides of bacon may contain them should muscle tissue be adherent, especially the skin muscles.

The frequency of trichinosis in hogs is variable and does not give rise to any characteristic symptoms in these animals. By far the greater number of trichinosed hogs of Germany come from the eastern portion of the Empire. In the Kingdom of Prussia 0.005 per cent. of hogs examined in 1904 were found affected. The same ratio was obtained in the Kingdom of Saxony during 1901-1905, whereas in 1891-1900, 0.01 per cent. of all slaughtered and inspected hogs showed trichinous infection. Trichinosis among hogs in Germany is therefore gradually decreasing. In Saxony it was found that hogs imported from Austria-Hungary contained more infection than those at home. Pork from America has been found trichinous in 4-8 per cent. of the cases, according to our observations [observations made in Germany. In the United States the percentage of trichinous hogs found by the trichina inspectors after examining thousands of carcasses averaged about 2 per cent. yearly.] Among 1,177 dogs slaughtered in Chemnitz during 1897-1900, 13=1.11 per cent. were found trichinosed. In the whole Kingdom of Saxony, in 1906, among 3,603 slaughtered dogs 8 (0.222 per cent.) were found infested with trichinæ.

In order to elicit the origin of infested hogs the Imperial Chancellor has instituted compulsory trichina inspection in the various states which traces the origin of

every infested animal and reports accordingly to the Reichsamt of the interior which in turn informs the affected sections of the allied states of the presence of trichina in hogs coming from their district.

A careful microscopic examination is necessary in order to recognize trichina in the meat; a magnification of 30 is best.

A careful examination for trichina of suckling pigs, wild hogs, dogs, and bears, according to the directions laid down, is also of importance owing to the prevalence of trichina in man, of which Opalka has recently presented interesting tables, see page 147.

Diluted acetic acid (1:30) may be added to preparations of indistinct, not entirely fresh meat, for the purpose of clearing it; diluted potassium hydrate solution may be added to salted meat or ham to aid swelling of the muscle fibers.

In the examination of hog meat, the specimens should always be taken in hams, etc., from the bones; that is, at the tendonous insertions of the muscles. The examination of sausage is naturally of doubtful value.

For the compulsory federated trichina inspection among the allied states of the German Empire see page 147.

The following may be confounded with muscle trichinæ in their various stages of development: Calcareous concretions (see page 203), Miescher's bodies (see page 252), specific muscle degeneration of the hog (see page 203), and crystals of tyrosin (ham); their characteristics on careful examination will, however, prevent mistakes. Vinegar eels may accidentally gain access to the preparation, but these are easily recognized by their active serpentine movements. They are also almost twice as large as muscle trichinæ, and will be found in the fluid which has been added, rarely between the muscle fibers. Worms, similar to embryos of *Strongylus paradoxus*, have been found in preparation for inspection for trichina (Wallman, Georges, Tiemann). They may happen to gain access as the result of cutting the lungs of the hog, and in this way get into the microscopic preparation.

In addition to the facts above mentioned there have been found trichina-like worms (so-called pseudo-trichinæ) in the musculature of various animals (rat, rabbit, mouse, fowl, fish, mole). With any care in examination, these are not at all likely to be mistaken for trichinæ. These roundworms *never occur in the muscle sheaths, possess no cell-body, and taper at both ends*. In the case of capsule formation they will be found not of the peculiar structure of the trichinæ capsule, but of connective tissue-like formation.

For details regarding Pseudo-trichinæ see Johne "Der Trichinenschauer."

Judgment.—Trichinosed meat is injurious to health as its ingestion causes trichinosis resulting fatally in 10 to 40 per cent. of the cases. The disease may occur epidemically when meat heavily infested with trichinæ is dispensed in numerous small portions at one time. It is to be presumed, however, that the trichinosed meat has been eaten in the raw state in an imperfectly cooked condition, or as slightly smoked ham or sausages.

The muscle trichinæ do not resist very strenuously the usual methods of preparation of meats. Temperatures of plus 62-70° C. kill the parasites by coagulation of the albumen. Salting or pickling of the meat will not kill the trichinæ in the surface layers in less than 14 days, and those in the deeper tissues will require 4 to 6 weeks for their extermination. Hot smoke is effective, partly through the heat, partly through the cresols of the smoke, thus destroying the trichinæ; but the process is rather a slow one in large pieces of meat.

In decaying meat and under the influence of low temperatures (minus 15-20° C.), the muscle trichinæ retain their vitality for weeks. Wandering trichinæ embryos are harmless, and muscle trichinæ continue their development in another host only after the development of the site of the sexual parts and having attained a body length of 0.5 to 0.75 mm.

Trichinosed meat of wild hogs, dogs, and bear is to be judged the same as that of domestic hogs; examination for trichinæ is absolutely essential before the meat is to be used for food.

Regulations.—Inasmuch as infested meat can be rendered harmless quite easily by the action of high degrees of temperature, there is no reason why trichinosed meat should be withdrawn from the food supply of man. And the judgment on the fat, in which trichinæ do not occur, will be more favorable even than that of the muscles. For similar reasons as in measles it will be necessary to distinguish between slightly and heavily infested meat. The latter is the case when microscopic examination of six preparations taken from the pillars of the diaphragm, and the costal portions of the diaphragm, the laryngeal and tongue muscles (24 specimens in all, six of each) shows trichinæ in nine or more of the preparations. While the strongly trichinous muscle meat, as well as trichinous dog meat, is to be considered unfit for use in every case, slightly trichinous meat, inclusive of the fat of the strongly trichinous hogs, may be considered fit, with certain restrictions.

Legal Regulations for Rendering Decisions

In the presence of trichinæ there is to be viewed:

1. As unfit—

(a) the entire body of the hog.

(b) the entire body, exclusive of the fat, of strongly trichinosed hogs.

2. As conditionally fit—

(a) the entire animal body in slightly trichinosed hogs.

(b) the fat of the hogs coming under 1 b.

The removal or destruction of unfit trichinosed meat may be done only by the employment of high degrees of temperature or by chemically effecting a dissolution of the soft parts.

5. General Diseases Produced by Protozoa

(a) *Sarcosporidiosis*

Of the sarcosporidia, which cause sarcosporidiosis, one genus inhabits the muscle fibers (*Miescheria*) and another is found in the connective tissue (*Balbiana*).

I. MIESCHER'S BODIES.—The Miescher's or psorospermial bodies, which, according to Blanchard, may be subdivided into the genera *Miescheria* and *Sarcocystis* are found in the musculature of hogs, sheep, horses, cattle, goats, dogs, deer, antelope, rabbits and chickens. They are composed of straight, faintly spindle-shaped structures of 3 mm. length and a width of 0.006 to 0.4 mm., and lie within the contractile contents of the striated muscle fibers.

General Development.—The Miescher's bodies are composed of a delicate enveloping membrane, sending delicate fasciculi into the interior. The latter is filled with spherical kidney or sickle-shaped bodies (sporo-

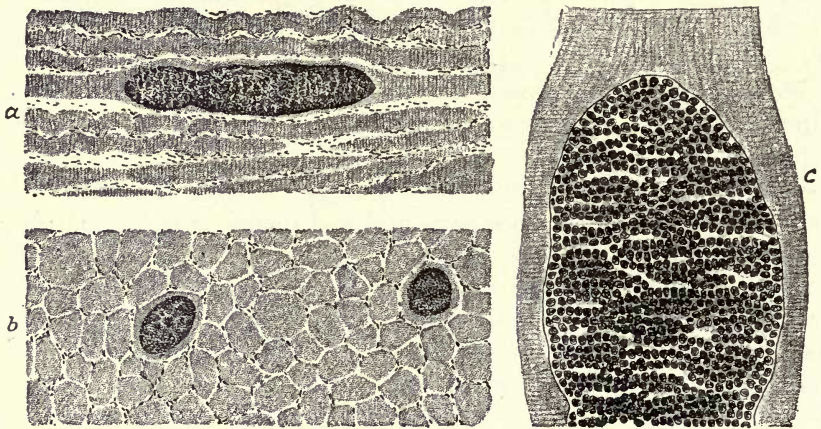


Fig. 106. Sacs of Miescher from hog muscles; a, b, longitudinal and transverse section of muscle. x 60 diam.; c, longitudinal section of muscle. x 380 diam. (after Ziegler).

zoites, Rainey's bodies), which are probably without a surrounding sheath, but nucleated. The sporozoites may decompose and form a granular detritus; quite commonly there occurs calcification of the psoroperms. In what manner and in what form these parasites gain access to the animal body is as little known as is their development in the animal body, which probably is of an embolic nature.

Lesions.—The sacs of Miescher (*Sarcocystis miescheriana*) occur in the striated muscles of the hog, but are found most frequently in the abdominal and diaphragmatic muscles. The large sacs, especially when

calcified, may be seen macroscopically as light gray, pointed or tapering oblong dots in the dark musculature, but the smaller ones cannot be found without the aid of the microscope. They are found to be peculiarly granulated structures within the otherwise unchanged muscle fiber (Fig. 106). In the smaller sacs, and with a high magnification, the thoroughly preserved striation of the muscles fibers may be made out alongside of the parasite. After calcification has occurred the sac will appear as a more or less opaque, almost black structure macroscopically. Of the muscles of sheep, the abdominal and skin muscles are most frequently inhabited, and here very large Miescher's bodies (*Sarcocystis tenella*) obtain. Small microscopic sacs may occur in other muscles also. Not infrequently macroscopic Miescher's sacs (*Sarcocystis bertrami*) are found in the neck and esophageal muscles of the horse. The Miescher's bodies (*Sarcocystis blanchardi*) are not common in cattle in this country and may be recognized by their millet-seed to barley-seed size of yellowish-green appearance.

Miescher's bodies, when in the calcified state, may be confounded with the so-called calcareous concretions (lime deposits) (see page 203); and, in the hog, with calcified trichinæ (see page 248). In both cases the addition of acetic acid will remove the calcification, and the microscopic examination will reveal the substratum of the calcification.

Judgment.—The very fact that the presence of Miescher's sacs in the muscles does not irritate the latter, nor produce any symptoms of disease in the animals, would lead us to conclude that these are harmless parasites. They have not yet been positively described as having been found in man; nor has their transmission through ingestion of meat been observed.

The report by Beel of a disagreeably sweetish odor of the meat in the case of a hog heavily infested with sarcosporidia, has not been verified by other authors.

Regulations.—The utility of the meat infested with Miescher's bodies depends on the appearance of the meat and the intensity of the infestation.

If the meat does not show infestation macroscopically it may be used with impunity. If the calcified sacs are visible macroscopically, and if they are present in large numbers in all the muscles, or if the meat (musculature) shows greenish or yellowish spots, or if it is aqueous, then the entire carcass, exclusive of the fat, is to be condemned. If the changes are confined to certain muscles (sheep, cattle) these are to be condemned. In intermediate grades of infestation of the meat with these parasites the meat is to be admitted to the trade, but considered as inferior meat.

In the cases of infestation with Miescher's bodies in which the meat has been condemned, the fat is to be rendered; in all other cases it is to be treated as the meat is treated.

2. **BALBIANIDÆ.**—The Balbianidæ are designated as psorospermial pouches as compared with the psorospermic bodies of Miescher. They occur in the esophagus of sheep, goats, horses, cattle, buffalos, and deer, often in large numbers. They are found more rarely in the tongue, laryngeal, thoracic, abdominal and eye muscles and in the heart. On account of their size Railliet named them *Balbiani gigantea*.



Fig. 107. Esophagus of sheep with balbianidæ.

Lesions—Finding.—In the intermuscular connective tissue of the esophagus are found millet-grain to hazelnut sized yellowish-white cysts, with suppurative contents, composed mainly of sporozoites (Fig. 107).

Judgment.—On account of their objectionable consistency all muscle parts inhabited by Balbianidæ are to be condemned.

(b) *Hemosporidiosis*

I. **PIROPLASMOSIS.**—Piroplasmoses are diseases of the blood occasioned by protozoa of the genus *Piroplasma* or *Pirosoma*. The transmission of these parasites is effected through the medium of ticks (in Europe *Ixodes reduvius* [*I. ricinus*], in other places *Rhipicephalus* or *Margaropus* [*Boophilus*] species).

(a) *Piroplasmosis of cattle.*—This epizootic or isolated, sometimes acute, but more often chronic disease, is produced by the *Piroplasma bigeminum* (*Pirosoma bigem.* Smith and Kilborne, *Apiosoma bigem.* Wallondeck Pèron, *Ixidioplasma bigem.* Schmidt).

Pathogenesis.—The parasites on gaining access to the blood by transmission through ticks, occasion destruction of the red blood corpuscles of cattle. This results in hemoglobinemia; and in severe destruction hemoglobinuria and icterus are caused. The cell detritus causes emboli, hemorrhages, and parenchymatous nephritis. After considerable increase in the number of parasites fever sets-in. In some cases death from asthenia occurs as the result of the disturbances of nutrition and rapid decrease of the erythrocytes.

Symptoms—Lesions.—In the living animal there may be present symptoms of fatigue, emaciation, fever of 40-42° C., disturbed rumination, and in the beginning one may observe irritation and even attacks of madness. There is retention of fecal matter and colic; later thin stools, with mixture of mucus and blood. The milk secretion is diminished. Later there follow muscular tremors, uncertain gait, swelling of superficial lymph glands, reddening of the mucous membranes, which subsequently become pale and icteric, lachrymation, urine at first reddish, later getting

darker and darker, foaming considerably. It is fatal in 4 to 5 days in unfavorable cases. In the lighter forms of the disease improvement occurs about the middle of the first week of the disease, the fever diminishes, but convalescence is as a rule very slow.

In the slaughtered animal one finds, according to the stage of the disease, catarrhal stomach and intestinal inflammation with small hemorrhages and erosions; hypertrophy of the liver, the latter being flabby, lusterless, faintly reddish-brown, and permeated by yellowish bands and spots; the spleen is considerably enlarged, the pulp highly injected and softened; urinary bladder is filled with light to dark red urine; the mucous

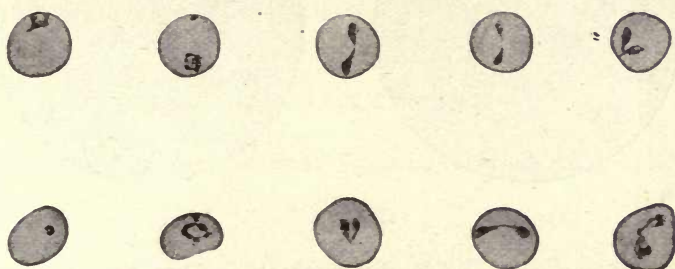


Fig. 108. *Piroplasma bigeminum*. Typical ring and pearl-shaped forms. The upper row stained with alkaline methylene blue; the lower according to Romanowsky (after Kossel and Weber from Hutyra and Marek).

membrane shows numerous hemorrhages; there is cloudy swelling of the kidneys; hemorrhages in the serous membranes; the blood is light red and thin; icterus is present in some cases.

The recognition of the disease is facilitated during life by finding the parasites on microscopic examination of the blood.

Dried cover-glass preparations are fixed in absolute alcohol, or in a mixture of equal parts of alcohol and ether, and stained with a 1 per cent. aqueous solution of methylene blue.

In the differential diagnosis we must consider anthrax, hemorrhagic septicemia, and hematuria; the symptoms in these diseases, as well as their bacteriologic findings, differ in important features from those of piroplasmosis.

The *judgment* will depend on the grade of the disease and on the fact that this affection is not transmissible to man by ingestion of the meat. In severe cases of the disease the meat is to be condemned; in lighter forms the question of inferior value will have to be considered.

[Carcasses affected with Texas fever should be condemned, according to B. A. I. Order 150, Regulation 13, section 14.]

Of the more important piroplasmoses should be mentioned :

1. Texas fever of cattle, which occasions tremendous losses in the United States of North America, and has necessitated the law preventing importation of American cattle.



Fig. 109

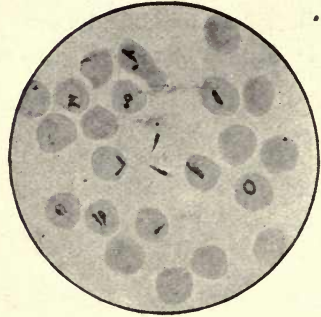


Fig. 110

Fig. 109. *Piroplasma bigeminum*. Round and pear-shaped forms. Cattle blood. Stained with methylene blue (after Hutyra and Marek).

Fig. 110. *Piroplasma bigeminum*. Rod-shaped forms. Cattle blood. Stained according to Laveran (after Hutyra and Marek).

Diseases of cattle similar in their intensity and rate of mortality to Texas fever occur in German East Africa, Hungary (forest disease), Roumania (epizootic hemoglobinuria), Italy (malaria of cattle), Sardinia (hematuria), Finland, Turkey, Argentine Republic (tristeza), Australia (tick fever), South Africa (redwater, or coast fever).

2. Infectious hemoglobinuria of cattle (enzootic bloody urine), occurs sporadically in Germany as well as enzootically. It differs from Texas fever by a longer period of incubation and a milder course.

3. The South African horse malaria (Geglielmi, Rickmann), which is frequently associated with a separate and distinct enzootic disease of horses, described by Theiler.

4. Carceag or parasitic ictero-hematuria of sheep in Roumania, which also occurs in other countries (malarial catarrhal fever).

5. Malignant jaundice of dogs in France, Hungary, Italy, Africa, and India (malignant malarial fever, malignant protozoan jaundice).

2. *Trypanosoma*.—(a) Surra, tsetse-fly disease or nagana of cattle (gall sick, Theiler) camels, horses (Mal de caderas), and elephants in

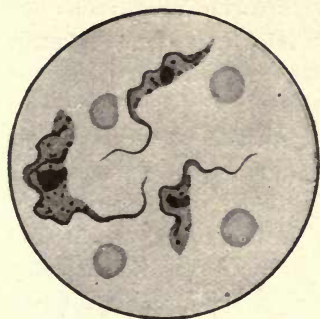


Fig. III. *Trypanosoma equinum* s. *Elmassiani*. Guinea pig blood (after Hutyra and Marek).

Africa and India are caused by flagellate infusoria (trypanosomes), and are without importance in meat inspection.

(b) The investigations of Schneider and Buffard indicated that dourine of horses must also be classified as a protozoan disease and the results of these investigators were confirmed by Nocard who found that a trypanosoma was the cause of the disease. At the present time this disease is of no importance from a sanitary police standpoint.

6. Infectious Diseases

A. Infectious Diseases of Food Animals Transmissible to Man

1. Tuberculosis

Tuberculosis occurs among all food-producing animals, and is the disease with which the veterinary inspector is mostly occupied. Etiologically it is identical with tuberculosis of man, and is caused by the tubercle bacillus discovered by Koch in 1882. The disease in animals runs a chronic course.

Pathogenesis.—The development of the disease requires a certain predisposition in the body which affords favorable colonizing conditions for the entering tubercle bacilli. The disease may, according to the mode of infection, become established in the following manner:

1. Through the respiratory tract (Inhalation tuberculosis).
2. Through the digestive tract (Ingestion tuberculosis).
3. Through the female genital organs (Genital infection, Generative tuberculosis).
4. Through the skin (Cutaneous tuberculosis).
5. From the umbilical vein during intra-uterine development of the fetus (Fetal tuberculosis, Congenital tuberculosis).

Although in accordance with these modes of infection the primary lesion of the disease is expected to be present in the respective organs, nevertheless it frequently happens that the tubercle bacilli will not produce an affection at the seat of entrance but will be disseminated throughout the body and only cause lesions remote from the place of entry.

The fact that lymph glands offer especially favorably conditions for colonization and development of tubercle bacilli is of importance in meat inspection, and they must therefore be regarded as favorite locations for tuberculosis.

As soon as tubercle bacilli find conditions favorable for development in any tissue of the body they multiply and cause a reaction of that tissue.

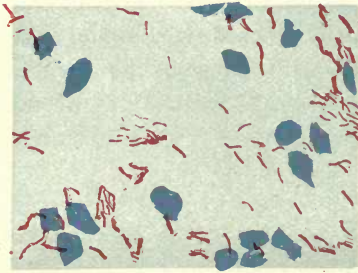


Fig. 112. Tubercle bacilli. Fuchsin and methylene blue staining. $\times 400$ diam. (after Ziegler).

This makes itself manifest as a round cell proliferation, which appears either in the form of an isolated tubercle or as a tuberculous infiltration. The isolated tubercle in its developed condition forms a gray, transparent, nonvascular, cellular nodule of the size of a millet seed which encloses tubercle bacilli. Amongst these cells there develop, as a rule, multinuclear giant cells, which are centrally located. In the case of tuberculous infiltration, principally exudative processes of a fibrous nature appear.

Soon retrogressive processes take place from the center of the tubercle, as a result of which the latter becomes clouded and changes to a grayish or yellowish-white color; the tubercle becomes caseous (coagulation

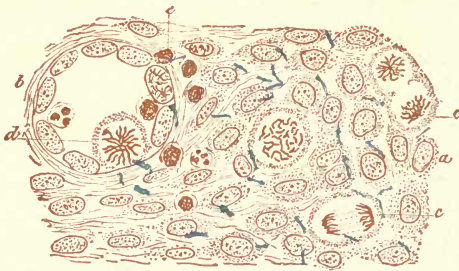


Fig. 113

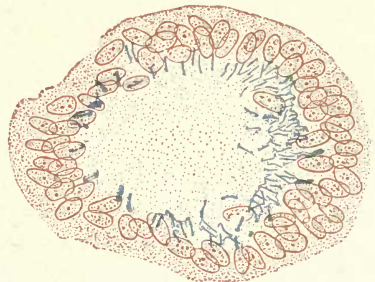


Fig. 114

Fig. 113. Changes in the tissue produced by a fresh invasion of tubercle bacilli (after Baumgarten): *a*, proliferating connective tissue; *b*, cross-section of blood-vessel; *c*, karyomitosis in connective tissue; *d*, karyomitosis of an endothelial cell of a vessel; *e*, migrated leucocytes. $\times 350$ diameters.

Fig. 114. Giant cell containing bacilli from a tubercle with necrotic center. $\times 350$ diameters (after Ziegler).

necrosis with secondary granular disintegration). In the tuberculous infiltration the retrogressive processes consist of a more purely coagulation necrosis, e. g., hyaline degeneration. If the periphery of the tubercle does not disintegrate it will gradually become fibrous, and caseo-fibrous

tubercle develops. The formation of entirely fibrous tubercles in food animals, excepting in the horse, is rare. These processes are followed by a further retrogressive metamorphosis, that of calcification of the tubercle, which is of especial importance in food animals. Suppuration of the tubercle and the formation of abscesses or cavities may result from a simultaneous infection with pus-forming organisms, or, as Bongert has proven in case of cattle, it may result when tubercle bacilli die gradually in great numbers. Abscesses and cavities occur comparatively rarely in food animals. Ulcers, however, may be formed as a result of the caseation of tubercles located on the surface of mucous membranes.

Notwithstanding the degenerative processes within the tubercle, the latter may increase continually in size on the outside and thus develop into larger nodules and tubercles. The confluence of small nodules may lead to the formation of conglomerates or to new formations of a fibrous character.

The method of dissemination of tuberculosis and its metastatic formations are of especial importance in the judgment of tuberculous animals, and take place as follows:

1. *Dissemination by the Lymphatic System.*—Lymphatic miliary tubercles are formed in the neighborhood of the primary tubercle and the lymph glands involved become diseased. By means of the further dissemination of the tubercle bacilli by the lymphatic fluid other lymphatic glands lying nearer the heart and finally the lymph of the thoracic duct and the blood itself may become infected.

As the lymphatic fluid flows from the inside of the organs toward their surface (e. g., toward the corresponding lymphatic glands), it becomes self-evident that an infection of the organ cannot be in an inward direction from the surface. Should the bacilli enter the lymph of the thoracic or abdominal cavities, then not only the serous membranes may become infected (serous tuberculosis) but the bacilli may also enter the adjoining cavity through the lymph spaces of the diaphragm.

2. *Dissemination by means of the blood* may take place after the entry of tubercle bacilli into the blood in the above-described way, or also after a direct penetration of tubercle bacilli into the blood stream, when the walls of the veins become diseased or destroyed by caseation of tuberculous foci. As a result of the dissemination of the tubercle bacilli by means of the blood a hematogenous miliary tuberculosis (embolic tuberculosis) develops at the point where the bacilli are deposited and multiply. The bacilli which have come into the venous blood may be retained in the lungs, and if their penetration occurred at the basic region of the portal vein they may be retained in the liver, which is not at all unusual in mild infection of the blood. When the venous blood is flooded with great



numbers of tubercle bacilli, or when the latter enter the veins of the lungs they pass into the arterial blood of the large circulatory system and thereby into the whole body. This process of dissemination is known as "generalized tuberculosis."

In the dissemination of tubercle bacilli through the large circulatory system the placenta may also become infected and from there infection may spread to the fetus.

3. *Dissemination of Tubercle Bacilli on the Surface of Mucous Membrane by Means of Secretions.*—This process may not only transmit a further infection of the organs belonging to the affected apparatus (larynx, trachea, bronchi, and other parts of the lungs; lymph glands of the palate, small and large intestines), but it may also lead to the infection of another organ or tract. Thus infection of the digestive apparatus may result in consequence of pulmonary tuberculosis if the tuberculous excretions of the respiratory mucous membranes are swallowed. To the first-mentioned form of dissemination belongs also the spreading of tubercle bacilli from the kidneys by means of the urine to the pelvis of the kidneys, ureters, bladders, or to the urethra.

Meat inspection must distinguish between *two forms of tuberculosis* in accordance with the aforesaid methods of dissemination.

1. *Localized Tuberculosis.*—This term designates the following conditions:

(a) The infection of a single part of the body with the corresponding lymph glands. This form of tuberculosis is most frequent in food-producing animals on account of the small number of bacilli in the tuberculous processes.

(b) Infection of several parts of the body without the concurrence of the large circulatory system. Accordingly it deals with tuberculous processes which have originated from a primary infection by continuous development through dissemination of the bacilli by means of the lymphatic or secretive juices, and, as far as the blood enters into consideration, through the portal circulation.

2. *Generalized Tuberculosis* exists when a part of the body is affected to which the tubercle bacilli can be taken by the arterial blood only (e. g., spleen, kidneys, suprarenal glands, testicles, ovaries, udder [Plate 1], bones, muscles, body lymph glands, central nervous system, eyes, etc.). The number and consistence of tuberculous processes which develop in the generalized cases depend upon the degree of prevalence of bacilli in the blood and upon the filterable action of the liver and lungs. When the latter is very marked many bacilli are retained by these organs, and both lungs and liver are found to be everywhere uniformly permeated with tubercular nodules of a similar stage of development (hema-

togenous miliary tuberculosis). Acute miliary tuberculosis is spoken of when the dissemination of tubercle bacilli by means of blood occurs only shortly preceding the death of the animal, resulting in the production in most of the organs of a countless number of eruptions of tubercles of uniform size which are only slightly degenerated. When the venous blood is poor in bacilli only a few single tubercles will develop in the liver and lungs. The presence of numerous embolic tubercles in the lungs has a prominent diagnostic significance, as it positively indicates infection of the blood with numerous tubercle bacilli and thereby points to the suspicion of generalized tuberculosis.

Generalization of tuberculosis, which is not a frequent occurrence among food animals, does not lead to uniform development of tubercles in all parts of the body. The arrangement of the blood vessels in the various organs and the extent of circulation of the blood in the organs is essentially decisive. Generalized tuberculosis, in addition to the already mentioned lesions of the lungs and liver, is usually found in the spleen and kidneys, in the various body lymph glands, in the bones and joints, and in the udder and uterus; tuberculosis of the latter, however, does not indicate a generalized condition in every instance (e. g., passing of tubercle bacilli from the abdominal cavity through the Fallopian tubes into the uterus). The muscles proper are so extraordinarily rarely affected that by many they have been considered as almost immune to tuberculosis. That those tubercle bacilli which enter the circulatory system but are not deposited in any of the organs die in from 4 to 6 days is an important fact which was established by Nocard and others.

Prevalence of Tuberculosis in Food Animals.—The statement made by Ostertag that “at least 25 per cent. of the older cattle are tuberculous” is perfectly true.

According to meat-inspection statistics of the German Empire the percentage of tuberculosis in animals slaughtered in 1904 was as follows:

Cattle, 17.88 per cent.; calves, 0.26; sheep, 0.20; goats, 0.69; hogs, 2.46; horses, 0.15; dogs, 0.85.

Tuberculosis in cattle was most prevalent in the Kingdom of Saxony with 34.48 per cent., Schaumburg-Lippe being lowest with 5.73 per cent.

Tuberculosis in calves was most prevalent in Pommerania (Prussia) with 0.79 per cent., while Alsace-Lorraine was lowest with 0.02 per cent.

The Kingdom of Saxony also had the highest percentage of tuberculosis in hogs with 5.13 per cent., Hohenzollern being lowest with 0.30 per cent.

Symptoms and Lesions.—The clinical appearance of tuberculosis can be only briefly described here. The symptoms become of diagnostic importance only when they are conspicuous, and when it may be assumed that the affection has reached an advanced stage. Even then they are not reliable. Highly suspicious symptoms in all food animals are hard, nodular swellings of the lymph glands, udder, or testicles, painless exostosis and swellings of joints, which cannot be attributed to other causes, cough-

ing, difficulty in breathing with very apparent loss of flesh. Hard, tight skin and a rough coat of hair, chronic bloating, hardening of the udder, and dry rattling may be additional indications in cattle. The symptoms which arouse suspicion in hogs—among which nutritive disturbances are rare—are principally exostosis and curvature of the spine without rha-chitic symptoms.

Other methods for diagnosing tuberculosis in the live animal (ante-mortem inspection) cannot be given in detail here.

The lesions present in the slaughtered animal differ in the various species.

In cattle tuberculosis occurs principally in two different forms, which,

however, are often combined—namely, tuberculosis of the serous membranes (pearly disease), and tuberculosis of the organs. The former begins with reddish, soft, granulation-like proliferations, from which large nodules of various sizes are developed (see Figs. 115 and 116), and which, either when isolated or confluent, show a tendency to become calcified early. Occasionally enormous, thick, fibrous or calcified tuberculous deposits are formed on the commonly diseased pleura and pericardium. Peritoneal tuberculosis is somewhat less common.

Concerning tuberculosis of the organs and mucous membranes the respiratory apparatus is most often the primary seat of

the affection (tuberculous bronchial pneumonia); next comes the digestive tract, while the female genital organs are very seldom affected. In the lungs there are now and then cavities. In the intestines of cattle the result is occasionally a uniformly marked thickening and coarse wrinkling of the mucous membrane, which represents a diffused epithelioid

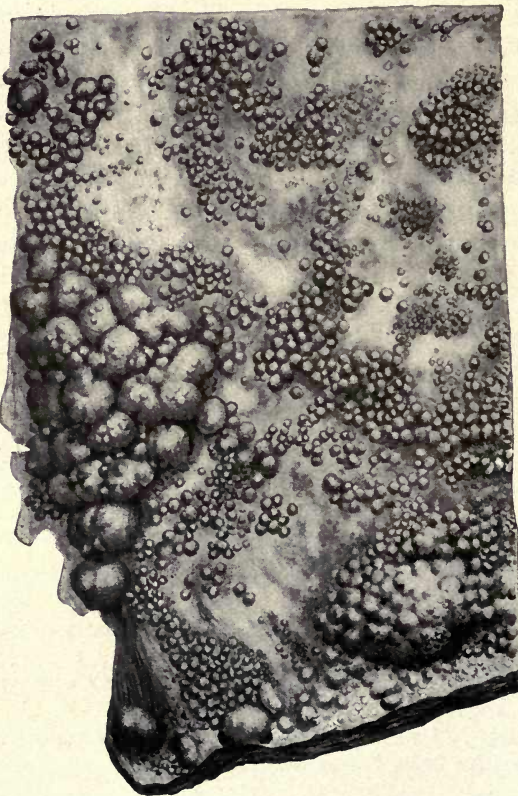


Fig. 115. Small nodular tubercles from the pleura of a cow

infiltration without the formation of nodules (Johne and Frothingham, Rieck, Markus, Bongert, and others), and in which caseation and ulcerations cannot be determined.¹

All parts of the body may be secondarily infected. The manifestation of the disease is influenced by the nature and the mode of infection as well as by the anatomical structure of the various organs. Lymph gland tuberculosis (see Plate II, Fig. 3) is often conspicuous for its enormous development. For tuberculosis of the udder compare Plate I.

Tuberculous processes in cattle tend generally toward dry caseation and calcification. Tuberculosis of any organ in which the lesions are softened may develop into generalized tuberculosis; the latter is characterized in young animals in the first place by an affection of the spleen, in older animals by involvement of the kidneys. Tuberculosis of the bones is not very common; on the other hand it is not uncommon that the body lymph glands become diseased without being accompanied by a similar affection in the spleen and kidneys.

Corresponding to the transmission of the disease by the placenta, calves very frequently manifest

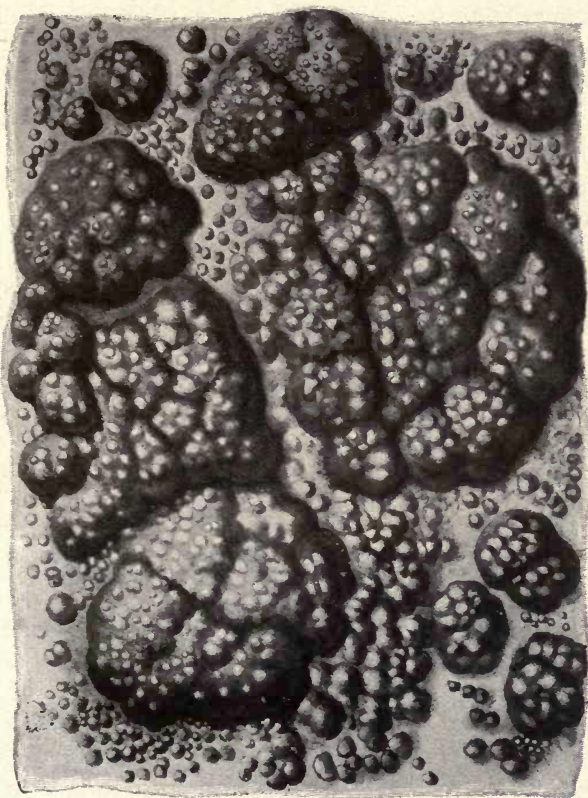


Fig. 116. Large nodular tubercles from the pleura of a cow

[¹Recently it has been satisfactorily shown by Bang, McFadyean and others that these intestinal lesions are not due to the tubercle bacillus, but to a somewhat similar acid-proof bacillus which produces this hypertrophy of the intestinal mucous membrane to which the names of Johne's disease, chronic pseudo-tuberculous enteritis, and chronic bacterial dysentery have been given.]

embolic tuberculosis of the various organs; first of all, in the liver, portal glands, lungs, posterior mediastinum, spleen and kidneys, but the disease may also result and spread by infection from the digestive tract. Generalization occurs in a majority of cases.

Tuberculosis, although comparatively seldom found in sheep, presents in a general way the conditions and appearance of tuberculosis in cattle. Lesions of the serous membranes occur also, although they are not so common as in cattle. Calcification takes place at a comparatively early period.

This disease appears also in a similar form in goats, in which pearly-disease and lesions in the lungs of a similar nature to those found in human phthisis (cavity formation) have been observed. [Generalized tuberculosis is not uncommon among sheep and goats in Germany, but is extremely rare among these species in the United States.]

In hogs tuberculous affections occur most frequently in the digestive tract from which secondary infection of the various organs, especially liver and lungs, and very often also generalized tuberculosis result, which are characterized by tuberculosis of the spleen in the majority of cases. Primary respiratory tuberculosis is less common than in cattle, while lesions of the serous membranes are even more rare. Calcification in the tuberculous foci begins at an early period. In generalized tuberculosis the lymph glands of the muscles and bones are often affected. Junack has described "tuberculosis without retrogressive alterations in swine." In one case in which a hog became so diseased the condition resembled sarcomatosis. (Plates IV, V, VII.)

Tuberculosis in the horse, which is very infrequently observed, resembles tuberculosis in cattle, but does not possess a tendency to calcify; it does, however, tend to soften at the center.

The formation of small fibrous tubercles is not uncommon. The lymph glands of the affected organs become considerably hyperplastic. Infection spreads principally from the lungs.

The general appearance of tuberculosis in the dog suggests the conditions found in the goat, but the tuberculous lesions in the lungs and lymph glands are of a more grayish-white color, similar in consistence to bone marrow. Instead of caseation there is degeneration into grayish-white decomposing masses which resemble whey.

In carrying out the general method of examination at the post-mortem inspection for tuberculosis, the following directions should be observed:

1. All lymph glands located at the portal of entry of the infection must be carefully incised; first of all the submaxillary and retropharyngeal lymph glands, tonsils, bronchial, mediastinal, mesenteric, and portal lymph glands.

2. Cutting into plainly visible seats of tuberculous affection, especially cavities, should be avoided, if possible, owing to the dissemination of tuberculous material. Contamination of the meat with tuberculous material must also be carefully guarded against. Soiled knives must be used only after boiling in a 2 per cent. solution of soda.

3. In an animal which is found to be tuberculous the parts which are least often affected (lymph glands of the muscles, spleen, kidneys, udder, bones) should be examined first. Von Stroh records some interesting studies concerning the prevalence of tuberculosis of the lymph glands of the muscles.

Identification of the common forms of tuberculosis is not difficult for the inspector, when once he is familiar with the manifold variations in the form of development of tuberculous processes and their metamorphosis. The lymph glands, as has repeatedly been emphasized, form a predilectory point for the development of tubercle bacilli and the specific condition of the lymph gland is therefore of especial importance for diagnosis (Plate II, Fig. 3). The condition of the lymphatic glands also verifies diagnosis of doubtful affections of organs, since it may generally be considered that at least one of the corresponding glands will be typically affected in tuberculosis of the organs.

It need not be emphasized that the characteristic conditions of development and structure of tuberculous granulations from the most diminutive transparent grayish nodules, which at first become clouded at the center after which they degenerate, together with the tendency to spread to the surrounding tissues by the formation of secondary nodules, are also indications worthy of cognizance. Ostertag recommends a microscopic examination (at about 40 diameters) of a crushed sample, in order to determine with certainty the character of doubtful nodules. By this method one can plainly see the round or elongated giant cells, which, as it is well known, are especially nicely developed in the tubercles of domestic animals. This method is also said to be well adapted for the examination of lymph glands for tuberculous foci, which cannot be determined macroscopically; they appear conspicuous from the surrounding normal lymph gland tissue by disclosing round, colony-like cloudy spots with giant cells in the center and epithelioid cells around the outside.

It is self-evident that the demonstration of the presence of tubercle bacilli also serves to make diagnosis positive, although an effort to determine their presence may result in failure even in genuine tuberculosis. It has been experimentally determined that in strongly caseated or calcified foci, attempts to find bacilli often fail, especially in tuberculosis of swine. Such foci are, however, infectious, which can be proved by animal experiment. This, however, cannot be utilized for practical meat inspection on account of the delay in the decision which it would cause.

The following-named conditions may be mistaken for tuberculous lesions:

1. Degenerated echinococci and measles (pages 235 and 239).
2. Actinomycotic processes (page 273).
3. Pentastome colonies in the lymph glands (page 234, Plate II, Fig. 4).
4. Strongyle nodules in the lung of sheep (page 226).
5. Lesions of hog cholera (page 306).

The characteristic indications of these diseases are sufficiently discussed under their respective heads, and when compared with the characteristic pathological peculiarities of tuberculosis they assure definite results in diagnosing the latter, such diagnosis being in addition based on the appearance of the lymph glands and the result of a microscopic examination.

Virulence of the Tissues of Tuberculous Animals

In testing the question as to the extent to which tuberculous changes in food animals may become dangerous to human health as a result of their utilization as food, one cannot avoid the premise that the tubercle bacillus of animals is identical with the bacillus which causes human tuberculosis. And as tubercle bacilli entering the digestive tract of man are apt to produce tuberculosis, and also since virulent tubercle bacilli are found in the tuberculous parts of food animals, it follows that all organs and parts of carcasses which are tuberculous must be regarded as infectious and dangerous to human health. Animals in which only the lymph glands are diseased belong in this category, as it is very possible that small, virulent tuberculous foci in the earliest stage of development have been overlooked at the macroscopical examination of the parenchyma of the organs. This fact makes it self-evident that tuberculous organs must be considered as totally unwholesome, even when only a few scattered lesions may apparently occur therein.

In regard to the virulence of the meat, e. g., the striated muscles, it must be remembered that the musculature is very infrequently the seat of tuberculous processes, that as a rule tubercle bacilli are carried to the muscles by the blood only, and that they occur in the blood rarely, and then they remain in the circulation only for a short period of time.

Numerous experiments in feeding and inoculation have been conducted on animals to test the virulence of tuberculous meat, but as has already been pointed out by Ostertag, the dissemination or extent and special character of the tuberculous affection in the animal, from which the sample of muscle was taken, were entirely disregarded. Ostertag summarizes the results of these experiments by saying that "muscle or juice

of muscle from tuberculous animals does not, as a rule, contain any or not sufficient bacilli to produce tuberculosis in experimental animals." The meat is infectious only in the most advanced stage of tuberculosis, and when suppurative softening of the tuberculous lesions are present. In connection with this it must also be considered that, although the susceptibility of man to tuberculosis is assumed to be the same as that of experimental animals, yet the number of bacilli which will produce tuberculosis on intraperitoneal inoculation is not sufficient to produce it by their introduction into the digestive tract, and that, therefore, a positive result from inoculation does not imply that the meat is unwholesome for food. Even the most recent investigations along this line by Hoefnagel, Westenhoeffer, Swierstra, in which the condition of the tuberculous animal, the extent of the affection, and the nature of the tuberculous processes were carefully taken into consideration, have corroborated Oster-tag's view.

From the same standpoint should be considered the results of the experiments regarding the blood and the muscle juice from tuberculous animals.

Notwithstanding all this, one must take into consideration, from a meat-inspection standpoint, that muscle is not the only form of meat which must be considered, or that the term "meat" does not include the striated musculature only; it also includes other constituents of meat, the lymph glands and bones of which especially are not uncommonly affected by tuberculosis when the disease has become generalized in the body. Precaution is therefore necessary in judging generalized tuberculosis.

In the utilization of meat from tuberculous animals the fact that the tubercle bacilli possess only a small degree of resistance to high grades of temperature is of great importance to national economy. According to Bang, 85° C. for a period of ten minutes will suffice to kill tubercle bacilli, while Yersin and Forster give 70 to 75° C. at ten minutes as sufficient. On this is based the utilization of the meat of tuberculous animals after cooking.

Tubercle bacilli are very resistant to pickling and to smoking and pickling.

In the *judgment* of tuberculous lesions of food animals by the veterinary inspector in connection with their harmfulness to man, the things to be considered are the extent of the affection and stage of development, the age and nature of the tuberculous changes, and the nutritive condition of the animal.

In general a poor nutritive condition, especially extreme emaciation, will unfavorably influence the judgment.

The same is true regarding the age of the tuberculous lesions when fresh disease processes exist, and especially when the latter are contiguous to the old infections. A fresh "blood infection" (fresh generalized condi-

tion, acute miliary tuberculosis in the most restricted sense), is present only when the spleen or the lymph glands are swollen, or when very small tubercles, not over the size of a millet seed, which have developed by way of the large circulatory system, are present. Fresh blood infection, which as a rule is seldom found in food animals, demands careful examination and consideration.

Precaution is recommended owing to the nature of tuberculous materials in the soft tuberculous processes (cavities and purulent cheesy abscesses), as a generalized condition is easily associated with them.

Regarding the extension of tuberculosis the forms mentioned on page 260 should be clearly distinguished.

The judgment of individual cases of tuberculosis must proceed according to the following outline which has been made public in connection with the meat-inspection regulations for the guidance of non-veterinary inspectors. Owing to the comprehensive character of this manual it has been deemed necessary to add explanatory notes giving the reasons on which the outline is based.

Outline showing the forms of tuberculosis in food animals, and disposal of the meat of tuberculous animals

Forms of Tuberculosis	Disposal of the Meat
I. Tuberculosis of one organ: a. With extreme emaciation. b. Not extremely emaciated.	Whole carcass unfit for food. Parts not changed are unconditionally fit for food.
I. Tuberculosis which is not confined to one organ: 1. In which infection was not spread by the large circulatory system. A. With extreme emaciation. B. Not extremely emaciated. a. With extensive softened lesions. b. Without extensive softened lesions: 1. When the disease is only slightly extended. 2. When the disease is greatly extended. 2. In which infection was spread by the large circulatory system. A. Manifestations of a fresh blood infection. a. With extreme emaciation. b. Without extreme emaciation: 1. Fresh infection in the viscera or in the udder only. 2. Fresh infection not confined only to the viscera or in the udder.	Whole carcass unfit for food. Parts not changed conditionally fit for food. The parts not changed are unconditionally fit for food. The parts not changed are fit for food, but materially reduced in value. The whole carcass is unfit for food. Unchanged parts are conditionally fit for food. Fat is conditionally fit for food, meat is unfit for food.

Outline showing the forms of tuberculosis in food animals, and disposal of the meat of tuberculous animals—Continued

Forms of Tuberculosis	Disposal of the Meat
B. Without the manifestation of fresh blood infection.	Whole carcass unfit for food.
a. With extreme emaciation.	
b. Without extreme emaciation:	Unchanged parts are conditionally fit for food.
1. With extensive softened lesions:	
2. Without extensive softened lesions.	Unchanged parts are unconditionally fit for food.
a' Tuberculous changes exist in the viscera or in the udder only:	
a'' When the disease is only slightly extended.	Unchanged parts are fit for food, but materially reduced in value.
b'' When the disease is greatly extended.	Of the unchanged parts, quarters of a carcass which contain a tuberculous lymph gland are conditionally fit for food.
b' Tuberculous changes not confined to viscera and udder only.	
a'' When the disease is only slightly extended.	The other unchanged parts are unconditionally fit for food.
b'' When the disease is greatly extended.	Fit for food, but materially reduced in value.

Remarks.—The changed parts under I b, II 1 B, II 2 A b 1, and II 2 B b are unfit for food.

An organ must even then be regarded as tuberculous when only the corresponding lymph glands of that organ show tuberculous changes; a similar position must be taken with regard to pieces of meat which have not been shown to be free from tuberculosis by careful inspection.

Regarding tuberculosis of individual organs the rule is that the whole organ should be always condemned when its corresponding glands show tuberculous changes.

When the mesenteric lymph glands are affected a distinction must be made between those of the small and large intestines, and the respective intestines to which the affected group of lymph glands belong must be condemned. The mesentery with the diseased glands may be permitted to be utilized for technical purposes after it has been thoroughly denatured.

When the submaxillary and retropharyngeal lymph glands are diseased they must be removed, together with the surrounding parts, including the tonsils; however, no other parts of the head need be condemned, as these lymph glands become infected almost exclusively from the mucous membranes of the mouth, nose, and pharyngeal orifice, none of which are used for food in Germany.

Relative to the judgment of a tuberculous "quarter," that part of the body is considered infected which corresponds to the region drained by the diseased body lymph glands. However, in case of tuberculosis of the vertebræ, ribs, or sternum, when the cause of the affection in the lymph glands can be traced to the respective bones, it will not be necessary to condemn the more posterior draining region of the lymph gland, but the altered bones and glands only need removal. The judgment of the remaining part of the carcass should naturally depend on the presence of other lesions.

When there is suspicion of tuberculosis of the bones, especially in hogs, it becomes necessary to remove the meat from the bones, and to split the latter.

In removing tuberculous parts, especially serous membranes, attention is called to the necessity of removing the associated lymph glands and the other parts adjoining them. In order to satisfactorily remove small lymph glands to which access is difficult, it is advisable to remove the surrounding parts of meat and bone with them. The veterinary inspector must do this himself or see that it is being done under his immediate supervision. In this operation one should not go to an extreme by removing more meat than is absolutely under suspicion of being tuberculous. In all this work care must be taken not to contaminate sound meat with tuberculous material; also special attention should be given to changing knives, saws, etc., which are soiled with tuberculous material.

Veal from calves which were vaccinated with protective tuberculosis vaccine (for example Bovo-vaccin and Tauruman) contains virulent tubercle bacilli for several months after the inoculation; owing to this fact several states have issued regulations permitting the use of such meat only after cooking.

[The judgment of tuberculous carcasses of food animals in the United States varies somewhat from that adopted in Germany. While it would appear that the condemnations from the extent of the lesions are stricter in this country, the affected carcasses which would pass conditionally in Germany being condemned in this country, yet the difference in the judgment of tuberculosis is principally due to the fact that there are no provisions made in the United States by which certain affected carcasses could be passed conditionally for food (after sterilization), as the "Freibank system" has never been established in this country. On the other hand, in accordance with the regulations governing meat inspection in the United States, the tuberculous carcasses which are conditionally passed for food in Germany are passed for lard and tallow in this country; such carcasses, however, have to be subjected to a temperature of 220° F. for not less than four hours.

In the following section, the requirements for the disposition of tuberculous carcasses are given, in accordance with B. A. I. Order 150:

Section 13. Paragraph 1. The following principles are declared for guidance in passing on carcasses affected with tuberculosis:

Principle A.—The fundamental thought is that meat should not be used for food if it contains tubercle bacilli, if there is a reasonable possibility that it may contain tubercle bacilli, or if it is impregnated with toxic substances of tuberculosis or associated septic infections.

Principle B.—On the other hand, if the lesions are localized and not numerous, if there is no evidence of distribution of tubercle bacilli through the blood, or by other means, to the muscles or to parts that may be eaten with the muscles, and if the animal is well nourished and in good condition, there is no proof, or even reason to suspect, that the flesh is unwholesome.

Principle C.—Evidences of generalized tuberculosis are to be sought in such distribution and number of tuberculous lesions as can be explained only upon the supposition of the entrance of tubercle bacilli in considerable number into the systemic circulation. Significant of such generalization are the presence of numerous uniformly distributed tubercles throughout both lungs, also tubercles in the spleen, kidneys, bones, joints, and sexual glands, and in the lymphatic glands connected with these organs and parts, or in the splenic, renal, prescapular, popliteal, and inguinal glands, when several of these organs and parts are coincidentally affected.

Principle D.—By localized tuberculosis is understood tuberculosis limited to a single or several parts or organs of the body without evidence of recent invasion of numerous bacilli into the systemic circulation.

Paragraph 2. The following rules shall govern the disposal of tuberculous meat:

Rule A.—The entire carcass shall be condemned—

(a) When it was observed before the animal was killed that it was suffering with fever.

(b) When there is a tuberculous or other cachexia, as shown by anemia and emaciation.

(c) When the lesions of tuberculosis are generalized, as shown by their presence not only at the usual seats of primary infection, but also in parts of the carcass or the organs that may be reached by the bacilli of tuberculosis only when they are carried in the systemic circulation. Tuberculous lesions in any two of the following-mentioned organs are to be accepted as evidence of generalization when they occur in addition to local tuberculous lesions in the digestive or respiratory tracts, including the lymphatic glands connected therewith: Spleen, kidney, uterus, udder, ovary, testicle, adrenal gland, brain or spinal cord or their membranes. Numerous uniformly distributed tubercles throughout both lungs also afford evidence of generalization.

(d) When the lesions of tuberculosis are found in the muscles or intermuscular tissue or bones or joints or in the body lymphatic glands as a result of draining the muscles, bones, or joints.

(e) When the lesions are extensive in one or both body cavities.

(f) When the lesions are multiple, acute, and actively progressive. (Evidence of active progress consists in signs of acute inflammation about the lesions, or liquefaction necrosis, or the presence of young tubercles.)

Rule B.—An organ or a part of a carcass shall be condemned—

(a) When it contains lesions of tuberculosis.

(b) When the lesion is immediately adjacent to the flesh, as in the case of tuberculosis of the parietal pleura or peritoneum, not only the membrane or part affected but also the adjacent thoracic or abdominal wall is to be condemned.

(c) When it has been contaminated by tuberculous material, through contact with the floor, a soiled knife, or otherwise.

(d) All heads showing lesions of tuberculosis shall be condemned.

(e) An organ shall be condemned when the corresponding lymphatic gland is tuberculous.

Rule C.—The carcass, if the tuberculous lesions are limited to a single or several parts or organs of the body (except as noted in Rule A), without evidence of recent invasion of tubercle bacilli into the systemic circulation, shall be passed after the parts containing the localized lesions are removed and condemned in accordance with Rule B.

Rule D.—Carcasses which reveal lesions more numerous than those described for carcasses to be passed (Rule C), but not so severe as the lesions described for carcasses to be condemned (Rule A), may be rendered into lard or tallow if the distribution of the lesions is such that all parts containing tuberculous lesions can be removed. Such carcasses shall be cooked by steam at a temperature not lower than 220 degrees Fahrenheit for not less than four hours.]

2. Pseudo-tuberculosis

As pseudo-tuberculosis are designated the affections which run their course by producing nodules similar to those in tuberculosis and which as a rule also caseate but which are not caused by Koch's tubercle bacillus. Foreign bodies, cocci, bacteria, bacilli and hyphomycetes may be etiologically involved. However, only those names which are etiologically correct are at present used in connection with the tuberculous-like processes caused by animal parasites, which were formerly also designated as tuberculosis.

Frequency.—Among food animals pseudo-tuberculous processes with conspicuous caseation or premature calcification occur most frequently in sheep. They have, however, been found in cattle, calves, guinea pigs, rabbits, and chickens.

In sheep the disease is caused by the bacillus *psuedo-tuberculosis ovis* Preisz, which appears as a very thin immotile rod, and which stains readily with aqueous anilin dyes and by Gram's method; the bacilli in cultures are both thicker and longer, developing also club and pear-shaped forms. (Hutyra and Marek.) (Fig. 117.)

[In this country the disease is called caseous lymphadenitis and is fully described in the 17th Annual Report of the U. S. Bureau of Animal Industry.]

The absence of giant cells and epithelioid cells, according to Ostertag, is of importance in identifying pseudo-tuberculous alterations. The dry, caseated pseudo-tuberculous lesions in the lymph glands are characterized by onion-like layers (Noack). An attempt should also be made to establish the cause of the processes. It may be confused with tuberculosis only,

but this may be avoided by carefully observing the aforementioned characteristics, together with those changes which are characteristic of genuine tuberculosis.

Judgment.—All parts of carcasses permeated with pseudo-tuberculous processes should be treated as unfit for food, regardless of the form of infection, whether it is of primary, secondary, or embolic nature. Whether or not the whole carcass shall be condemned, or declared of inferior value for food, depends upon the condition of the animal and the character of the meat. Noack recommends that similar action be taken as in genuine tuberculosis until it has been proven that man is not susceptible to the bacillus pseudo-tuberculosis.

[The judgment of carcasses affected with pseudo-tuberculosis is carried out in this country on the same lines as is prescribed for Germany.]



Fig. 117. *Bacillus pseudo-tuberculosis ovis*. Agar culture. Gram's staining. After Hutyra and Marek.

3. Actinomycosis

The ray fungus disease (which is caused by a fission fungus, the *Actinomyces bovis*, or *Streptothrix actinomyces*) (Fig. 118) is a disease of slow course, which occurs in cattle, swine, sheep, and horses, as well as in man. It is characterized by the formation of tumors, connective tissue infiltrations and abscesses.

Pathogenesis.—The ray fungus can enter the body through the digestive or respiratory tracts or through the outer skin. After entering the tissues the fungus develops a nodule, in the neighborhood of which an inflammatory area and a granulation zone soon arise. Around this center changes will then occur, either the formation of connective tissue neoformations which lead to induration and hardening, or destruction of tissue and abscess formation. The latter condition occurs especially among swine. The actinomycotic growth in domestic animals shows chiefly fibrous characters, but occasionally a myxofibromatous consistence may also appear. Both enclose the above-mentioned granulation center, in which the actinomyces fungi may be recognized macroscopically as fine-grained, sulphur-yellow bodies.

Microscopically the latter appear to be greenish and of a characteristically radiated structure, and when calcified are somewhat darker in color.

Metastatic extensions of the fungus from the primary lesion may occur, causing generalization in other parts of the body, but this occurs with remarkable infrequency, as does also any affection of the lymphatic glands, where neither purulence nor calcification are often found to occur.

Symptoms and Lesions.—In cattle the chief symptoms are hard tumor-like distentions of the jaw-bones, at which points red, sarcomatous proliferations may break out through the skin. Such tumors may also

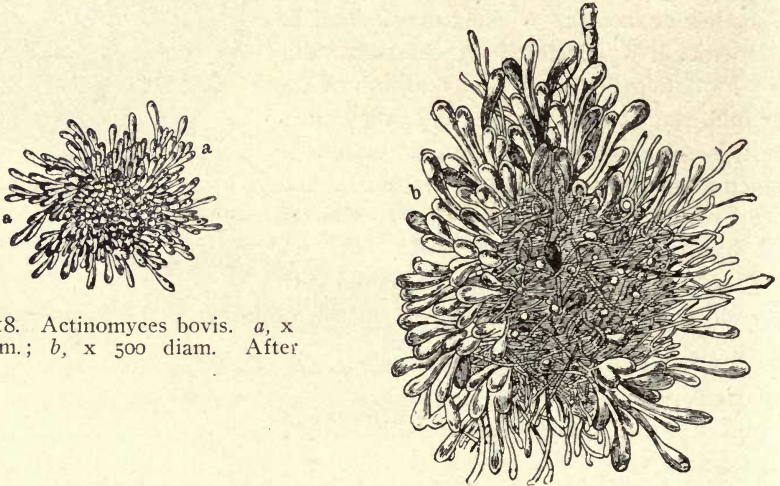


Fig. 118. *Actinomyces bovis*. *a*, x 200 diam.; *b*, x 500 diam. After Johne.

occur in the region of the parotid glands, on the cheeks, the lips, and more rarely on other parts of the body. The tongue changes to be described below, while occurring much more frequently than the affection of the jaw, are noticed only in the most severe cases during the life of the animal, or when the animal is noticeably troubled in taking up its food. The latter condition will gradually lead to the emaciation of the animal, although its general health is undisturbed. In swine the most common indication of actinomycosis consists in nodular growths and cold abscesses within the udder. The first may also be accompanied by ulcerations or fistulous formations. Larger tumors are comparatively rare. Small actinomycotic nodules may be observed at the seat of castration, both in male and female hogs. In other food animals actinomycotic affections are very rarely recognized during life.

In slaughtered cattle the most frequent seat of the disease is the tongue, the actinomycotic affection starting as a rule, in the transverse groove (Fig. 119). In and around this location little nodules may arise, scattered about in the mucous membrane. Whenever these growths permeate the lingual muscles, inflammation results which affects chronically the intermuscular connective tissues leading to enlargement and harden-

ing of the organ (wooden tongue). On the surface of the tongue actinomycotic erosions and fungiform prominences may develop. Similar alterations may also occur upon the cheeks and gums.

The changes in the jaw-bones usually result from the entrance of the

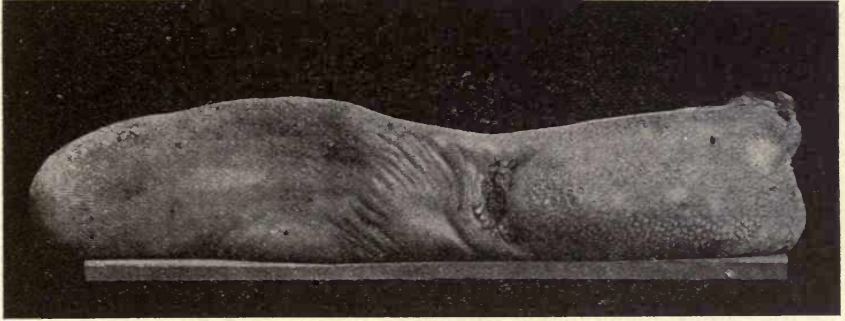


Fig. 119. Actinomycotic ulcer on the dorsum of the tongue of cattle. According to Hutyrá and Marek.

fungus alongside of the teeth, and often lead to considerable swelling and deformities (Fig. 120). The infrequently occurring actinomycotic changes in other mucous membranes and viscera appear as pedunculated tumors (in the buccal cavity, esophagus, and stomachs), or as nodular tumors, which through myxomatous infiltrations may reach great dimensions (especially in the lungs).

In the udder the changes occur as nodular growths or as diffuse indurative inflammations in conjunction with the former. Actinomycosis of the skin is seen principally on the head and neck in the form of tumors, or as diffused bacon-like infiltrations. Pieroni found actinomycotic changes in the dura mater and the occipital bone.

As previously mentioned, actinomycosis of swine appears most frequently as a disease of the mammae, manifested either by nodules with skin erosions, or by cold abscesses with or without fistulous formations. Extensive infiltrations are comparatively rare in these parts. The lesions at the places of castration are

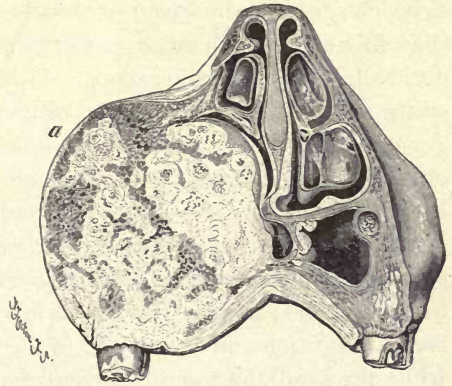


Fig. 120. Frontal section through the nose and superior maxilla of cattle with an actinomycotic growth. *a*, nodules consisting of connective tissue, bone, and small suppurative foci. $\frac{1}{4}$ of the natural size. After Ziegler.

mostly nodular. Actinomycotic changes in the fauces are relatively quite rare (Johns); likewise abscesses in the region of the throat and on the other parts of the skin.

Actinomycosis has been found in the lungs, muscles, and on the lips and tongue of slaughtered sheep.

The cases of actinomycosis of the horse are limited to a few observations of the disease in the spermatic cord lymph glands, bones, tongue, and generalized affections.

Diagnosis is not difficult if attention is given to the pathological characteristics mentioned above. The scattered yellowish granules are to be especially noted in the growths, the microscopical examination of which assures a diagnosis. This may be a hard undertaking where degeneration of the actinomyces fungi has become established, but in food animals this condition does not occur often. The fungi stain readily with Gram's stain and with picro-carmine.

Actinomycotic tumors may be mistaken for various other growths, especially for tuberculous nodules, when the characteristic structure of the actinomycotic tumors is not considered, and besides when insufficient attention is paid to the condition of the lymph glands.

Judgment.—Although actinomycosis may at times affect man dangerously, no instance has been observed of a direct transmission of the fungus to people, either from living or slaughtered animals. The actinomycotic tissues should be condemned as unfit for human food on account of their decidedly abnormal consistence. This disposition should be made of the entire organ wherever multiple local infection has occurred. In cases of generalized actinomycosis the entire carcass should be carefully examined on account of the atypical course of such generalization and the parts showing actinomycotic changes should be condemned.

[In accordance with B. A. I. Order 150, Regulation 13, section 11, paragraphs 1-3, carcasses affected with generalized actinomycosis should be condemned; in case the affection has not extended from the primary area of infection and is confined to the head, the carcass is passed for food while the head and tongue is condemned. Where the lesions are uncomplicated and localized the infected organ or parts are condemned, while the carcass is passed for food.]

Actinobacillosis, which has been found by Lignieres and Spitz, in the cattle and occasionally in the sheep of Argentine, is not of importance to the German inspector of meats.¹

¹In Canada this disease has been reported in cattle and recently a case of actinobacillosis was observed in a hog in this country.]

4. Botryomycosis

Botryomycosis is a chronic, tumor-like connective tissue proliferation, caused by the *Botryococcus ascoformans*, Kitt. It grows as spherical or grape-like colonies (Fig. 121), which soon are surrounded by hyaline capsules. These clumps of round micro-organisms were called *Botryomyces* by Bollinger; *Biscomycetes equi* by Rivolta; *Micrococcus ascoformans*, by Johne, and *Micrococcus botryogenus* by Rabe. This disease occurs almost exclusively in horses, but it has also been observed in cattle and hogs in isolated cases.

Symptoms and Lesions.—The characteristic lesions are fibrous nodules and tumors with softened yellowish-brown areas in the center, in which small sand-like granules of a yellowish-white color are found. The latter are composed of grape-shaped, conglomerate, closely adherent clumps of botryococci.

The most common site of these nodules in the horse is the subcutis and spermatic cord, but they may also occur in the udder, ribs, muscles, and on the pleura. Guenther, Czokor, Immelmann, and Reali have also reported it in cattle, while Wilbrandt and Schneidemühl have found botryomycosis in the hog. A generalization of the disease has been variously observed.

The disease is recognized by microscopic examination of the above-mentioned granules, which stain with all the basic anilin stains, thereby avoiding confusion with other infectious granulomata, such as actinomycosis and glanders.

Judgment.—All parts affected with botryomycotic processes are to be condemned as unfit for food and destroyed. [See B. A. I. Order 150, Regulation 13, section 23.]

5. Anthrax

Anthrax, which occurs in all food-producing animals, in game, and in fowls, is produced by the *Bacillus anthracis*. The hog and dog are somewhat resistant to infection, but anthrax infection has been satisfactorily demonstrated in them.

Bacteriology.—The anthrax bacilli (Figs. 122 and 123) measure 1.5 to 3 microns in length, 1 to 1.5 microns in width, with slightly convex or perfectly square ends. They form obtusely angular chains reaching a maximum of 10 microns in length. The anthrax bacilli are immotile, and those taken from the blood are

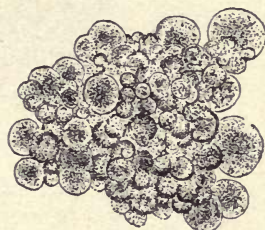


Fig. 121. Colony of botryomycetes. After Rabe.

surrounded by a characteristic, capsular or gelatinous membrane, by which they are distinguished from other similarly formed bacteria. The anthrax bacillus grows only in the presence of oxygen and forms spores (Fig. 123); the latter, however, never form in the live animal body or in the intact cadaver. The best way to prepare suspected material (spleen pulp) for shipment and bacteriological exami-

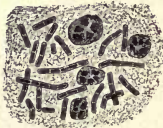


Fig. 122

Fig. 122. Anthrax bacilli with stained capsule. x 500 diameters.

Fig. 123. Anthrax bacilli containing spores. Agar culture 8 hours old. Stained by fuchsin. After Hutyra and Marek.



Fig. 123

nation is by careful slow drying of thick smears on glass slides or on the inner surface of test tubes (Bongert and Hosang; or perhaps better still, by the Forster plaster-paris rod method (Marxer, Jacobsthal and Pfersdorff, Eberle, Dausel).

Staining of the anthrax bacilli with their capsules.—After Luepke: Slightly boil the cover-glass preparation with a 0.2 per cent. gentian violet solution; rinse thoroughly with water. After John: Stain in hot 2 per cent. gentian violet solution; wash in water; decolorize for 10-20 seconds in 2 per cent. acetic acid; wash in water. After Klett: Boil in alcoholic methylene blue solution (1:10 Alk. : 100 Aq.); wash in water; stain in alcoholic solution of fuchsin (1:10 Alk. : 100 Aq.); wash. After Olt: Heat the cover-glass over a flame after applying a 3 per cent. aqueous safranin solution; wash in water. After Raebiger: Air-dried cover-glass preparations stained cold with formalin-gentian violet (150 g. 40 per cent. formalin with 15-20 g. gentian violet) for 20 seconds; wash in water.

Pathogenesis.—The anthrax bacilli, or their spores, enter either through injuries of the skin or through the digestive apparatus into the organism. Only the spores are effective by the latter method. The infection by way of the air passages, which occurs in man, is exceedingly rare in animals. From the point of inoculation the bacilli enter the blood, where they multiply rapidly, and through their toxins produce a severe febrile affection.

Symptoms and Lesions.—The clinical symptoms vary considerably, according to the infection, species of animals, and individuals, and they may be entirely overlooked in abortive cases (apoplectiform anthrax). Otherwise, characteristic symptoms are the sudden appearance of the disease, the rapid course, high fever, and general severe constitutional symptoms, hemorrhages into the mucous membranes, and bloody discharges, cerebral or pulmonary congestions, colic and drying up of milk-secretion

in lactating animals. In some cases there may be present visible localizations, such as carbuncle, and edema of the skin (especially in cattle and horses) and mucous membranes (especially of the tongue, termed gloss-anthrax); also edema of the neck in hogs.

Of the pathological findings, the most important is the swollen spleen, whose pulp is blackish-red and of a fluid consistency. In the hog and horse, exceptionally also in emergency slaughtered cattle, enlargement of the spleen may be slight or absent. Further there occurs cloudy swelling of the heart, liver, and kidneys with venous stasis or formation of hemorrhagic infarcts and petechial hemorrhages. The latter may occur on any part of the body, especially beneath the pericardium and pleura. Marked stasis in the mesenteric, intestinal and hepatic veins is present with brownish-red discoloration of the mucous membrane of the aboma-

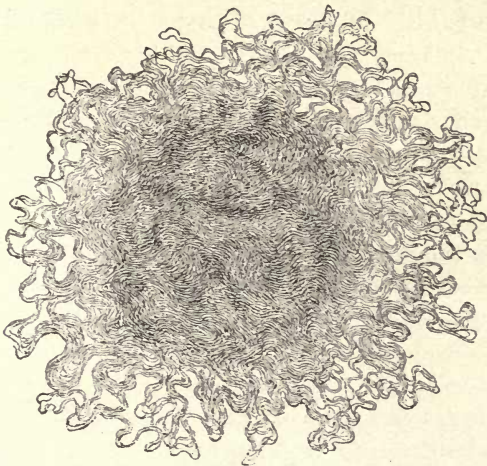


Fig. 124

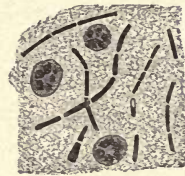


Fig. 125

Fig. 124. Superficial colony of the bacillus anthracis in a 24-hour-old agar plate culture. x 50 diameters.

Fig. 125. Cadaver bacilli. x 500 diameters.

sum and intestinal walls, in which hemorrhages may occur, bloody infiltration of the mucous membranes of the small intestines, and to less degree of the colon mucosa. Pulmonary edema and marked cervical edema, especially in hogs, may be noted, and also yellowish gelatinous and bloody infiltrations of the subcutis, with engorged veins of the skin and muscles. The majority of the lymphatic glands are strikingly edematous, hyperemic, and show bloody extravasations. Rigor mortis is absent. The blood is not coagulated, and is, as a rule, dark to black-red (tar-like); there occur cases, however, which run a rapid course, in which the color of the blood is not materially changed.

The unopened cadaver rapidly becomes distended, and from the natural body openings there will flow discharges mixed with blood; in the body cavities will be found a blood-stained serous fluid.

The recognition of anthrax is based on careful consideration of the anatomic findings and the microscopic examination of a stained cover-glass preparation made from the splenic pulp, the lymph of the mesenteric glands, the blood of the veins of the skin, or from the edematously infiltrated portions of the subcutis. In doubtful cases test inoculations and culture growths for the demonstration of the bacilli will be effective; but these cannot be considered at this point. It might be emphasized, however, that the plate method (Fig. 124) is the best and safest for the bacteriological diagnosis of anthrax (Kitt, Bongert, Hosang, Kaesewurm).

For differential diagnosis must be considered: Blackleg, malignant edema, hemorrhagic septicemia, septic diseases, petechial fever, certain intoxications, overfeeding of cattle after long transportation, and erysipelas in hogs. For particular characteristics of these diseases, as compared with the symptoms of anthrax as well as the differentiating characteristics of some of the microorganisms of these diseases, the reader is referred elsewhere for their description.

Partial splenic enlargement (infarcts) resulting from torsion or emboli is characterized by firm consistency of the swollen parts. A very large splenic tumor, involving the entire organ, has been observed in the hog as a result of torsion. A confusion of cadaver bacilli with anthrax bacilli is excluded in the light of our recent staining technique and upon careful study of the two species (Figs. 122 and 125).¹ Kaesewurm has called attention to a pseudo-anthrax bacillus which also forms colonies composed of bundles of wavy, tangled filaments.

Judgment.—The meat of anthrax animals should be considered injurious as food, and is to be condemned and destroyed. The latter is effected by the veterinary police; every case of anthrax or suspected anthrax is, according to the regulations, to be immediately reported to the local police authorities.

Meat suspected of having been only superficially soiled with anthrax bacilli, which may occur in the case of an animal infected with anthrax being slaughtered in an abattoir with other animals, may be utilized for food after having been sterilized with steam.

If on ante-mortem inspection an animal be suspected of having anthrax, slaughtering is to be forbidden, and the necessary measures should be taken to prevent its spread to man or to animals and arrest further dissemination of the infectious material.

[¹ McFadyean has recently described a peculiar staining reaction of anthrax bacilli which is specific. Smear preparations are stained for a few seconds with a 1 per cent. aqueous solution of methylene blue; the amorphous material around and between the bacilli appears violet or reddish-purple, while the bacilli and cell nuclei are blue.]

If a slaughtered animal be found diseased, all parts thereof are to be confiscated and left to the disposition of the veterinary authorities. Persons engaged in the slaughter of the animal or in handling it in any way are to be carefully examined for probable infection (wounds on hands or arms).

The fact that much anthrax meat has been eaten without any harm to man is explained by the loss of vitality of the bacilli (not of the spores, however) in the intestinal tract, where, as a rule, they are destroyed by the gastric juice. This meat nevertheless remains dangerous to man on account of the liability to inoculation by handling or by ingestion through the injured mucous membrane of the digestive tract.

[In accordance with B. A. I. Order 150, Regulation 13, section 2, carcasses affected with anthrax should be immediately incinerated; the same disposition should be made of the hides, hoofs, horns, viscera, and all other parts of the diseased animal. The killing bed and all the instruments used in the slaughter of the animal should be disinfected with a 10 per cent. formalin solution.]

6. Rabies

On account of its rarity and the exceedingly difficult recognition of rabies (lyssa, rabies) in slaughtered animals, it will be but slightly touched upon. This disease may occur in all food animals and is usually occasioned through the bite of a rabid dog.

Etiologically rabies requires further research [although it is quite generally accepted that the nerve cell inclusions discovered by Negri in 1903, and termed Negri bodies, are the causative agents].

Symptoms and Lesions.—In view of the multiplicity of variation of the clinical symptoms of rabies in the different animal species and the uselessness of an extensive description, the reader is referred to the special text-books of veterinary medicine. The anatomical changes are not characteristic.

The recognition of a well-developed case of rabies in the living animal is not so very difficult, especially if it can be observed for several days. In the slaughtered animal, however, a probable diagnosis of rabies can only be established, which may be verified by the determination of a bite from a dog at some previous time, and a comparison of the clinical symptoms reported. In the dog, suspicion is further incited by the presence of indigestible material (wood, straw, hair, cloth, etc.) in the otherwise usually empty stomach; the intestinal tract is also generally free from normal food stuffs. The absence of any other distinct organic disease which might be the cause of the symptoms also supports the diagnosis of rabies.

Absolutely certain establishment of diagnosis is obtained by subdural, intraocular, or intramuscular inoculation of the substance of the central nervous system into experiment animals. Histologically the diagnosis may be made by the demonstration of Negri bodies. Negri bodies are round, oval, or pear-shaped structures, situated in the interior of the large ganglia cells of the central nervous system; they assume a dark red color on staining with eosin-methylene blue solution, while the cells and cell-nuclei appear blue. In the section for the treatment of rabies at the Royal Institute for Infectious Diseases in Berlin, the diagnosis of rabies is accepted on the finding of the Negri bodies without recourse to animal inoculation.

Judgment.—As the meat of rabid animals is dangerous to health and unfit for food, it should be condemned. Although transmission of rabies has not been observed to result from ingestion of meat from rabid animals, the disease is nevertheless possible if inoculation occurs while handling the meat. According to v. Rátz, the virus of rabies remains active for 13-24 days after death of the animal.

Veterinary police measures with rabies are the same as with anthrax, e. g., report of cases, forbidden slaughter, destruction or removal of the cadaver so it can do no harm.

In the incubation stage of the disease slaughtering of domestic animals, with the exception of cats and dogs, is not prohibited, and the meat may also be utilized after removal of the bitten area.

[In accordance with B. A. I. Order 150, Regulation 13, section 7, carcasses of animals affected with rabies should be condemned.]

7. Glanders

Spontaneous glanders (*malleus*) is an exceedingly infectious disease of solipeds, but may be transmitted to sheep, goats, cats, and various other animals, especially man. Of the food animals, cattle are immune, while hogs are nearly so. The disease is produced by the glanders bacillus discovered by Löffler and Schütz.



Fig. 126. Glanders bacilli from a pure culture. $\times 730$ diameters. After Weichselbaum.

Bacteriology.—The *Bacillus mallei* (Fig. 126) is immotile, 2 microns long, 0.3 micron wide and frequently arranged in pairs. Sporulation does not take place. The staining is best accomplished, according to Löffler, by using anilin aqueous gentian violet for 5 minutes, to which has been added the same quantity of potassium hydrate solution (1:10,000). Next dip in acetic acid solution (1:100), to which has been added a few drops of tropæolin solution, and then wash in water.

Potato culture is characteristic; at a temperature of 37.5° C. for two days it shows a yellow homogeneous growth, which later turns dark brownish-red and assumes a honey-like appearance.

Pathogenesis.—The glanders bacillus gains entrance in solipeds in most cases by way of the digestive apparatus; next in order through the abraded skin. The infection occurs rarely by way of the air passages. Only in very severe infections do the bacilli produce changes or lesions at the point of entrance (intestinal mucosa). As a rule they are disseminated by the lymphatic or blood stream and produce diseased processes embolically in the most remote organs. There will form either millet to pea-sized, subepithelial nodules (nodular glanders), or diffuse cellular infiltrations of the mucous membranes (infiltrated glanders). Disintegration of the nodules of the mucous membranes causes ulcers with a yellowish infiltrated base, which rapidly enlarge. Healing of the ulcers with radiating cicatrices may also occur (Fig. 127).

The nodules, nodes, and diffuse glanderous growths in the interior of the organs are partly light-gray and abundant in cells, partly opaque,

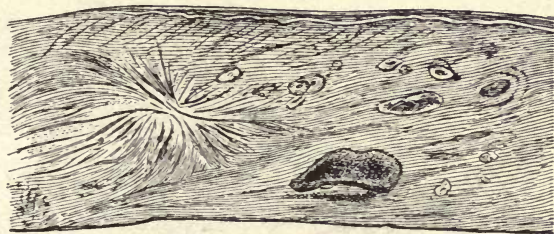


Fig. 127. Nasal septum of a horse showing ulcers and a scar of glanders. After Ostertag.

yellowish-white, caseated or approaching suppuration, partly also of grayish-white firm consistency.

In infection of the skin (farcy, cutaneous glanders) there form, partly in the papillary portion, partly in the subcutis, rapidly disintegrating nodes, which give rise to abscesses. From these abscesses a glanderous lymphangitis develops.

All glanderous processes are associated with specific inflammation of the lymphatic glands, which is characterized by inflammatory swelling, formation of nodules, areas of degeneration and chronic inflammatory proliferation of connective tissue, which extends to the neighboring tissues, resulting in coalition of the glands with the surrounding tissues.

Symptoms and Lesions.—Of the various symptoms of chronic glanders, which is frequently recognized with difficulty in the living animal—acute glanders not coming into consideration in inspection—the following are of particular importance on ante-mortem examination: Nasal discharge, which is irregular; adhesive mucus which is gray or greenish-yellow, may be mixed with a clear catarrhal secretion; nodules or ulcers or cicatrices on the mucous membranes of the nose; diffuse enlargement of the submaxillary lymphatic glands, which later appear painless, nodular, hard, and attached to the maxilla; nodes, ulcers, corded lymphatics in the skin, and glanderous phlegmons of the latter.

The anatomical changes correspond to the clinical symptoms, as above described, from the very beginning of the disease. Aside from the changes in the skin and the nasal and accessory cavities, especial attention should be directed to changes in the lungs (embolic glanderous nodules (Fig. 128), glanderous growths sometimes of considerable magnitude). Furthermore, emboli occur particularly in the liver, spleen, kidneys, testes, muscles, heart brain, and bones. The above-described lesions will also be found in the lymph glands.

The anatomic recognition of glanders is of especial importance. The glassy-gray, transparent, or translucent appearance of the glanders nod-

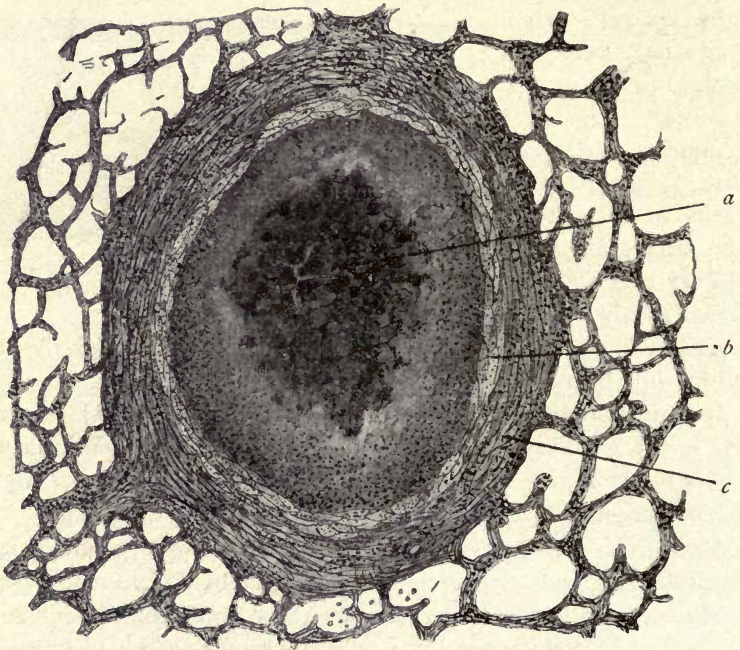


Fig. 128. Old glanders nodule from the lung; *a*, central necrosed portion; *b*, innermost cellular capsule; *c*, connective tissue capsular layer. x 30 diam. After Ostertag.

ules, their red area and involvement of the corresponding lymph glands (swollen and nodular on section), have been emphasized by Ostertag. Schütz has also called attention to chromatotexis of the pus cells in glanders, in which, during progressive cell necrosis, the chromatin of the nuclei is broken up into fine granules. A bacteriological and cultural test is indicated in all suspected cases, which are to be immediately turned over to the veterinary police authorities. The work of practical meat inspection does not permit of animal experiments, as a rule.

In order to avoid confusion with other diseases, there must be considered parasitic lung nodules (calcareous and fibrous nodules); small multiple areas or processes in traumatic pneumonia; embolic lung nodules in pyemia and strangles tuberculosis, actinomycosis and botryomycosis of the lungs, leukemia, colt distemper and nasal catarrh. In all of these diseases the characteristic glanderous lesions will be absent, or similar findings will be found to differ on comparison.

Judgment.—Upon the recognition of glanders in the living animal, its slaughter is to be prohibited and the necessary sanitary precautions left to the veterinary police. The meat of glanderous animals is to be declared unfit for food as it is dangerous to health.

From a veterinary police standpoint there must be considered the compulsory reporting and killing of the diseased animals, the latter to be done under the direction of the regular veterinarian; also the removal of the cadaver which is not to be skinned.

Great care in handling glanderous or suspected animals is urgently advised.

[Solipeds are not slaughtered as food animals in the United States, and as glanders is chiefly a disease of solipeds it is of little importance in meat inspection in this country; the disease, however, may be transmitted to sheep and goats, and it is only natural that animals showing lesions of glanders should be condemned.]

8. Foot and Mouth Disease

This peculiar affection of cloven-foot animals, also called aphthous fever, is a febrile disease starting with vesicles or blisters on the mucous membranes of the digestive apparatus and outer skin. The affection most frequently occurs in swine and cattle. Sheep, goats, and wild cloven-footed animals are seldom affected. It may be transmitted to cats, fowls, and human beings.

The exact cause of this disease is not known, but the virus is filterable and is exceedingly contagious.

Pathogenesis.—The initial symptoms of the infection is a slight internal fever, with rapidly forming vesicles. In cattle the latter appear on the lips muzzle, all parts of the buccal mucous membrane, between the claws, on the pads of the hoofs and around the coronary band. Exceptionally these erosions are also found at the base of the horn, udder, vulva, perineum, and on the scrotum of the male. In sheep and goats there appear most frequently very small vesicles between the claws; very seldom are lesions found in the mouths of these animals. Swine are first affected in the interdigital space and around the supernumerary digits; later small vesicles are noticed on the muzzle and snout.

These rapidly appearing blisters soon burst, leaving a red, moist erosion. These erosions, as a rule, heal very rapidly and are covered by shreds of epithelium from the edges. In very severe cases the claws may drop off, and further the tendons of the digits may become affected by extensive suppuration, or suppurative arthritis may develop with accompanying septicemia or pyemia.

The disease usually takes a malignant course in suckling animals, which generally die from inflammation of the stomach and intestines:

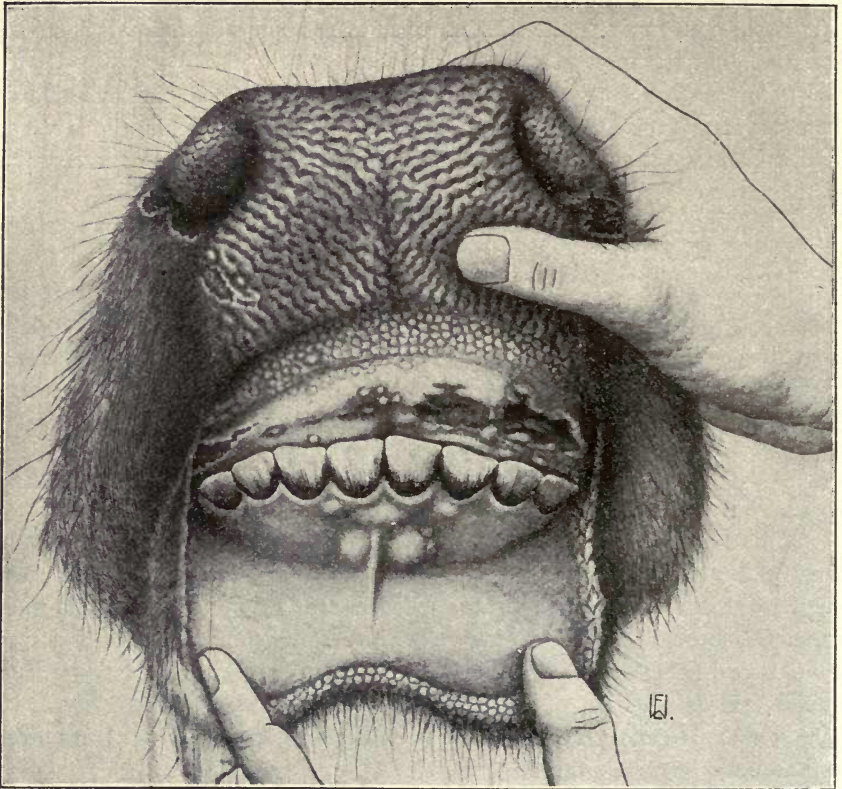


Fig. 129. Cysts and ulcers on the gums, the latter also on the muzzle of a cow affected with foot and mouth disease. After Hutyra and Marek.

besides a malignant type of disease is also observed in older animals during certain periods of the plague, when the animals die of apoplexy or with manifestations of an intoxication in connection with a violent type of diarrhea.

Symptoms and Lesions.—Besides the appearance of vesicles, there is lameness, an affection of the buccal mucous membranes and dribbling of saliva. In cattle the latter appears thick and tenacious, containing large

bubbles. This salivation may be absent in cases where the eruption and formation of vesicles are on the posterior parts of the buccal mucous membrane in which cases the animals swallow the saliva. Besides inappetence there is a characteristic "smacking" noise of the lips, which is caused by a fast in and out motion of the lips. The other symptoms of this disease appear according to the previously mentioned development of the disease.

The anatomical changes are in accord with the development of the disease and include moist erosions which may be followed by complications such as suppuration and ulceration of the joints and feet.

In the virulent form of this disease the lesions present themselves very differently, according to the clinical manifestations. Severe gastroenteritis, multiple embolic myocarditis, parenchymatous or amyloid degeneration of the heart, and other indications of blood poisoning are, however, seldom absent.

The recognition of typical cases of foot and mouth disease is not difficult. In the early stages it may not be easily recognized, and in certain conditions the disease may only be diagnosed in the slaughtered animal. The slaughtering of "suspects" should preferably be carried out in abattoirs so that an accurate diagnosis can be established and the rapid eradication of the disease accomplished. In the formation of vesicles on the dorsum of the tongue, it should be noted that the fungiform papillae remain standing apparently intact in the eroded places. (Leutsch.)

Other lesions of the oral cavity, which may be confused with foot and mouth disease are:

- I. Traumatic injuries to the epithelium of the mouth.
- II. Chemical and thermic injuries.
- III. Superficial actinomycotic lesions.
- IV. Pseudo-aphtha (Leutsch) or erosive stomatitis (M. Müller).
- V. Benign stomatitis; stomatitis bovis specifica (Ostertag and Bugge, Hess, Peters, Hajnal [Stomatitis oidica]).

The first two, as a rule show irregular destruction of the mucous membrane or deeper tissues. The actinomycotic erosions, which are characterized clinically by very slight sensitiveness, appear as sharply circumscribed, mostly rounded defects of the mucous membrane with brownish-red base, from which flat, reddish, button-like proliferations gradually protrude like mushrooms.

In pseudo-aphtha or erosive stomatitis, the lesions range in size from a pea to a penny and commence as flat elevations on the mucous membrane of the mouth. Small amounts of saliva dribble from the mouth, but the appetite is not destroyed: later these elevations change into superficial ulcerations. Occasionally fever and depression accompany this disease. The origin of this affection is not known.

Erosive stomatitis ononidea, according to Müller, is produced only by eating *Ononis spinosa*, or *O. repens*, and, as a rule, is accompanied by inappetence.

The benign stomatitis can be transmitted to calves, and otherwise corresponds to pseudo-aphtha. In the benign buccal eruptions, described by Hess, papules form on the mucous membrane and border of the lips in sizes ranging from a hemp-seed to a pea, in the center of which appears a quickly bursting vesicle. After this bursting occurs, superficial ulcers are observed. The general health of the animal is not disturbed and the disease is not transmissible.

The following hoof diseases enter into consideration in differential diagnosis:

(1) Animals transported over hard and stony roads are, as a rule, affected with hardening of the pad of the hoof, which occurs uniformly on all four feet.

(2) Contusions of the feet in hogs are not infrequently seen, mostly in but one foot, which shows infiltration of blood without vesicles, or a small blood blister on the coronary band.

(3) Swelling of the coronary band and pad, due to long standing on wet ground.

(4) Inflammation of the interdigital space, especially foot-rot in sheep, but there are no vesicles present.

Judgment.—The meat of animals affected with this disease should not, as a rule, be condemned on account of the disease itself. On the other hand, the diseased parts must be scalded on account of the danger of spreading the disease to animals and man. In febrile cases and complications, the clinical appearance and anatomical lesions are decisive in the utilization of the meat.

From the standpoint of veterinary police, compulsory notification of the disease should be observed. The hide should not be permitted to be moved from the premises until dried unless a direct shipment is made to the tannery. Only the veterinary inspector is to decide on this question, as well as on the disposition of the affected parts. In consideration of the easy dissemination of the disease by the inspectors themselves, the greatest care is advised.

[Foot and mouth disease does not exist at the present time in the United States, and therefore it does not concern the meat-inspection service of this country.]

9. Variola

Of the pock-like diseases which occur in all animals that are slaughtered for their meat, the pox of sheep and the vaccination pox of calves are of importance.

(a) *Sheep Variola*

Sheep pox, which has been absent in Germany for a number of years, has recently reappeared. It is produced by an easily disseminated, filterable virus, whose pathogenicity varies. It is probable that it is taken into the system through the air passages.

Pathogenesis.—After a period of 6 or 8 days' incubation, the clinical symptoms of sheep variola appear, beginning with fever, debility, loss of appetite, suppurative conjunctivitis with swelling of the lids, severe muco-purulent nasal and pharyngeal catarrh, and foul odor from mouth and nose. After a day or two there appear red, round, or oblong, nettle-rash-like excrescences (*Roseola variolosa* according to Hutyrá and Marek) in the skin of those portions of the body which are devoid of wool or only slightly woolly, such as the vicinity of the eyes, cheeks, lips, *alæ nasi*, inner part of thighs, under surface of tail, lower chest, and posterior part of the abdomen.

In the normal course of the disease pimples develop in these spotted areas, which may increase at their base to the size of a penny (*Stadium papulosum*). From under the surface of the papules exudes a tenacious fluid which soon forms vesicles (*S. vesiculosum*), containing a yellowish or slightly reddish fluid. By the 6th or 7th day this becomes cloudy and purulent (*S. pustulosum*, *S. suppurationis*). A crust or scab (*S. crustosum*) follows desiccation of the vesicle, which dries and later falls off.

As the skin and subcutis become edematously infiltrated at the diseased areas there occurs swelling of these portions of the body, which may be especially marked at the head and extremities.

In some epizootics the pustular stage is absent at first and during the further course of the disease develops slowly.

Although the constitutional condition of the sheep improves with the decrease of the eruption, severe catarrh of the mucous membranes will remain in some cases, followed by catarrhal pneumonia. A sweetish, nauseating odor emanates from these animals; they cease to feed, and finally succumb to the disease.

Among other complications there are of especial significance the appearance of extensive hemorrhages (*Variola hemorrhagica*), the confluence of the pox, and the development of gangrenous pox, in which septicemia or pyemia leads to fatal results.

The symptoms and lesions in the live animal are as above described. In the slaughtered animal we find corresponding lesions in the skin and the subcutis of the mucous membranes, where pock vesicles may also appear and give the sign of only slight or of severe general constitutional involvement (pyemia or septicemia).

Judgment.—If sheep are slaughtered while suffering from variola, which rarely occurs, the meat may under most favorable circumstances be admitted as impaired in value. In complications, especially extensive suppurations and gangrenous or putrid pox, the meat is to be condemned as unfit for food. If the pox are healing and the nutrition of the sheep is good, the meat is serviceable for food.

From the standpoint of the veterinary police regulations, compulsory notification is required and the disposition of the hides should be in accordance with the instruction applying to hides from animals affected with foot and mouth disease, great care being necessary on account of the easy manner in which pox contagion is spread.

(b) *Cowpox*

While the spontaneous appearance of cowpox from a meat-inspection standpoint is insignificant, the vaccination pox of calves, which is artificially produced in special institutions for the purpose of preparing vaccine lymph for protective vaccination of mankind against smallpox, deserves special mention. Following the slaughter of calves from which lymph of vaccine vesicles is taken as above mentioned, the carcasses are inspected, but they do not offer any ground usually for condemnation. By way of exception a febrile intercurrent, intestinal catarrh, with ensuing deterioration of the flesh, causes this class of meat to be considered of inferior quality.

Imperfect scarification on the lower abdomen, leads occasionally to gelatinous infiltration of the subcutaneous tissue and of the superficial muscular layer, in which case the altered portions, with the adjacent lymph glands, must be rejected as unfit for human food.

[According to B. A. I. Order 150, Regulation 13, section 6, carcasses of vaccine animals, when affected as described under Regulation 11, section 3, should be condemned.]

10. *Tetanus*

By tetanus is understood a specific infectious disease, the exciting cause of which produces in the body tonic contractions of the transversely striated muscles, through the formation of toxic substances acting on the nervous system. Tetanus appears in all food animals and especially in horses and lambs.

Pathogenesis.—The Cause of Tetanus.—The tetanus bacilli or their spores penetrate a wound of the skin or mucous membrane of the body, multiply in the coagulated blood or in the necrotic tissue of the wound without passing through the blood, form spores, and produce toxins, tetanotoxin, tetanolysin (Ehrlich) which are carried through the blood and lymph, as a result of which there is an increased reflex excitability of the spinal cord and nerves, with consecutive tetanic muscular contraction.

The tetanus bacilli (Fig. 130) are 3-5 microns long, and 0.3-0.5 microns wide, motile, anaerobic, and as soon as their terminal spores are formed appear as stick-pins in shape. They stain by the ordinary stains and also by Gram's method.

Symptoms and Lesions.—From clinical appearances there is only to be mentioned the progressive stiffening of the muscles, which following tetanic contractions, appear as hard as boards. The condition begins to

prevail in the head as trismus and spreads out more or less rapidly to the muscles of the limbs. With this there are present, excitability, great fear, frequent sweatings, and increased respiration.

The post-mortem findings are generally negative. In advanced cases there may appear evidences of imperfect bleeding; the blood is blackish-red and improperly coagulated, ecchymoses appear on the serous and mucous membranes and also on the heart. There is also parenchymatous degeneration of the liver, heart, kidneys, and muscles, certain groups of which show a diffused dirty red, bluish-brown, soft or cooked appearance. Hypostatic pneumonia may be present.

The recognition of tetanus is as difficult and even impossible after slaughter as it is easy during life.

It may be mistaken in animals slaughtered in advanced cases for septicemia, hemoglobinemia, suffocation, certain cases of morbus maculosus and cerebro-spinal meningitis, but each of the diseases mentioned may be differentiated from tetanus by one or more of their specific symptoms.

Judgment.—Because the tetanus bacilli do not pass through the blood, the meat of animals suffering from tetanus when slaughtered early so that only one or a few groups of muscles are diseased, can be marked as fit for consumption after rejecting the possibly affected meat, but it is, however, of inferior quality, when improper bleeding or other slight changes (fetid odor and taste, deviation in color, consistency, and keeping quality) are in evidence. If there exist improper bleeding in a higher degree or degeneration of the parenchyma, the meat should be declared as unfit for consumption because of the high degree of deterioration. The tissue around the supposed point of entrance of the bacilli must also be condemned.

According to Kitasato, the tetanus toxin is broken up and destroyed by cooking at 65° C.

[According to B. A. I. Order 150, Regulation 13, section 8, carcasses of animals affected with tetanus should be condemned.]

11. Malignant Edema

Malignant edema is an acute febrile wound infection which appears spontaneously in horses, cattle, and sheep, and less often in other food-producing animals.

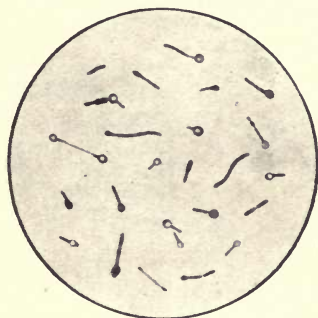


Fig. 130. Tetanus bacilli with spores in various stages of development; 4 days old agar culture. Carbol-fuchsin solution. After Hutyra and Marek.

A particularly prominent form of malignant edema is the so-called parturient symptomatic anthrax, the careful study of which, by Albert and Carl, has demonstrated with great certainty that genuine symptomatic anthrax cannot develop in this form (Hutyra and Marek).

Pathogenesis.—The causative factors of edema are ubiquitous and appear normally in the intestines. They are slender bacilli 3-5 μ long, 0.8-1 μ wide (Figs. 131 and 132), with rounded ends (thus differing from anthrax bacilli) and possess slight motility. They form chains and flagella, are anaerobic, and therefore do not

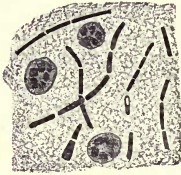


Fig. 131

Fig. 131. Bacilli of malignant edema. Cover-glass smear preparation stained with methylene blue. $\times 500$ diameters.

Fig. 132. Bacilli of malignant edema. Peritoneal exudate from a guinea pig. Cover-glass preparation stained with fuchsin. $\times 1,000$ diameters. After Hutyra and Marek.

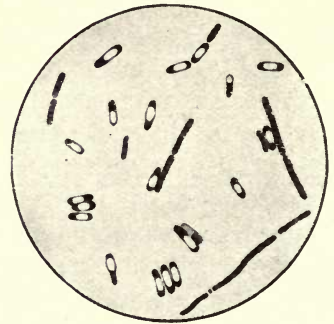


Fig. 132

appear in living blood. After death they wander out of the intestines into the portal blood in case the carcass chills very slowly. On that account they may be found in the spleen after 24 hours; and, under such conditions, they form centrally located spores in the blood, which are easily stained, but not by Gram's method.

After entrance of the bacilli into the connective tissue, there develops an edema infiltrated with gas bubbles, the reabsorption of which causes fatal constitutional disease.

The clinical symptoms are manifested by quickly progressive, dough-like, hot swellings, which afterward show crepitation, and also strong febrile reaction.

Lesions.—Yellow gelatinous infiltration of the affected connective tissue and of the surrounding muscles, together with infiltration of these areas with fetid-smelling gas bubbles are observed; the parenchyma is occasionally not affected, but sometimes, however, it is degenerated; by way of exception, there is a spleen tumor or swollen spleen. In cases where the disease originates in the uterus, the latter is slightly contracted; its walls are edematous and the mucous membrane is swollen with the destruction of the affected cotyledons. The connective tissue of the small pelvis is edematously infiltrated.

For recognition of malignant edema, it is necessary to take into consideration all morphological and biological characteristics of the bacilli of

malignant edema; nevertheless their presence is not decisive, because they can spread easily into the body of an animal from the intestines after death.

It can especially be mistaken for:

1. *Symptomatic Anthrax*.—Here the foul odor of the edematous swellings is absent. The bacilli of symptomatic anthrax form only end spores and do not grow in filaments. The appearance of blackleg in certain sections of the country is to be considered, and also the fact that the muscles are only occasionally attacked by malignant edema.

2. *Anthrax*.—In malignant edema there are the above-mentioned morphological characteristic of the bacilli, their absence in blood, and failure in inoculating rats and guinea pigs. They do not grow on potato and gelatin media. Besides those differential characteristics mentioned there is no crepitation in the edematous swellings of anthrax.

3. *Inflammatory Edema*.—This does not present crepitation.

4. *Subcutaneous Emphysema*.—In this case fever is absent.

Judgment.—Although the meat is not injurious to health, it should be declared as unfit for food, principally on account of objectionable alterations in the meat. Only seldom, in early slaughtered cases, can the question of passing the meat as of inferior quality arise after the rejection of the edematous areas.

[In accordance with the meat-inspection regulations of the United States, carcasses affected with malignant edema should be condemned, not alone on account of the possibility of dissemination of the bacilli all through the carcass by the blood, but also on account of the changes of the meat produced by the high febrile condition of the animals in the course of the disease.]

12. Septicemia

By the collective term "sepsis"¹ is designated, from a purely scientific point of view, a severe hemolysis brought on through the entrance of infective material (microorganisms or ultra-visible contagions) into the blood. (Sepsis in a narrow sense.)

For practical meat inspection those hemolytic diseases of sepsis which are caused by the entrance of products of pathogenic bacteria (toxins and toxalbumins) into the blood or by the combination of both the former and latter conditions, that is through the infectious material as well as through toxins, are to be considered under the term septicemia. (Sepsis in a broad sense.)

It can also deal with a bacteriemia or a toxinemia, and mixed cases as toxemic bacteriemia.

¹ The designation "ichorus" or "putrid blood poisoning," for sepsis, should not be used any longer in consideration of the etiology of the latter.

The presence of toxins produced in the blood through the activity of saprophytic bacteria, causes toxinemia, which is called putrid intoxication or sapremia in contradistinction to septicemia.

The term sepsis includes the entrance of all pathogenic bacteria and their toxins into the blood channels; and it includes also the spreading of purulent matter through the blood, though the disease of the blood termed pyemia constitutes a special affection when metastatic suppurative foci develop in consequence of bacterial dissemination.

The combination of septic toxemia and pyemia is called septicopyemia.

It is evident that the other microparasitic blood infections which develop under the manifestation of sepsis and which bear distinct names (anthrax, erysipelas, etc.), on account of the well-defined characteristics of their causative factors as specific blood infections belong in the broadest sense to septic diseases.

Pathogenesis.—Although there are still no definite results in fundamental investigations for exciting causes of all the septic diseases of food-producing animals, yet certain forms of the streptococci and staphylococci should be etiologically considered here. Doubtless also other bacteria (for instance, certain forms of coli, Gärtner's enteritidis bacillus) cause septic conditions, and it is probable that such conditions are also favored by other bacteria (proteus) under certain symbiotic relations.

The point of entrance for the exciting causes of sepsis can, in many cases be recognized as a local disease (wounds, inflammations, and disintegrating foci), while obscure infections do, however, occur without any noticeable place of inoculation. The further effects of the deleterious microbes result from the above explained facts, the principal factor being always the formation of toxic substances, which almost invariably cause a fatal termination of the disease.

Symptoms and Lesions.—The clinical as well as the anatomical appearances of septic diseases are frequently so little apparent that an especially thorough examination and careful estimate of every single symptom are absolutely necessary. Of the clinical phenomena the following are to be given special mention:

1. High fever (in cattle 41-42° C.), beginning occasionally with rigor, which is absent only in very exceptional cases. During the last stage of the disease, normal and subnormal temperatures appear.

2. Cardiac weakness and greatly accelerated, wiry pulse.

3. Severe psychical depression, muscular weakness, tremor, and paralysis of certain nerve regions, which however in most cases are hard to establish.

4. Dirty red, blurred coloring of the visible mucous membranes, showing petechia and ecchymosis.

5. Drying up of the milk during lactation.

6. The presence of an injury or of a suppurating wound upon the surface of the body where the septic disease originated or discharge of an ichorous nature through a natural orifice of the body (especially from the vagina), but such areas as described above may be absent.

In the post-mortem examination there are especially to be observed:

1. Cloudy swelling of the heart, liver, and kidneys, which is sometimes accompanied by fatty degeneration. The latter should not be mistaken for normal fatty liver of animals which are in an advanced stage of pregnancy or have recently given birth to young.

2. Swelling and serous infiltration of most lymphatic glands. These may also be permeated by isolated hemorrhages or hemorrhagic foci. Lymph stasis, following obstruction in the circulation (as for instance in traumatic pericarditis), should not be mistaken for marked saturation of the lymph glands in the dependent portions of meat that is hanging up.

3. Petechia—ecchymosis and suggillations—under the serous membranes and in the mucous membranes, for which the so-called asphyxiation hemorrhages should not be mistaken (page 215).

4. Bloody imbibition of the intima of the great blood vessels.

5. Blood-stained serous exudates in the thoracic and abdominal cavities.

6. Imperfect coagulation of the blood.

7. Insufficient rigor mortis and imperfect bleeding.

8. Soft, withered, watery character of the meat, which has a singular, generally dark color, and sometimes develops a peculiar sweetish repugnant odor, which as a rule appears only during the cooking test.

9. Alkaline reaction of the meat, which is permanent (this should, however, be compared with page 38).

10. The existence of a center of origin for the septic disease, which in many instances may be present only as an insignificant lesion, and sometimes it cannot even be detected.

11. The duration of the course of the disease must be in certain relation to the intensity and the time of supposed infection.

The recognition of sepsis, from the pronounced view of the disease, is not difficult, especially if a point of origin can be demonstrated, but in new cases and where infection is obscure, the diagnosis may be difficult. In such instances all changes, even insignificant ones, must be observed and their relative importance carefully weighed. There should always be taken into consideration the fact, correctly pointed out by Ostertag, that the more prominent pathological changes in the internal organs, by which the marked symptoms may be explained, are very often absent, yet sepsis is present regardless of the fact that these lesions are absent. In doubtful cases, and especially where immediate slaughter becomes necessary, a sec-

and examination must be made after 24 hours. In some instances the method proposed by Basenau (page 136) may be of aid in reaching a diagnosis.

The septicemic diseases of cattle appear chiefly in the following forms, only the most important characteristic symptoms of which are mentioned here:

1. *Septic Polyarthritis of Calves*, following septic infection of the navel (septic paralysis in calves).—Flaccid inflammation of the navel, with dirty red, offensive secretions, very often accompanied by ichorous disintegration of the umbilical vessels, serous arthritis with gelatinous infiltration of the periarticular portions, especially of the tarsal and carpal joints, as well as of the radio-ulnar, hock, and hip joints, tumefaction and marked saturation of the muscular lymph glands, and sometimes icterus are present.

2. *Hemorrhagic Enteritis of Calves*, which runs a rapid course, so that in some cases no cloudy swelling of the parenchyma is observed. Bloody diarrhea, blood-stained intestinal contents, and acute hemorrhagic enteritis, especially of the small intestines with swelling and bloody saturation of the mesenteric lymph glands are observed. The disease is probably a form of scour of calves (page 319).

3. *Septic Enteritis of Cattle*, similar to the foregoing, but incomplete with regard to symptomatology. Every inflammation of the intestines of cattle, accompanied by severe febrile and general disturbances, must be looked upon as suspicious of sepsis.

4. *Septic Metritis of Cows*, which follows retention of fetal membranes, or as result of an injury to the genital passages. In the latter there are mostly diphtheritic patches and ulcers. Septic metritis is accompanied by pelvic peritonitis, saturation of the pelvic connective tissue and marked infiltration of the sacral and iliac lymph glands. It has been emphatically stated by Albrecht that not all febrile diseases of cattle caused by metritis are of septic nature from the beginning, and with timely slaughter and good bleeding the meat may not be injurious to health. Perhaps Albrecht's case was one of general sapremic affection, caused by secondary retention (page 300). On the other hand, great precaution is necessary when cattle are slaughtered in an advanced stage of the disease, in case of incomplete bleeding, or of extensive gangrenous alteration of the genital passages.

5. *Septic Pleuritis and Peritonitis*, which are caused by external injuries, or coming from the intestines, respectively, or by bursting of abscesses or ichorous processes.

6. *Septic or Traumatic Pericarditis*.—This affection appears only in cattle, and is caused by penetration of foreign bodies through the stomach into the pericardium. All cases of pericarditis, however, are not accompanied by offensive secretions of septic nature.

7. *Septic Mastitis of Cows*.—This is distinguished from other inflammatory conditions of the udder by its rapid progress, accompanied by severe general symptoms. It may affect at least one-half of the udder or the entire udder which is considerably swollen, dark-red and hot, with corresponding swelling and infiltration of the lymph glands of the udder. Extension of the inflammation to the abdominal wall and to the surface of the inner thigh may follow.

8. *Septic wounds and injuries* of any kind and origin may lead to septicemia. Wounds of the joints are predisposed thereto, as are also deep puncture wounds with improper drainage, as well as wounds on the digits, with extensive destruction of tissue.

9. In classifying *morbus maculosus* (petechial fever, purpura hemorrhagica) of horses and cattle under septicemic forms, I agree with Ostertag, Hutyra, Marek, and others in regard to the most striking symptoms of the disease, i. e., hemorrhages and marked changes in the parenchyma indicate that morbus maculosus is a septic intoxication.

Judgment.—From experience gained in cases of poisoning of persons by meat, it is essential that carcasses of all food animals affected with sepsis should be considered as unfit for human food on account of their danger to health and disposition made of them in such manner as would cause no harm. Inasmuch as the toxalbumins of septicemia bacteria are not positively destroyed by heat, the use of this meat even in a cooked condition is not permitted.

The practice proposed by Basenau, namely, the feeding of fresh and cooked meat to mice to prove that it is poisonous, cannot be recommended universally on account of the circumstances frequently accompanying suspected cases of septicemia.

[In accordance with B. A. I. Order 150, Regulation 13, sections 5 and 18a, carcasses showing lesions of septicemia should be condemned.]

13. Pyemia

Pyemia is a disease of the blood caused by microorganisms entering into the circulation and resulting in the development of metastatic abscesses, or suppurative osteomyelitis (*osteomyelitis suppurativa*). It is described as a purulent blood poisoning.

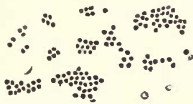


Fig. 133

Fig. 133. *Staphylococcus pyogenes*. Stained preparation from a pure culture. $\times 1,000$ diameters. After Weichselbaum.



Fig. 134

Fig. 134. *Streptococcus pyogenes*. Stained preparation from a pure culture. $\times 1,000$ diameters. After Weichselbaum.

Pathogenesis.—The pus-forming microorganisms which are the exciting causes of pyemia, are principally *staphylococcus pyogenes aureus* (*micrococcus pyogenes* Fig. 133) and *streptococcus pyogenes* (Fig. 134),

which usually enter the blood by a local suppurative focus direct or through the lymph channels, but the disease may also develop from an obscure origin.

As long as bacteria circulate in the blood they will produce fever; elimination therefrom follows partly through their having been deposited in the various organs, of which according to the point of inoculation, the lungs and liver come first into consideration, then the kidneys, spleen, bone marrow, joints, muscles, brain, etc. The results of suppurative emboli differ according to the character of the pyogenic bacteria. In cases where the beginning of embolic suppurative foci are characterized by the appearance of grayish-yellow areas that are surrounded at first by a red zone, they may be considered principally streptococcic emboli. From these foci abscesses develop in the interior of the organs, their growth being arrested by encapsulation and later the abscesses become consolidated by drying and calcification. Accordingly, recovery from pyemia is possible, and is not infrequent in food animals. The disseminated pus-forming organisms, however, may also produce suppurative inflammation of the serous membranes.

When, on the other hand, the changes described below occur in the marrow, they should be considered staphylococcic emboli (Ostertag).

Symptoms and Lesions.—Clinically, the disease can only be diagnosed as pyemia by the presence of local suppurations, accompanied by intermittent high fever and depression. If, in addition, there is inflammation of the joints and of the bones, or if affections of the lungs or kidneys are manifested, then the seat of the metastatic abscesses are indicated. The pathological lesions are the result of the pathogenic effect of the bacteria. It is to be especially observed, however, that as long as actual pyemia exists, there are always manifest appearances of severe infection of the blood and particularly cloudy swelling of the parenchyma, punctiform hemorrhages in the kidneys, lymph glands, and under the serous membranes; these are present in addition to the above-mentioned punctiform, puriform foci, or suppurative inflammation, and changes in the bone marrow.

The recognition of pyemia in slaughtered animals is not difficult when the disease is well developed. In the first stages, diagnosis will have to be established even without the presence of the metastatic suppurative foci, through the other manifestations of a general blood infection, if local suppuration or local osteomyelitis be visible; when doubtful, the unfavorable should always be accepted.

Although pyemia may develop as a consequence of any local suppurative process, the following forms, whose symptomatology deserve only slight mention, may be particularly noted:

1. *Pyemic Polyarthritis*, occurring especially in calves (suppurative lameness in calves, suppurative inflammation of umbilical vein). It can also exist without a conspicuous affection of the umbilicus, as a disease of the carpal, tarsal, radio-ulnar, hock, and femero-tibial joints with corresponding general symptoms. Attention is also called to the fact that numerous instances of recovered cases of pyemia in calves have been noted.

2. *Hemorrhagic and Purulent Osteomyelitis* is often of obscure origin. At first there is hyperemia of the bone marrow with hemorrhages therein, but later puriform softening of the bone marrow occurs with suppurative ulcerations in the joints.

3. *The Pyemias following Swine Plague and Caseous Pneumonia*, especially in sheep, goats, and calves, present no special characteristics.

4. *The Pyobacillosis of Pigs*, under certain conditions, may run the course of pyemic cachexia; but symptoms of acute intoxication are not prominent.

Judgment.—As the causes of suppuration in animals and man are identical, and the meat of pyemic animals contains pus-producing bacteria with their metabolic products (toxalbumins), and as such meat has been shown to be injurious to the health of mankind from numerous poisonings which have occurred through infection, it must be designated as unfit for human food, for even boiling does not remove its injurious properties.

It is not yet clear whether the toxicity of the meat from pyemic animals is due to the pus-producing organisms alone, or more to the introduction of other microorganisms (enteritidis bacilli, coli forms) from the intestines into the many juices of the body as a result of the severe constitutional disease.

When metastatic abscesses occur in the animal body, without any constitutional symptoms—processes which therefore do not belong to pyemia as such, and can be viewed only as possibly healed pyemia—the portions of the carcass not infected are always to be considered as harmless. It is not necessary that there always exists a distinct encapsulation of the abscesses; but in no case should there be present any signs of blood poisoning. As to whether in the cases of multiple abscess formation the utilizable meat portions are to be declared of impaired value, depends on the nutritive condition of the animal, the extension of the metastases, their intensity and location, as well as to any changes in the meat (variation of odor and consistency from that of normal meat). In certain cases (for instance, suppuration of the body lymph glands and joints, muscular abscesses) it may be necessary to consider the meat as unfit for food on account of its deteriorated or spoiled condition.

For hypophrenic abscesses, see page 210.

Contamination of meat with pus from the heart or abdominal veins, in which pus enters after death from rupture of hypophrenic and hepatic abscesses, has been described by Lohbeck, Reimers, Haffner.

[According to B. A. I. Order 150, Regulation 13, sections 5 and 18a, carcasses showing lesions of pyemia should be condemned.]

14. Putrid Intoxications

Putrid intoxication or sapremia (Ostertag) recently separated from the clinical diagnosis of septicemia is more rarely observed in meat inspection since septic processes are frequently associated therewith. Sapremia is an intoxication of the blood produced by resorption of the products of metabolism of saprophytes (saprophytic bacteria) which settle in a portion of the organism not engaged in nutrition (necrotic areas thrombi, hematoma, retained secretions and excretions), and produce decomposition. The bacteria, it is true, produce constitutional disturbances, but this, however, is not marked, as the toxins present in the blood are destroyed by active, healthy cells. Parenchymatous affections are absent or are insignificant on post-mortem of sapremic animals, but they invariably show a putrefactive process of bad odor.

In traumatic pericarditis of cattle there may be occasionally observed pure clinical examples of sapremia. In these cases there will frequently be found marked changes in the heart and pericardium with very malodorous masses of exudates, showing no signs of fever during life, nor presence of any other pathologic lesions. In such cases the meat is not to be considered injurious to health, though of impaired value, in view of its diseased condition. Occasionally the meat will be found edematous, or organic disease of other organs may be present and for this reason it will be necessary sometimes to declare the meat as unfit for food.

On account of the possibility of transmission of the putrid odor from the exudative masses in the pericardial sac to the rest of the meat, the boiling test should always be applied.

In retained placenta of cattle there may develop at the beginning a purely sapremic constitutional disease, which may lead to recovery under proper treatment in spite of slight or moderate fever. In these cases the meat of animals slaughtered early and showing no signs of sepsis is harmless. However, on account of complications with inflammatory lesions of the uterus (septic metritis), care should be exercised.

[Carcasses showing putrid intoxications are judged in the meat inspection service of the United States on the same lines as infection with septicemia or pyemia, and therefore should be condemned.]

Erysipelas of Hogs.—Although more recent observation shows the possibility for transmission of erysipelas of hogs to man under certain conditions, this form of septicemia will be treated in the following section on account of its relation to other diseases.

B. Infectious Diseases Characteristic of Food Animals But Not Transmissible to Man

1. Swine Erysipelas

Erysipelas of swine, also called rotlauf and bacillary erysipelas, is an acute, frequently occurring epizootic disease, produced by a specific bacillus (*Bacillus rhusiopathiae*), discovered by Löffler.

According to certain German investigators, the disease which will later be described as urticaria belongs etiologically to erysipelas, but is, however, to be differentiated from the latter for practical reasons.¹

Pathogenesis.—The erysipelas bacilli, which may also develop ectogenously, gain admission to the organism through the digestive tract or through wounds of the skin. Perhaps they are regular parasites in the body of the hog (intestines, tonsils), which may under certain conditions become pathogenic, according to the recent observations of Olt, Bauermeister, and Jensen.

The erysipelas bacilli are about 0.8 to 1.5 μ long; 0.1 to 0.2 μ wide, and stain with basic anilin stains; also by Gram's method (Fig. 135). In nutritive gelatine media at room temperature stab cultures will assume the characteristic bottle-brush shape after 3 or 4 days (Fig. 136). The bacilli are not particularly resistant to atmospheric influences; but while Petri's observations, which have been practically verified by Stadie, showed that the usual preparation and conservation methods of handling meat are not sufficient to kill the organisms, heating in steam kettle apparatus destroys them.

After passing through mice, the erysipelas bacilli lose their virulence for hogs (Prettner).

The bacilli, after gaining entrance into the blood, multiply rapidly, producing toxins whose action extends particularly to the blood, the larger organs of the body, and the nervous system. In the majority of cases the disease runs a fatal course, and on account of its dangerous character frequently leads to the emergency slaughter of the animal.

Symptoms and Lesions.—In the living animal, redness of the skin is particularly noticeable, occurring in spots on the inferior part of the abdomen, inner thigh surfaces, breast neck and ears. The red spots spread rapidly, turn blue or brownish-red and are evenly discolored. At the same



Fig. 136



Fig. 135

Fig. 135. Bacilli of swine erysipelas. Dried blood preparation. $\times 500$ diameters.

Fig. 136. Erysipelas bacilli, stab culture in gelatine. 5 days old in room temperature.

¹ If urticaria were a chronic form of erysipelas, one would naturally expect to find some acute cases of swine erysipelas; but, although the former prevails to a considerable extent in this country, the latter has never been observed.]

time, there exist severe general disturbances, such as fever, debility, anorexia, constipation followed by diarrhea, accelerated breathing, etc.

The pathological lesions vary with the stage of the disease during which the animal was slaughtered. It frequently happens that when the hog is being scalded redness of the skin becomes even more intensified, and may extend deep into the subcutaneous fatty layer (Speckschicht). In addition there is but slight "bleeding out," insufficient rigor mortis, enlargement of the spleen, parenchymatous degeneration of the liver, heart and kidneys, which latter usually show hemorrhagic inflammation, hemorrhages beneath the serosa and in the cortical layer of the kidneys, hemorrhagic gastro-enteritis, swelling of the intestinal lymph follicles, enlargement and marked transudation of the mesenteric glands and other lymph glands, which may also show punctiform hemorrhages. In very severe cases, and especially in cases slaughtered when approaching death, the musculature appears sero-sanguinolent, grayish-red, and has a tendency to decompose rapidly.

Endocarditis valvularis verrucosa may be observed as a sequel.

The above-mentioned symptoms furnish sufficient basis for the recognition of the disease, the demonstration of the erysipelas bacillus being best effected through specimens taken from the splenic pulp. Inoculated mice or pigeons succumb after 3 or 4 days, and a culture will develop the already mentioned characteristic properties within the same period of time.

In order to avoid confusion in the recognition of erysipelas there must be considered:

1. *Swine Plague and Hog Cholera*.—Both resemble in the acute stage during life the course of erysipelas; in the slaughtered animal, however, the anatomical findings will differ decidedly.

2. *Urticaria*.—This disease during life produces characteristic skin macules, while on post-mortem examination, there is an absence of the lesions in the viscera. At most there may be present enlargement of the spleen or liver, if the animals be slaughtered at the height of the disease.

3. *Erythema of Thermic or Mechanical Nature*.—These are confined to the skin of certain portions of the body only, and in mechanical causes hemorrhages occur; internal lesions are absent.

4. *Heat-stroke* (Hitzschlag), which frequently occurs in the summer transportation of hogs, is accompanied by bluish-red discolorations of the skin, the latter, however, being mostly hypostatic; on post-mortem examination indications of suffocation will be found.

5. *Wound-erysipelas*; the latter being almost always restricted to the head, is usually unilateral and characterized by severe infiltration of the subcutis of the parts affected. Kleinert has observed two cases in hogs of more extensive erysipelas of the head, breast, abdomen, outer surface of the thighs, back, and ears, associated with putrid metritis (suppurative metritis).

6. *Anthrax*, which is very rare in hogs, occurs generally as gloss anthrax, and demonstration of the bacilli confirms the diagnosis.

For *judgment* of erysipelas in hogs see page 308.

Urticaria.—Nettlefever, or diamond skin disease, of hogs is a macular hemorrhagic dermatitis, accompanied by febrile constitutional symptoms, and runs a mild course. Since Lorenz, Jensen, Schütz, Luepke, etc., have demonstrated erysipelas bacilli in the skin, the disease is classed with erysipelas, although the other symptoms differ from it.¹

The clinical findings are characterized by flat, red, round, or rhombic skin plaques, which rapidly increase in size and number. In the slaughtered animal the plaques usually present a rhombic shape (Fig. 137), and extend deep into the cutis and even into the subcutis. Diseases of internal organs are absent in slight cases, but severe cases may be associated with splenic tumor and hyperemia of the liver.

The recognition of urticaria is easy; to avoid confusion, it will be necessary to consider the diseases mentioned in discussion on differential diagnosis of erysipelas.

Judgment.—The diseased skin areas should be removed and no further restrictions placed on the meat.

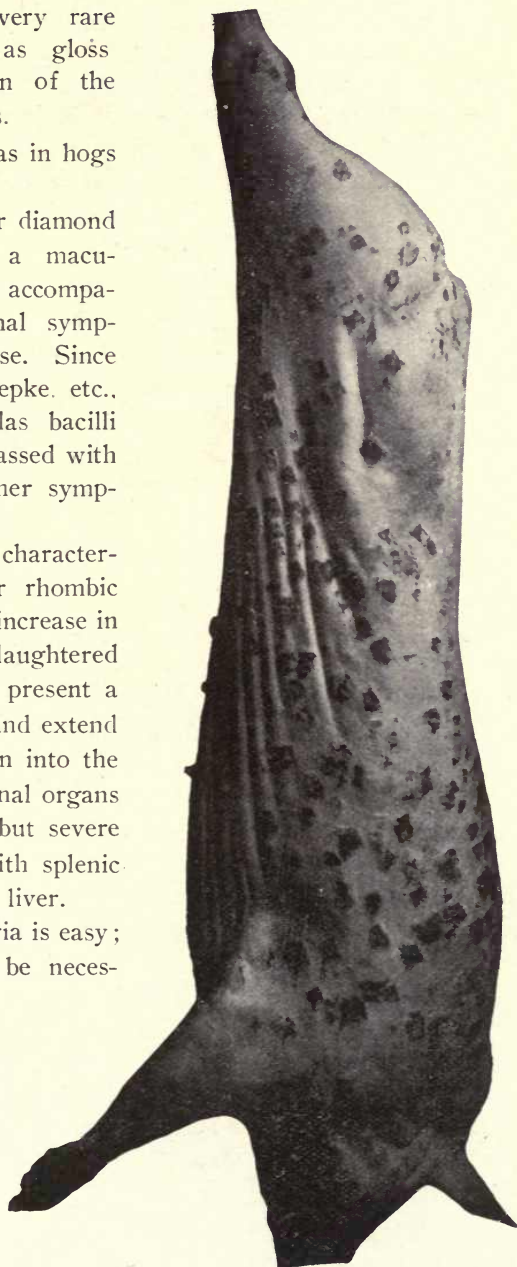


Fig. 137. Side of a hog with urticaria

¹In this country, urticaria has never been found associated with the erysipelas bacillus, and furthermore swine erysipelas does not exist in the United States. The urticarial disease found in post-mortem work is caused by vaso-motor changes, resulting from the consumption of certain food stuffs, as in other species of animals.]

In Prussia this disease is subject to the same veterinary regulations as erysipelas, according to the decree of March 11, 1902.

[According to B. A. I. Order 150, Regulation 13, section 21, hogs affected with urticaria may be passed after detaching and condemning the skin.]

2. Swine Plague

Swine plague or swine septicemia (Löffler, Preisz) is a subacute or chronic contagious disease of hogs, frequently occurring associated with hog cholera in the same animal. The pure forms of swine plague are characterized by severe pneumonia, accompanied by pleuritis and pericarditis and their complications and sequellæ.

According to Ostertag, every inflammation of the lungs in hogs which cannot be proven to be caused by foreign bodies, parasites, tubercle bacilli or pus-bacteria, is to be suspected as being swine plague.

Pathogenesis.—Swine plague is caused by bacteria, which are usually oval in shape, but occasionally bacillus-like (*Bacillus suisepiticus*). They belong to the group of bacteria causing hemorrhagic septicemia (Hueppe), i. e., rabbit septicemia (Koch).

The bacteria (Fig. 138) are about 1μ long, 0.5μ wide, oval, immotile, and take a bipolar stain with gentian violet. According to Preisz, this is best accomplished when stained with aqueous fuchsin, and then decolorized with alcohol or weak acetic acid. These bacteria are found in the blood as well as in the diseased tissues.

The bacteria of swine plague enter the body through the respiratory organs or by the digestive tract and from thence to the blood, producing a rapid or gradual general infection similar to septicemia. The lungs are the sites of predilection for their destructive action. In accordance with the virulence of the swine plague bacteria there are various "types" noted, but they do not differ morphologically.

The course of the disease may be peracute, simulating hemorrhagic septicemia; acute, as a multiple caseous pneumonia; and chronic with the symptoms of a catarrhal pneumonia, the latter being the most common form. Recovery may occur, leaving more or less extensive pathologic lesions, such as adhesions between the pleuræ, and between the lungs and pericardium, fibrosis of the lung tissue, and caseous, sequestered areas.

When swine plague and hog cholera occur in the same animal, Preisz holds that in acute cases the latter infection is primary, while the former is only secondary.

Symptoms and Lesions.—The clinical symptoms depend on the course of the disease; for at one time they are of general septic infection, while at others those of pneumonia will predominate. The special pathologic conditions are: Severe pneumonia in various stages of hepatization

with multiple necrosed areas, hemorrhagic, fibrinous pleuritis and pericarditis, and occasionally peritonitis may be associated. During the height of the disease there are also marked enlargement and redness of the lymph glands with hemorrhages in them as well as in the kidneys, degeneration of the large organs, and occasionally icterus.

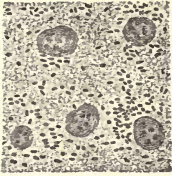


Fig 138. Swine plague bacteria. Dried blood preparation. \times 500 diameters.

It may prove quite difficult to recognize swine plague in the living animal; therefore diagnosis in some cases cannot be made with any degree of certainty except when marked pneumonic symptoms (cough) are present. In slaughtered animals diagnosis is verified by the above-mentioned conditions, by bacteriological examination, and through inoculation of white mice, which die in from one to three days' time. Only in acute forms of swine plague are bacteria found in the blood, while in

chronic cases they are only present in parts affected though according to Junack, it is impossible to find bacteria in about one-third of all the cases diagnosed as chronic swine plague. Certain types of the *Bacillus suisepitiscus* develop in addition to short forms, long threads which, however, do not occur in the animal body. In differential diagnosis the following diseases come into consideration:

1. *Swine Erysipelas*, especially in acute cases of swine plague, where red coloration of the skin also occurs, but is present only in those parts of the body involved by the disease. In swine erysipelas there are no characteristic pulmonary changes of swine plague; and finally, the bacteriologic and bacterioscopic findings will establish the nature of the infection.

2. *Hog Cholera* in its initial stages, when the intestinal changes are not yet well developed or when mixed infection exists, which rapidly terminates the life of the animal.

3. *Tuberculosis* after the inflammatory changes have run their course. In swine plague there are no characteristic multiple infections of the lymphatic glands as in tuberculosis, the areas of caseation or necrotic areas of the lungs being without new formation of granulation tissue at the periphery; nor are those peculiar secondary nodules of tuberculosis present in the vicinity.

4. *Verminous Pneumonias* which occur *en masse* and may be readily recognized by the presence of parasites.

5. *Traumatic Pneumonias*.—These lead to gangrene, as a rule, and are found in the main lobes of the lung.

Regarding the judgment of swine plague carcasses see page 308.

Pyobacillosis of Pigs.—Pyobacillosis, pyemic cachexia of pigs, occurs in young hogs quite frequently as a nonacute disease, produced by the *Bacillus pyogenes suis*, which is viewed by Grips, Nieberle, and Glage as belonging to swine plague. The disease is characterized by catarrhal changes or suppurative catarrhs of the intestines and air passages, associated with sero-fibrinous inflammation of the pleura, pericardium and peritoneum, as well as suppurative or caseated changes in the lungs, with hepatization and atelectasis in their vicinity. A generalization of the pyobacillus and suppurations in the joints, bones, tendon sheaths, muscles, body lymph glands, mammae, etc., are also observed.

In the judgment of pyobacillosis, its form of appearance and the nutritive condition of the animal must be taken into consideration. As the latter is usually greatly impaired, the entire carcass will usually have to be condemned, and where the suppurative changes are generalized, the same holds good also.

As pigs are rarely slaughtered while affected with pyobacillosis but as a rule die of the disease, the importance of meat inspection is not significant in this disease.

[In the United States carcasses of pigs affected with pyobacillosis should be judged on the same principles as pyemia, and therefore should be condemned.]

3. Hog Cholera

Hog cholera, or swine fever, is an infectious disease of hogs which runs partly an acute and partly a chronic course, characterized by marked lesions in the digestive apparatus and an infiltration of the lymph apparatus, especially of the lymphatic glands. In many instances the disease occurs complicated with swine plague.

Pathogenesis.—Until quite recently the *Bacillus suispestifer*, whose portal of entry is the digestive tract, has been accepted as the cause of hog cholera, but recent investigations indicated that the disease is due to an ultramicroscopic filterable virus, and that the saprophytic hog cholera bacilli bring about changes only secondary to the conditions produced as a result of the presence of the invisible virus. This is the view of de Schweinitz and Dorset, McFadyean, Hutyra, Ostertag, and Stadie. Schreiber-Landsberg takes issue with these writers and still adheres to the old theory that the *Bacillus suispestifer* is the exciting cause of the German hog cholera, and that it acts mainly through the medium of its metabolic products. Schreiber considers the filterable virus the toxin which is formed by *Bacillus suispestifer* infection, which acts as an aggressin furthering the infection and mobilizing the hog cholera bacilli in the body. Ostertag and Stadie hold this view of Schreiber's as incorrect and disproved by their experimental results.¹

The *Bacillus suispestifer* (Fig. 139) is a short, motile, typhoid-like bacillus with rounded ends, 1.2-1.5 μ long and 0.6 μ wide. The bacilli lie singly or arranged in pairs and possess flagella. The latter may be indistinctly visible if the specimens are

[¹ Hutyra believes that the invisible filterable virus is responsible not only for so-called hog cholera, but for swine plague as well, and that the respective bacilli of these previously considered separate diseases are merely secondary invaders.]

stained with Löffler's flagella stain. The bacilli stain best with Löffler's alkaline methylene blue solution. The swine-pest bacilli are most readily found in the mesenteric lymph glands. In more advanced necrotic changes resulting from hog cholera the necrosis bacilli also come into consideration (Bang, Preisz, Karlinski, Ostertag, Kitt).

As a result of the invasion of the organism by the hog cholera bacilli there occur, according to the virulence of the bacilli and the resistance of the tissues, either hemorrhagic intestinal inflammations with infection of the blood and a rapidly lethal course, or chronic forms with marked destruction of the intestinal canal and mesenteric lymph glands.

Symptoms and Lesions.—The clinical symptoms in the development of hog cholera vary. In acute cases there are fever, diarrhea, red petechia of the skin, with exanthemata on the ears, nose (snout), the inner surfaces of the thighs and around the anus, suppurative conjunctivitis, great weakness and debility. In the less rapid course variable symptoms arise (constipation and malodorous, green diarrhea), those of the intestinal canal predominating; also emaciation, weakness, chronic skin exanthemata with crust formation. When complicated with swine plague, symptoms of chronic lung disease with dyspnea, cough, etc., may be observed.

The pathologic lesions in the peracute cases correspond to those of hemorrhagic septicemia with croupous and necrotic changes of the intestinal mucosa. In less acute types there is a specific affection of the colon, the mucosa of which presents croupous-diphtheritic changes. Corresponding to the solitary and multiple lymph follicles of the intestinal mucous membrane, there are millet to hazelnut sized definitely circumscribed or confluent caseous, yellow, button-like projecting ulcerations covered with a crust-like dirty coat (Fig. 140). On removal of the latter, the irregular ulcers are exposed. The ileo-cecal valve especially is, as a rule, pathognomonically enlarged and caseated (Ostertag). The above-mentioned changes are in some cases recognizable on the exterior of the intestine as prominent yellowish-gray spots. In addition to this, it is by no means uncommon to find certain portions of the intestinal wall quite rigid, hypertrophic, or even the entire large intestines may be grown together into tough, thick rolls. If such is the case there will, as a rule, be found fibrous adhesion to the peritoneum also. Similar characteristic areas and ulcers develop also in the small intestines. The mesenteric glands are always swollen, of a dark bluish-red or pale color, and partially or entirely caseated. Similar changes are also usually observed in the cervical, and occasionally in the pelvic lymph glands. Croupous-diphtheritic mem-

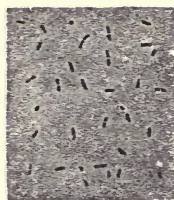


Fig. 139. Hog cholera bacilli. Pure culture. x 500 diameters.

branes may also be found on the mucosa of the tongue, cheeks, gums, tonsils, pharynx, and epiglottis. The spleen may be enlarged and injected, and the kidneys present petechial hemorrhages in the cortex.

If a multiple caseous pneumonia is present, it is an indication of a complication with swine plague. Whether the metastatic bone and joint caseations and suppurations in the chronic cases are a part of the descriptive symptoms of hog cholera or of pyobacillosis, still remains to be proven.

Recognition of the developed chronic forms of hog cholera is not difficult, but the following diseases must be considered in differential diagnosis:

1. *Swine Erysipelas* in acute and peracute cases of hog cholera. In addition to the absence of the swine erysipelas bacilli there is the absence of the intense hemorrhagic nephritis and the presence of intestinal lesions.

2. *Tuberculosis of the Digestive Apparatus*.—Differentiation from this disease is indicated by the extensive destruction of the intestinal mucous membrane, the total caseation of the lymph glands, the absence of the characteristic tubercular nodules in the vicinity of the lesions, the absence of calcification in the affected lymph glands, and the absence of tuberculous changes in other organs.

Judgment of the Meat in Swine Erysipelas, Swine Plague, and Hog Cholera.—In view of the fact that the meat of these diseased animals has frequently been used for food without ever having incurred any impairment or injury to man it can hardly be



Fig. 140. Portion of large intestines with lesions of hog cholera.

classed as injurious to health; in individual cases, however, the following should be considered:

1. The entire carcass is unfit for food as soon as marked substantial changes (congestion of blood, serous infiltration, degenerations, yellow discoloration) of the musculature or fatty tissue is observed, or when marked emaciation has occurred.

2. In all other cases, with the exception of the chronic forms of swine plague and the sequelæ of this disease and those of hog cholera, the carcass in all three of these diseases is to be considered fit for food, but

subject to certain conditions. For veterinary sanitary reasons and partly in consideration of the presence of the causative agents in the blood of cases of swine erysipelas, swine plague, and the acute forms of hog cholera, the meat and fat are to be boiled, steamed (rendered into lard), or pickled. The portions affected by the disease should be condemned.

3. In case of slow chronic forms of swine plague, without disturbance of the general condition, or sequelæ of this disease (adhesions, cicatrices, capsulated caseated areas, etc.), or of hog cholera (caseation of the mesenteric lymphatic glands, adhesions of intestines, formation of cicatrices in the intestinal mucosa), only the affected portions of the meat are to be condemned and destroyed. The remainder of the carcass is fit for food without any restriction.

[In accordance with B. A. I. Order 150, Regulation 13, section 10, paragraphs 1-4, carcasses which are well nourished, showing only slight limited lesions of hog cholera or swine plague may be passed; those showing well-marked and progressive lesions shall be condemned, while those carcasses in which the lesions are more extensive than those of carcasses to be passed, yet not sufficiently severe for condemnation, may be rendered into lard, provided they are cooked by steam for four hours at a temperature not lower than 220° F.]

4. With regard to judgment of urticaria, see page 303.

Veterinary Police Regulation.—In compliance with the decree of the Imperial Chancellor, dated September 8, 1898, every case of swine erysipelas, swine plague, and hog cholera is to be reported, in all parts of the Empire, to the police authorities at the nearest point to where they occur. Nonveterinary inspectors may, under the inspection regulations of the Imperial meat-inspection law, inspect only light forms of swine erysipelas, provided the local government permits the exercise of this function (for instance, the Kingdom of Saxony prohibits such action).

4. Contagious Pleuro-pneumonia of Cattle

This epizootic disease of the lungs is a chronic, contagious pleuro-pneumonia peculiar to cattle. [It was eradicated from the United States in 1892.]

Pathogenesis.—The cause of the disease, according to Nocard and Roux, seems to be minute, motile microorganisms of indefinite morphology, which enter the lungs by the air passages and gradually produce progressive pleuro-pneumonia, beginning in the connective tissue of the lungs.

Symptoms and Lesions.—Since the clinical symptoms of this disease, when occurring in isolated cases, can never be diagnosed on ante-mortem inspection, they will not be discussed here.

The anatomical lesions, however, are quite characteristic (Plate II, Fig. 1). The unilateral (left) inflammation of the lungs is superficially recognized by a varying grade of pleuritis and the coarse condition of the changed portion of the lung, which contains no air. Section of the diseased area will reveal marked proliferation of the interlobular connective tissue, which will be found as thick, gelatinous, intermixed with fibrinous, grayish-yellow bands, about 2 cm. wide, separating the compressed lung lobules and the lobules of the adjoining lung sections. The diseased lobules may appear singly or in groups with varying degrees of inflammation, while fresh inflammatory lobules will be seen lying beside older forms. Hyperemic, edematous and bright red hepatized lobules alternate with dark red, liver-like lobules, and with some which show a grayish-yellow to grayish-brown color. The latter are cloudy, dry, and point to an early stage of necrosis, which may lead to sequestration of smaller or larger lung areas. As a result of the condition just described, the lung presents a marbled appearance on section (Plate II, Fig. 1). The above-mentioned inflammation of the pulmonary pleura extends also to the other pleural surfaces, in advanced cases of the disease, and leads to extensive fibrin deposits, adhesions, and collections of exudate within the pleural sac.

Pleuro-pneumonia is recognized quite readily when the above-mentioned pathologic lesions are present. Only in quite recently formed cases will any difficulty of diagnosis be met, and in these great care should be exercised on account of the grave consequences which might follow an error in diagnosis.

Pleuro-pneumonia may be mistaken for—

1. *Foreign Body (Traumatic) Pneumonia*, which occurs either at one particular point only or in multiple places, and may also present a marbled appearance. Here the foreign body may be demonstrated, however; and in the latter case the widely distributed areas will not suggest pleuro-pneumonia.

2. *Genuine Croupous Pneumonia*, which however is rare, usually occurs on the right side and presents uniform processes throughout.

3. *Hemorrhagic Septicemia* of cattle in the pectoral form. Here the rapid clinical course and the anatomically uniform acute pulmonary inflammation differentiates it from pleuro-pneumonia. Mice and rabbits die of hemorrhagic septicemia within 12 to 36 hours after inoculation.

4. *Contagious Broncho-Pneumonia of Calves*, which occurs as a lobular catarrhal inflammation of the lung without involving the interlobular tissue.

5. *Pneumonomycosis*, which is readily recognized microscopically.

Judgment.—Inasmuch as the meat of animals suffering from pleuro-pneumonia is not harmful to man as food, it may be declared serviceable after removal of the diseased portions, provided emaciation, fever, serosity and other conditions of the meat do not impair its value. It would be necessary to condemn the carcass only exceptionally in cases of pronounced emaciation with serosity.

[Contagious pleuro-pneumonia of cattle does not exist at the present time in the United States and as the regulations governing the importation of cattle prescribe a quarantine of 60 days, which constitutes the longest period for the incubation of this contagion, it is not likely that the disease will reappear in this country, and accordingly it is not of any great interest in meat inspection.]

Veterinary Police Regulations.—The occurrence of the disease is to be immediately reported and the entire carcass confiscated. Regulations require that the lungs be buried at the depth of one meter, and that the meat be not removed from the diseased lot until it has been cooled thoroughly, and that the hides should also be retained until they have been completely dried, unless they are turned over directly to a tannery.

5. Blackleg

Symptomatic anthrax or blackleg may attack cattle, sheep, goats, very rarely horses, and also hogs, but this infectious disease is usually restricted to certain localities. Blackleg is characterized by the formation of gas-containing swellings in the subcutis which rapidly spread.

Pathogenesis.—Blackleg is caused by anaerobic bacilli, which enter the organism through abrasions of the skin or mucous membrane.

The bacilli measure 3 to 6 μ in length and 0.5-0.7 μ in width, are motile as long as they have not developed spores, and stain readily; they do not stain by Gram's method, however. They are never found in the living blood, but always in the subcutaneous and intermuscular connective tissue.

After the bacilli have gained entrance into the body there develops crepitating, rapidly spreading swellings in the connective tissue, especially at the neck, shoulders, beneath the breast, thigh, flanks, and more rarely at the gums, base of tongue and wall of the pharynx, accompanied by severe general febrile symptoms.

Symptoms and Lesions.—The symptoms in the living animal correspond to the above description. Anatomically the subcutis and the intermuscular connective tissue beneath the partly necrosed skin appear of a yellowish color, bloody, permeated by air bubbles and of an offensive odor, which in many instances is similar to that of rancid butter. At these points the musculature is a muddy brownish-red, crepitating, and very juicy; the corresponding lymphatic glands contain a bloody, serous

infiltration, are swollen, and contain hemorrhagic areas. The latter are also found under the serosa. Sero-sanguinolent extravasations or exudates in the body cavities and occasionally perirenal and mesenteric bloody gelatinous infiltrations are noted. Degenerations of the heart, liver, and kidneys occur, while the spleen and blood remain unchanged.

Blackleg is easily recognized in differential diagnosis. The following diseases must be considered:

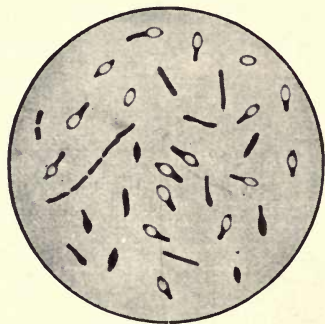


Fig. 141. Blackleg bacilli with spores. Muscle juice from guinea pig. Cover-glass preparation. $\times 1,000$ diameters. After Hutyra and Marek.

1. *Malignant Edema*, which need rarely be differentiated clinically from blackleg. Anatomically attention should be directed to the foul necrotic odor of the edematous swellings, the more plump morphology of the edema bacillus (page 292), which in addition possesses spores in the center of the organism and not at end, as is the case with the blackleg bacillus. The latter do not develop into threads in the cadaver, like edema bacilli.

2. *Anthrax*.—The clinical course of this disease differs considerably from that of blackleg, and in the slaughtered animal the blood and spleen alterations, as well as the demonstration of the bacillus of anthrax,

serve to differentiate it from blackleg.

3. *Mechanical Subcutaneous Emphysema*, which clinically and anatomically differs entirely, particularly in that it produces no necrosis of the skin.

4. *Phlegmons* of the subcutis as a result of pyogenous wound infection, run a much slower course than blackleg and remain localized.

Judgment.—If blackleg is found on ante-mortem inspection, or if it is even suspected, slaughtering of the animal is to be forbidden. The meat of animals suffering from blackleg, although not injurious to man, must be condemned on account of the marked substantial changes therein, and is not to be considered fit for human food.

Veterinary Police Regulations.—In this respect blackleg is to be treated just like anthrax (see page 281), since in almost all states compulsory notification is required of all cases that may arise.

That the so-called "parturient blackleg" is not true blackleg, but a form of malignant edema, has already been stated on page 292.

Reindeer pest is quite similar to blackleg, and this is mentioned on account of the fact that no inconsiderable quantities of reindeer meat are imported into Germany. In reindeer pest there is found gas formation in the subcutis, the intramuscular, subpleural, and subperitoneal tissues, and especially abundant beneath the renal capsule. As compared with blackleg it is found that reindeer pest differs also

in the presence of abundant gas formation in the internal organs. The cause of reindeer pest, according to Lundgren and Bergman, are aerobic rods, thinner than those of blackleg or anthrax bacilli, forming spores either in the middle or at the end, and staining by Gram's method. On account of the great similarity to blackleg the meat of animals affected with reindeer pest is to be judged like that of blackleg.

[According to B. A. I. Order 150, Regulation 13, section 3, carcasses of animals showing lesions of blackleg should be condemned.]

6. Bradsot

The disease called bradsot (rapid plague) is an acute infectious disease of sheep, which originated in Iceland, Norway, Scotland, and occurs in Germany, according to Peters, in Mecklenburg, Pommerania, and recently also in Middle Germany (Dammann and Oppermann, R. Froehner). It occurs almost exclusively during the winter months, particularly in young animals and in its nature it is a gastromycosis.

Pathogenesis.—The plague is produced by the *Bacillus gastromycosis ovis* (Nielsen), an anaerobic, slender, motile schizomycetes, which stains by Gram's method. It forms central or polar spores and is frequently found arranged end to end.

The entrance of the bacillus into the digestive tract produces a hemorrhagic, abomaso-duodenal inflammation followed by general infection or intoxication.

Pathology.—On account of the frequent peracute course of the disease clinical symptoms (debility, gnashing of teeth, difficulties of respiration, coma, tympanitis) are rarely observed. The anatomical changes have been described in the pathogenesis. In addition to these, there occur occasionally fibrinous infiltrations of the subcutaneous connective tissues with gas formation and sero-sanguinolent exudates in the abdominal cavity. Decomposition sets in quickly.

Judgment.—Although injury to human health is unlikely as the result of ingestion of meat from sheep affected with "bradsot," as has been noted by certain observers, it is necessary to condemn it on account of the severe general infection or intoxication which is present.

In view of the rapid course of the disease it is not likely that many sheep affected with this disease will be brought to abattoirs for slaughter.

[Bradsot has not been observed in the United States and therefore it is of no interest in meat inspection. The occurrence of the disease would naturally require a condemnation of the affected carcasses on account of the severe infection and intoxication.]

7. Rinderpest (Cattle Plague)

Cattle plague is an acute infectious disease peculiar to cattle, which may be transmitted to other ruminants, and occurs as a severe, febrile general infection associated with inflammation of all mucous membranes, especially those of the digestive tract. The plague has been extinct in Germany for years, but might readily be carried in again from foreign countries. [It has never occurred in the United States.] There is little known in regard to the nature of the infectious material.

Symptoms and Lesions.—Clinical symptoms: Chills (rigor), high fever, marked depression, constipation, and after a few days catarrh of all visible mucous membranes, which are stained scarlet red, either diffusely or in spots (petechia). Difficulty in respiration and dysenteric feces occasionally mixed with blood, occur later. The visible mucous membranes show erosions, upon which grayish-white crusts appear, and when these are cast off ulcers become visible. As the animals rapidly emaciate, the secretions of the mucous membranes become discolored, puslike, malodorous, and the temperature sinks to subnormal.

The anatomic lesions, according to Kitt. are: In the primary stages hyperemia and catarrhal condition of the mucous membranes, then croupous diphtheritic exudates with marked hyperemia, particularly along the entire digestive tract, and at the orifice of the female genitals; occasionally simultaneous croupous exudate in the bronchi occurs. To these are added ecchymosis of the heart and exanthema of the skin. The third stomach is frequently filled with very dry, powdered fodder; the gall bladder is usually full and distended; parenchyma degenerated; musculature wasted, soft, and filled with small blood extravasations.

Diagnosis.—In order to recognize cattle plague, which is exceedingly difficult in isolated cases, all of the diagnostic factors will have to be most carefully considered, such as the symptom-complex, autopsy findings, the course of the plague, and its history.

It may be mistaken for:

1. *Malignant Catarrhal Fever*, in which, however, the mucous membranes of the head, the respiratory apparatus, and the eyes are particularly involved, and in which the viscera are intact. It usually occurs only enzootically.

2. *Dysentery and Mycotic Enteritis.*—Here the intestinal symptoms predominate and the other pest symptoms are absent.

3. *Poisoning, Especially Mercurial and Caustic Poisons.*—Here the contagion is absent and the generalized croupous-diphtheritic inflammation of the mucous membranes is also lacking.

4. *Infectious Hemoglobinuria of Cattle* (page 256), when on post-mortem examination of cattle which have died from this disease ulcers

and lamellar deposits are found in the abomasum and duodenum (Hutyra-Marek). There is, however, an absence of the changes in the oral mucous membranes, the air passages and genitals, while the hemoglobin-containing urine will attract attention.

Judgment.—The killing or slaughtering of animals affected with cattle plague or those suspected of having this disease is to be prohibited. Although the meat of cattle-plague animals has been proven to be harmless to man when used for food, it is nevertheless to be destroyed or declared unfit for food on account of the great danger in spreading the disease, and is to be buried in accordance with regulations of the rinderpest law of April 7, 1869.

[Inasmuch as the disease does not exist in the United States there are no provisions made in the regulations for the judgment of animals affected with rinderpest; it is, however, self-evident that the occurrence of the disease would require condemnation of the affected carcasses with strict veterinary police regulations to prevent its spread.]

8. Vesicular Exanthema of Horses and Cattle

This contagious disease of the genital organs, which occasionally produces a constitutional disturbance, is mentioned here only on account of its veterinary police (sanitary) importance.

Symptoms and Lesions.—Marked redness and swelling of the mucous membrane of the vagina, prepuce, and penis, itching, slight discharge and strangury, development of delicately covered vesicles of sizes from a millet seed to a dime, which burst and change into superficial ulcers. They form brownish crusts and heal, leaving white cicatrices. It is sometimes difficult to observe the symptoms in bulls, since only fine erosions and small vesicles appear on the mucous membrane of the prepuce. In severe cases there occur confluent, deeper penetrating ulcers, with suppuration and foul pus, more marked discharge, and swelling of the surrounding parts as well as grave febrile general disturbance.

Judgment.—The meat of animals afflicted with vesicular exanthema, is generally fit for food; in severe cases, which, however, are rarely brought for slaughter, the grade of the disease and complications present decide whether the meat is to be declared of *impaired* value, or to be entirely *condemned*.

The veterinary police regulations require report of such cases and retention of the diseased portions for examination by the veterinarian in charge.

[In the meat inspection of the United States carcasses of animals affected with vesicular exanthema may be passed for food provided the disease has not caused general systemic disturbances and the lesions are confined to the genital organs, which should be condemned.]

For contagious vaginal catarrh, see page 212.

9. Hemorrhagic Septicemia (Game and Cattle Plague)

Game and Cattle Plague.—This disease, belonging to the group of septicemia hemorrhagica (Hueppe), occasionally occurs epizootically in cattle, deer, and black game, and in isolated cases may be transmitted to the horse, goat and hog. It appears in pectoral and exanthematous form, though both may occur together.

Pathogenesis.—The cause of this disease (*Bacillus [bipolaris] bovis-septicus*), which simulates that of swine plague, may gain entrance to the organism in various ways, corresponding to the above-mentioned forms of the disease. According to Dammann and Oppermann a species of mosquito (*Simulia ornata*) is the intermediate host in the transmission of this affection. The bacilli produce local inflammations, and passing into the blood create various changes resembling the course of sepsis.

Symptoms and Lesions.—In cattle the exanthematous form is the most frequent. The clinical symptoms are the rapidly arising warm swellings of the subcutis of the head and neck, as well as the oral cavity, high fever, and difficult respiration. Anatomically there are sanguino-gelatinous exudations at the above-mentioned areas, marked swelling of the retropharyngeal and cervical lymphatic glands, cloudy swelling of the large viscera and hemorrhages into most organs.

The pectoral form, which predominates in game, runs the clinical and anatomical course of severe croupous pleuro-pneumonia with marked dyspnea. The above-mentioned hemorrhages are never absent.

In both forms there also exists marked hemorrhagic enteritis, which is noticeable clinically by bloody discharges in addition to the severe general constitutional condition. These intestinal forms or symptoms were previously described as a special intestinal form of *game and cattle plague*.

The positive recognition of the plague *intra vitam* is oftentimes impossible, though *per post mortem* it is quite easy. The presence of the bacteria, inoculation of rabbits and mice, and feeding infectious material to birds, causing death to all within 12 to 36 hours, confirm the diagnosis.

It might be mistaken for:

1. *Anthrax*; in hemorrhagic septicemia the marked splenic changes are absent, and the blood alterations and anthrax bacilli as well.
2. *Pleuro-pneumonia*; from this the uniform age and synchronicity of all the diffuse pneumonic areas in game and cattle plague differ considerably.
3. *Malignant Edema, Blackleg, and Cattle Pest (Rinderpest)*, whose differential diagnostic features have already been cited.

Judgment.—The slaughter of animals affected with hemorrhagic septicemia is prohibited, and they are to be treated like those affected with

anthrax. In some states it is required to report the occurrence of this disease.

In view of the danger in spreading contagion, the entire carcass is to be *condemned*, although the ingestion of the meat by man is not dangerous to health.

[According to B. A. I. Order 150, Regulation 13, section 4, carcasses of animals affected with hemorrhagic septicemia shall be condemned.]

10. Malignant Catarrhal Fever of Cattle

This miasmatic infectious disease peculiar to cattle is characterized by marked inflammation of all mucous membranes of the head (inflammatory disease of the head) and eyes, accompanied by severe constitutional and cerebral disturbances.

Pathogenesis.—The still unknown infectious material, aside from the above-mentioned symptoms, causes sometimes more extensive affection of the respiratory apparatus as well as croupous-diphtheritic inflammation of the digestive tract, and occasionally vesicular or nodule-like skin exanthemata (skin eruptions), while nephritis, cystitis, and colpitis may also occur.

Symptoms and Lesions.—The most prominent clinical symptoms are rapidly increasing fever, marked fatigue, and impairment of sensation, muscular tremors, inflammation of the mucous membranes of the head, particularly those of the eyes, difficulty of respiration, diarrhea, which may be mixed with blood, and rapid emaciation. Predominating anatomical lesions are catarrhal or hemorrhagic, later croupous and diphtheritic inflammation of the mucous membranes of the entire respiratory apparatus and occasionally also involving the digestive apparatus; great congestion of blood in the cranial cavity; marked swelling of the lids, conjunctivitis, keratitis and even iritis; enlargement of the spleen and cloudy swelling of the liver and kidneys which are usually not marked; and at times nephritis, cystitis, colpitis, and the above-mentioned skin changes may occur.

The recognition of the well-developed cases of malignant catarrhal fever is not difficult. For differential diagnosis should be considered:

1. *Rinderpest*, in which the affection of the eyes is conspicuously absent, and in which the rapid course is characterized by the predominating gastric symptoms, while in catarrhal fever the affection of the respiratory apparatus is most marked. In catarrhal fever the organs are only slightly involved, whereas in animals suffering with rinderpest they are greatly degenerated.

2. *Mycotic enteritis*, when the intestinal infection predominates. Here are noted, however, the absence of marked depression symptoms and changes in the mucous membranes of the head.

Judgment.—The meat is not injurious to man as food. It may, however, have to be condemned in advanced cases on account of the occurring emaciation and the objective changes in the meat (increased blood contents, etc.). In any case, the meat is always to be considered impaired in nutritive value.

[According to B. A. I. Order 150, Regulation 13, section 9, carcasses of animals affected with malignant epizootic catarrh and showing generalized inflammation of mucous membranes shall be condemned.]

11. Necrotic Stomatitis (Diphtheria) of Calves

Diphtheria of Calves.—Diphtheria of calves is not related to diphtheria in man, and occurs comparatively infrequently as an infectious disease with rapid course of development, characterized by the appearance of croupous-diphtheritic changes in the mucous membranes.

Pathogenesis.—The exciting cause of the disease is the necrosis bacillus (Bang), which appears in motile rods (1.8-2.4 μ long, and 0.6 μ wide), and also in threads. Without doubt the bacillus gains admission through wounds or abrasions, whereupon it effects its further action by way of the blood. Sepsis may be associated with the course of this affection.

Symptoms and Lesions.—The clinical symptoms are similar to those of foot and mouth disease, but in addition, cough, difficulty of respiration, and diarrhea occur. Pathologically there are noted in advanced cases croupous-diphtheritic ulcers on the mucous membrane of the mouth, pharynx, larynx, trachea, stomach, and intestinal canal, pneumonic areas, and also cloudy swelling of the internal organs.

Recognition of necrotic stomatitis of calves is based on the above-mentioned findings, which are not likely to be mistaken for anything else, unless it be foot and mouth disease.

Judgment.—If the animals are slaughtered in the early stages, the meat may be considered as of *impaired value*, later it becomes unfit for food on account of rapid emaciation and general constitutional symptoms, which produce such changes as to unfit it for food. The latter is also the case when sepsis has occurred.

The passing of a carcass for food after condemning the diseased parts is possible in Germany, as the animals are not usually slaughtered until general constitutional symptoms have set in.

[In accordance with meat inspection in the United States, carcasses of animals with necrotic stomatitis may be passed if the lesions are only

local in character; if there is indication of toxemia, associated with emaciation, the carcasses should be condemned.]

12. Diarrhea or Dysentery of Calves

White scours of calves is an infectious intestinal inflammation, which may occur also in other sucklings and sometimes appears enzootically.

Pathogenesis.—The exciting agents of dysentery, according to Jensen, Poels, and Joest, are bacteria belonging to the colon group, which are facultatively pathogenic and enter the blood from the intestinal tract, producing general infection with special localization in the intestinal canal.¹

There is nothing particular to be said about the clinical symptoms. Pathologically there is emaciation, anemia, reddish blurred injection of the mucous membrane of the abomasum and the entire intestinal tube, swelling of the mesenteric glands, and subserous hemorrhages, the musculature being flabby, lusterless, and of a muddy red color.

With the aid of a microscope recognition of this disease is readily accomplished.

It is apt to be mistaken for—

1. *Acute Gastric and Intestinal Catarrhs*, in which, however, the course is milder, and in which the signs of blood infection are lacking.
2. *Diarrhea of Septicemia and Pyemia*, whose other symptoms, however, are usually easy of recognition.

Judgment.—When the calves are slaughtered early in the disease their meat may be permissible as food, though being rated as of *impaired value*. If a general infection had already set in, the meat will have to be declared *unfit* for food, on account of the possibility of its being dangerous to health. Inasmuch as the bacteria are found in the blood and rapidly multiply in the carcass (Ostertag), caution is imperative from the well-known fact that the varieties of the coli bacteria may assume marked pathogenic properties.

[Inasmuch as white scour in calves represents a general infection and since the disease is usually associated with general debility and emaciation, therefore carcasses thus affected are condemned in the Federal inspection service.]

13. Distemper and Influenza of Horses

Diseases of horses coming under this classification do not require special notice here since they do not necessitate slaughter of the animals, because the diseases in question either run a mild course or cause death in severe cases, not bringing into question the possibility of emergency slaughter. If such an exceptional case should arise, however, judgment of the meat will not be difficult, when it is borne in mind that septic or pyemic infections may complicate the course of distemper, influenza, and pneumonia of horses.

[¹ Nocard, Mettam, etc., consider the cause of this disease to be a pasteurellose.]

7. Intoxications and Autointoxications in Slaughtered Animals

A. Poisoning

Poisoning of slaughtered animals is only of importance from the point of hygiene of the meat when changes have occurred in the flesh as a result of the toxic action of the poison, or when the meat itself has been poisoned.

As a rule, poisoning in slaughtered animals is rare. Still the owners of the animals frequently consider some diseases as such, since the layman is inclined to view all suddenly occurring affections as due to this cause. Poisoning is usually accidental, the poisonous substances being ingested with the food or while searching for food; or they may be the result of improper administration of drugs.

Regarding the clinical symptoms and pathology of various poisonings in living animals, text-books on toxicology must be referred to as only general remarks may be indulged in here with regard to the findings in the slaughtered animals. The following groups of intoxication are to be differentiated:

1. Poisons which exert a pronounced local effect and those which primarily affect the parts with which they come in contact are relatively easy of recognition. To these belong among others, caustic, acids, alkalies and salts; phosphorus, arsenic, catharadin, and also insect and snake venom. Marked inflammation, swelling, hemorrhages, and eschars, especially in the digestive tract and on the skin, occur at the points of contact with the poison, but the main effect of the poison is usually secondary and is to be sought in disturbances of function of the more important body organs.

2. Some of the blood poisons combine with the hemoglobin of the red cells (carbon monoxid, hydrocyanic acid, sulphuretted hydrogen) and reduce their functional power as carriers of oxygen; while others (nitrites iodine, potassium chlorate, pyrogallol, picric acid anilin, carbon bisulphide and others) destroy the red cells and form methemoglobin. As a result the blood will appear light-violet to cherry-red and even chocolate-brown in color. These changes may not be marked, however, if the animals have been slaughtered early on account of the serious effect of the poison on the central nervous system. Urine of a red to dark-red color will doubtlessly be present in severe intoxication by poisons of the latter group.

3. In nerve and heart toxins, anatomical changes as a rule are not demonstrable, in spite of extreme nervous irritation or paralysis.

For the purpose of meat inspection, another group might be added to the three foregoing—

4. Those which develop marked odor and thereby reveal their presence in the slaughtered animal, such as chloroform, ether, alcohol, petroleum, chloral hydrate, camphor, ethereal oils, phosphorus, carbolic acid, etc. The effect of these drugs would be similar to one of the three classes already mentioned.

As recognition of poisonings and their essential causes may be quite difficult in certain instances, it will be possible to establish only a probable diagnosis in many cases, unless an exact chemico-analytical examination is made. The latter would rarely be practicable for purposes of meat inspection on account of the amount of time required, and may then fail in some cases.

The judgment of this class of food animals is dependent upon the separation of the meat proper in its narrow sense from the viscera. Of the latter, the stomach and intestinal canal will always have to be condemned as dangerous to health. It has been shown that the other viscera are harmless in a number of instances, while in doubtful cases, however, it is necessary to consider the nature of the poison and the probable course it pursues in the organism. In one case the udder of a cow was found dangerous to health, the animal having been fed large quantities of veratrum album. In subcutaneous administration of poisonous substances, the site of injection and its vicinity, as well as the associated lymphatic apparatus up to and including the nearest lymph glands, are to be removed.

Careful observations by Fröhner and Knudsen lead to the assumption that meat in "medicinal treatment of an animal with any drug, cannot result in becoming dangerous to health," and what holds good for the medicaments of powerful action as the result of experimental and observational research applies also to other poisonous drugs.

Whether the meat is of reduced or impaired value in case of an animal slaughtered on account of having been poisoned, depends on the associated conditions or circumstances and the nutrition of the animal. We may, of course, preclude here that consumers will be prejudiced against meat of this class. The value of it is *below par* as soon as odorific poisons have given the meat an abnormal odor. (See boiling test, page 137.)

Meat of poisoned animals is always to be considered unfit for human food whenever a nauseating or loathsome odor is present, when septic infections are present, or when marked changes in the meat (emaciation, serosity) occur associated with poisoning.

[The judgment of this class of food animals in the United States is carried out on the same principles as those followed in Germany.]

B. Autointoxications

Autointoxication designates the transition of toxic substances developed in the intestines (enterogen), or in the tissue (histogen), into the fluids of the body. The transition of such poisons is either caused by the presence of exciting or toxic metabolic products, by a physiological increase in their production, or as a result of their incomplete destruction. In the same manner the blood may also receive toxic substances in disturbances or suspension of the functions of certain organs.

1. Cholemia

The presence of the constituents of bile in the blood is, strictly taken, only a symptomatic condition, a well-marked manifestation of which consists in a yellow coloration of the tissues, called jaundice (icterus). The etiological classification of cholemic affections in catarrhal, hepatotoxic, and hematogenic icterus, is also to be considered from the standpoint of meat inspection.

Of the clinical symptoms, the yellow coloration of the mucous membranes is of importance in meat inspection, and also the condition, whether a considerable general affection is absent or present. In the latter case, severe organic changes are present, or an intoxication (lupinosis, phosphorous poisoning), or an infectious disease (sepsis, anthrax, swine plague, influenza), with its characteristic symptoms, is found to be the original cause. On the latter depends also the anatomical lesions which are thus associated with yellow discoloration of the tissues. This is not only noticeable to a high degree on the serous membranes, but also on all tissues and organs and shows also occasionally distinct greenish-color tints. In animals with normal white fat tissue the slightest degree of yellow coloration is also recognizable on the fat, but this must not be mistaken for the yellow coloration resulting from feeding, and the old age discoloration of the fat in cattle.

The *judging* of icteric animals should be carried out only in daylight. It is also to be remembered that slight yellow colorations may almost entirely disappear in a certain time after death, as a result of the reductive action of the body cells; therefore, slightly icteric carcasses are judged only after 24 hours. In severe forms of icterus with parenchymatous degeneration as a result of infections or intoxications, this is not necessary: In the latter case, the meat is spoiled in a high degree, and is unfit for human consumption. Otherwise, in cases which are pronounced icteric, the meat should be declared of inferior quality, while it may be passed if in 24 hours after slaughter the yellow coloration disappears, or if only a nominal discoloration remains.

[In accordance with B. A. I. Order 150, Regulation 13, section 19, carcasses affected with icterus and showing the characteristic yellow or greenish-yellow discoloration after proper cooling should be condemned, while those which lose the discoloration after cooling may be passed for food.]

2. Uremia

For the nature of uremia, the same statement applies which was mentioned above for cholemia. The occurrence of uremia in food animals is limited, with a few exceptions, to male individuals, in which the anatomical peculiarities of the urethra (S-shaped bending in ruminants and in hogs) favor this occurrence. The latter is principally the seat of obstructions with concrements, which as a result produce gangrene of the urethra or a rupture of the bladder. The absorption of the constituents of urine effused into the periurethral connective tissue, or into the peritoneal cavity, results in a uremic poisoning of the blood. Very rarely uremia may also develop as a result of an insufficient excretion of the constituents of urine, as for instance, in double-sided pyelonephritis of cattle, or in the presence of double-sided cystic kidneys.

Symptoms and Lesions.—The living animals show the known symptoms of *retentio urinæ*, which it is true, in indolent steers, is not very pronounced. After the resorption of urine, febrile symptoms, accelerated pulse, pronounced psychic depression, strong urinary odor of the expirations, uremic convulsions, and under certain conditions even subnormal temperatures are manifested. On the slaughtered animal and in the immediate vicinity of the carcass pronounced urinary odor may be noted, which, however, is absent in fresh cases. Corresponding with the cause there may be found an infiltration of urine in the scrotal region, rupture of the bladder with peritonitis, or severe kidney changes. The muscles have a distinct uriniferous odor, which gradually becomes less marked with the increased cooling of the carcass; intermuscular hemorrhages may also be present.

Therefore in the examination of a cooled carcass in which uremia is suspected, the meat should be always subjected to a boiling test, during which the possible presence of a urinary odor again becomes recognizable.

The *judgment* should be made only after the cooling of the meat, and the employment of the boiling test. If during the latter only a very slight uriniferous odor is perceptible which occurs in fresh cases exclusively, the meat may then be passed for human consumption, but should be declared of inferior quality. In advanced uremia the odor of the meat becomes so intensely uremic on account of its highly spoiled condition that it must be condemned as unfit for human food.

[B. A. I. Order 150, Regulation 13, section 20, provides that carcasses which give off the odor of urine should be condemned.]

3. Hemoglobinemia of Horses

The hemoglobinemia of horses, which is also designated as hemoglobinuria, azoturia, and lumbago, is usually a rheumatic affection. It probably results from an autointoxication of myogenic origin, in which the muscular coloring matter which is identical with hemoglobin is present, as well as other transformed products of the existing parenchymatous myositis, which penetrate into the blood and act destructively upon the erythrocytes.

Of the clinical symptoms, there are especially conspicuous the well-known dark red to dirty brown and black coloration of the urine, and the paralysis-like weakness of the hind-quarters. Mucous membranes are highly congested and show a dirty discoloration; the temperature, on the other hand, is usually only very slightly elevated. In the slaughtered animal the blood is of a varnish color and tar-like; edematous swelling and pale coloring of the psoas and croup muscles, as well as of the quadriceps femoris, may be noted as a result of parenchymatous myositis. Secondary lesions are: Swelling of the liver and spleen, infiltration of the red bone-marrow, parenchymatous nephritis, and hemorrhages in various organs. In cases of longer duration, septic lesions may be present as a result of decubitus gangrene.

Judgment.—The meat of horses slaughtered in the early stages of this disease may be passed for food. Later, insufficient bleeding and muscular changes render the meat unfit for human consumption on account of the highly spoiled condition.

[Hemoglobinemia of horses is at the present time of no interest to meat inspection in the United States, inasmuch as horses are not included as food animals in this country.]

According to Schlegel's investigation, another more rarely occurring infectious hemoglobinemia of horses has to be mentioned, which he designates as an infectious spinal meningitis, caused by the streptococcus melanogenes. The later stages of this infectious hemoglobinemia pass off under the semblance of septicemia.

4. Parturient Paresis

Parturient paresis (parturition fever, calf-fever, milk-fever) is observed principally in cows; more rarely in goats and hogs. While this affection until recently was considered as an autointoxication in which the udder was supposed to be the place for the development of toxins (Sonnenberg), recent publications (Meier, Gebauer, and others), and

especially the beneficial results following the air treatment of this disease, make it apparent that the affection is the result of a circulatory disturbance in the brain. It is possible, however, that both causes must be given consideration. The disease appears, as a rule, in 12 to 48 hours after parturition; it however has been observed before that time.

The conspicuous symptoms in the living animal are characteristic manifestations of depression and paralysis. If these have advanced to a certain degree the animals will lie with their legs half way bent or stretched out, and their heads turned to the side, resting on the thorax. At the same time there are present somnolence, ptosis, absence of skin reflexes, paralysis of the muscles of the tongue and pharynx, and salivation. As a result of the paralysis of the muscles of the stomach, intestines and bladder, flatulency and retention of urine develop. The body temperature is unevenly distributed; the internal temperature is slightly elevated only in the beginning of the disease; later it is normal or subnormal.

On the slaughtered animal the findings are principally negative. The uterus is usually strongly contracted and without abnormal contents; the abdominal viscera are frequently highly injected, while insufficient bleeding will be noted in delayed slaughter.

The recognition of this disease in the living animal is very easy. Nevertheless a careful examination is necessary in order to determine the possible presence of other puerperal affections (sepsis), special attention being paid to the absence of high fever and to whether there is tenesmus or indications that the animal was given cold water enemas. On the slaughtered animal the diagnosis has to be made by the exclusion of other diseases and by giving consideration to the history of the case. First of all, the attention should be directed to the absence of inflammatory changes in the uterus and the genital organs, as well as to the characteristic lesions of sepsis.

Judgment.—The meat of animals which are slaughtered on account of parturient paresis is not injurious to human health. In early slaughter and in well-nourished animals there is sometimes no ground for condemnation. Delayed slaughter renders the carcass inferior in quality on account of the greater blood content of the meat. The carcass will have to be condemned when complications with sepsis are present, or when marked substantial changes of the meat or otherwise severe internal affections are present. If an infusion of iodide of potassium or iodide of sodium were made into the udder, which may transmit a peculiar stale odor and taste to the meat (boiling test!), it should be always condemned on account of its repulsiveness. Owing to the repeated administration of

strong-smelling remedies (camphor, turpentine, ether, and others), their absorption by the meat should be thought of and the boiling test applied (see page 137):

[In accordance with B. A. I. Order 150, Regulation 13, section 25, carcasses of animals showing symptoms of milk-fever at the time of slaughter should be condemned, which action is based not only on the changes of the meat relative to its consistence, color, etc., but also on the present view of the pathology of the disease, which suggests an auto-intoxication.]

VIII. Post-mortem Changes of Meat

The first changes of the animal tissues after death are of a physico-chemical nature, such as appearance of coagulation, changes of color, changes in reaction. The appearance of coagulation is most distinctly marked in the stiffening of fat in fat cells, and in the coagulation of myosin in striated muscles. The latter is probably brought on by acid formation in the muscles, and rigor mortis is the result. The muscles thus obtain an acid reaction, a condition which is designated as a simple souring of meat by W. Eber, who was the first to bring under a certain system the decomposition processes of meat. To this is added the sour fermentation which may occur in two forms:

1. Fermentation Processes in Meat

A. *Simple sour fermentation* begins with rigor mortis and produces the so-called "ripening" of the meat. The latter becomes more tender, appears more juicy and gradually loses the quality to take up a bright scarlet-red color on the cut surface. The cut surface then becomes light-brown to yellow. The odor of the ripening meat is sourish—aromatic. Later, traces of formation of hydrogen sulphide (*haut goût*) may develop (W. Eber, Glage) as a result of the sulphur compounds present in the meat.

The nature of ripening of meat consists, according to recent investigations (Salkowski, Jacoby, M. Müller, Vogel), in fermentation processes, which may be designated as an auto-digestion (Salkowski); or autolysis (Jacoby, M. Müller), also as a physiological destruction of the meat (Glage).

B. *Stinking sour fermentation* occurs in meat which could not cool out. Thus it appears in game which is tightly packed together while still containing body heat, or in meat of slaughtered animals if it is piled up without being sufficiently chilled. The condition is designated in game as "overheated;" in meat, as "suffocated."

[This condition is termed "sour side" in the United States, and is produced by hanging the sides too close to each other in the cooler, thus preventing the proper circulation of cooled air between them; and also by too sudden chilling of the carcass, whereby insufficient time is given for gradual disappearance of body heat.]

In game the hair can be pulled out by the handful from the skin, the subcutis is colored green, and the cut surfaces of the copper-red-colored

muscles change in the same way; gas cysts may appear. The last two changes are also observed in pieces of meat of food animals. The stinking products contain large quantities of H_2S . The determination of fermentation processes is not difficult by these described changes. The presence of an acid reaction is necessary, and the absence of ammonia (see Demonstration of Putrefaction).

Judgment.—While meat in a state of simple sour fermentation is suitable for human consumption, as a matter of fact it is designated in that condition as "table ripe;" on the other hand, meat showing the slightest trace of stinking sour fermentation should be considered highly spoiled, and be condemned, as injurious to health.

[The above judgment applies also to meat inspection in the United States (see B. A. I. Order 150, Regulation 19, section 1)].

2. Putrefaction of Meat

Putrefaction of meat is a parasitic decomposition, which by adequate treatment, curing or preserving, may be checked. On the other hand, it is above all superinduced by heat and moisture. The last two factors facilitate the growth of putrefactive microorganisms.

Nature and Development.—Obligatory anaerobic bacteria come into consideration as agents of putrefaction, especially the bacillus putrificus (Bienstock), bacillus edematis maligni (page 292), bacillus gangrenæ emphysematosæ (page 312), for whose existence and development satisfactory conditions are produced on the surface of the meat through abstraction of oxygen by the aerobic bacteria. Of the aerobic bacteria in putrefactive meat, there may be found staphylococci, bacterium coli, species of proteus (Fig. 142 and 143), and bacteria, which greatly resemble the bacillus enteritidis Gärtner. The bacillus paraputrificus Bienstock, retards putrefaction.

The action of putrefactive micro-organisms consists in the decomposition of albuminous bodies and gelatinous substances, which are broken up under the formation of gases of a disagreeable odor. The freer the supply of oxygen to the putrefactive meat, the quicker and more completely decomposition progresses (rotting). With an insufficient supply of air, a stinking putrefication develops. As end products of putrefactive decomposition there develops, according to Gotschlich:

1. Gases (CO_2 , CH_4 , H_2 , N_2 , NH_3 , H_2S);
2. Fatty acids (formic, acetic, butyric, valerianic, palmitic acid);
3. Oxy—and more basic acids (lactic—succinic—oxalic acid);
4. Various other substances (amines, amides, amido-acids, leucin, tyrosin, aromatic acids, indol, scatol, peptone, ptomaines, toxins).

Toxins appear to assume the properties of strong poisons only in the presence of a free supply of air (Nielson).

Lesions.—Putrefaction as a rule begins on the surface of meat and penetrates the deep parts, following the course of the connective tissue. The muscle fibers proper resist putrefaction for some time. Meat of ani-

mals which had febrile affection, or that of insufficiently bled animals, putrefies quicker than flesh of healthy animals.

Stinking, putrefactive, malodorous substances do not necessarily appear, as was mentioned above, in all putrefactions; besides they vary considerably in accordance with the kind of meat. In putrid meat-sausages and salted meat stinking odors are sometimes entirely absent. Some of the putrefactive odors appear more pronounced in treating meat with acids or alkalies; some again are not influenced by such treatment. Marked changes of color (turning gray, yellow, green) are not always characteristic. Changes in the consistence appear noticeable only in advanced stages of putrefaction, and then the meat appears sloppy, smeary, porous. Alkalinity alone is no criterion of putrefaction, but it may be found always to be present in the same. Putrefactive toxins are very resistant against the customary methods of preparing meats, and cannot be even completely destroyed



Fig. 142

Fig. 142. *Proteus vulgaris*. From a pure culture. x 730 diameters. After Weichselbaum.



Fig. 143

Fig. 143. Colony of the *proteus vulgaris* with swarming processes. Gelatine plate. x 70 diameters. After Weichselbaum.

by ordinary boiling; they lose their poisonous effects after heating for $1\frac{1}{2}$ hours at 100° C., according to Scholl.

For proof of putrefaction, the changes of meat in relation to color, consistence, odor, taste, resistance, should be taken into consideration, but they may appear greatly varied, and their detection must depend to a large extent on subjective perception by the inspector. Besides, the bacterioscopic and bacteriological examination shows very large numbers of anaerobic and aerobic bacteria. The muscle fibers under the microscope appear cloudy and infested with bacteria; triple phosphate crystals may be present.

According to Marxer, meat should be considered as putrefactive if one gram contains over a million of organisms of any kind, or proteus bacteria in large numbers. W. Eber recommends proving the presence of free ammonia, which develops in meat in all putrefaction; and his putrefactive test (see below) is based upon this fact. In opposition to this, however, Glage claims that it cannot by itself be decisive for the demonstration of putrefaction, as the presence of ammonia is not an exclusively specific sign of putrefaction, and its development does not occur sufficiently early with the formation of toxins in the meat. Glage demands a bacteriological examination of meat which is in the act of decomposition by making smear-preparations, cultures, and animal experiments. However, this requirement which may be justified from a scientific standpoint, could be carried out in practice only with the greatest difficulty. In large pieces of meat, examination should extend particularly to the deeper layers of muscles, as putrefactions of the surface may be present without involving deeper parts.

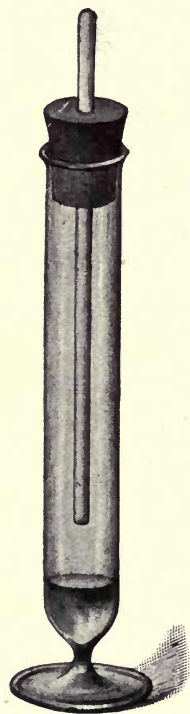


Fig. 144. Reagent glass for Eber's test for putrefaction.

Eber's test for putrefaction is based on the fact that when ammonia and hydrochloric acid vapors combine, gray to white sal ammoniac clouds form. For this test the following reagents are used: Acid hydrochloric, pur. 1.0, alcohol, 3.0, ether 1.0. Of this mixture, enough is poured into a 2 cm. wide reagent glass (Fig. 144) to cover its bottom to the depth of 1 cm. The glass can be closed by a rubber stopper, through which a glass rod is inserted, which almost reaches to the surface of the fluid. On the rod is placed a small sample of the material to be examined, or from the latter some of the juice is taken up by the glass rod. After the reagent has been shaken in the test tube, in order to fill the tube with the vapors of the hydrochloric acid the glass rod is set into the tube. The reaction varies in accordance with the quantity of ammonia, which is set free from the sample. There is a formation of gray, smoke-gray, or white clouds, which, starting at the sample, sink down to the surface of the fluid. Naturally no free ammonia should be present in the room where the examination is made; the sample to be examined should not be colder than the reagent glass.

This test is not applicable on pickled meats on account of the presence of trimethylamin.

Proof of the presence of hydrogen sulphate, which can be easily tested with a paper moistened in a 10 per cent. solution of nitrate of lead, cannot essentially support the diagnosis of putrefaction, as H_2S forms soon, even in fresh meat (Rubner, Glage).

The *judgment* of putrefactive meat which shows considerable perceptible changes is not difficult, as such would at once be considered highly

spoiled and unfit for human food. In general, it may be considered injurious to health, but this is not in direct relation to the intensity of the putrefaction. The nature of the causative agents of putrefaction enters into this question; also numerous unknown additional circumstances, and besides symbyotic processes of the concerned bacteria. Therefore, Eber's test alone cannot be sufficient for establishing the injurious properties of meat, but in general, it is only useful as a supporting diagnostic method for determining bacterial decomposition.

Judgment.—With reference to this condition, and in consideration of the significant poisonous properties of putrefactive toxins under various conditions (see Chap. X), precaution should be taken to withhold even slightly putrid meat from the market; however, from the standpoint of law its injuriousness to health cannot be positively asserted, which has also been considered as doubtful by van Ermengem. Therefore, in making decision it should be always with consideration of the forensic results. It is always advisable to declare meat with superficial decomposition of inferior quality, and at the same time the changed layers of the meat should be removed.

[In accordance with the regulations governing the meat inspection of the United States, meats which on reinspection show evidence of putrefaction should be considered unhealthful and therefore unfit for human food. (See B. A. I. Order 150, Regulation 19, section 1.)]

3. Mixed Processes in the Decomposition of Meat

Various kinds of fermentative and putrefactive processes may naturally develop simultaneously in the meat, and it is not always possible to characterize exactly their nature. Especially difficult is the demonstration of the presence of the exceptionally dangerous bacillus botulinus (page 364) in the meat either microscopically or bacteriologically. The judging in such cases has to depend principally upon the objective characteristics of the meat, and the unfavorable conditions should be always considered as decisive.

4. Other Microphytic Changes of Meat

A. *Mould* formation on meat is mostly the result of keeping it in damp, poorly ventilated rooms. Of the known mould fungi, the penicillium, aspergillus, and mucor species are especially apt to establish themselves on meat, the surface of which they cover with their white, gray, or grayish-green tufts, which may also proliferate into the slits, gaps, vessels and cuts of the meat (Figs. 145, 146, and 147).

Regarding the chemical changes of mouldy meat, the results of Butjagin's investigations contain the desired information.

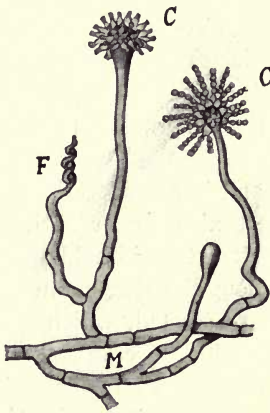


Fig. 145. *Aspergillus glaucus*. C, conidia chains; F, young eurotium-perithecium; M, mycelium. x 300 diameters.

B. The *phosphorescence* of meat in the dark is the result of an infection of its surface with phosphorescent bacteria. The organism which comes principally into consideration in this connection is bacillus (photobacterium) phosphorescens, which, according to Molisch, is the most widely distributed phosphorescent bacterium.

Matzuschita classifies the phosphorescent bacteria into two groups, one of which liquifies gelatine, while the other leaves it unliquified. To the first belong 4 species of the bac. phosphorescens: the bac. luminosus and the bac. cyaneo-phosphorescens; to the second, 6 additional species of the bac. phosphorescens.

According to Sacksland the phosphorescence bacteria are very resistant to high degrees of cold.

C. *Red and Blue Colorations of Meat.*—A spotted reddening of the surface of meat may be produced by an infection with various species of the bacillus prodigiosus.

This condition should not be confused with the diffused reddening of boiled meat which has already been mentioned on page 76, and which is produced by the action of nitrites and sulphites.

Superficial blue coloration of meat is produced by the *Bacillus cyanogenus*.

D. *Diverse Changes of Meat.*—Besides the above-mentioned microorganisms, the most varied microbes thrive on meat, the development of which is greatly favored by the suitable nutritive substance and by inadequate storing of the meat.

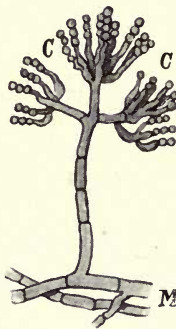


Fig 146

Fig. 146. *Penicillium glaucum*. C, conidia; M, mycelium. x 300 diameters.

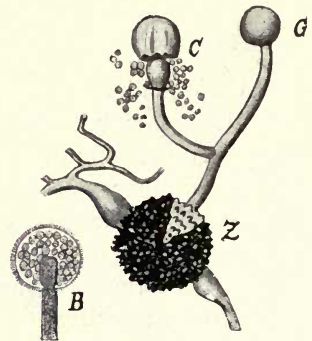


Fig. 147

Fig. 147. *Mucor mucedo*. C, bursted sporangium with conidia; G, closed sporangium; Z, germinating zygosporangium; B, carrier of conidia with sporangium in a schematic longitudinal section. x 300 diameters.

At this point there come into consideration the aroma bacteria (Glage), which belong to the ice bacteria, and which develop only on meat kept in cool places. They produce, besides ammonia, a fruit-like odor.

As the causes of some of the infectious diseases of man (typhoid, cholera, scarlet fever and others) thrive on meat, it should not be kept anywhere near a place where any such contagion exists.

In *judging* the changes of meat described in this section it should be remembered that they are principally of a superficial nature, and that they do not otherwise affect the meat to a disadvantage. If, therefore, no decomposition (putrefaction, stinking fermentation) accompany these conditions, mouldy or phosphorescent meat or meat showing colored spots is, as a rule, neither injurious to health nor spoiled; and after removal of the fungoid vegetation or washing with vinegar, it should be passed for food.

A declaration of inferior quality should be made only if the described changes are well marked. In the presence of moulds it should be remembered that meat might take up a mouldy taste and odor, which should be determined by the boiling test.

A highly spoiled condition, and with it an unfitness for food, occurs in the presence of marked mouldy taste and odor.

The red coloration of sardines is supposed to be injurious to health.

[Meats showing changes described above are judged in the United States on the same lines as in Germany; however, a declaration of inferior quality does not enter into consideration, and in such cases the extent of the changes decides whether the meat should be passed for food or be condemned.]

5. Insect Larvæ on Meat

During summer this condition may easily occur. The flies deposit their eggs or living larvæ on the meat, from which the fly larvæ (maggots) develop rapidly, sometimes within 24 hours. The following species especially come into consideration:

A. *Musca vomitoria* (blow-fly, muck-fly, blue-bottle fly). Stubby, cheeks black, red hairs, four black back shield stripes; rear of body steel-blue (Fig. 148).

B. *Sarophaga carnocia* (meat-fly). Slender; gray; rear of body checkered; three black back stripes; eyes red. Prefer putrid meat, and deposit living larvæ (Fig. 149).

The length of the latter on the first day is 1 mm., and every day it increases about 1 mm.

C. *Musca domestica* (house-fly), and

D. *Stomoxys calcitrans* (stinging-fly). Gray, resembling the house-fly, with horizontal stinging proboscis on the head. Back shield with

three whitish stripes. Lays eggs only exceptionally on decomposed meat; otherwise prefers horse manure (Fig. 150).

Besides these flies there is the *aglossa pinguinalis* (fat cockroach), which lays its eggs on bacon, and later these eggs develop into the 16-footed glittering brown caterpillar. This cockroach is reddish brown, has glittering wings, the front ones of which are covered with spots resembling cross-bands, while the hind wings have long fringes.

By keeping ham in bran or flour, it may become infested with the *tyroglyphus farinae* (flour mite).



Fig. 148



Fig. 149

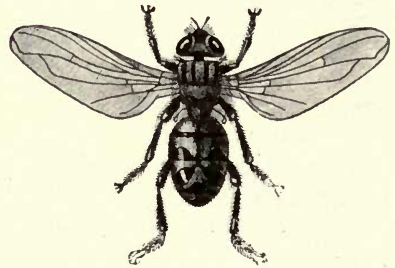


Fig. 150

Fig. 148. *Musca vomitoria*. x 2 diameters.

Fig. 149. *Sarcophaga carnaria*. x 2 diameters.

Fig. 150. *Stomoxys calcitrans*. x 3 diameters.

Judgment.—As the larvæ of flies may occur on the surface of perfectly fresh meat, their presence is not sufficient to claim that it is spoiled or of inferior quality. This, however, could be asserted and even total condemnation made if the maggots enter the meat. Be-

sides, the consistency of the meat has also to be taken into consideration in this decision.

[Judgment in the United States is the same as in Germany.]

6. Other Changes

A. In the soiling of meat during slaughter with urine, bile, intestinal contents, pus or ichor, it frequently happens that simple washing of the meat is not sufficient for their removal, and in such cases, especially in soiling with pus and ichor, the superficial layers of the meat should be removed.

Regarding contamination of meat with anthrax bacilli, see page 280, with pus-producing organisms, page 299. That tubercle bacilli may be transmitted to the meat by contaminated tools of butchers is possible, according to the investigations of Decker.

B. Absorption of odors may occur through unsuitable storing of meat. Especially are the odors from the following substances readily absorbed and retained: Carbolic acid, chlorine, turpentine, tar vapors, tobacco, and carrion. The corresponding odor and taste appear, as a rule, only after the meat is prepared; therefore a boiling test should be made in all suspected cases.

Sulphurous acid, according to Kickton, may occur in meat if it be kept in sulphurated rooms.

Carbolic acid can be demonstrated in meat by bromide water, which forms with a watery carbolic solution a yellowish-white precipitation of tribromide of phenol (Glage).

C. Metallic poisons may be transmitted to meat through unsuitably prepared storage containers (tin boxes, lead solder), or by machines for working up meat.

Judging of the above-mentioned cases follows in accordance with the cause itself.

D. Peculiar changes in color, the nature of which is yet to be determined, are shown occasionally in boiling apparently normal udders of cows. The entire substance of the udder, after boiling is completed, appears of a bluish, dark blackish-blue, or an ink-like color.

These changes are observed only after a certain time following slaughter, in the working up or during the culinary preparation of the tissue, and they are supposed to occur only in udders of older animals during lactation. Such changes cannot be determined, even after thorough examination of the organ in an unprepared condition.

While no injurious results to health, so far as known, have been observed from their ingestion, yet such changed udders should be condemned.

7. Souring and Rancidity of Fats

Fatty acids in large quantities develop in fats and in meats rich in fat when unsuitably stored, and produce a souring of the product. The causes for this lie principally in the influence of light and oxygen, which split the fatty acids and oxy-fatty acids from the fats, and possibly also from the action of fat-splitting micro-organisms.

Souring is usually accompanied by the development of rancidity, but the degree of souring is not in proportion to the acidity of the fat. The rancid odor and taste of fats are in connection with the formation of aldehydes and ketones, which originate from the glycerin. The formation of alcohol from lactose probably plays a part in this also.

Rancid odor may also be produced without any marked changes in the meat through infection with the *Bacillus botulinus*. However, in those cases souring of meat is absent, as the *B. botulinus* grows only on alkaline soil.

Souring and rancidity in meat containing fat is recognized by the characteristic changes in odor and taste, both of which may be designated as stinking and repulsive. The degree of acidity, that is the quantity of acid in fat, and its rancidity should be established by the chemist.

Judgment.—Rancid meat products should be declared of inferior quality, inasmuch as rancidity does not demand the total condemnation of the meat. No injurious effect to health from the ingestion of rancid meat has as yet been proven, and the same applies to free fatty acids.

If *Bacillus botulinus* is the cause of the rancid changes, then the meat is always injurious to health (page 365).

[There is no standard adopted in the United States by which the rancidity of meat and fat is judged. The condition, taste, and odor are the guides by which the dispositions are made.

Fats are looked upon with suspicion if they contain over $1\frac{1}{2}$ per cent. of acidity, and when in such cases there is also a marked rancid taste and odor they are considered as unfit for food.]

IX. Examination and Judgment of Prepared and Preserved Meats, as Well as Chickens, Game, Fish, Amphibia, and Crustaceans

1. Preserved and Prepared Meat

The properties of the meat to be discussed in this section, as well as the manner of obtaining it, has been amply discussed in Chapters I and III. For examination and judgment of such meat in general, all the principles apply which have already been described in the previous chapters. Therefore, only those essential characteristics will be mentioned in the following discussion, which deserve special significance for the kind of meat belonging here.

A. Ground Meat, Sausages, and Meats Prepared by Culinary Methods

The composition and ingredients of ground meat and sausage, also of culinary prepared meat preparations when they consist of small pieces, are difficult to determine.

The addition of starch flour may be quite easily established by treatment with tincture of iodine or Lugol's solution. It is best to boil a small piece of the sausage, etc., in water, and then to the cooled decoction add Lugol's solution. While smearing the cut surface of sausage with iodine solution also discloses the blue coloration developing from the presence of starch flour, yet in these cases the occurrence of single blue dots (starch from spices) should not be considered as intentional addition of starch. As is well known, the starch granules can also be easily recognized microscopically. The quantitative determination of the addition of starch should be trusted to professional chemists.

Testing for mixtures of egg albumen and gum tragacanth ("albumina") (page 72) should also be left for the chemist.

Regarding the tests for horse meat, see pages 66 and 69.

Trichina and measles are the principal parasites which should be given consideration. While microscopic examination of presumably pieces of pork might disclose the presence of trichina, such an examination will always remain incomplete for easily understood reasons, taking into con-

sideration the comminuted masses of meat. This should be also considered in delivering an opinion. The examination for measles is very circumstantial and uncertain.

Regarding the occurrence of coloring materials, a striking red color of the ground (chopped) meat indicates mixing with sulphurous acid salts. In the presence of a superficial red coloration of boiled or roasted meat, the nitrate action on the muscle-coloring matter mentioned on page 76, should be remembered.

Coloring of sausages with artificial materials (page 73) is suspected when the fat pieces present show a red coloration on their peripheries. For the demonstration of artificial coloring matter, the following method will be found satisfactory:

Two lots of ground meat each containing 20 g. are heated for $\frac{1}{2}$ hour in a water bath with occasional shaking: the first

(a) With 40 c. c. of a slightly acidified mixture of equal parts of glycerin and water: the second

(b) With 40 c. c. of a 4 per cent. aqueous solution of sodium salicylate; then it is pressed and filtered. If one or both filtrates show a red color it is evident that artificial colorings are present. In the presence of carmine in the filtrate a, following an over-saturation with an ammoniac solution and addition of alum solution after a few hours standing in a glass cylinder, a red stained deposit on the bottom of the container can be seen. For the demonstration of coal-tar colorings a thread of raw cotton is boiled with a part of the stained extract and with 10 c. c. of a 10 per cent. potassium sulphate solution for a considerable time. In the presence of coal-tar coloring the thread turns red and retains that color, even after washing in water.

Examinations for spoiled conditions and decompositions should be made according to the instruction given on page 330. Spoiled sausages have mostly a smeary appearance, and show a cyst formation under the covering, which is brittle and separates readily from the sausage filling. Blood sausage, after it is spoiled, shows on its cut surface a pale red color; the odor is sour, and the fat areas appear yellowish-green. The cut surface of liver sausage reddens after being spoiled, and very soon emits a sour odor. Jelly sausages turn soft, friable, smeary, sour, and stinking. Meat sausages appear, according to their water contents, of a uniform gray, grayish-green, or reddish-yellow color, with a discoloration of the fat.

All sausages which are rich in carbohydrates putrify under certain conditions very rapidly and strongly. Furthermore, all other manifestations of putrefaction, taste, mold formation, etc., should be considered.

Shilling undertook investigations in regard to the contents of dirt in sausage coverings, by examining fresh intestines which had been cleaned in the usual way. He found that each meter of

Hogs' small intestines weighing 2.16 g. contained 0.330 g. dry substance.

Hogs' large intestines weighing 4.98 g. contained 0.530 g. dry substance.

Cattle small intestines weighing 2.47 g. contained 0.275 g. dry substance.

Cattle large intestines weighing 5.00 g. contained 0.666 g. dry substance.

The considerable amount of dirt in the large intestines is caused by the number of deep folds.

Meat sausages, the filling in which has a gray border, or which has entirely turned gray (page 73), should not be considered as spoiled without further thought, but they should be examined for characteristic signs of fermentation and putrefaction.

Rancidity (page 335) should be determined by taste, which is sharp, harsh, and consequently disagreeable. The exact test for rancidity should be made by a chemist, who should also establish the degree of acidity.

The *judging* of deviations mentioned here is made according to previously developed principles with regard to the spoiled condition and the presence of parasites.

Regarding the admissibility of starch flour in making sausages, and the addition of so-called albumina, see page 72.

Von Raumer demands punishment for adulteration when binding substances are used. Sausage prepared with 1 per cent. of binding substance contained 53.075 per cent. water; with 4 per cent. of such substance, it contained 58.08 per cent. of water, compared with 43.33 per cent. of water in sausage without binding substances.

The coloring of sausage filling, but not of casings, is prohibited throughout the German Empire. The same applies to the use of sulphurous salts and borates. If colored meat products, etc., containing the above-mentioned substances are offered for sale they should be confiscated.

[In accordance with the regulations governing meat inspection in the United States only such coloring matters as may be designated by the Secretary of Agriculture as being harmless may be used, and these only in such a manner as the Secretary of Agriculture may designate.

The use of chemical preservatives with the exception of salt and saltpeter, as well as the addition of potato flour in sausage filling, is prohibited, while cereals and water may be only used in moderate quantities. (See B. A. I. Order 150, Regulation 22, sections 1 and 2, and Regulation 23, section 3.)]

Regarding the consistence of sausage filling, the methods characteristic to the various localities and described on pages 71-75, are decisive. The working up into sausages of testicles, uteri, fetuses, and cattle skins, is to be judged as an adulteration.

B. Meat Preserved by Physical Methods

In canned preserves (page 79) examination should at first determine whether they are spoiled, which can be accepted when the contents of the container can be shaken. Bulging of the otherwise concave bottoms of the cans also indicates accumulation of gases within the can, as a result of putrefaction. If the gases were present, but had been removed, then on the bottom of the can double soldering places will be found, together with a movableness of the canned contents.

If a can with shakeable contents had been exposed to heat, it should be allowed to cool, as the jelly in the cans liquifies at 26° C.

According to Pfuhl and Wintzen, the cause of bulging in canned preserves may be also due to an insufficient soldering of the containers. The formation of hydrogen and the separation of ferrous phosphate stand in direct relation to each other, and are traceable to the action of the organic acid contained in the bouillon on the iron of the walls of the container, and to the following secondary processes:

As soon as decomposition sets in it is found on opening the can that the jelly is liquified, of a disagreeable odor, and that corresponding changes have occurred in the pieces of meat. But even without decomposition, the liquifying of canned jelly is a suspicious sign and makes a more careful examination necessary (bacteriologic, boiling test, etc.). It should also be examined for adulterations, prohibited additions of chemicals and a content of inferior quality in the cans (gelatinous admixtures).

Suspicion of lead salts in canned material as a result of a considerable content of lead in the pewter used for soldering requires chemical examination.

The examination of frozen meat, to be done accurately, should be undertaken only after thawing it out in the usual way (page 147). Such meat appears softer and more moist; also the red blood corpuscles on microscopic examination can be distinguished from those of meat not frozen, inasmuch as they are discolored, deformed and swim in a greenish serum.

The latter contains the hemoglobin in the form of irregular yellowish-brown crystals.

The *judging* of frozen meat, and also of canned meat, is carried out in accordance with the general principles. In spoiled canned meats there is always a suspicion of harmfulness to health; wherefore they should be declared as unfit for consumption (see Meat Poisonings, Chap. X). Adulterations, to which should also be added the gelatin containing admixtures, render the canned products of inferior quality.

[In accordance with B. A. I. Order 150, Regulation 23, section 2, the contents of defective or leaking cans should be condemned unless the

repairing or repacking is done within 6 hours of the time of original sterilization. If the contents show a spoiled condition they should always be condemned.]

C. Meat Preserved with Chemical Substances

1. Pickled Meat

Regarding the occurrence of decomposition in pickled meat, the consistence, surface, and condition of brine, and of the meat near the bones, and the larger tracts of connective tissue should be especially considered. Regarding the examination for measles, trichina, and other diseased changes, nothing further need be said here.

The iridescence of cooked, pickled, or smoked meat on the cut surfaces is the result of deficiency in muscular coloring matter (Legge), and is otherwise unimportant.

For testing of common salt in the deeper portions of the meat, dotting the cut surface with 10 per cent. solution of nitrate of silver serves satisfactorily and causes a thick white precipitation to form. A better test for determination of thorough pickling is Glage's method, which is described in the following:

(a) Preparing the reagent; 100 c. c. of a 2 per cent. nitrate of silver solution is shaken with 23 c. c. of normal ammonium hydrate. Then more of the later reagent is added drop by drop until the precipitate which develops has disappeared and the solution is as clear as water. An excess of 40 c. c. of normal ammonium hydrate is then added and the solution is diluted to 200 c. c. by the addition of distilled water. This solution should be kept in yellow bottles, each containing 20 c. c.

(b) Method of performing the test: From the center of the meat a piece the size of a hazelnut is taken and placed in a test tube with 20 c. c. of the solution and thoroughly shaken several times. If a white precipitate develops, which in daylight rapidly turns black, it is an indication that the meat is salted through; otherwise it is fresh.

For determining the presence of saltpeter in pickled meat the brucin reaction is the best, by which the presence of saltpeter can be determined in a dilution of 1 : 100,000, according to Simon.

Several small cut pieces of meat are soaked out in the reagent-glass, with a few cubic centimeters of water. One or two drops of this solution are placed, by means of a glass rod, into a white porcelain dish, to which 2 drops of a brucin solution is added (brucin is shaken with aqua distillata, so that only a small quantity of brucin remains undissolved). To this are added 5 to 10 drops of concentrated sulphuric acid, which must be free from nitric acid. The solutions are then allowed to flow together. A pink coloration will develop in the test solution, the intensity of which depends on the quantity of saltpeter present.

If there is a suspicion of the presence of boracic acid, the following test will prove satisfactory for the demonstration of boracic acid and its salts:

Thirty grams of ground meat is well mixed with 5 c. c. of a saturated sodium carbonate solution, dried and ashed in a platinum dish. The ash thus obtained is dissolved in a small quantity of sulphuric acid, and with the latter a strip of carcum paper is moistened, which is then dried on a watch glass at 100° C. If in this process the carcum paper shows a red coloration on the moistened part, which changes into a blue by an addition of a drop of a sodium carbonate solution, the presence of boracic acid is proven.¹ The remaining portion of the ash solution is made alkaline and evaporated. The residue is then slightly acidified with hydrochloric acid, the solution is placed in a Woulff's flask, mixed with methyl alcohol, and hydrogen passed through the solution. The hydrogen, when ignited, in the presence of boracic acid, burns with a green-bordered flame.

If the meat is treated with the salts of sulphuric acid, sulphurous acid, or their salts, their presence may be best determined by Kaemerer's method, which is best adapted according to Edelman, Meyer, and Strauss for a quick qualitative test of sulphurous acid and hyposulphites in meat. It is as follows:

The sample to be examined (fine-cut meat) is placed on iodide of potassium starch paper, which is prepared with iodide of potassium. The meat is moistened with dilute sulphuric acid (1:8), whereupon the presence of dinatrium sulphite or sulphurous acid, a deep brown ring develops around the meat sample, as a result of the formation of iodide of starch.

While salicylic acid is not employed in the preservation of canned meat, it is used occasionally, however, for the preservation of fresh meat. The test is made as follows:

Fifty grams of ground meat is macerated in 200 c. c. of a 1 per cent. sodium carbonate solution; then it is heated to a boiling point, acidified with hydrochloric acid, and after adding 5 g. of sodium chloride it is squeezed and filtered. The filtrate is then mixed with a sodium carbonate solution until a slight alkaline reaction is obtained. It is then evaporated to 30 c. c., and if necessary it is again filtered. The liquid is acidified with sulphuric acid and mixed with an iron chloride solution. A violet coloration indicates the presence of salicylic acid.

Although formaldehyde is not adapted for the preservation of meat on account of its disagreeable odor and taste, the method for its determination should be indicated:

¹If this test is carefully executed with reliable carcum paper it is decisive, and the test by other methods may be omitted.

Thirty grams of ground meat is placed in a flask with a capacity of about 500 c. c. to which is added a mixture of 200 c. c. of water and 10 c. c. of an aqueous 25 per cent. solution of phosphoric acid. After a $\frac{1}{2}$ hour's standing 40 c. c. of this quantity is distilled, 10 c. c. of the distillate is mixed with 1 c. c. of a fuchsin solution, which has been discolored by sulphuric acid. The presence of formaldehyde causes a red coloration. If the latter does not appear it does not necessitate a further examination. In case of a positive reaction of the test described above, the remaining portion of the distillate is mixed with an excessive quantity of ammonium hydrate solution and is then evaporated. In the presence of formaldehyde characteristic crystals of hexamethyltetramin will remain. These are dissolved in a few drops of water. One drop of the solution is placed on each of 2 object glasses and tested with both of the following reagents:

1. With mercuric chloride in excess immediately a crystalline precipitate develops; soon stars may be observed of 3 or more rays and later octohedra. The latter develop in large quantities in a concentration of 1:10,000, but also very distinctly in 1:100,000.

2. With mercuric potassium iodide and a small quantity of diluted hydrochloric acid hexagonal, pale yellow stars develop; they appear very distinct even in a concentration of 1:10,000.

The presence of formaldehyde can only be established as proven when the obtained crystalline residue shows the two reactions described above.

Tyrosin deposits may form on barreled livers, which are preserved in brine (Gröning). The surface of such livers, and the intima of the vessels of the liver, is covered with small roundish, millet-sized granules, which show a yellowish center, surrounded by a narrow, whitish-gray zone. On section, such a liver appears mottled and sprinkled with white dots. Microscopically under large magnification and after clearing with glycerin, fine, light needles lying closely together in bundles may be seen radiating from the opaque, yellowish granules toward the periphery. A yellowish-green solution of the granules in nitric acid turns red on heating.

2. Smoked Products

In examination of smoked products for spoiled conditions the parts lying around the bones should be especially observed, as well as the larger connective tissue tracts and the consistency of the skin, if such is present. On account of the meat being more apt to decompose along the bones, it is a custom to introduce thin wooden sticks into hams in order to be convinced by the odor test of the good or spoiled condition of the respective meat layers.

[In the United States, the so-called "tester"—a sharp-pointed steel rod with a handle, is introduced toward the ham bone]

As a result of gas formation within the ham during pickling, small vacuoles may develop in the muscles (*caro porosa*).

Regarding the iridescence of smoked meat on the cut surface (salmon ham), see page 341.

The judging of meat products belonging to this section does not offer anything special. As the use of boracic acid, sulphurous acid salts, and formaldehyde is prohibited in the German Empire, all meat found on the market to be treated with these substances should be confiscated as unfit for consumption. For police or penal prosecutions of such offenders the preliminary tests mentioned should be supplemented by exact chemical examinations.

The iridescence and vacuole formations in meat are of no importance when other processes of decomposition can be excluded.

[The use of the above-mentioned preservatives is prohibited in the United States (see B. A. I. Order 150, Reg. 22, secs. 1 and 2)].

D. Various Conserve Preparations

Meat Extract (pages 41 and 91).—Decomposition and mould formation, which are easily recognizable, spoil meat extract and render it unfit for food.

Wilhelmy made investigations regarding the bacterial flora of meat extracts. The number of organisms, which principally occur as spores, is not very large.

Adulterations are only recognizable by a careful chemical examination.

The suspicion of the presence of horse-meat is excited when the extract is of a thick slimy consistence, has a fatty taste, and does not dissolve clearly in water. Broth made from such extract forms films on the surface like cream on milk, which repeatedly reappear after removal.

Lard and Cooking Tallow.—The principal adulterations are mentioned on page 92. Their detection, as well as the determination of the degree of acidity and rancidity (page 335), is only possible by technical examination.

For control of the fat trade, the Zeiss-Wollny refractometer is best adapted for ascertaining suspicious kinds and grades. This is also used for the examination of fat imported from foreign countries.

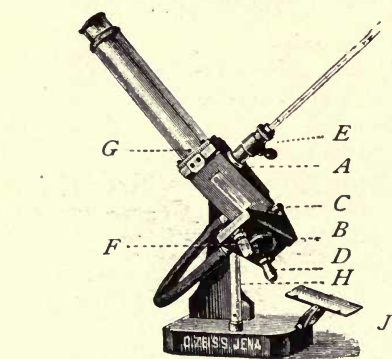


Fig. 151. Refractometer by Zeiss-Wollny in Jena. *A*, fixed half of the prism case; *B*, movable half; *C*, joint; *D*, nozzle for the attachment of a rubber tube for conducting warm water; *E*, nozzle for the attachment of a rubber tube for drawing off the warm water; *T*, closing pin for the prism case; *G*, opening for adjustment of the scale; *H*, supporter for *B*; *J*, mirror.

For examination of fats which are not fluid at ordinary temperatures, the apparatus must be brought to a corresponding high temperature and maintained there. This is accomplished through a warm water heating arrangement. The filtrated liquid fat is placed at the one-half of the prism case *B*, and the prism from

B is pressed against that of *A*. Then, through the ocular, the micrometer scale is observed on the inside of the tube, and the refraction thus observed is compared with the temperature as well as with the permissible value limits on a scaled table. Recently the apparatus has been improved by Wollny through a so-called indicator thermometer, the scale of which does not contain the temperature degrees, but it indicates the permitted value limits for butter and lard, so that by comparing the micrometer value and the thermometer degrees. it is at once disclosed whether the sample is suspicious.

If the examination with the refractometer indicates a conspicuous high negative (—) value, or a higher positive value (+) of more than 1.3 (+1.3) the fat should then be examined for an adulteration.

In various tallows—beef, mutton, and goat tallow—which appear on the market in a raw or rendered state only the preserved condition comes under consideration.

Tallow with an abnormal odor, and that which is changed in color, should be utilized only for technical purposes.

In the examination of fats the following principles should be observed:

1. In the presence of moulds, fungi, or colonies of bacteria, it should be determined whether these represent—
 - a An insignificant localized pollution from the outside (for instance, as a result of slight defects in the packing).
 - b A significant outside covering of the fat, or
 - c Proliferations in the inside of the fat.
2. In the judgment of the color, care should be taken to see whether the fat manifests a color which is not characteristic for that particular kind of fat, or whether it shows any perceptible foreign ingredient.
3. In the test for odor it should be examined for a rancid, tallowish, oily, sour, musty, mouldy, as well as for a putrid repulsive odor.
4. In testing for the taste, it should be established whether there is a bitter or a repulsive taste. Care should also be taken to detect foreign ingredients by the taste.
5. If a musty odor or taste is established the fat should be examined to learn if this originates from insignificant outside pollution of the fat or of the package.

Of the chemical examinations of fats it is deemed advisable to describe only the tests for foreign colorings and for adulteration with cotton-seed oil.

Test for Foreign Coloring Matter.—The presence of foreign coloring matter in fat is established by dissolving the melted fat in about double the quantity of absolute alcohol. In artificially colored fats the cooled alcoholic solution shows a pronounced yellow or reddish-yellow coloration.

For the demonstration of certain coal-tar colorings, 2-3 g. of fat is dissolved in 5 c. c. of ether, and the solution is thoroughly shaken in a

test tube with 5 c. c. of hydrochloric acid, which has a specific gravity of 1.125. In the presence of certain azo coloring matters the layer of hydrochloric acid which sinks to the bottom shows a distinct red coloration.

Test for Cotton-seed Oil.—In a corked flask, which is provided with an upright tube, 5 c. c. of fat are mixed with an equal quantity of amyl-alcohol and 5 c. c. of a 1 per cent. solution of sulphur in carbon bisulphide, and heated for 15 minutes in a boiling-water bath. If a coloration does not appear, 5 c. c. more of the sulphur solution are added and it is again heated for $\frac{1}{4}$ of an hour. A distinct red coloration of the solution is produced by the presence of cotton-seed oil.

If the above-described test indicates that the fat is adulterated with vegetable oils a test should be made for phytosterin.

The test for the demonstration of phytosterin should be carried out in the following way:

One hundred grams of the fat is melted in a water bath in a flask of about 1 liter capacity, provided with a return condenser, and the fat is then saponified over the boiling-water bath by adding 200 c. c. of an alcoholic potassium hydroxide solution, which contains 200 g. potassium hydroxide in 1 liter of alcohol (70 per cent.). After the conclusion of the saponification, which requires about $\frac{1}{2}$ hour, the saponified solution is mixed with 600 c. c. of water, and after cooling it is shaken out four times with ether in a separating funnel. For the first shaking 800 c. c. of ether is used, while for the three following 400 c. c. of ether is used for each; the solution is then distilled and the residue is again heated in a water bath for 5-10 minutes with 10 c. c. of the above alcoholic potassium hydroxide. The solution is then mixed with 20 c. c. of water, and after cooling is shaken twice, using 200 c. c. of ether in each shaking. The ether solution is washed four times with 10 c. c. of water, then is filtered through a dry filter and the ether is distilled off. The residue is placed in a glass dish and dried at 100° C. Then 2-3 c. c. of acetic acid anhydride is added, the dish is covered with a watch glass, and heated to boiling on a wire net for about $\frac{1}{2}$ minute. The excess of acetic acid anhydride is then evaporated off on the water bath. The residue is then crystallized 4-5 times from 1-1.5 c. c. of absolute alcohol, and after the third crystallization the melting point is determined for each crystallization. If the last crystallization product melts only at 117° C. (corrected melting point), or higher, the test for vegetable oil should be considered established.

Caviar.—In the examination of caviar mentioned on page 94, it should be considered in regard to color, consistence, odor, taste, neutral reaction, size of eggs, and foreign ingredients.

Adulterations are made with sago, oil, bouillon, white beer, and sometimes are very difficult to recognize.

Acid and rancid conditions in suspicious cases should be chemically determined, as should also suspiciously high, plain salt contents.

Putrefactive decompositions are evident in the presence of ammonia and hydrogen sulphide.

Judgment.—In the previously mentioned preparations, all decompositions should be judged in accordance with the degree; and if such be present in caviar, it is to be always considered injurious to health. A marked acid and rancid state, renders fat and caviar spoiled (inferior quality), and even unfit for food.

According to Niebel, the line between inferior quality and rancid caviar appears to be a 4.5 per cent. content of free fatty acid.

2. Examination and Judging of Fowls, Game, Fish, Amphibiae, Crustaceans, and Mollusks

The meat belonging in this section has been already mentioned in Chapters I and II, with reference to its origin and characteristics. As the conditions to be observed in the examination and judgment of such meat corresponds in general with those which were established for food animals in the narrow sense (page 134), it is necessary to mention only a few characteristics in the following:

A. Fowl

Domestic fowl should be examined in life, and also when slaughtered, after plucking. The slaughter wound should be noted in fowls which are brought to the market after being plucked.

The skin should not be discolored (bluish or bluish-gray, faded or shrivelled), and should not disclose cadaver spots.

Light, poorly nourished geese are occasionally inflated, according to Ostertag.

1. Age

Regarding the age of fowl, a distinction is made, as a rule, only between young and old; that is, whether it is under one year old or over. Niebel points out the following signs of age:

The domestic pigeon is considered young until the attainment of sexual maturity; but most unfledged animals (5-6 weeks) are usually sold as young. In very young squabs the breast appears white. Very soon it changes to a bluish-red, until it finally becomes blue-red. In very young pigeons the entire breast-bone is flexible; in young ones only the posterior end, while in old pigeons it cannot be flexed at all. A young pigeon possesses long yellowish down, the tail-feathers appear stemmed; that is, the shaft of the same on the lower end does not contain any feathers; the feet are closed. An older, full-fledged pigeon, has red-colored feet and no down. According to Cornevin, the bill for the first 6-8 months is soft, later becoming hard.

In very young domestic fowl the back portion of the breast-bone can be easily bent outward; in young fowls it breaks easily, and in old fowls, only when considerable force is applied. The breastbone keel bends sideways readily in young animals; in old ones it remains stable. The ischium and the os pubis can be pressed forward without breaking in young animals, while in old ones the latter occurs with a cracking sound. An old cock has a spur over 1 cm. in length, which in the young is correspondingly smaller. Occasionally spurs may be also met with in hens. Older hens have hard spurs and rough scales on the legs; the lower half of the bill cannot be bent at all with the fingers, as is the case with young hens.

In young guinea fowls the feather flag of the outside quill feather is pointed; in the old birds it is more or less rounded.

In turkeys the age is determined by the spur, and also by the above-mentioned appearance of the first quill-feather. This is also decisive in turkey hens, in which the rectum of old animals is also surrounded by a red ring. In a young domestic goose or domestic duck the trachea at the entrance of the thorax can be easily impressed; in the old it resists pressure. If a goose still possess yellow down, it is then at the most but 10 weeks old.

2. External Diseases

Of the external diseases of fowl, may be mentioned chicken-pox (epithelioma contagiosum), which preferably occurs in hens, turkey hens and pigeons, on the combs, wattles, corners of the bill, and also on the mucous membranes of the head and neck, and, according to Marx and Sticker, is produced by an ultramicroscopical filterable virus.

The comb-scab (tinea galli, chicken favus) and the leg-scab (dermatoryctes mutans), which leads to the development of the so-called lime feet (scaly feet), should be considered.

3. Internal Diseases

The numerous animal parasites occurring internally in fowls are, as a rule, of no importance for the veterinary inspector, except in severe infestations and cachectic conditions, thereby effecting changes in the meat. The connective tissue mite (symplectapetes or laminosioptes cysticola), however, deserves special mention, as it frequently produces in the subcutaneous and muscular connective tissue of chickens dull white or yellowish spots and nodules, up to the size of 1 mm., occurring frequently in very large numbers. The contents of these formations are otherwise granular, fatty or chalky. In severe infestations with this parasite the meat becomes unfit for human food; milder cases make it a spoiled (deficient) food. The air sac mite (cystodites nodus) lives in the neck, breast, and abdominal air sacs in chickens and pheasants, where they may cause inflammatory changes and necrosis. In invasions of the lungs and trachea, inflammation and dyspnea are observed. As a result of the numerous presence of *davainea mutabilis* in the intestines of chickens, cachectic conditions may develop (Ruther).

Of the specific infectious diseases of fowl, the following come under consideration:

(a) *Chicken cholera* is a septicemic affection which occurs in all domestic fowl, and spreads rapidly in an epizootic form.

The cause is the bacterium *avicidum*, which belongs to the group of hemorrhagic septicemia bacilli (page 316).

Symptoms and Lesions.—In the living animal the symptoms are not characteristic: Fever, dullness, difficulty in respiration, feathering bristled, and livid coloring of the comb in chickens.

Occasionally also there is sudden death without showing pronounced signs of illness. The anatomical findings consist principally in a hemorrhagic enteritis; hemorrhages under the serous membranes, epicardium, on the heart and in the lungs; infarctions of the muscles which in longer sickness may also degenerate.

The recognition of chicken cholera depends on the demonstration of the bacteria, which may be found in the blood of larger veins. In doubtful cases Kitt recommends the inoculation of blood into pigeons with the aid of lance prickings of the chest muscles. In case of chicken cholera, death occurs in 12-48 hours. Animals slaughtered in the last stage of the disease, which becomes conspicuous by the cadaver spots on the inside of the legs and on the lower portion of the abdomen, are, as a rule, not offered for sale.

Judgment.—As there is no danger to human health from eating these fowl, the degree of the disease and the condition of the bird decide whether it should be considered as highly spoiled and accordingly condemned, or after a previous boiling it should be admitted for consumption. The latter precaution is necessary from a veterinary police standpoint, for preventing the spread of bacteria.

(b) *Chicken pest* is an acute contagious, infectious disease, which almost exclusively occurs in chickens, very rarely in pigeons and waterfowl, and terminates fatally within 2 to 4 days. The cause is an ultra-microscopic filterable virus.

Symptoms and Lesions.—In the living animal there are noted dullness, lethargy, dark-red coloration of the comb and wattles, slimy discharges from the opening of the mouth, occasionally profuse diarrhea. The anatomical findings in quickly terminating cases may be limited to several punctiform hemorrhages on the pericardium, breastbone, and peritoneum. Otherwise there is a collection of mucus in the nasal and buccal cavities, pulmonary hyperemia, pericarditis, hemorrhages on the mucous membranes and under the serous membranes, intestinal catarrh, fibrinous exudate in the abdominal cavity, salpingitis, cloudy swelling of the liver, edema on chest and neck.

For the recognition of chicken pest it is always advisable to inoculate a pigeon and a chicken; if the chicken pest is present, death occurs in from 12-48 hours. Besides, the absence of the causative bacillus of chicken cholera and absence of a marked intestinal inflammation are decisive.

Regarding the judging, the same principles should be applied as in chicken cholera.

For chicken cholera and chicken pest compulsory notification was established by proclamation of the Imperial Chancellor in 1903.

(c) *Chicken diphtheria* is an infectious disease of chickens and pigeons running an acute or chronic course, and which is produced by the bacillus *diphtheriæ avium*.

Lesions.—Yellowish-white membranous deposits on the tongue, palate, and buccal mucous membrane appear, and in advanced affections also croupous diphtheritic inflammation of the mucous membranes of the eye, the nose, the deeper air passages and the intestinal canal. In the latter cases, it is generally accompanied by anemia, cloudy swellings of the parenchyma, and hemorrhages on the heart.

Judgment.—Although Piorkowski has recently declared chicken diphtheria identical with human diphtheria, still there are no deleterious effects observed on human health from ingestion of the meat; neither are there any observations recorded of transmission of the disease from chicken to man. Whether the meat should be considered spoiled, depends on its objective changes.

(d) *Tuberculosis of fowl* should be judged for the present in the same manner as in mammalia (page 267), although there is no pathogenicity of the bacilli of fowl tuberculosis for man and for certain other domestic animals.

Finally there should be mentioned fowl arthritis with changes of the joints, and calcareous incrustations in the skin, kidneys, and serous membranes. For the test of uric acid deposits the murexid reaction is applied as follows: The concrements are mixed with a small quantity of nitric acid, evaporated by drying to an onion-red mass, which, on the addition of a drop of ammonia, gives a beautiful purple-red color. The meat of animals severely affected with arthritis must be considered as spoiled food. Egg concrements in the body cavity, which is occasionally observed in hens, are of no importance.

The general judging of fowl meat does not deviate from the general principles described for other flesh.

4. Post-mortem Changes of Fowl Meat

Borchmann called attention to the unfavorable influence on goose meat through long storing of undrawn geese in refrigerators and cold-storage houses (ice geese, Russian geese). The objective deterioration of the appearance of such geese consists in a whitish-yellow to a whitish-green discoloration of the skin ("cadaver color"), which after thawing out becomes oily, yellow, leather-like and tightly attached. Besides, there may be present hypostasis of the skin, of the lower abdomen and rump. The muscles of cold-storage geese are red-violet or deep dark red, and when roasted appear dark brown to brownish-black and tough. The fat

of a cold-storage goose is oily, does not stiffen and deposits a gray, gritty sediment; its taste is rancid or musty. Due to these characteristics, cold-storage geese are, under all conditions, of inferior quality, and besides they may also be in a highly spoiled condition and consequently unfit for consumption.

Bacon also pointed out the dangers of long storing of undrawn fowl in cold-storage houses.

B. Game

The meat of game is characterized in general by its high blood content, which favors its decomposition when unsuitably kept, notwithstanding the fact that the meat of game resists putrefaction for comparatively a long time.

Although game should, as a rule, disclose shot wounds, nevertheless wild fowl can be seen occasionally which were caught in traps or nets, and only display traces of strangulation. The shot wounds which are produced post mortem have no bloody infiltrated borders.

1. Age

Regarding the age which sometimes comes into consideration in haired game, principally in rabbits, deer, fallow deer, roe, and boars. Niebel established the following fixed points:

In young rabbits the thorax can be easily pressed in; and in compressing the posterior branches of the maxillæ, the two middle incisors spread apart as wide as the thickness of a finger. The hair of a young rabbit, especially on the abdomen, is softer than that of an old animal. The aponeuroses of the lumbar region are, in the young rabbit, grayish-white, thin, transparent; in the old, yellowish-white and not transparent. The ribs of young animals break easily; those of the old do not. The pelvic symphysis is cartilaginous in young animals; in old rabbits it is ossified. The meat of old rabbits is dark red, while in young rabbits it is pale and grayish-red.

In deer the question occasionally arises whether it is a calf or a full-grown deer. According to Whering, an alleged deer which possesses less than six molar teeth in each row, and accordingly is less than 16 to 18 months old, must be considered a calf. Whering indicates the changes of teeth in the roe, common stag, and fallow deer in the following exhibit:

	Roe	Common stag	Fallow deer
The center incisors appear after...	6-8 months	10 months	15 months
The inside laterals appear after....	10-11 months	13 months	17 months
The outside laterals appear after....	12 months	15 months	20 months
The corners appear after.....	13 months	22 months	18 months
The premolars appear after.....	14-15 months	24 months	30 months

The young of the wild boar have at 3 to 4 months 3 pairs of temporary incisors, 3 temporary molars in each row, and temporary tusks. When 8 to 9 months, they have besides, one permanent molar in each row and the tusks. A shoot of 20 months has 3 pairs of permanent incisors, the wolf-teeth, 5 permanent molars in each row, and the temporary tusks are replaced by permanent ones. In boars and sows $2\frac{1}{2}$ years old the last permanent molar is also present.

For wild fowl Niebel gives the following signs of age:

An old partridge is distinguished from a young one by the stronger-developed structure, gray to grayish-blue legs, which in the young are more yellow, and by yellowish-brown feathers on the head, which in the young are gray. But after 4 months the young partridge also has yellowish-brown head-feathers, and, therefore after that age only the outside quill-feathers show indications by which to decide, their ends being pointed in young partridges, while in the old they are rounded.

In the mountain partridge the age is determined by the extreme outside quill-feather.

In the woodcock, heathcock, heathpout, and white grouse the extreme outside quill decides, together with the breastbone and spurs.

The spur of a young pheasant cock is short and stubby; that of an old bird is 10 mm. long, and 7 mm. wide; in a cock about 10 months old the spur is only 6 mm. long.

The breastbone is flexible in earliest youth; it can be broken in young birds; in old ones, however, it is broken only with great difficulty. The feathers, until the second year, are of a dark color tint, which remains permanently in the hen; while in the cock at 2 years, the variegated feathering and long tail-feathers develop.

In wild geese and ducks the firmness of the trachea is decisive.

In young bustards the end of the chestbone is flexible. In snipe, quail, and others the age is of no importance.

2. Sex

The establishment of sex is occasionally of some importance in the eviscerated deer.

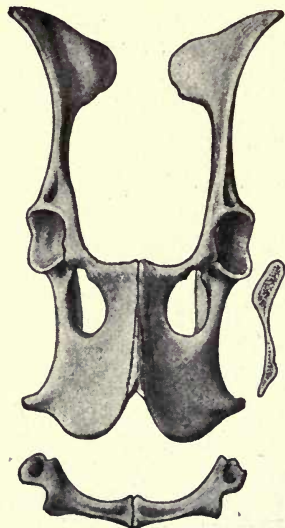


Fig. 152

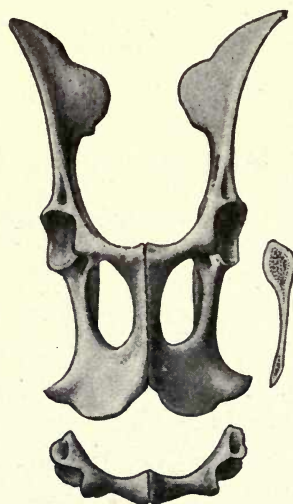


Fig. 153

Fig. 152. Pelvis of a doe with a front view of the os pubis and a section through the symphysis.

Fig. 153. Pelvis of a fallow deer with a front view of the os pubis and a section through the symphysis.

When the sexual organs are removed and the cranial covering sawed off, the pelvis is decisive, as indicated by Whering and Schaff, in the following:

The pelvis of the doe (Fig. 152), when viewed from above appears broader, more spacious, less slender than the pelvis of the buck (Fig. 153); the distance of the outside angles of the ileum from each other is as 50:40. On the pubic symphysis the pelvis of the buck is thick and like a protuberance; that of the doe is thin, flat in front, and slightly hollowed. It is emphasized by Whering that the appearance of the symphysis can only be utilized with a degree of certainty in older deer, as all the young individuals have a thickened protuberant symphysis; accordingly, Malkmus recommends cutting out the halves of the pelvic bones and boiling them.

The common stag and fallow deer show also similar sexual differences in the pelvis.

Regarding the value of the meat of both sexes in haired and feathered game, the meat of male animals is preferred in general on account of its stronger taste of game. During estrum the meat of deer is supposed to have a repulsive taste similar to that of the buck.

3. Diseases

The important diseases which occur in game have already been mentioned in Chapter VII. Anthrax, hemorrhagic septicemia, and animal parasites, measles, trichina in wild boars, as well as the so-called rabbit measles (*Cysticercus pisiformis*) should be especially indicated. Regarding measles of deer and reindeer, see pages 239 and 240. Strongylides in the lungs and intestines of rabbits may produce severe affections and may result in numerous fatalities.

4. Post-mortem Changes

Regarding post-mortem changes (page 327), no concessions should be made by the sanitary police to the current conception of "land flavor." In animals not eviscerated the intestinal putrefaction soon passes over to the abdominal walls, and discolors them green or bluish-green. The appearance of the eyes is also an indication of the freshness of game; if they are markedly sunken, it is then quite certain the game was shot several days previously.

Regarding the judging of meat of game there is nothing to be added to what has already been described regarding other flesh.

C. Fish

The killing of fish should be preceded by stunning with a blow on the head.

Although in the water of moderate climates there occur no fish the meat of which in itself would be poisonous,¹ yet it should be remembered, that the roe of perch and occasionally also that from pike, herring, carp,

¹ For further particulars see Kobert, on "Poisonous Fish and Fish Poisons." Vortag, Stuttgart, 1905.

trench, and breem may contain during the spawning time, cholera-like acting poisons (barbel cholera, signatera).

The raw meat and blood of the river eel and sea eel, as well as of the lamprey, contain a tox-albumen (ichthyotoxicon) which is destroyed by cooking. In the lamprey there may also appear a poison in the skin, which remains active even when the fish are boiled to a soup. Some of the fish also possess poison glands in the mouth and skin; in the latter class are included the so-called "poison stingers" (dragon fish, sea scorpion). For distinguishing fresh fish from stale and decomposed fish, the following fixed points are of service:

Condition	Scales	Eyes	Gills	Body in general and meat	Spec. gravity
Fresh.....	Glittering, free of slime, firmly adherent.	Standing out	Gills, lids and mouth closed.	Solid; placing the fish horizontally on the hand, it does not bend. Meat firm, elastic, tight on bones.	Sink in water.
Not fresh, stale for some time.	More or less easily removable, slightly slimy or smeary.	Red bordered, sunken; cornea cloudy.	Lids open or can be easily opened; gills pale, yellow, dirty, or grayish-red, covered with the same kind of fluid, odor disagreeable.	Body bends easily, especially at the tail end; occasionally bloating of the abdomen, which may be bluish discolored. Finger impressions are easily made, and remain; meat is soft, can be easily removed from the bone.	Swim on the water.
Putrefied...	Very loose, covered with a smeary slime-like mass of disagreeable odor.	Breaking down; are frequently removed.	Very off-colored; extremely offensive odor.	Withered, flabby, soft, pale, bloated. The meat is sloppy.	Swim on the water.

With the possible exception of carp, the age of fish is not regarded. To establish it a scale from the side should be cleaned in alcohol and held against the light.

If in the center of this scale a light point is noticed, the carp is then of one summer. In a two-summer carp, the central point is noticed, surrounded by a ring; that of three summers has two rings, and so forth.

Deceptions in Commerce with Fish Meat.—Occasionally a species of cod fish (*Merluccius vulgaris*) is used for sea salmon (*Raebiger*). According to Glage perch (*Caraux vulgaris*) should not be sold for genuine sprats. *Gadus pollachius* goes as Spanish salmon. The meat of the thorn-hound (*Acanthias vulgaris*) is offered as sea eel, and sea salmon, as well as that of the common nose-fish (*Chondrostoma nasus*), a cheap sweet-water fish, is sold as mackerel, according to Rehmet.

The substitutions of sprats for sardines or anchovies in box conserves is determined, according to Henseval, by a spiny comb on the abdominal side of the sprats, which is characteristic of these fish, and which can be perceived by passing the finger over the body in the direction of the head.

Of the diseases of fish, the following should be referred to:

(a) Nodular disease (*morbus nodulosus*, fish pox) commonly occurs in barbs, carp, tench, perch, pike, and red-eye. It is produced by myxosporidiæ (*myxobolus*). The latter are located in the epithelia of the skin, muscles, gills, and in the internal organs, and produce cyst-like tumors, swellings and abscesses. In the rump muscles of various species of salmon, cysts may appear the size of hazelnuts produced by myxosporidiæ (*Henneguya Zschokki*) which displace the muscle and become visible externally in the form of boils. The meat has a yellowish color, becomes soft, jelly-like, and tastes bitter.

(b) *Fish Measles.*—The plerocercoid of the *bothriocephalus latus* (broad tapeworm of man) lives in the muscles and the various viscera of the pike, turbot, perch, trout, grayling, salmon, and its varieties. In Germany these measles occur principally in fish from the Ost Sea, and from the East Prussian Seas, but may be also observed in those from the Starnberger Sea.

These worm-like plerocercoid are 8-30 mm. long, not encapsulated, and lie mostly slightly curved with their grayish-white indistinctly annulated bodies. They are easily found on the pyloric appendices of the turbot; they may also occur in the caviar of pike.

Cysts of 3.5 mm. long and 1.5 mm. broad, containing the larva of *tænia tetraarhynchus* were found in the meat of codfish and halibut, but they are harmless for man (Bergmann).

(c) The young form of the *ascaris capsularia*, described by Leuckart as *filaria piscium*, lives as a 2-5 cm. long encapsulated roundworm in the meat of various salt-water fish, and especially of the *gadus callarias* (a species of codfish). Cooking the meat facilitates their finding, as in the process the worms turn red-brown in color.

(d) Muscular distomes of various kinds are not infrequent in fish.

(e) The young state of the *distomum felineum* which produces cancer-like affections of the bile passages in the liver of man, is supposed to live, according to Askanazy, in the red-eye (*Leuciscus rutilus*); however, thus far only the eggs of the parasite have been found in this fish.

(f) The various infectious diseases of fish can be left unconsidered, as the fish with such affections spoil rapidly and are seldom placed on the market. For



Fig. 154. Plerocercoid of *bothriocephalus latus*, from the musculature of the pike; a, head extended; b, head drawn in.

details, see Hofer's Handbook of the Diseases of Fish, and Ostertag's Handbook of Meat Inspection.

According to Kobert, the bacillus piscicidus agilis (Sieber) produces a septicemic affection in carp, which may also become injurious to man.

Judgment of Diseased Fish.—Fish with bothriocephalis measles are injurious to health. In all other diseases the meat is, as a rule, to be considered as highly spoiled.

Regarding post-mortem changes in fish meat, it is safe to emphasize that such conditions appear rapidly, and that in putrid fish poisons develop which act more intensely than the putrefactive toxins in meat of warm-blooded animals. The fish poison, according to van Ermengem, is similar to sausage poison, and appears to be strongest at the beginning of putrefaction.

D. Crustaceans, Mollusks, and Amphibians

Crabs and lobsters should only be offered for sale alive, as they spoil quickly when boiled. Crabs boiled after they have died, have distended bodies, and the caudal fin is not rolled in. A lobster which has been boiled shortly before death, has the caudal end turned toward the abdominal side, and can be readily moved up and down ("Wippen"). If the lobster be boiled some time after death, the meat of the caudal portion cannot be taken out intact; it crumbles between the fingers.

Of diseases there should be mentioned the "spotted disease" which produces black spots on the shell, and is caused by oidium astaci, and the crab plague found by Hofer to be produced by the bacterium pestis astaci in the muscles is also pathogenic for fish. Mycosis astacina is accompanied by milky discoloration of the under side and mortification of single limbs of crabs.

Canned lobster is always alkaline, even in an unobjectionable fresh state. Adulterations occur with the palimurus vulgaris. As these shell crabs have no claws, the canned products are often sold as "lobsters without claws."

Occasionally the inferior quality North Sea crab is boiled in fuchsin water and sold as Ost Sea crab. The coloring is then spotted, and the eggs under the abdomen are bright red; by boiling crabs in alcohol the artificial coloring matter may be extracted. Furthermore, the zoological signs should be considered.

Dead oysters show open shells, and at the beginning of decomposition a black ring appears on their inner surface. They very soon develop a disagreeable odor. According to Bardet, all oysters are diseased during summer. They show a milky appearance, and their liver is greatly enlarged, gray, and white. To obtain a green color, oysters are placed in a copper acetate solution, whereby they turn grass-green but not dark green. If vinegar is poured over such oysters an inserted iron needle will show a metallic copper luster, while, with the addition of ammonia, the oysters turn a dark blue (Springfield).

That oysters may be carriers of typhoid bacilli has been repeatedly established.

The common mussel (clams) is dead when the shells do not close after they are taken out of the water. Certain mussels, especially those from stagnant water, may contain poisons, the development and nature of which is still obscure. Mytilotoxin occurs principally in the liver, and in man produces the poisoning called mytilismus, which belongs to the ichthyosismus (page 364). Poisonous mussels are supposed to produce a sweetish nauseating bouillon odor; they are also less pigmented, and their shells are easier broken and are broader than those which

are poisonous. The liver is larger and more mellow. Water in which poisonous mussels are boiled appears bluish; that of healthy mussels is light. The meat of poisonous mussels is yellow, that of the nonpoisonous is whitish. Placed in alcohol, poisonous mussels color it a strong golden-yellow; the nonpoisonous scarcely make any noticeable change.

According to Salkowski, if this solution is heated with a few drops of nitric acid in a reagent glass, the poisonous solution turns a grayish-green, while the nonpoisonous remains almost colorless.

In snails, turtles, and frogs' legs, special changes and injurious effects were not observed.

Judgment.—On account of the great danger which diseased, poisonous, or decomposing crustaceans and shell fish produce to human health (mytilismus), such food should be positively withheld from human consumption.

X. Meat Poisonings

In this chapter special diseases of animals are not treated, nor are injurious effects of meat, but more particularly diseases of men which appear as a result of meat consumption, and which on account of the symptomatic picture are designated poisonings.

Therefore, while there is nothing which could be supplemented here in relation to meat inspection proper, these meat poisonings cannot be left undiscussed, as they are of great importance to meat hygiene, and their etiological relations are noted partly in important diseases of animals and partly in particular changes of the meat.

Poisonings which are to be traced to consumption of meat can be arranged, according to van Ermengem, into three groups with reference to their etiology—namely, meat poisoning as a result of micro-organisms which belong to the group of the bacillus enteritidis; meat poisonings through the bacterium coli and the proteus group; and botulismus.

1. Meat Poisoning as a Result of Bac. Enteritidis

The nature of meat poisonings which are produced by the group of bac. enteritidis, consists either in an intoxication of the human body with chemical poisons (bacterial toxins, toxalbumens, toxigenic substances), developed by the micro-organisms in the animal body; or else in an infection with the bacteria themselves; or finally in a united action of toxic substances and the bacilli of infection.

In so-called paratyphoid meat poisoning there enters into consideration the action of the metabolic products of bacteria which in themselves are not poisonous, but at the same time increase the action and aggressiveness of the bacilli.

The character of the diseases developed in this manner in man varies extraordinarily. According to van Ermengem, the symptoms in general show an acute course, and develop as an attack of cholera, cholera nostras, or an inflammatory gastro-enteritis (febris gastrica), sometimes accompanied by muscular weakness or ataxy. The symptoms may, therefore, act delusively in a typhoid condition. Frequently, however, they can be hardly distinguished from a gastro-intestinal catarrh.

Convalescence is always slow; relapses and even fever of two months' duration (Neter) may occur. Mortality hardly exceeds 2 to 5 per cent.

Without doubt the various forms of the disease are greatly influenced by the nature and intensity of the poisons in consumed meat, by their quantity, preparation, etc.

Accordingly, since there does not exist a uniform typical clinical picture in meat poisoning, it would be possible to establish a diagnosis of poisoning by meat only by connecting a concrete affection with corresponding complex symptoms, together with the history of consumption of certain meat foods, and in the absence of other kinds of disease-producing influences. That suspicion of meat poisoning is justifiable if symptoms occur soon after the ingestion of meat appears self-evident, but the time of incubation may also extend over several days.

Causes.—Based on extensive statistics, it can be stated that the septic and pyemic affections with their various forms in food animals (page 293) are principally the causes of meat poisoning proper. But as these affections of animals result very frequently in their emergency slaughter, it, therefore, is not at all surprising that by far the most meat-poisoning cases may be traced back to emergency-slaughtered animals.

To what extent the bacteria of the enteritidis group play a part in the development of septic and pyemic affections, has not yet been explained. From a diseased food animal, either the entire meat may contain injurious properties or the latter may be confined only to single parts of the viscera of the animal. In both instances the virulence of the meat or viscera may be widely different, and accordingly the degree of the poisoning may vary greatly. The virulence of the meat depends on the severity and nature of the affection of the food animal at the time of slaughter and the bleeding of the animal as well as on the nature of storing and the preparation of the meat.

With reference to storing, it must be accepted that under certain conditions (heat, dampness) the post-mortem poisonous properties of meat are further increased by continuing the activities of the causal agents of the infection. Thus Basenau, Poels and Dhont have proved that the species of bacteria which stand very closely to the bacterium enteritidis find in the muscular tissues very suitable growing conditions for a luxuriant development, even at a low temperature (10° C.). The preparation of the meat plays an important part, inasmuch as experience has shown that the consumption of raw meat, as a rule, results in more severe disturbances than from boiled and roasted preparations; for the exciters of infection which exist in the meat proper are to a great extent destroyed, and thereby the danger which threatens human beings through the multiplication of these causal factors is averted by their incorporation into the digestive apparatus. That the chemical poisonous substances (toxins of the bac. enteritidis) which are present in the meat, are not destroyed by culinary boiling or roasting, has been frequently established by experience (see below); and this serves as a proof that the nature of a large number of poisonings by meat is an intoxication. It is readily apparent that these toxic substances may be weakened through the prepa-

ration of the meat by soaking or through the formation of chemical combinations, which at the same time causes an attenuation of the poison in the meat. It has been shown by careful observation that in certain cases the meat broth contained prominent toxic actions.

Inasmuch as individual organs, especially the liver and kidneys, proved to be poisonous, while the meat proper and the muscular structure of the same animal proved to be harmless, it must be accepted that these organs were either exclusively the seats of the toxic elements, or by virtue of the physical functions they absorbed larger quantities of the poisonous substances.

Finally, concerning cases in which the poisonous quality of meat obtained its virulence only on post mortem, this becomes readily comprehensible by the above-mentioned observations of Basenau, Poels, and Dhont, as well as by the fact that the bac. enteritidis occurs quite extensively distributed in putrefying organic material and also in many carcasses (Gärtner).

According to recent observations, cases of poisoning resulting from the ingestion of fish-meat and oysters (Netter, Herdmann and Boyce, Vivaldi and Rodella), as well as affections of so-called paratyphus of unknown cause, belong to the sphere of action of the bacillus enteritidis.

Etiology of the Toxicity of Meat.—The bacteria of the group of bacillus enteritidis, which produce the poisonous qualities of the meat, possess, according to van Ermengem, the following characteristics:

1. Short bacteria, very frequently of ovoid form (coccus bacilli) of 0,2 to 0,4 μ , usually arranged in pairs; sometimes they stain irregularly, especially in somewhat older gelatin cultures, as well as in peritoneal and pleuritic exudates, in the liver, etc., so that they resemble the bacteria of hemorrhagic septicæmia.

2. They do not stain by Gram's method.

3. They are quite motile similar to the typhoid bacillus, and possess peripherally arranged flagella, 4-8 μ long, but sometimes they are more than 10-12 μ long.

4. The superficial colonies on gelatin are quite polymorphous; frequently they are only slightly distinguished from those of the bact. coli, and while they are in general more transparent, they are less lobate, and show usually a transparent border.

5. They do not form indol, or at the most, they produce it only in extremely small quantities.

6. They do not coagulate milk; but after about 10 days reduce somewhat its opaqueness. In fact it renders the milk slightly transparent, which at the same time takes up a yellowish color similar to coffee and milk and becomes markedly alkaline.

7. They always ferment dextrose with abundant gas formation, and also generally decompose the other kinds of sugars—lactose, galactose, maltose, cane-sugar, etc.—and even glycerin with gas formation, excepting certain varieties of the organisms, as for instance, those described by Fischer and Durham, which do not affect lactose.

8. They cloud bouillon very quickly, and a membrane forms on the surface which tears readily, but no distinguishing odor is communicated to the nutritive media.

9. On potatoes the growth is frequently barely visible; in other cases it is quite thick, dirty yellowish, or of a brownish development.

10. The quite luxuriant growth in Petruschki's litmus milk effects no change in the color, nor is there an acid production.

11. A more or less pronounced formation of fluorescence takes place in the neutral-red agar of Rothberger with a 0.3 per cent. addition of dextrose, the nutritive substance is discolored after 18 to 24 hours, and gas is produced.

12. On the nutritive media of Drigalski-Conradi, bluish colonies develop after 16 to 18 hours, which are somewhat larger and less transparent than those of the typhoid bacilli.

These micro-organisms further distinguish themselves from the more or less related species with which they might at first be confused; or, for instance, with certain varieties of the bacterium coli, by their great virulence and by their characteristic production of toxins, which are resistant to high temperatures. These poisons penetrate the nutritive media and may be demonstrated in the filtrate which is free of the organisms.

The mode of infection by the bacillus enteritidis and its passage into food animals cannot be taken up here. It should be considered, however, that a pollution of the latter may occur through contact with the bacilli without the presence of an infection in the animal itself; the latter, however, does occur in rare instances.

The paratyphus bacilli may be left unconsidered here

That the bacillus suipestifer, notwithstanding its relation to the paratyphus bacilli and to the enteritidis group, does not belong to the meat-poisoning bacteria has been established by C. Joest.

De Nobele convinced himself, according to van Ermengem, of the fact that the muscular juice of affected animals, which are infected with micro-organisms of the bacillus enteritidis group, possesses a pronounced quality of agglutination for the latter. According to this investigation, it would be sufficient to test the muscle plasma in quite strong concentrations (1:10 to 1:20) with each of the representatives of the two groups of micro-organisms which he established. As the expressed muscular juice of healthy animals does not agglutinate the micro-organisms in question even in a concentration of 1:1, it would thus be possible by this test to obtain a definite result within two hours. It would be necessary to resort to the cultural method only in case the agglutination gave negative results. It would be advantageous to keep the meat to be examined for 24 hours after slaughter at a temperature of 18 to 20 C., and to make the culture inoculations only after that time. By this procedure a marked increase of the micro-organisms is obtained, which are not frequently numerous immediately after slaughter. On the other hand, through this method the results of examination are unfortunately much longer delayed.

In scientific or forensic examinations regarding the poisonous qualities of meat, the sero-diagnosis possesses a great importance for the distinction of the suspicious bacilli found thereby.

Also for the diagnosis of poisoning in men and animals by meat, the agglutination test of the blood of affected individuals may be of value.

Occurrences of Poisonings.—The first critical enumeration of cases which occurred before 1880 is found in the work of Siedamgrotzky. The review of similar poisonings, by Bollinger, in the same year, gives an account of 17 endemic poisonings by meat, which probably belonged principally to the enteritidis group, affecting almost 2,400 cases, with 35 deaths. The statistics of Ostertag, taken up in his Handbook, increases the number of poisonings by meat to 90 outbreaks, which he obtained from the literature of the last 23 years. These 90 outbreaks involve more than 4,000 individual cases, of which the largest portion falls to Germany.

For the recognition of poisonous qualities in meat, the examination could be carried out for bacteria by the method recommended by Basenau (page 136); however, such a bacteriological examination could be used in practice only in emergencies.

This would also be the case with the method of examination suggested by De Nobe. Stress should be laid on the prevention of poisonings by meat through a conscientious examination of food animals before and after slaughter by the veterinary inspector. As has been already emphasized, the post-mortem examination should be especially carried out with the greatest care and conscientiousness in emergency slaughter, and should be executed with the application of all technical methods available (page 134).

Although there will be certain doubtful cases for the practiced expert in which the rendering of a decision will not be easy, at the same time it will be possible for him, by considering and valuing all clinical and pathological characteristics of septic and pyemic affections, to prevent the occurrences of poisonings by meat almost completely; at any rate to the greatest extent possible, according to the present standpoint of scientific meat inspection.

2. Meat Poisoning with *Bacterium Coli*, *Proteus Species*, etc.

This concerns a poisonous action of meat, which originates from entirely healthy animals being infested sometimes only after slaughter, with pathogenic or saprophytic organisms which produce toxins. Sometimes such disease-producing meat is visibly changed, decomposed, or affected with slight putrefaction by the action of bacteria, but in numerous cases there are absolutely no changes noticeable in poisonous meat. The latter was principally observed in so-called chopped-meat poisonings (see below).

Nature and Manifestations.—The cases belonging here represent principally pure intoxicants by the toxins produced by microorganisms in the injurious meat. This speaks especially for the early manifestations of the disease which soon appear after ingestion of the meat (3 to 4

hours). Of course intoxication may be combined with a pathogenic infection where severe symptoms of poisoning and a protracted course of the sickness develop after some time has elapsed as a result of the increase of injurious microorganisms in the digestive apparatus of affected persons. The manifestations of these meat poisonings vary considerably, and are similar to those which are observed in the genuine poisonings by meat. Nausea, vomiting, diarrhea, giddiness, headache, dizziness, and debility occur, which may increase to faintings; while in children and weak persons cholera-like symptoms have also been observed. Recovery is the rule; but deaths have been also observed, especially in children. As a cause for this group of meat poisonings, according to van Ermengem, two saprophytes come into consideration, both of which are common inhabitants of putrid animal substances, namely: the bacterium coli, and the bacillus proteus with its numerous varieties—for instance, proteus radians (Gutzeit); also the microbe named by Hamburger as bacillus cellulæformis, which is somewhat distinguished from the bact. coli, and appears of etiological importance. As these bacteria play a secondary part in the putrefaction of meat, the injurious properties of such meat may be traced to them.

The injurious action of these bacteria consists principally as has already been mentioned, in the formation of toxins which are not destroyed by ordinary boiling and roasting of meat, although they are somewhat attenuated. According to experience, it is true, boiled and roasted meat foods have produced a great number of poisonings; but the latter were mostly milder than when the meat was consumed without previous heating, or was insufficiently boiled or roasted.

The intensity of the decomposition of meat does not stand at all in relation to its presumed poisonous character; and in this, experience has also taught that frequently only slight manifestations of decomposition of meat were connected with severe poisonous actions.

A statistical arrangement of poisonings is not possible, since the affections belonging here, with the exception of the chopped-meat poisonings do not take, as a rule, an epidemic character, but are limited to separate cases, the scientific investigations of which are made very difficult for obvious reasons.

The recognition of the poisonous quality of the meat belonging to this group is practically impossible, as has been mentioned, since objective changes may be entirely absent, notwithstanding the presence of the poison. In decomposing meat the signs described on page 328 are sufficient to demonstrate putrefaction of the meat and to judge the same, according to the views given on page 330.

For the prevention of this group of meat poisonings it is necessary to exclude all such meat from traffic in which putrefaction had been dem-

onstrated, or with manifestations of decomposition. Otherwise these meat poisonings must be prevented by the care of the housewife or servants in selecting for use only unobjectionable meat. When suspected meat cannot be unconditionally excluded from human consumption, it should be utilized only after a complete boiling or thorough roasting.

The so-called chopped-meat poisonings belonging here, have been observed only in the warmer seasons. This alone sufficiently speaks for the fact that it depends upon a pollution of the easily decomposing meat with bacteria (bacterial content, see page 71), which grow well on the meat and form toxins.

Chopped-meat poisonings of larger extent were almost exclusively observed at such places where a large amount of slightly smoked sausage or raw meat, or partially roasted meat had been consumed. Recently, epidemic chopped-meat poisonings were observed in Chemnitz, Dresden, Gerbstadt, Gera, Halle a. S., Sülken, Velbert, Hamburg, Berlin, and elsewhere, affecting over 600 people, with several deaths. However, isolated cases occur every summer.

Lately chopped-meat poisonings have been observed, in which paratyphus bacilli were supposed to be the cause. These should not belong to the chopped-meat poisonings proper, but to the meat poisonings of the enteritidis group.

To prevent poisoning by chopped meat it is advisable not to keep it at a summer temperature for any length of time; wherefore the prohibition of the use of preserving substances should be of assistance; and the meat should not be consumed in a raw state or insufficiently prepared.

3. Botulismus

As botulismus (allantiasis, sausage poisoning) are designated certain cases of affections in man produced by the consumption of meat, which are specially characterized on account of the symptoms deviating from both of the previous groups. The name "sausage-poisoning" originates from the fact that the first critically observed cases, by Justmus Kerner, in the year 1820 were connected with the ingestion of injurious sausages; and also later many severe affections of this kind could be traced to this source.

Here, too, belong most of the poisonings known as ichthyosismus and mytilismus, which are produced by the meat of fish, crustaceans, and other shell-food.

Nature and Manifestations.—Botulismus consists in an intoxication of the human organism by poisonous substances, which are produced by the bacillus botulinus, named and discovered by van Ermengem.

The symptoms, especially characteristic, are disturbances in the sight; paralysis in the region of the optics, oculomotorius (mydriasis), trochlearis abducens facialis (ptosis), as well as of the lachrymalis and trigeminus nerves; they may occur singly or in association. Striking manifestations originating in the digestive apparatus are frequently absent

or only slightly pronounced and passing. On the other hand there exists a persistent constipation, retention of urine, and marked debility.

Fever as well as disturbances in consciousness and sensibility is absent. The symptoms of the disease appear 24 to 36 hours after the meal; occasionally, however, even later. Regarding the severity and duration of the disease, there exist great differences. The mortality is about 25 to 30 per cent., much higher than in meat poisonings.

Causes.—As is already indicated by the name, botulismus is chiefly caused by the ingestion of sausages which are infested with the bacillus botulinus, producing toxins. But as this organism thrives also in other meat foods (see below), the most varied meat food may enter into the question in sausage poisoning.

Of those sausages which frequently cause poisoning are first of all to be mentioned liver—as well as other visceral and jelly sausages, which in certain localities are quite voluminously prepared, and by smoking are made into cured sausages. The sausage content itself does not resist putrefaction to any extent, and in the large sizes in which sausages mostly appear when they are prepared on occasions of so-called home slaughter for domestic consumption, it may readily occur that on account of insufficient boiling the bacteria contained within the sausages remain undestroyed. Also the bactericidal action of the smoking is only slight in very large sausages, on account of the difficulty of penetrating them; and especially will it fail when the smoking is carried on for only a few hours (during the day), which occurs frequently in the households of the country.

Proof that the poisonous effect of sausages can be traced to bacteria lies in the fact that other meat foods in the state of putrefaction also produced entirely analagous affections to those of sausage poisoning. Thus poisonings were observed in partially decomposed hams, in slightly putrid meat, and in their broth; also in fermenting pickled meat; through the ingestion of roasted geese, which were allowed to hang undrawn for a day in the cellar; through old roast-mutton gravy; sausage meat; liver; liver-pâté; spoiled canned preserves, etc. At the same time the respective foods did not in the least display any striking changes, and showed principally only musty, slightly rancid, sourish odors and taste.

The bacillus botulinus has some similarity to the edema bacillus; it is 4-6 μ long and 0.9-1.2 μ broad; straight with slightly rounded ends. It is an anaerobe; forms oval spores at the end of the rod; grows luxuriantly on alkaline media at 18 to 25° C., and develops a sharp odor of butyric acid. At higher degrees of temperature (35-37°) it grows only sparingly and without the formation of toxins. By heating half an hour at 80° C. the bacillus becomes inactive the same as when exposed for 1 hour at 10° C. As the bacillus does not grow on pork containing 6 per cent. salt, well pickled meat foods which always contain a larger quantity of salt should not be infected with it. But as pickling is frequently quickly and

superficially accomplished, pickled and smoked products may contain botulinus bacilli and their toxins.

Van Ermengem classifies the bacillus botulinus in a group of microorganisms newly established by himself, the toxigenic saprophytes, which do not multiply in the living body, but act only through their toxins. The enormous poisoning action of the botulismus toxins appears evident, when it is considered that for instance 1-2 drops of a gelatin culture, or 0.001 cm. of dextrose bouillon culture administered *per os* to monkeys or guinea pigs, constitute a fatal dose in from 24 to 36 hours.

Casuistics.—Most of the sausage poisonings, both epidemic and endemic cases, which have occurred in Württemberg, according to Oster-tag, can be accredited to the lack of intelligence by which formerly certain kind of sausages, as liver and blood sausages, were prepared. Also in Bavaria, Baden, and North Germany sausage poisonings have been observed, although less frequently; and single cases are reported in the literature from everywhere.

For prevention of botulismus, the following statement prepared by van Ermengem, besides the instructions to the public on the proper preparation of sausages, is worthy of consideration:

1. Preserved food substances, which are exposed to anaerobic bacteria, must never be consumed in a raw state, but should be properly cooked.

2. Preserved food substances which by a rancid or butyric acid-like odor arouse suspicion should be rightly excluded from consumption.

3. For pickling, only such brine should be employed which contains at least 10 per cent. common salt, as the bacillus botulinus cannot multiply in this solution.

From a therapeutic standpoint, the antitoxin serum prepared by Kempner for the treatment of botulismus, is worthy of consideration.

XI. History of Meat Hygiene

Of the history of meat hygiene, and especially of meat inspection, which is inseparably connected with the history of the meat food of man in general, only a few brief remarks should be made here,¹ which characterize its development in the main.

There is no doubt that man at all times, at least as far as his appearance can be traced paleontologically, has consumed meat food. Especially for Europe, it can be considered as proven that the paleolithic inhabitants of caves had already utilized as their food the meat of various living animals and fish. Also the findings of later epochs leave no doubt as to the meat consumption of man, and this may with certainty be established from the oldest historical traditions.

As the oldest facts in the history of meat inspection may be considered, the food and edicts of the Egyptians who designated certain animals, first of all the hog, as unclean, and excluded their meat from the consumption of man. The Egyptian priests who held to this with great strictness may be therefore considered as the first representatives of a method of meat inspection.

The Egyptian food laws, of which the prohibition of hog meat was besides accepted by all of the Semitic races of those times, were without a doubt prefigurative for the Mosaic food laws of the Israelites. Also with this race the priests were the judges of the meats, which is explained by their connection with the extensive religious animal offerings and the share of the priests in the meat of the sacrificed animal. The sacrificed animals, and in a broader sense all the food animals, must have been healthy and without a blemish.

Otherwise, animals adapted for food were divided into clean (ruminants, domestic fowls, and birds which do not live on carcasses, as well as fish having fins and scales) and unclean (solipeds, hogs, etc.). The consumption of young animals was interdicted, and especially strict was the prohibition maintained against consuming fat and blood as well as meat of hogs. These edicts experienced amplifications from time to time, and were enlarged, especially during the so-called Talmudic period, which extended through the first century A. D., by specific instructions regarding the slaughter and examination of food animals (page 27). To the first belong especially the rulings for the "shacten" (page 24).

¹ For details see Ostertag's *Handbuch der Fleischbeschau*; Baranski, *Anleitung zur Vieh-und Fleischbeschau*; Goltz, *Geschichte der Fleischnahrung und Fleischnahrungsmittel*.

Similar to the Israelitish and Egyptian food laws are those of the Mohammedans even of to-day. The latter considered both the hog and the dog as unclean, according to the Koran.

In contrast to the views regarding the meat foods of the Semitic races, stand those of the old Greeks and Romans. Pork was not interdicted, but was rather greatly favored by the Romans, and the Greeks likewise favored the meat of young castrated dogs. On the other hand, the consumption of meat of lambs, which were not shorn, at one time was forbidden to the Athenians, and the Romans disdained the meat of goats as unhealthy. Police were located at the Athens market from the earliest times. In Rome, since 388, following the foundation of the city, two state Aedils provided for order and supervision of the stock and meat markets, where also an official inspection of meat was conducted.

The salting of meat, which is mentioned by Homer, was known to the Romans, as well as the preparation of various kinds of sausages (botuli fry, incisia, slice circelli ring, temacina chopped sausages) and smoked products. Well-equipped abattoirs (lameuæ) and meat markets (macelli) existed, according to Ostertag, in old Rome. The beginning of the old Roman meat control has not, however, been further developed, for it ceased with the downfall of the western Roman Empire.

From Northern Europe and the old Gallics and Germanians there are no traditions regarding a supervision of meat foods, or on any other special customs. Not until the spreading of Christianity were Old Testament food laws inaugurated, which were strictly supervised by the church. The prohibition of the consumption of horse meat, issued by Apostle Bonifacius, under the direction of Pope Gregory III, at the beginning of the eighth century can be considered as the first special food edict in old Germany, which, however, was not so much used from a hygienic standpoint as from consideration to the horse offerings of the heathen Germans. Later it was prescribed by Bonifacius, under the direction of Pope Zacharias, that bacon and pork should not be eaten otherwise than cooked. Also the consumption of diseased meat from dead and torn animals was prohibited.

In later times the civil authorities of Germany gradually paid more attention to meat, as this formed the principal food of the people in the Middle Ages. With this the meat industry developed into a particular business, which was later highly respected. Although the oldest German records in which meat traffic received consideration have existed since the year 1120 (documents of the foundation of the city of Freiburg), butchers, however, are mentioned for the first time in 1156, in the "Iustitia civitatis Augsburg" as "carnifices." With the further development of the trades, it was not only the individual control of the meat industry in relation to the orderly traffic of meats which progressed more and more, but

also the ecclesiastical and civil authorities concerned themselves about it. Thus a distinction between marketable and nonmarketable meat is found for the first time in a record which was imparted by Bishop Lütold in the year 1248 to the butchers' fraternity at Basel.

Although the decrees issued in the thirteenth and fourteenth centuries relative to meat traffic were principally of a local significance for individual cities, they contain important meat-inspection regulations. Thus are especially mentioned the measles of hogs, the bloating of meat, immaturity of calves, meat of emaciated and diseased animals, pearly disease, etc., and in the year 1276 compulsory slaughter as well as compulsory inspection and declaration of sick animals, was ordered for the public abattoir in Augsburg.

That state regulations were also found necessary in certain states becomes evident from a decree of the state of Mecklenburg for the year of 1572, according to which the butchers were to be controlled by the city bailiff and two competent persons.

After the Thirty Years' War, only little remained of the former fraternal and official supervising regulations in the domain of meat traffic, and only toward the end of the seventeenth century and the beginning of the eighteenth did the administration again direct some attention to meat and the slaughter of food animals. Without regarding local regulations, the decrees which existed at these times for Mecklenburg, Hannover, Braunschweig-Lüneburg, and the electorate of Saxony, as well as the general decrees of Baden, are worthy of mention. Also prohibitions against importations of pickled and smoked meats were even then issued by states (Hannover, Saxony), and cities (Leipscic), doubtlessly for fear of rinderpest. To a large extent, this led to a decree in Baden in the year 1772, according to which the professional opinion of the district physician was required on cattle which were affected with an infectious disease; and in other diseases that of the stock examiner was necessary regarding the fitness of meat for consumption, in order that meat, which at that time was very expensive, should not be unnecessarily withheld as human food. Even somewhat earlier, in the year 1761, the government of Bavaria prescribed a renewal of the inspection of food animals by official meat inspectors. At that time a change was also effected in the judging of pearly disease. Until then it was accepted as identical with a venereal affection; and, therefore, the meat of all such affected cattle was destroyed without further consideration. But after Graumann, in 1784, explained that the nodules of pearly disease were not injurious to human health, the meat and milk of cattle affected with this pearly disease were no longer considered as unfit for food.

Until the end of the eighteenth century, little was known of a scientific system in food regulations; they gradually appeared with the

establishment of veterinary schools, on a basis of the medical views of those days. These, however, were not favorable to meat inspection, since the teachings on the injurious effects of meat in certain diseased animals led to the view that no danger threatened human health from consumption of meat of diseased animals. With this not only was a supervision of the meat traffic declared superfluous, but also the formerly recognized hygienic importance of the public abattoirs was ignored to such an extent that, in 1826, a Prussian ministerial script even declared the introduction of compulsory slaughter on the part of the local authorities as inadmissible. As a result of this the number of public abattoirs in Prussia was not only not increased, but even already existing abattoirs were abandoned.

Not quite so unfavorable were the meat-inspection conditions in South Germany, where in Baden and Kurpfaltz the institution of animal inspection was not discontinued, and in the year 1802 a Ministerial decree was issued in Württemberg for the prevention of very frequent poisonings by sausage. Also in the kingdom of Bavaria was soon seen the necessity of recognized meat inspection, which was first expressed in a meat-inspection ordinance for Southern Bavaria October 21, 1836, and for Schwaben and Neuburg January 10, 1857. Further meat-inspection regulations followed for Württemberg March 14, 1860; Northern Bavaria June 2, 1862, and Baden August 17, 1865. The further development of meat inspection, which in North Germany was based on the Prussian abattoir laws of March 18, 1868, belongs to modern times. Concerning the development of meat hygiene in other European states, handbooks on meat inspection must be referred to as well as special historical works.

[The history of meat inspection in the United States is practically the history of the U. S. Bureau of Animal Industry. While there were forms of municipal meat inspection carried out in several cities previous to the organization of this Bureau, the inspection was not established on a scientific basis until the inauguration of the Federal meat-inspection service. The reasons for commencing this work were as follows:

The foreign sales of the meat-packing industry from the first included numerous varieties of meats and meat products, and by 1879 the export trade in American bacon alone, without mentioning other foodstuffs, had become well established, when the continental countries became alarmed, seemingly on account of the presence of trichina in American hog products, and accordingly prohibitive measures against these meats were instituted. Italy was the first to promulgate these restrictions, and by 1881 Austria, Germany, and France had likewise prohibited the importation of American pork or its products. American cattle met a similar rebuff at the instance of Great Britain in 1882, when regulations, commonly called the "Slaughter Order," were instituted by the Order-in-Council of the

Board of Agriculture, which compelled American cattle to be slaughtered at the port of entry. This prohibition of store cattle was caused, presumably, by the presence of contagious pleuro-pneumonia among the cattle in a few of the Eastern States and Illinois, but notwithstanding this disease was effectually eradicated from this country in 1892, and since that time not a single case has been found either in cattle imported into Great Britain from the United States or among our herds, the restrictive measures continue to be enforced and the stigma constituting the assumed reason for this embargo remains. While it is plainly evident to any one who has given this subject the least consideration that these two alleged sanitary procedures of foreign governments were directly pointed at the meat and live-stock industry of this country, and although the vast falling-off in the value of our exports in these lines was to those variously engaged therein a hardship which continued for a decade, nevertheless, these interdictions must be considered as the potent and exciting factors in securing legislation for the scientific inspection of meats for foreign and domestic use, and incidentally in advancing the cause of veterinary science in the United States.

The exclusion of American pork products finally became intolerable, and in order to relieve the situation and regain an export market for these foodstuffs, Congress passed the act of August 30, 1890, providing for the inspection of salted pork and bacon. It was but natural to presume that with the passage of such a law providing for the certification of the pure and healthful character of American meats all restrictive measures against our export trade would be revoked. However, this initial act was not sufficiently comprehensive, referring chiefly to the manner in which the products were packed and their appearance immediately before shipment, without taking into consideration at the time of slaughter of the animals producing these meats. For this reason the European countries failed to abolish their restrictions against American pork. The relief expected in consequence of this act was not, therefore, realized, and on March 3, 1891, Congress, recognizing the importance of protecting and fostering this export industry, the value of which had reached the sum of \$104,660,000, in 1881, and of acquiring and maintaining a pure and wholesome meat supply for our own people, passed a more effective act. This legislation authorized the issuance of regulations providing for the ante-mortem and post-mortem examination of all cattle, sheep and hogs intended for export and interstate commerce, especially providing for post-mortem inspection of cattle the meat of which is designated for export; for a microscopic examination of all hogs for export in order that certificates could be issued setting forth their freedom from trichinosis; the condemnation of all diseased animals; the marking or stamping of all inspected carcasses and the labeling of food products made from such carcasses intended for export or interstate traffic.

The work connected with the endorsement of this act was placed under the care of the Bureau of Animal Industry, which had been established in 1884, for the purpose of collecting information concerning the nature, cause, treatment, and prevention of diseases of animals and the publication of the best measures for the prevention and eradication of such diseases. These increased duties rendered it desirable that the various lines of work be divided, and accordingly, on April 1, 1891, the Bureau was organized into several divisions, one of which was designated the Meat Inspection Division, and, as its name implies, had, among other duties, special supervision of the inspection of meats for export and interstate commerce. Regulations were immediately adopted for the purpose of carrying into effect this act of Congress. A system of inspection was devised, a force of veterinarians and their assistants organized, and the inspection of meats inaugurated within ten weeks from the passage of the act, or on May 12, 1891, at the abattoir of Eastman & Co., of New York City. Other abattoirs made application for inspection, and by the end of the first complete fiscal year, 1892, inspection had been granted to twenty-eight abattoirs in twelve different cities.

It will thus be observed that Federal meat inspection has only a very recent history, but one of which our people and our profession can justly be proud.

The microscopic examination of pork for trichina was first established in Chicago, June 22, 1891, and likewise started in other cities before the end of that year. At first there was some hesitancy and skepticism among the packers as to the practical application of this microscopic examination without seriously retarding the business of the firms and causing vexatious and unnecessary delays, but all doubts were shortly dispelled by the satisfactory performance of the work, and the problem was efficiently solved by the persistence and skill of the Chief of the Bureau of Animal Industry and the growing perception and ripening knowledge of his assistants. As a direct result of these microscopic examinations of pork products which were subjected to the keenest scrutiny of the attachés of European countries and favorably reported upon by them, the decree of September 3, 1891, was made by the German government after the Saratoga Convention which readmitted American pork that was officially certified as having been microscopically examined before shipment from the United States.

Subsequently similar interdictions were removed by Italy, France, Denmark, and Austria, and in consequence of this reestablished confidence relative to the healthfulness and purity of the pork products of this country the export trade began at once to show decided and gratifying increase and to gradually expand and regain its former importance and value.

The beneficial and desirable results that would necessarily accrue in consequence of having the supervision and inspection of the Government meat inspectors to certify to the purity and soundness of the products of their abattoirs, soon appealed to and was quickly acted upon not only by the packers who sought to compete in foreign markets, but those doing strictly a local and interstate business. The proprietors of those abattoirs desiring inspection for their meat products are required to make written application to the Secretary of Agriculture, stating the kind and number of animals slaughtered, and the destination of the products thereof, and to agree to such supervision of their business as may be demanded by the regulations of the Bureau. On conforming to such requirements the packing house is given a serial number by which it and the products thereof are thereafter known, and an inspector is placed in charge of the plant and furnished with a sufficient number of veterinary inspectors and inspector assistants to carry out the required inspection.

The extension of the work caused by the enforcement of the act of Congress cannot be fully appreciated or comprehended without a knowledge relative to the importance and magnitude of the subject. The successful and speedy elaboration of many details which necessarily required much labor and consideration and the care and efficiency with which they were immediately enforced exceeded all expectations when the difficulties and obstacles—the inherent perplexities of the question—were considered. Moreover, this inspection was an innovation in sanitation in this country, and was of necessity carried out principally by inexperienced men who were chosen chiefly on the strength of their political influence rather than by the breadth of their veterinary knowledge.

The next epoch in the history of meat inspection is marked by the placing of all employees of the Bureau into the classified service by Presidential order. This took effect July 1, 1894, since which time all appointments to the force have been made only after the applicant has passed a rigid and highly satisfactorily examination. By this means only the intelligent, competent and superior candidates are chosen from the eligible list by certification from the U. S. Civil Service Commission. Now that the merit system is in vogue, not only the personnel of the Bureau has been improved, as would be expected, but the harmony and discipline resulting therefrom is vastly better than is possible where political intrigue forms a basis of appointment, promotion and retention. The first requisite to be met by those aspiring to the position of veterinary inspector is to be a graduate of a recognized and reputable veterinary college, and then to pass a rigid examination that destroys the ambition of a large percentage of applicants. After successfully meeting these requirements and receiving an appointment, his future service depends

entirely upon the personal equation, and would include the ability, integrity, and discretion with which his onerous and multiple duties are performed.

Previous to 1894 the inspection consisted principally in the examination of beef for export and the microscopic examination of pork destined for continental Europe, but at this time, owing to an increased demand for official inspection of meats, a similar ante-mortem and post-mortem examination was extended to hogs as had already been in operation from the beginning with cattle. In the following year calves and sheep were likewise subjected to inspection both before and after slaughter. As the inspection gradually increased and covered a large number of animals, it became more and more important to obtain sufficient authority from Congress to dispose of the condemned carcasses, as the original act failed to grant power for the proper disposal of such products. The danger of allowing condemned meats to remain undestroyed is palpable when taken into consideration with the limited authority of the Federal Government regarding the use of such carcasses within the State. That it was highly unsatisfactory to the Bureau, as well as to the health of our people, to permit the packer to have absolute control over the final disposition of unwholesome meats, was readily appreciated, especially in view of the dearth of state and municipal sanitary authorities vested with the power for properly disposing of those products. Consequently Congress, by the enactment of March 2, 1895, granted full power to the Secretary of Agriculture to adopt such rules and regulations as would be necessary to prevent the use of condemned carcasses for export or interstate traffic, making it a misdemeanor punishable by a fine not exceeding \$1,000 or imprisonment, in the discretion of the court. The work was rapidly advancing as the inspectors became more thoroughly trained and experienced. New problems and duties were taken up as fast as the previous ones had been elucidated and controlled, and the progress made was highly gratifying. In keeping with this policy of steady conservative progress, the service was extended in 1895 by new legislation to include the interstate cattle inspection, and by 1897 not only all the beef and the greater part of pork and other meat products exported to Europe, but a large amount of meat intended for interstate commerce was inspected in accordance with the law.

Although the legislation of neither 1891 nor 1895 mentioned sanitation, the Department in February, 1906, issued a sanitary regulation demanding the installation of toilet rooms for the employees of the various packing houses and insisting on cleanliness in all official abattoirs. Considerable progress was being made along these lines when the agitation of 1906 drew attention to the unsatisfactory conditions relating principally to canned and prepared meats, the use of preservatives, and the

insanitary condition and methods of the packing establishments, although the Department at that time had no control over such matters under the law. These defects of the law under which inspection was being conducted, had been realized and unsuccessful efforts had been made by the Department to improve the efficiency of the service by new legislation and increased appropriations, but it required the agitation of a sensational press to direct public attention to the inadequacy and defects of the law, which finally resulted in the adoption of the meat-inspection act of June 30, 1906.¹

This act provides that all cattle, sheep, goats, and hogs shall be subject to ante-mortem examinations when the meat thereof is to be used in interstate or foreign commerce, and such animals as are rejected must be slaughtered subject to post-mortem inspection. It further provides for the post-mortem inspection of all cattle, sheep, swine, and goats, the products of which are intended for interstate and foreign trade. Those found fit for human food are marked "U. S. Inspected and Passed," and those carcasses found diseased or otherwise unfit for food are marked "U. S. Inspected and Condemned," and all such condemned meats are destroyed in the presence of a Government inspector. All meats which are marked "U. S. Inspected and Passed" may be reinspected at any subsequent time, and if it has become tainted, unclean, or otherwise unfit for food it must be destroyed. In order that the above slaughtering establishments will be under the supervision of the Government at all times, it is provided that the employees of the Bureau of Animal Industry shall have access to all portions of the plant day and night, whether it is in operation or not. Furthermore, power is granted the Secretary of Agriculture to destroy all food products containing dyes, chemicals, or ingredients which render the meat unfit for food. And all food products handled in any official establishment must be under the supervision of an inspector during their preparation for preserving in cans, tins, pots, or other receptacles. These containers shall then bear a label that the contents have been inspected and passed. Nor are these food products allowed to be sold under any false or deceptive name. The Government is also empowered to have experts in sanitation to make inspection of all establishments, and to prescribe regulations of sanitation to be maintained, and when the sanitary conditions are not satisfactory the meat of such an establishment cannot enter interstate commerce. This act further provides that on and after October 1, 1906, no carrier shall transport or receive for transportation any carcasses, meat, or meat-food products which have not been inspected and marked "U. S. Inspected and Passed," and any person or firm violating any of its provisions may be punished by a fine not exceeding \$10,000 or imprisonment not longer

¹ This law is reproduced on page 127.

than two years, or by both such fine and imprisonment. For the enforcement of this law a permanent yearly appropriation of \$3,000,000 is made. When it is considered that heretofore the yearly appropriations for meat inspection have always been less than requested by the Secretary of Agriculture, and that in the years of the largest appropriations they averaged a little over \$800,000, it will be readily appreciated that a great advance has been made, not only in securing a rational and eminently satisfactory law on meat inspection, but also an appropriation which will permit of its efficient and continued enforcement. And it can no longer be said, as it has been stated in the past, that we are more particular in protecting the people of Europe than our own citizens.

Meat inspection in Canada is only of recent origin. There was no government control maintained in Canada in connection with meat-food products until the necessity for such action was brought to the attention of the people through the meat-inspection agitation in the United States. Then the Parliamentary authorities passed a meat-inspection bill in September, 1907, which provides for a competent meat-inspection service, not alone for the increasing export of meat and meat-food products, but likewise for the control of the meat supply destined for home consumption.

Accordingly, in order to provide a sufficient number of well-trained veterinary inspectors for this work, arrangements were made through the Veterinary Director General for a special course of instruction in meat inspection in one of the veterinary colleges of the United States, located near a large packing center. Thus the Canadian veterinarians were admitted daily to the large abattoirs and were paired with the inspectors of the Bureau of Animal Industry in order that they should acquire a most valuable practical knowledge of the duties required by the Canadian government. At the same time a full course of lectures was given to the students on the scientific aspect of meat inspection.

The requirements for the appointment as veterinary inspector in Canada are practically the same as in the United States. Graduates of recognized veterinary colleges are required to pass a special examination on veterinary branches.

The regulations governing meat inspection in Canada follow the same lines as those in force at the present time in the United States. They provide for an ante-mortem and post-mortem inspection of all food animals slaughtered in an establishment where government inspection is maintained as well as strict sanitation of those establishments. The principles in the judgment of carcasses are also similar to those adopted in the United States meat-inspection regulations.]

XII. Abattoirs and Stock Yards

The supply of meat forms for all communities, especially for large cities, a factor of pronounced economic and hygienic importance. This meat supply is being obtained in more and more abundance from certain central places, in which the largest quantity of meat, the so-called dressed meat, is sold. Such central places are the public abattoirs (slaughter houses), which at the same time form the principal and central points for ante-mortem and post-mortem inspection mentioned in this book. For a more accurate study of the questions and conditions to be considered in the building and equipment of public abattoirs, the reader is referred to special literature on that subject.¹

As the larger abattoirs are frequently connected with stock yards, these stock yards must also be mentioned.

1. Abattoirs

By abattoirs are understood establishments which serve for slaughter of such animals the meat of which is utilized as food for human beings. Further, the meat is roughly prepared there for the market, is stored in the various departments, and frequently also the so-called offal is worked up or is preliminarily treated as well as removed, if further utilization cannot be found. As the use of the abattoir is available for every one, they are designated in general as public abattoirs. With this, as a rule, is usually associated compulsory slaughter or slaughtering in abattoirs. With the latter, the inhabitants of a locality are compelled to carry out the contemplated slaughter of animals of certain species only and exclusively in public abattoirs, provided accidental or emergency cases do not exceptionally require immediate emergency slaughter of an animal at any other place. With the introduction of compulsory slaughter further use of all private slaughtering places which may exist in the locality for slaughtering purposes is accordingly prohibited.

The construction and use of public abattoirs is regulated by law in many German cities.

¹ Among others, Schwarz, Building Equipment and Operation of Public Abattoirs and Stock Yards, Berlin, 1898; Schwarz, Machine Technique for the Operation of Abattoirs, Berlin, 1901; Osthoff, Abattoirs and Stock Yards; newly adapted by Dr. M. Fischer, Professor of the University of Halle a. s., 2d. edition, Leipsic, 1903.

The law applying to abattoirs of the kingdom of Saxony has the following wording:

Law Concerning the Public Abattoirs, of July 11, 1876

1. In localities in which public abattoirs are present in sufficient numbers, or such that are to be established by local statutes, there may be prohibited—

(a) The establishment of new private slaughtering places as well as

(b) A further use of existing private slaughtering places. All such statutory provisions to be made effective, require the approval of the Minister of the Interior.

2. Inasmuch as the owners of private slaughtering places are entitled to indemnities in cases of certain diseases, the latter should be granted by the community.

3. The Department of the Interior is authorized to suspend in whole or in part the statutory provisions enacted in accordance with law if the provisions given in the introductory remarks are no longer present, and if the community does not remedy the existing deficiency inside of a given time; if such conditions apply to a city community with city regulations, a hearing should be given before the District Commissioners; in all other cases, a hearing before the County Commissioners should be taken.

A. Location of the Abattoir

In selecting a location for an abattoir it should be considered that the building should—

1. Be located outside the city, and there should be no indication of it being soon surrounded by other buildings.

2. Easy of access from all points of the city by good roads.

3. Be easily connected by a side track with the existing railroad line.

4. Have underground drainage for the waste water, without coming in contact with the built-up section of the city, and executed in such a way that it should empty below the city into a water drain, or into a constructed waste-water cleaning plant.

5. Have a sufficient water supply to cover the great demand of wash water which is required in abattoirs.

6. Be of such sufficient size that an extension of the plant at that location should be assured for at least 30 years.

B. Entire Establishment

Regarding the location of the various buildings and rooms of an abattoir, there are distinguished three systems in general:

1. The German arrangement of the buildings (Fig. 155) aims to make the plant appear closed as much as possible. Therefore, the most important operating rooms are either united in a single building under one roof, or most of the buildings are connected by roofed connecting

passages, in such a way that larger open courts are not present between the various buildings.

The advantages of the German arrangement of buildings lie in the smaller requirement of space, lower buildings, and operating expenses; good facilities for surveying and supervising, convenient connections of the working establishments, and consequently saving of time in slaughter

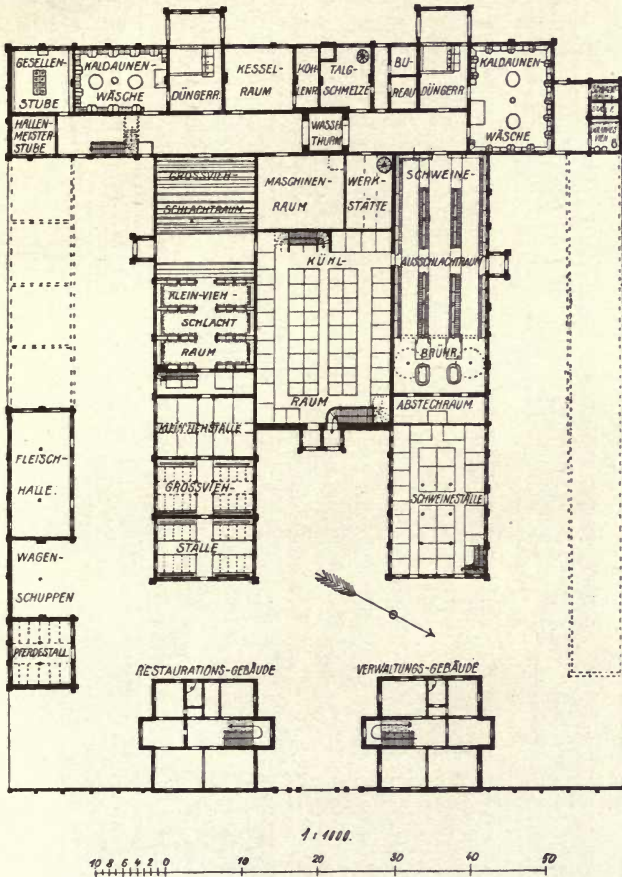


Fig. 155. Ground plan of an abattoir (Tilsit) with German arrangement of the buildings.

and an easy control of the butcher helpers by the foremen, as well as protection against draught, rain, snow, and cold, which such a closed plant affords to a greater advantage than an open establishment. As a disadvantage of the German system stands out prominently the difficulty for extensions, the effect of which, however, may be avoided by correct measuring for the requirements of space, and commodious arrange-

ments of the principal operating rooms. On account of the latter conditions, the German arrangement of buildings is not adapted for abattoirs of larger cities; while on the other hand, it possesses great advantages without a doubt for medium and small abattoirs, as compared with the French system; and above all, it is also more suitable in climatic relations for most parts of Germany.

ageplan. *Städtischer Vieh- und Schlachthof zu Dresden. (Stadtbaurat Hans Erlwein.)*

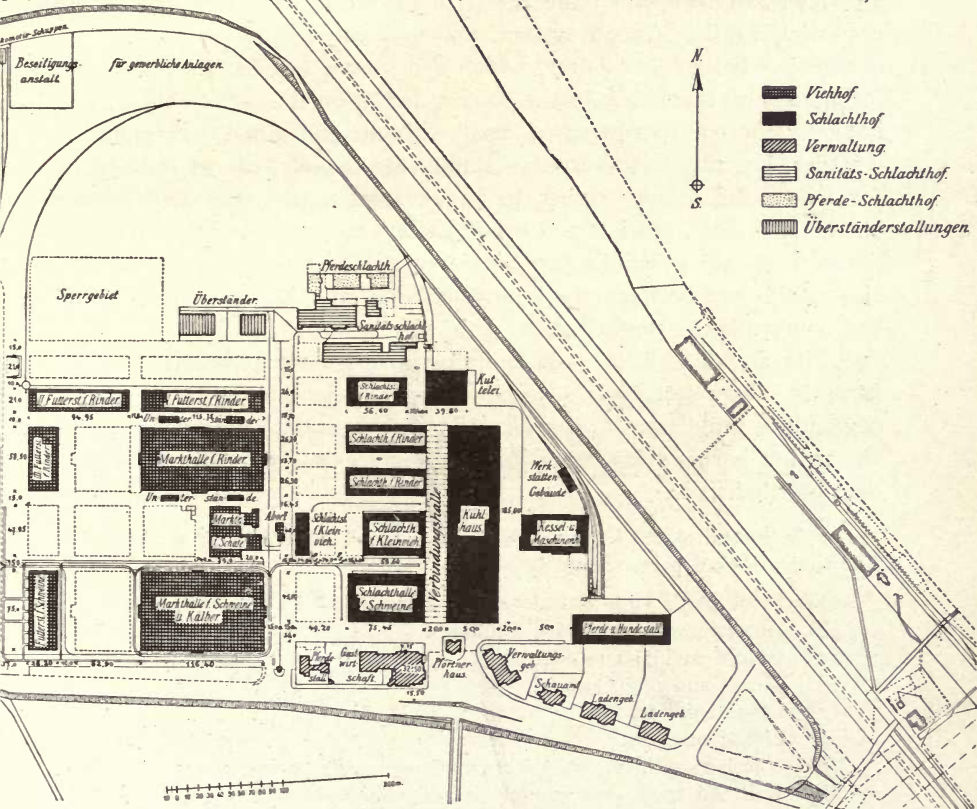


Fig. 157. Ground plan of an abattoir and stock yards, in which the first is arranged in accordance with the combination system.

2. In the French arrangement of buildings (Fig. 156), there are open courts or streets between the various buildings, the grouping of which is arranged according to their operation; thus the closed appearance of the German system is absent.

The advantages of the French system lie, above all, in the easy possibility of extension of every part of the plant; its disadvantages are brought out by the advantages of the German arrangements. Large

abattoir plants can be practically constructed only after the French system, or by the following combination system:

The original characteristic slaughter-cell arrangement of the French system, into which every abattoir was divided, must now be considered as a condition that belongs to the past.

3. As a combination system for abattoir plants (Fig. 157) is designated a system of building which has been more and more adopted in the last few years, in which the principal operating buildings are arranged according to the French system, and connected by roofed passages or connecting halls. The latter, which are found between the various killing houses on one side and the cooling house on the other, make possible not only the transportation of meat without exposure to the changes of weather, but they also serve as stands for the utensils of the butchers, for whom the roofing serves to an advantage, just the same as to the butchers, dealers, officials and other visitors to the abattoir, who frequent the corresponding buildings. Similarly roofed connecting passages are also established between the killing halls on one side and the tripe house and manure house on the other.

The advantages of such building arrangements become apparent from the above description. Disadvantages may be present when the corresponding buildings do not face the connecting passageway with their fronts, but border the same with long surfaces of wall, thereby affecting slaughter halls, etc.

In the central plant of a large abattoir which is connected with stock yards, the following principal parts should be considered:

- (a) Stock yards with special quarantine pens.
- (b) Abattoir with accessory buildings.
- (c) Official and plague abattoir.
- (d) Horse and dog abattoir.
- (e) Office building.
- (f) Living quarters.
- (g) Vaccine establishment (for preparing lymph against small-pox).
- (h) Railroad tracks and station for disposition of railroad cars.
- (i) Provision for sewers and clearing plant for waste water.
- (k) Water-supplying plant.
- (l) Lighting plant.
- (m) Streets and places with roofed wagon-stands.

C. Buildings and Rooms

The required buildings and rooms of every abattoir with their purposes and principal equipments, are obtained from the following:

1. In the killing houses, the animals are slaughtered, skinned or hair removed, eviscerated and inspected; also frequently they remain

there hanging to cool out. While in small abattoirs, a single room may serve for slaughtering all species of food animals, in medium-sized abattoirs cattle and small stock are slaughtered together, while only hogs are butchered in a special room. In large abattoirs, special slaughtering rooms must be provided for cattle, small stock, and hogs.

The slaughtering of horses requires an individual killing house, separated from the others of the abattoir, in which the slaughtering of dogs may also be carried out. In the same way there must be provided a special killing house for the slaughter of sick animals.

Regarding the general equipment of the abattoirs, the following requirements should be fulfilled:

As much light as possible; hard, impenetrable floors; good drainage for the water used in washing, through open shallow gutters; smooth walls which must be easily washed to a height of 2 meters from the floor; a plentiful supply of cold and hot water; abundant ventilation, and according to judgment also slight heating in winter.

(a) In killing houses for large stock windlasses are found particularly necessary for hoisting both cattle and horses. These winches are termed stationary when the slaughtered animal is left to hang on them until cool, and movable when special equipments are provided for cooling the carcass and the windlass serves only for hoisting and transporting the slaughtered animal to the already mentioned hanging floor. The latter, as a rule, is connected with coolers by practically arranged rails and proper transporting equipment in such a way that the undivided hanging sides of large stock may be conveyed to the coolers without exertion.

(b) Killing houses for small stock are characterized by hook-frames built into them for hanging thereon mostly skinned calves and sheep and their viscera. These animals are slaughtered on trestles.

Lately there are also in use special slaughter trestles, which are fastened to the floor and may be raised in such a way that at the same time they also serve for hanging arrangements. Hook-frames are thus made superfluous.

(c) The killing houses for hogs are distinguishable by the sticking and scalding rooms, as well as the dressing room. In the first are present the striking and sticking sheds; also hot-water vats, in which the stuck hogs are scalded in order to facilitate an easier removal of the hair. Sometimes the latter is also carried out on special tables in this room; however, the scraping is frequently executed in the room in which the carcass is dressed. The latter contains hooks on frames or rails for hanging and eviscerating hogs after the hair has been removed; also hanging arrangements and tables for the viscera and other parts.

For the conveyance of hogs from the scalding vat to the scraping table and from here to the hanging floor and chill room, very practical arrangements are frequently installed which save human strength as much as possible.

One of the latest devices belonging here, and which has attracted the attention of abattoir constructors to a great extent, is a patented gliding-rail system, with traversable spreaders, constructed by the firm of Kreiser and Co., in Kassel.

In connection with hog-killing houses of large abattoirs, trichina-inspection rooms are usually established.

2. The tripe room (gut room) is used for emptying and cleaning of the gastro-intestinal canal. In small abattoirs there is only one common room; in large ones, however, there are separate tripe rooms for every slaughter house. The tripe rooms of cattle slaughter houses are most always connected with a special manure house for the reception of the contents of the stomachs. Otherwise the tripe rooms are supplied with troughs for cleaning stomachs and intestines in warm and cold water, with vats for scalding certain parts, and with tables.

3. The equipment and operation of the cooling rooms and coolers, which are to-day inseparable even in small abattoirs, have already been fully described on page 85.

4. Stables must be present for all species of food animals, as well as for horses and draught dogs which are employed in the industrial traffic of abattoirs. For the stabling of sick or suspicious stock, stables located apart from the others are equipped, and they must also be used for stabling foreign food stock.

With regard to the equipment of stables, the omission of wood-work, unpercolating and easily cleaned floors and wall surfaces, good lighting and ventilation, sufficient water supply, and good drainage for the filthy water are indispensable.

5. The manure houses which have given the best satisfaction for the disposition of manure are so equipped that they possess elevated platforms with openings through which the manure is poured or thrown into closed iron manure cars, which are switched there. Especially good ventilation and the quickest method for carrying off the manure are necessary above everything. In large abattoirs practical devices have lately been established for the disposition of the manure and for its further utilization.

6. *Tallow Factories for Rendering Fat and Tallow Obtained in the Abattoir.*—Blood-utilizing plants, stripperies, hide-salting establishments and hide-houses, and plants for the industrial utilization of condemned products are only found in larger abattoirs. An odorless working plant, which may vary greatly, should be required as absolutely necessary.

7. Boiler and engine houses are required in order to obtain steam for heating and operating purposes, as well as for working the engines for operating the refrigerating machines, electric dynamo machines, pumps, etc. The latter convey the water into special tanks placed at some elevation in order to obtain a ready flow for the water supply.

8. As sanitary institutions or police slaughterhouses (official, plague slaughterhouses) are designated the establishments which are present in medium-sized and larger abattoirs, for the separated stabling, slaughtering, sanitary and veterinary police disposition of diseased food-stock and those suspected of disease or plagues. They represent to a certain extent a small abattoir within a larger establishment, and are correspondingly equipped. There are also placed, as a rule, the contrivances for harmless disposition of condemned meat (page 170) required by the meat-inspection regulations, for rendering and steaming meat (page 161), for rendering fat (page 169), pickling (page 169), and for curing meat, as well as the apparatus and plants mentioned under 6.

9. In the official building are quarters for the general and financial management of the abattoir and for the meat and trichina inspection should they be not located in the slaughterhouses proper; wardrobes for the foremen and assistants; the restaurant, if there be no special restaurant building, and living quarters for officials.

Also an inspection office for meat brought from the outside, as well as a Friebank salesroom, may be located in the office building, if they are not placed in other buildings.

10. Special doorkeepers and scale houses are only necessary in medium-sized and large abattoirs.

11. Waste water cleaning plants, for which the most varied systems are in existence, must be provided for all abattoirs in view of the great pollution of the waste water of abattoirs. Their construction naturally is principally underground.

D. Management of the Abattoirs

The experience of many years has demonstrated that the management of abattoirs must be positively effected by the community itself; it is desired to avoid all numerous unpleasant conditions and incidents, which were observed in the management of such establishments at first, by receiving hearty cooperation for the public welfare from private individuals, corporations, and butchers' cooperative associations. Proper veterinarians have always given the best satisfaction as managers of abattoirs.

The same state of affairs exists in the erection of public abattoirs, which are to be managed entirely by local administration. Aside from the noteworthy fact that in public abattoirs the police rights of the com-

munity are exercised to a very great extent, it should be especially considered that the public abattoirs are not only very good investments of capital, but that they are continually proving to be a profitable source of income. But they should principally benefit the community, and not the private individual or corporation.

When an abattoir is not owned by the municipality, nor managed by it, it should be at least required that the experts assigned to the execution of the ante-mortem and post-mortem inspection, as well as the general supervision of employees, should be permanently appointed city officials.

Relative to the supervision and veterinary police work in abattoirs, what is said on page 389 will apply.

2. Stock Yards

Stock yards which serve for commercial traffic in food animals in specially constructed buildings are appropriately equipped. They are an important necessity for all cities which cannot supply their demand for food animals from the immediate surrounding country, but are obliged to draw their demand from larger stock-raising localities. Special favorably located stock yards, or such which are well attended, develop frequently to be central points for animal commerce of large territories; and consequently from such stock yards a considerable amount of shipping takes place.

As a rule, a large proportion of the stock sold at the stock markets is slaughtered at the same place. Therefore it is practical to connect the stock yards directly with the abattoirs, which appears especially of great advantage when it becomes necessary, on account of an outbreak of contagion in the stock markets, for the immediate slaughter of affected stock.

A. Location of Stock Yards

In the selection of a location for the erection of stock yards, the same points of view should be followed as those in the establishment of an abattoir. However, an immediate track connection with a railroad is a natural necessity, and for the above-mentioned reasons the advantage of its connection with an abattoir becomes apparent. Accordingly, stock yards and abattoirs represent mostly a complete establishment both of which are dependent upon each other. A distinct separation of the abattoir from the stock yard in such a way that the one may be closed against the other is indispensable from a veterinary police standpoint, and also on the grounds of its technical management.

There are no special systems for grouping stock yard buildings. This is rather influenced by the location of the various buildings of the abattoir, and especially by the practical points of view. As single parts

of the stock yards there are separated for special purposes: Yards for animals left over from the market; quarantine and plague yards, which, however, in smaller stock yards are mostly represented only as isolated stables.

B. Buildings and Plants

The buildings and plants which belong to a well-equipped stock yard will be briefly described. Regarding their equipment in general, it may be remarked that where in the stock yards a public traffic is maintained, or food animals are brought, they should in the first place satisfy the veterinary police and sanitary requirements in relation to cleanliness and possibility for disinfection (hard, impenetrable floors; smooth, easily washed walls; omission of wood-work; good arrangements for ventilation; good light; abundant water supply, and good drainage for filthy water).

1. Stock which is transported to the stock yards is put up for sale in special market halls, which as a rule occurs only on certain market days. Whether a special hall is provided for every species of food animal depends on the size of the stock yards and the existing trade activity.

At some places calves are also put up for sale in the market hall used for cattle, while in others they are sheltered in the market hall used for hogs; and in still other stock yards there exists special small-stock market halls for calves.

Regarding the equipment of these market halls, railings should be provided in those used for cattle for tying the animals; and in the halls for smaller stock divisions into smaller and larger pens are required for placing the animals. Equipment for feeding stock in the market halls (mangers, troughs, racks) is not necessary in case there is ample stable room present, in which stabling and feeding may take place before and after market.

2. Special value should be placed, from the standpoint of veterinary police, on good and sufficient stables. However, the construction of large attached stable rooms should be omitted and small stable divisions should be favored.

Special stables for horses are required for the horses employed in the business of the stock yards. The stable loft serves, as a rule, as a storage room for feed and straw.

3. An exchange building with restaurant is only necessary in large stock yards. In this building offices and business rooms are also provided for traders, stock commission men, animal insurance companies, stock yard banks, etc.

4. A special office building for the officials and the management of the abattoir is necessary in those instances where the required rooms cannot be obtained in the other buildings (exchange halls, stables).

5. The location of railroad platforms for loading and unloading stock is influenced on the one hand by track connections, but on the other hand the traffic with market stock is considerably facilitated by the suitable location of the stables to the platform.

A special platform, or a separated part of the general platform, must be provided for the traffic of quarantined stock or animals infected with a contagious disease.

On the platforms are holding and counting pens necessary for temporary quarantine of the stock, which should serve also for veterinary police purposes.

Small platforms for loading stock into vehicles are suitably erected at various practical places in the stock yards.

6. A dung yard must be provided when the stable manure is not immediately loaded into cars from special manure houses (page 384). Lately it is aimed however to compound the manure, by which method the vegetable and animal organisms which produce disease are rendered harmless through a development of self-heating manures as a consequence of the process.

7. Equipment for washing hogs (wash pens, vats) and for the preparation of scalded feed and gruels (gruel kitchens), are usually established in connection with the respective stables.

8. The water supply (cold and warm water) of the stock yard is obtained, as a rule, from the corresponding plant of the abattoir.

9. A disinfection plant for railroad cars, with necessary tracks, steam and hot-water boilers, hydrants, etc., are found only in larger stock yards.

10. The above-mentioned part of the stock yard used for animals left over from the market is indispensable for large stock yards at a time of danger from plague. It represents a closed portion of the stock yard with stables for all species of animals which were not sold, for the time being, on the market.

11. The quarantine or closed yards are somewhat similar to those previously mentioned, and are used for the accommodation of market stock from foreign countries which is not allowed to come in contact with native stock.

It is more correct to connect the quarantine yards directly with the abattoir, or to provide an equipment in the yards for slaughtering animals placed in the quarantine pens.

12. The plague yards, as a rule, connect with the sanitary establishment mentioned on page 385, in order that the infected stock may be slaughtered there.

C. Management of Stock yards

The management of stock yards can be conducted in the same manner as has been described on page 385, concerning the management of abattoirs.

Veterinary supervision of the stock yards, as a rule, devolves upon the competent state official veterinarians, if special state veterinarians are not employed for this purpose; or the director of the stock yards is authorized by the government to maintain this supervision, assigning an official veterinarian to attend to the duties.

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Section of a tuberculous udder of a cow with corresponding lymph glands



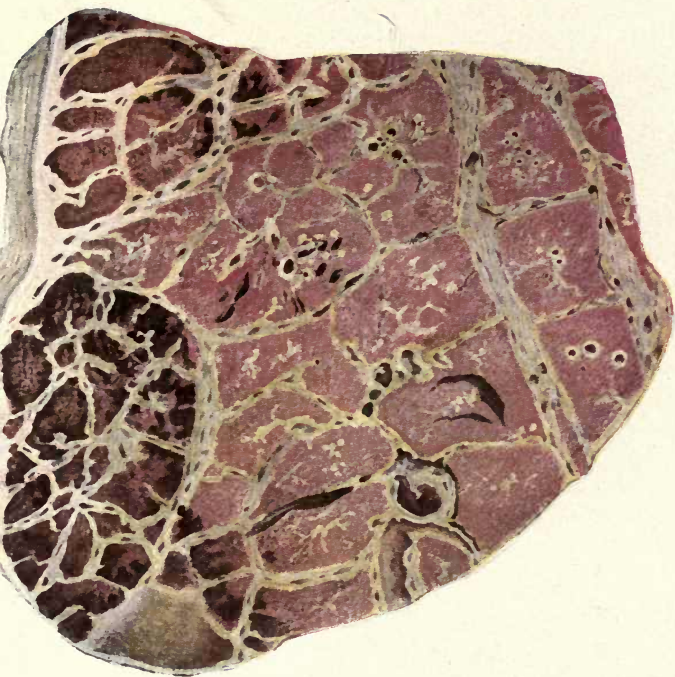


Fig. 1. Section of a beef lung showing contagious pleuro-pneumonia



Fig. 2. Angiomata in a beef liver



Fig. 3. Section of a tuberculous bronchus with a lymph gland from



Fig. 4. Section of a mesenteric lymph node of a cow with tubercle foci.





Tuberculous Liver of Cow





Tuberculous Lungs of Hog



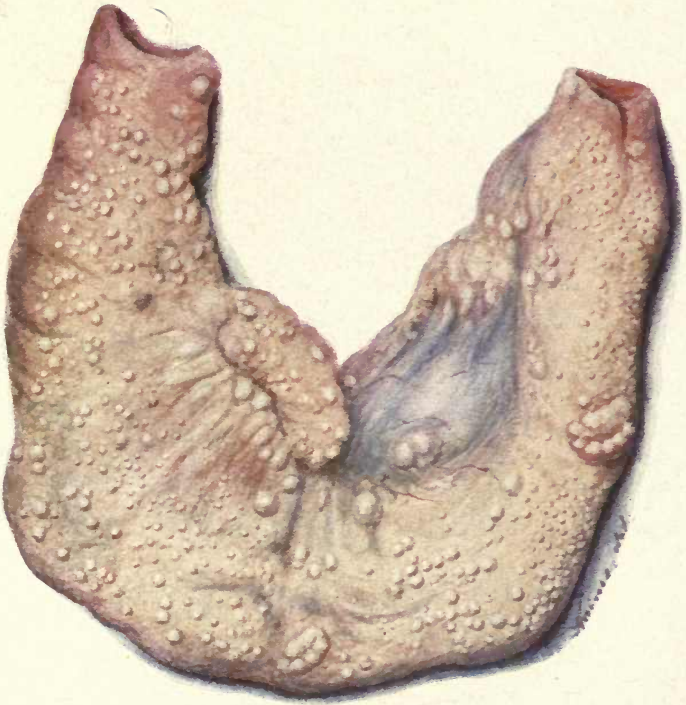


Tuberculous Spleen of Hog



Spleen of Healthy Hog





Tuberculosis of Intestine of a Child, caused by a bacillus of bovine type



Tuberculous Ovary of Cow









Tuberculous Lung of Calf, caused by subcutaneous inoculation with pure culture human tuberculosis



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