other symptoms it is not reliable for diagnostic purposes (Starr).

Vertigo also occurs in many cerebral diseases, such as endarteritis, general paresis, cerebral hemorrhage, cerebral syphilis. If the lesion be cerebral the vertigo is usually slight and transient.

Certain diseases of the eyes cause vertigo, especially ocular palsies. This is sometimes reflex and sometimes, probably, suggestive, the result of the double image. These cases can be relieved by blindfolding one eye, or by rectifying the muscular anomaly when possible.

Suggestive vertigo is seen often in persons who for the first time look down from a great height. It is purely psychic, and not a true vertigo at all.

Aural Vertigo.—This may occur as the result of any diseased condition affecting any part of the ear, from the auricle to the encephalic opening of the internal auditory meatus. It is specially common in labyrinthine disease. There is a type of otitis interna which gives rise to a definite and characteristic variety of vertigo, known as Ménière's disease. Anatomically it consists usually of a hemorrhage into the labyrinth, which may be caused by violence, such as a blow upon the head, or certain operative precedures upon the tympanum, such as mobilization of the stapes (Dench). Politzer says with reason that it is not the hemorrhage, as such, that causes the symptoms, but the effect of the extravasated blood upon certain structures of the membranous labyrinth. Therefore it is possible that there should be a considerable extravasate in the labyrinth without causing vertigo, or, on the other hand, a very small amount might produce it, according to whether or not the ampullar nerves are interfered with.

The true, typical, apoplectic form of this trouble is rare. According to Politzer, Frankl-Hochwart has been able to collect only twenty-seven cases in all the literature. It begins with giddiness, of such degree that the patient falls to the ground. He also suffers from intense nausea, vomiting, marked deafness, and sometimes a subjective noise in the ear like a loud report (Starr), or loud and distressing tinnitus (Politzer). The loss of hearing is usually bilateral. It may or may not be complete, but it is always severe. The course of the disease is to a slow and incomplete recovery. The nausea and vomiting first subside, and then, in the course of ten days or two weeks, the giddiness improves and the patient slowly regains his equilibrium. The deafness, however, persists in very nearly its first intensity, and the gait is apt to be more or less unsteady for months or years. Treatment must be on general principles—cold and local depletion at the outset, with rest in bed, catharsis, and nerve sedatives as required, morphine if necessary. After convalescence is established, a general supporting and building-up treatment is indicated. Politzer recommends potassium iodide, gr. xv. a day for three or four weeks, and also pilocarpine, gr. $\frac{1}{10}$–$\frac{1}{8}$ a day.

The diagnosis of true labyrinthine vertigo rests upon: 1, Its intensity—it is always severe; 2, the accompanying deafness and tinnitus; and 3, the absence of signs of (*a*) cerebral disease, or (*b*) middle-ear trouble. In Ménière's disease the symptoms are usually bilateral; in traumatic cases they may be unilateral. A very interesting case of this sort is reported by Starr. A fireman fractured the base of his skull and tore the left auditory nerve. His chief symptoms were complete deafness on the left side and constant and agonizing sense of rotation of his body on its longitudinal axis, so that if left alone in bed he would roll over and over in the opposite direction to overcome this feeling. He died on the fifth day after his accident.

Other forms of aural vertigo are less severe and less typical. The vertigo that occurs as the result of trouble in the external auditory canal (cerumen, furuncle) is slight and transient. Occasionally chronic aural catarrh will cause a certain degree of vertigo, which may be quite severe. And in chronic suppurative otitis, with cholesteatoma, vertigo may occur at any time as the result of erosion of the external semicircular canal. The writer has seen two such cases, one of which was operated upon by Dr. Whiting, of this city, with complete relief. Vertigo occurring in these cases, at the end of a long period of suppuration, is a dangerous complication, and calls for prompt surgical interference.

It is the firm conviction of the writer that in every case of vertigo, whatever be the history and circumstances, the condition of the ears should be carefully and thoroughly investigated. *Donald M. Barstow.*

VESICO-VAGINAL FISTULA. See *Vagina, Diseases of.*

VETERINARY SCIENCE IN ITS RELATION TO PUBLIC HEALTH.—Veterinary science includes in its domain a complete knowledge of the domesticated animals. It is not limited, as many suppose, to their anatomy, physiology, pathology, and therapeutics, but, in addition to these subjects, it covers zootechnics, or the economical production of animals, veterinary hygiene, or the maintenance of animals under healthful conditions, veterinary sanitary science, or the control of contagious diseases, the exclusion of exotic contagion and the inspection of animal food products. It may be said, therefore, that it is the province of veterinary science, (1) to aid in producing a supply of animal food of the best quality and in the greatest abundance; (2) to protect the sources of this food supply so far as possible from the ravages of communicable diseases; (3) to prevent the use of animal food products contaminated by disease; (4) to guard mankind from the plagues and parasites of animals which may be transmitted to the human subject; (5) to make scientific investigations of animal diseases which will advance our knowledge of these diseases and of general pathology. All of these lines of work operate directly to improve the public health.

The Animal Food Supply.—An abundant supply of wholesome food is necessary for the preservation of the public health; and as the food supply deteriorates in quality or diminishes in quantity the conditions of life become more difficult. Want, distress, and misery result. Following the impoverishment of the body come disease and an augmented mortality. Famine and pestilence are words which the long and bitter experience of the human race has associated together. The scarcity and bad quality of food is felt first and most severely where the population is most dense, and where a large part of the people, at best, have a serious struggle for existence. It follows, of course, that as a country develops and becomes more densely populated, as cities multiply and contain a greater number of people who even in times of abundance must eat inferior food, the effect of deteriorations of the food supply becomes more evident. A nation with an abundant supply of good food is already well on the way to prosperity and healthfulness.

Animal food forms a most important part of the general food supply. The stock of animals maintained in the United States at this time for the production of human food is approximately 17,105,227 milch cows, 44,659,206 other cattle, 63,964,876 sheep, 46,922,624 swine, and 250,681,593 fowls of various kinds. The raising, marketing, and slaughtering of these animals, and the production of the milk, butter, and cheese involve many problems which the veterinarian can solve, or at least should help to solve. And just as the increasing density of the human population brings new problems to the health officer and sanitarian, so an increase in the number of animals and the change from natural to artificial conditions bring new problems to the veterinarian. When animals are allowed to roam over large tracts of land, seldom or never stabled, and not pressed for the largest attainable product, when traffic between different sections of the country is at a minimum, the animals are found in the most vigorous and healthful condition. On the other hand, when animals are crowded together, stabled, fed to their highest capacity, and become a subject of traffic, disease and parasites multiply; questions of ventilation, of general sanitary methods, of proper feeding, of protection from contagion and parasites arise and become more and more urgent.

The quantity of animal food consumed in the United States cannot be very accurately estimated. Under the federal meat inspection service there were slaughtered in the year ending June 30th, 1902, 6,115,805 bovine animals, 7,434,478 sheep, and 25,277,107 hogs. In addition, many of the same kinds of animals were slaughtered for local consumption or in establishments where no inspection has been instituted. There is no systematic inspection of poultry at the time of slaughter, but the production of an abundant supply of poultry and eggs must depend somewhat upon the preservation of fowls from contagious diseases, and the knowledge through which this is to be accomplished must come from veterinary sanitary science.

The quantity of milk in its natural condition consumed in the United States is about 21,751,258,560 pounds, of condensed milk 172,647,355 pounds, of butter 1,465,299,727 pounds, of cheese 278,538,146 pounds.

These figures show the enormous extent to which animal products enter into the food supply of the country, and they indicate the importance of establishing safeguards which will make it reasonably certain that such products are wholesome and will not prove a source of disease to the consumers. Dairy cows should be inspected from time to time to determine that they are free from disease, and especially that they are free from diseases communicable to man. Dark, unventilated, damp, and filthy stables should be abolished, and it should be insisted that animals be kept under hygienic conditions. Milk is too often sold from cows suffering from tuberculosis, actinomycosis, metritis, mastitis, and other diseases which may seriously affect its quality.

It is equally important that animals should be inspected at the time of slaughter. A certain proportion of diseased animals will be found even among those which superficially appear the most healthy. It is a common practice to ship to market animals which no longer thrive on the farm; and while in many cases the owner does not know what ails them, it often happens, as with hogs affected with cholera, that they are shipped to market because they are known to be infected, and that the losses among them will be heavy if they are retained upon the farm. In addition to the animals diseased when they leave the farm, there are many which become bruised, wounded, crushed, and otherwise badly injured in transit. Some of these when they reach the abattoirs are suffering from abscesses, septic infection, abortion, and various other pathological conditions the result of injuries. These conditions can, of course, be recognized and graded as to their seriousness only by the trained veterinarian.

The Protection of Animals from Infectious Diseases.—Probably the most important line of work for preserving the food supply both in quantity and quality is that which controls, eradicates, and excludes the contagious and infectious diseases of animals. This is particularly necessary at the present time, when transportation routes and means of communication between all parts of the world have multiplied, when facilities for shipping animals and animal products have been greatly increased, and the time required to bring these from the most distant part of the world has been enormously diminished. We have reached a degree of development in these matters when it may be said that the time of transit is no longer a protection against the importation of contagion from the most distant countries.

As the veterinarian examines the condition of animals in other countries he finds that Asia, the Philippines, and Africa are overrun with rinderpest, that most deadly of all cattle diseases. He finds the contagious pleuropneumonia of cattle in Asia, Australia, Africa, and in several countries in Europe. He finds epizootic aphtha, or foot-and-mouth disease in Europe, Asia, and South America. He finds surra in India and in the Philippines. He finds Texas fever in most warm countries of the world, including South Africa, Australia, South and Central America, the West Indies, Mexico, and the southern parts of the United States. He finds sheeppox, scabies, anthrax, hog cholera, and various other destructive diseases widely disseminated throughout the world. The country must look to him to exclude such diseases, which would not only diminish the food supply, but which would increase the proportion of diseased animals coming to the abattoirs.

The United States, fortunately, has been free from some of the worst of these plagues, but distance is no longer the barrier that it has been in the past, and active measures are now required against them. Europe has again and again suffered the most terrible losses from invasions of this character. And at this writing, foot-and-mouth disease has been prevalent in most of the countries of continental Europe for more than fifteen years. Considering the large number of live animals of various kinds which annually enter the United States from abroad, including domesticated animals, menagerie animals, and those for zoological parks, pets, etc., also, the enormous quantities of wool, hides, and hair imported, it is plain that there are many channels through which contagion may be carried.

Within the last year there has occurred, in the New England States, an outbreak of foot-and-mouth disease which started near the docks of Boston, undoubtedly from imported contagion, and which has been stamped out only by the most prompt and rigid measures. With this disease in South America threatening us from the south; with rinderpest in our Philippine possessions; with foot-and-mouth disease and pleuropneumonia still existing in Europe, it is plain that nothing less than constant vigilance can preserve our flocks and herds from these plagues.

The measures adopted in the United States for excluding exotic contagion consist of an inspection of all susceptible animals, the quarantine of ruminants and swine which come from infected countries, and the disinfection of the hides of neat cattle. The period of quarantine varies from fifteen to ninety days, the animals being held in the regularly established quarantine stations of the Government. Cattle imported for breeding purposes must be tested with tuberculin to guard against tuberculosis. An inspector from the United States is now stationed in Great Britain to make such tests before the animals are purchased, as it has been found that a very large percentage of some of the principal British breeds are tuberculous. On the other hand, animals from the Channel Islands have been found free from tuberculosis and are no longer tested.

The measures for controlling contagion within the United States consist of an inspection at the principal stockyards, and at other convenient points for supervising the interstate traffic. This inspection is maintained by the Federal Government and has for its object at present the control of Texas fever of cattle, scabies of sheep and cattle, and hog cholera. In addition, many of the individual States and municipalities maintain a service for the repression of glanders, tuberculosis, rabies, Texas fever, scabies, and other diseases of the domesticated animals.

The Protection of Mankind from the Communicable Diseases and Parasites of Animals.—That there are certain diseases of animals which are communicable to man has long been known. There are also parasites of animals which likewise may be communicated and which produce results more or less serious according to the species of parasite which is involved. Among the most common of these diseases and parasites are: (1) Glanders, a disease of the genus *Equus*, generally fatal when contracted by man; (2) anthrax, a disease of horses, cattle, sheep, and swine, appearing in man either as malignant pustule or as internal anthrax, and often fatal; (3) tuberculosis, a disease common in cattle and swine, but also occurring in horses, sheep, goats, dogs, poultry, cage birds, and menagerie animals; (4) rabies, a disease of the genus *Canis*, communicable to all warm-blooded animals and to man; (5) epizootic aphtha, commonly known as foot-and-mouth disease, a very infectious malady of cattle.

sometimes communicated to the consumers of the milk of diseased cattle; (6) *Cysticercus bovis*, found in cattle, is the larval form of the tapeworm of man known as *Tænia saginata*; (7) *Cysticercus cellulosæ*, found in swine, is the larval form of the tapeworm of man known as *Tænia solium*; (8) the *Trichina spiralis*, a common parasite of swine, may develop in man and sometimes produces fatal results; (9) the *Echinococcus* found in the lungs, liver, and other organs of the meat-producing animals is the cystic phase of the *Tænia echinococcus* of the dog.

It is evident that the most satisfactory way of protecting man from this source of danger is to eradicate these diseases and parasites so far as possible from the domesticated animals. Hence all veterinary sanitary work having this object in view has a direct bearing upon the public health. As complete eradication cannot be accomplished for many years and in some cases not at all, there must be constant efforts for repression and control. People must be made familiar with the dangers; too close association with animals should be avoided; the inspection of meat and of dairy cows should be universal; swine flesh should be well cooked; hides, wool, and hair, often infected with the anthrax bacillus, should be handled with suitable precautions; biological products used for the prevention or cure of human diseases should be surrounded with every safeguard to avoid contamination.

Investigation of Animal Disease as to its Influence on Human Pathology.—The investigation of the diseases of animals, and experiments conducted upon animals, have done much to advance the knowledge of pathology and therapeutics. The use of cowpox virus to vaccinate against smallpox has been of inestimable value for the control of this scourge of the human race. The existence of glanders and rabies in man has been proved by the successful inoculation of susceptible animals from suspected cases of these diseases in the human subject. The study of silkworm disease and anthrax in animals established the germ theory of contagion.

Investigations of the fowl-cholera microbe first proved that a virulent virus might be artificially attenuated to such a degree that it might be used as a vaccine to prevent disease. Experiments with the toxin developed by the bacillus of hog cholera showed that immunity might be developed by the use of such toxins. This conclusion revolutionized the prevailing ideas of immunity, and led to the researches which gave us the knowledge now possessed relative to toxins, antitoxins, and the nature of immunity. The study of Texas fever in cattle showed that the protozoan organism causing the disease was dependent upon the cattle tick (*Boophilus annulatus*) for one stage of its existence and for its conveyance from animal to animal. Later investigations brought out the fact that certain diseases of man, such as malaria and yellow fever, likewise required two distinct organisms for their production. The study of tuberculosis in animals directed attention to the communicability of the disease, and comparative inoculations of animals have demonstrated that the bacilli from certain human cases were identical with bovine bacilli. Doubts as to the transmission of tuberculosis from animals to man have thus been removed.

These instances are referred to as illustrations of the close relation between human and veterinary pathology, and of the influence of the latter upon the development of the former. It has been well said that human and veterinary medicine are not merely sister professions, but they are sister branches of the one great profession of medicine. The closer the relations existing between these two branches of the medical profession, and the more each utilizes the knowledge of the other that may be applicable to its work, the more successful will be our efforts for the amelioration of suffering, the prolongation of life, and the uplifting of humanity.

The limits of this article are such that it is not advisable to attempt a complete description of the several diseases of animals liable to be communicated to man or injuriously to affect his food supply. There are, however, important questions connected with these diseases which should receive consideration, and if the author in confining himself to such subjects as he deems essential, has produced an article that appears incomplete, it should be remembered that many topics which might have been introduced here are discussed elsewhere in this HANDBOOK by other writers.

TUBERCULOSIS OF ANIMALS.

General Characters.—The disease caused by the *Bacillus tuberculosis* affects a wide range of animal life, and is especially seen outside of the human subject, in the various species of the monkey tribe, in most kinds of menagerie animals, including mammals, birds, and reptiles; in all the domesticated animals, but more particularly in cattle, swine, and poultry; in cage birds; and in frogs and fishes. Taken from such widely different sources the bacilli are found to differ considerably both morphologically and biologically. For example, the temperature limits within which the mammalian bacillus may grow are approximately 86° to 105.8° F.; the avian bacillus, however, may multiply in temperatures all the way from 77° to 113° F.; while the reptilian and piscine bacilli have been observed to multiply in those from 50° to 98.6° F. Notwithstanding these biological differences the mammalian bacillus has been so modified that it has acquired the piscine and reptilian characteristics; and the avian has been made to take on the mammalian characteristics. The modifications which have been noticed by various investigators relative to the length, breadth, smooth or beaded form, and appearance of the colonies on various media, are not entirely constant in the bacilli obtained from the same species of animals and change very materially on different culture media. While these characters may aid in determining the source of a given bacillus they are not absolutely certain in their indications.

The avian type of tuberculosis is not readily communicated to any mammalian species and probably is very slightly if at all dangerous to man. Parrots and small birds, however, contract mammalian tuberculosis, and this is sometimes very virulent for mammals, and is believed to be dangerous for the persons who are closely associated with them. There is considerable difference between the bacilli that are generally obtained from the human subject and those derived from bovine animals. This relates both to the morphology and to the virulence. We, therefore, often speak of the human and bovine types of bacilli. Swine are most frequently found affected with the bovine type. The constancy of these types is doubtful, but in certain instances a given strain of bacilli has been known to retain its characteristics for a long time (one or more years) after being transferred to a different species of animals.

Bovine animals are the ones most frequently found tuberculous, and they are probably in most cases the source of the disease in the other domesticated species. Bovine tuberculosis has therefore attracted more attention than that of other animals and is most interesting to the sanitarian. Many points relative to this disease have been in doubt, but the investigations of recent years have added much to our knowledge of it, and we are now in a position to speak positively in regard to the principal questions at issue.

Distribution and Prevalence.—Bovine tuberculosis is a disease widely distributed and of great frequency in certain countries. Slaughter-house statistics of Prussia show 16.6 per cent. of the cattle and 2.41 per cent. of the swine to be tuberculous; in Saxony the percentage is 29.13 with cattle and 3.10 with swine; in the city of Leipsic there were found 36.4 per cent. with cattle and 2.17 per cent. with swine. Of 20,850 bovine animals in Belgium tested with tuberculin in 1896 48.88 per cent. reacted. Of 25,439 tested in Denmark from 1893 to 1895 49.3 per cent. reacted, and of 67,263 tested from 1896 to 1898 32.8 per cent. reacted.

The condition of Great Britain in this respect is particularly interesting because most of the animals imported for improving the stock of the United States are of British origin. The returns from testing British cattle with tuberculin, supplied by the Royal Veterinary College, as stated in March, 1900, showed that among 15,392 animals tested, 4,105, or 26 per cent., reacted. Of 300 head killed near Edinburgh for pleuropneumonia, 120, or 40 per cent., were tuberculous. Of 4,160 killed in England for the same reason, 20 per cent. were tuberculous. Of 398 bovine animals taken haphazard in the city of Manchester, 120, or 30 per cent., were tuberculous. The testing of the Queen's herd at Windsor showed that 36 out of 40, or 90 per cent., were tuberculous. The British Dairy Farmers' Association made investigations in 1899 with a view to some more definite understanding as to the possible extent to which tuberculosis exists in dairy cattle. Nine herds were selected for testing, and these contained 461 cows and 12 bulls. Of these animals 188, or 40.8 per cent., reacted.

During the years 1901 and 1902 a veterinary inspector has been stationed in Great Britain by the Bureau of Animal Industry, whose duty it is to test animals which are to be exported to the United States. In 1901 there were tested 720 animals, of which 74, or 10.28 per cent., reacted. In 1902 the animals tested reached the number of 935, of which 156, or 16.68 per cent., reacted. Curiously enough but one reaction was obtained, and that of a doubtful character, among 377 cattle from the islands of Jersey and Guernsey, but 99 cattle of the Jersey and Guernsey breeds which had been in the herds of Great Britain gave 34.3 per cent. of reactions. Some breeds appear to be much more seriously infected than others. Thus, of 42 British Jerseys 54.76 per cent. reacted; of 362 Aberdeen-Angus 28.73 per cent. reacted; of 33 Ayrshires 24.24 per cent. reacted; of 228 Shorthorns 23.25 per cent. reacted; of 36 Galloways 16.67 per cent. reacted; while of 428 Herefords but 3.97 per cent. reacted.

It is especially unfortunate that tuberculosis has developed to this extent in the principal British breeds and is allowed to continue its propagation. These breeds are the best in the world, and are sought for to improve the native cattle of various parts of the world. They are particularly in demand in the United States, and as might be expected they have carried tuberculosis wherever they have gone. From Australia, Argentina, and Canada we have similar accounts of the importation of British cattle and the spread of bovine tuberculosis. The United States Government has endeavored to exclude tuberculous cattle by requiring a tuberculin test. For British cattle this is made by a United States inspector located in Great Britain, and for Canadian cattle it is made by the officials of the Dominion Government.

State.	Number tested.	Number tuberculous.	Per cent. tuberculous.
Vermont	60,000	2,390	3.9
Massachusetts	24,685	12,443	50.0
Massachusetts, entire herds	4,093	1,080	26.4
Connecticut	6,300	....	14.2
New York, 1894	947	66	6.9
New York, 1897-98	1,200	163	18.4
Pennsylvania	34,000	4,800	14.1
New Jersey	2,500	....	21.4
Illinois, 1897-98	929	....	12.0
Illinois, 1899	3,655	560	15.32
Michigan	....	....	13.0
Minnesota	3,490	....	11.1
Iowa	873	122	13.8
Wisconsin: Experiment station tests—			
Suspected herds	323	115	35.6
Non-suspected herds	935	84	9.0
State veterinarian's tests—			
Suspected herds	588	191	32.5
Tests of local veterinarians under State veterinarian on cattle intended for shipment to States requiring tuberculin certificate	3,421	76	2.2

The percentage of the cattle in the United States affected with tuberculosis has not been accurately determined, and most of the herd tests have been made where there was reason to suspect the existence of the disease. The statistics of such tests show a higher percentage of reacting animals than would the average of all the cattle in the respective States. From a recent review by Drs. Russell and Hastings, of the Wisconsin Agricultural Experiment Station, of the tests of cattle which have been made in the United States, the preceding summary is presented.

The beef cattle coming to our markets are still quite free from tuberculosis. Of 5,559,969 cattle slaughtered during the year 1902, but 8,096, or 0.14 per cent., were sufficiently affected to cause the condemnation of carcasses or of parts of carcasses. Of 25,277,107 swine inspected at slaughter in the same year, 19,627, or 0.077 per cent., were so affected as to cause condemnation of either a part or the whole carcass. This is approximately one-half the proportion found in beef cattle. The inspection statistics show that the percentage of condemnations with both cattle and swine is increasing from year to year.

With hogs tuberculosis is a disease generally contracted from the ingestion of infected food, and hence, as the disease is allowed to spread among cattle, it will become more frequent with the hogs that follow the cattle in the pastures or that eat the skim milk, buttermilk, and other waste products of the dairies. The disease is more acute with swine and has a greater tendency to generalization than with cattle, and consequently there is more danger of the meat containing the bacilli.

Tuberculosis is not pre-eminently a disease of poor, neglected, underfed scrub cattle, as some have supposed, but on the contrary its ravages have been seen more particularly among the better class of cattle. This is accounted for by its introduction and spread through imported, pure-bred stock which entered and infected many of the best herds in the country. From these herds of improved stock it has extended to the dairy herds and common cattle.

A brief list of infected herds which have been carefully studied is inserted to show the extent to which the disease develops and the difficulty of building up a herd of good cattle under the best conditions and keeping it free from this disease:

Herd of	Number in herd.	Number tuberculous.	Per cent. tuberculous.
Soldiers' Home, Washington, D. C.	63	53	84
Massachusetts Agricultural College	32	25	78
New Jersey Agricultural Experiment Station	42	25	60
Vermont Agricultural Experiment Station	33	21	64
Ohio Agricultural Experiment Station	30	14	46
Texas Agricultural Experiment Station	21	10	48
Wisconsin Agricultural Experiment Station	30	26	86
Kansas Agricultural College	56	15	27
Government Hospital for the Insane, Washington, D. C.	102	79	77
Maine Agricultural Experiment Station*	..	..	..

* So badly diseased that entire herd was slaughtered in 1886.

DIAGNOSIS OF TUBERCULOSIS IN ANIMALS.—*The Tuberculin Test.*—The diagnosis of tuberculosis in animals by an ordinary clinical examination during life is in most cases difficult and often impossible. When cough, marasmus, enlarged glands, and râles are found in cows it is not difficult to reach a conclusion, but such cases are exceptional. Many cows, which show no symptoms of disease during life, are found on post-mortem examination to be seriously affected. This is even more likely to be true of breeding animals of the beef types. In hogs this disease is rarely recognized during the life of the animal.

The discovery of tuberculin and of its power to produce a rise of temperature in tuberculous individuals has

been of the greatest value to the veterinarian in diagnosing the tuberculosis of animals; indeed, it may be said that the use of this agent is essential to the control and eradication of this plague. There is a consensus of opinion that every animal which reacts is tuberculous; but it must be understood that every rise of temperature is not necessarily a reaction. There may be other causes acting to increase the temperature during the same period that an increase would be expected from the tuberculin. It requires some skill to decide correctly as to what constitutes a reaction. The principal points considered are: (1) the initial temperature should not be abnormally high —not over 102.5° F.; (2) to constitute a reaction the rise should be not less than 2° F.; (3) the temperature should go above 104° F.; (4) the rise and fall of the temperature should be gradual so that when charted it shows the tuberculin curve.

Some animals which have tuberculosis do not react to tuberculin. These are generally in such an advanced stage of the disease that a diagnosis by other means may be made, or they are cases in which the disease has been arrested and the lesions are calcified or encysted. A tuberculous animal, which has already received one or more doses of tuberculin, may fail to react for this reason, particularly if the drug has been administered within two or three months. Some cattle owners use tuberculin in this manner to prevent cows reacting on an official test, and it is alleged that breeders in Great Britain have administered antipyretics to accomplish the same purpose.

Tuberculin may be used for diagnosing tuberculosis in all species of animals, and is especially valuable for the selection of experimental animals which are free from this disease.

In making the tuberculin test the temperature of the animal to be tested is first taken at intervals of two or three hours for a sufficient length of time to establish the normal temperature of the individual under the ordinary conditions of life. The proper dose of tuberculin is then injected under the skin with a hypodermic syringe. This injection is usually made late in the evening and the temperature is taken every two hours the following day, beginning early in the morning and continuing until late in the evening if a complete record is desired. From a study of a large number of such records it appears that in general the rise of temperature begins from five and one-half to six hours after the tuberculin is injected, reaches its greatest height from the sixteenth to the twentieth hour, and then gradually declines, becoming normal again by the twenty-eighth hour.

It has been charged that tuberculin is injurious to the animals upon which it is used, causing shrinkage of the milk, abortion, and aggravation of this disease. The evidence brought forward is not sufficient to sustain these assertions. Those who have had most experience in testing cattle are of the opinion that tuberculin is harmless in the dose used for this purpose. Abortion is common with dairy cows and would occur sometimes after the tuberculin tests as a mere coincidence. The milk secretion of cows may also be reduced by the excitement incident to taking the temperature, particularly if this is done by persons who are strange to them. It is possible that in some cases tuberculosis is aggravated by the tuberculin test, but in general no effect of this nature is observed with cattle. It may be concluded, therefore, that tuberculin, as used for testing cattle, has no appreciable effect upon the general health of the animals, and that it may be used without hesitation whenever it is desirable to know whether any animals in a herd are affected with tuberculosis.

Hereditary or Congenital Tuberculosis.—Tuberculosis is generally contracted by contagion from animal to animal, but a small proportion of calves are affected before birth. There are few statistics which indicate accurately the proportion of cases in which the disease is thus transmitted. Siedamgrotzky has compiled statistics from the slaughter-house returns in Saxony, from which the following data are taken:

SLAUGHTER-HOUSE STATISTICS OF SAXONY.

Year.	PER CENT. TUBERCULOUS.	
	Calves.	Adult cattle.
1895	0.24	27.48
1896	.21	26.72
1897	.26	29.13

This table indicates that in a country where about twenty-seven per cent. of the adult cattle are found to be tuberculous, approximately 0.25 per cent. of the calves are tuberculous. If we admit that fifty per cent. of the cows have the disease, we should arrive at the conclusion that one-half of one per cent. of the calves from tuberculous mothers are affected at the age of slaughter. It would be difficult to say what proportion of these contracted the disease from the mother's milk after birth, but probably the greater part of such cases are congenital. The small proportion of calves from tuberculous mothers which suffer from hereditary tuberculosis has made it desirable in certain cases to allow breeding from valuable cows which have the disease. If the calves are taken from the mothers after feeding once or twice upon the mother's milk and are afterward fed with milk of sound cows, experience shows that not over one or two per cent. at most are afterward found to have the disease.

Tuberculosis of the Udder.—Only a small proportion of the cows which react to tuberculin have lesions of tuberculosis in the mammary glands. Siedamgrotzky's summary of the slaughter-house statistics of Saxony from 1888 to 1897 covers 70,156 tuberculous cows, of which 1,040, or 1.4 per cent., had tuberculosis of the udder. The same authority states that Röckl found 1.62 per cent. of udder lesions among tuberculous cows in Germany. It would seem, therefore, that we might assume that in round numbers 1.5 per cent. of cows reacting to tuberculin may be expected to have lesions in the mammary glands. This subject is of considerable importance, because it has been assumed by some writers that the milk of tuberculous cows was dangerous only when the udder was directly involved; and evidently the milk must be more dangerous when there are such local lesions than when the tubercles are confined to other parts of the body.

Proportion of Reacting Cows in which the Milk is Virulent.—It has often been held that the milk of tuberculous cows is free from infective qualities until the mammary glands become affected. Numerous experiments have been made with the milk from reacting cows, some of which have given negative results, but in others it has been shown that from ten to sixty-six per cent. of the reacting cows gave virulent milk even when no lesions of the udder could be detected. In a recent investigation made by the pathological division of the Bureau of Animal Industry with fifty-six reacting cows it was found that twelve of these, or 21.4 per cent., at one time or another during the experiment gave milk which contained virulent tubercle bacilli. Taking all the researches on this subject, it is clear that the proportion of reacting cows giving infective milk is very much larger than the percentage of udder tuberculosis in tuberculous animals. The bacilli must, therefore, find their way to the mammary glands from the other organs of the body where the lesions are developing, and, passing through the capillary walls, gain access to the milk ducts.

Transmission of Bovine Tuberculosis to Man.—There has been much discussion over the question of the transmission of animal tuberculosis to man. Previous to the discovery of the tubercle bacillus there was much doubt as to whether the tuberculosis of cattle and human tuberculosis were identical. But when it was shown that each was produced by the *Bacillus tuberculosis*, there was a general disposition to accept the identity of the disease in the two cases and admit that it was communicable in either direction. Experimenters found, however, that

the tubercle bacilli, as observed in different species of animals, varied considerably in their biological characters, and that it was difficult to transfer them, by inoculation, from some species of animals to others. It was shown that inoculations of cattle with the sputum of tuberculous persons generally failed to produce serious results, while similar inoculations with tuberculous material from bovine animals were generally fatal. There was a disposition on the part of some authorities to conclude that there might be a difference between the tuberculosis of man and that of cattle, and that it was doubtful if the disease could be transferred either from the human subject to cattle or from cattle to man. These suppositions culminated in the address of Koch at the British Congress on Tuberculosis held in London in 1901.

In this memorable address Koch held, from the results of his experiments, that human tuberculosis could not be communicated to cattle, and that if bovine tuberculosis was communicated to man this was only to an insignificant extent, the cases occurring from this source not being greater, in his opinion, than those from hereditary tuberculosis.

Numerous experiments have since been made to determine this point, and it has been found that tubercle bacilli from human subjects vary greatly in their virulence and power to cause disease in cattle. A number of investigators have succeeded in isolating bacilli from human material which were as virulent for cattle as were the bacilli obtained from the bovine subject.

A German commission was appointed to investigate this question, and the results of its experiments have recently been made known by Kossel. This commission has been more successful in producing tuberculosis in cattle with bacilli from human sources than was Koch in his experiments upon which his London paper was based. Altogether, cultures from 39 cases of tuberculosis in man were tested according to the principles laid down by Koch. He concluded that human tuberculosis was not communicable to cattle, and that therefore if cattle were inoculated subcutaneously with cultures of bacilli from human subjects and a progressive and fatal disease was produced, this would demonstrate that the person had been infected with bovine bacilli. Of the 39 cultures tested, 19, or a little less than 50 per cent., did not produce the slightest symptoms in cattle. Nine cattle exhibited, in the prescapular glands, after the lapse of four months, foci which were mostly encysted, and which in any case showed no inclination to develop. In 7 of the cases more marked disease of the prescapular glands occurred, but there was no considerable extension of the process to the adjoining glands. Four of the cultures, all of which were from children, caused generalized disease in the cattle upon which they were inoculated. These cultures were so virulent for cattle that they were considered as having been originally bovine bacilli. As there were 16 cultures of tubercle bacilli from children tested, and 4 of these had the virulence for cattle of the bovine bacillus, it is evident that 25 per cent. of the cases of tuberculosis in children investigated by this commission were due to bovine infection, according to the test proposed by Koch. On the other hand, no bacilli were found among the 23 cultures obtained from adults which were virulent for cattle. The experiments made by this commission and by other investigators apparently settle the question of the transmission of bovine tuberculosis to children, and indicate that this occurs with considerable frequency, and that measures should be taken to guard against it.

RABIES.—Rabies is a contagious disease of dogs in which the saliva is virulent, and the contagion is communicated from animal to animal by biting. The human species, and nearly all species of animals, are susceptible to this disease and contract it when inoculated. The disease is not communicated otherwise than by direct inoculation.

This disease appears to have been known from the earliest historical times, and has been referred to with such detail as to manner of transmission and symptoms that there can be no doubt as to the identity of the disease with that which is now known under this name. There have been numerous cases recorded in which the disease spread among wolves, and these animals became so savage that they attacked human beings and caused many cases of rabies in man. Notwithstanding the length of time during which the disease has been described, there have been many who doubted its existence, and especially doubted its being communicated to the human subject. These people explain the deaths of persons following bites of rabid dogs by attributing them to nervous troubles produced by fear. Questions relative to the nature and identity of rabies were in much confusion until the subject was taken up by investigators and studied experimentally.

Zinke in 1804, and Count Salm-Reiferscheid in 1813, recorded successful experiments in the communication of rabies from animal to animal by inoculation. From 1836 to 1860 Renault and Rey in France made many successful inoculations, demonstrating that this was a specific disease, and that the period of incubation might vary from ten days to over one hundred days. Magendie, Earle, Hertwig, Renault, and others made successful inoculations from man to animals, proving that the human subjects were affected with this specific disease, and that the contagion could be reinoculated into animals, such as dogs and rabbits, and reproduce the disease in them. In Magendie's case the dog which was inoculated from the human subject was allowed to bite two other dogs, which in turn became rabid after forty days. It was consequently demonstrated that rabies is communicable to man as well as to animals, and that the saliva becomes virulent with man as it does with the lower animals. The value of rabbits for making the biological tests of rabies was pointed out by Galtier in 1879, and by Pasteur a few years later. The investigations of Pasteur (1881) showed the constant virulence of the brain and medulla, and that these organs, being protected from saprophytic germs, furnished a pure virus which might be used for biological tests. He also showed the value of the method of inoculating upon the surface of the brain, in which case the disease was transmitted with great certainty and the period of incubation was reduced to a minimum. This method of inoculation has been of much value to investigators in saving time and in making their results more accurate.

Notwithstanding the experimental demonstration that rabies is a specific disease and can be easily transmitted by inoculation from animal to animal or from man to animal, there are still physicians who express doubts as to the existence of the disease. Those who oppose the enforcement of measures for reducing or eradicating the disease in dogs support their position by quoting the sceptical opinions of such physicians, and are often able to counteract the efforts of sanitarians to lessen the evil. It has been alleged that disease with the symptoms of rabies could be produced in animals by inoculating them in the surface of the brain with various inert substances, and the conclusion was drawn from this that the disease produced when inoculating from brain to brain of supposedly rabid animals was a non-specific disorder of the nervous system. This rather far-fetched conclusion never had much foundation in fact, and has been completely disproved. It is impossible to produce a disease having the period of incubation and symptoms of rabies by inoculating with inert substances, and the disease which is produced in that manner is not communicable from animal to animal, neither is such disease accompanied by virulent saliva, nor can it be reproduced in dogs and cattle by inoculating subcutaneously with the saliva or with portions of the medulla, as can be readily done with rabies. The scientific demonstration of the existence of rabies as a specific disease is as complete as has been made in the case of any other disease, and it is decidedly unfortunate that so many physicians have failed to inform themselves of the details of these investigations. The general public look to physicians for reliable information on such questions, and when the opinions which