and to improve the breed and productivity of the swine, while at the same time complete unconcern is displayed for protecting the sovkhozes from the transmission of infection from the outside.

When inoculation is performed, sanitary measures and the need for increasing the resistance of the organisms of inoculated animals are often forgotten.

It is an urgent and important task to root out these faults.

The Planning of Measures.

The correct and skilfull planning of prophylactic and sanitary veterinary measures is destined to play an exceptionally important part under the conditions of our socialist national economy.

The possibility of carrying out planned measures based on the latest achievements of science and on government directives with respect to the campaign against infectious diseases is one of the greatest advantages that the socialist soviet system has over the capitalist system.

It is the mission of veterinary specialists to know how to make full use of this advantage of ours.

For this reason the most serious attention should be devoted to the planning of veterinary measures. It is essential decisively to suppress the well-known underestimation of planning that is current here and there among our veterinary organs and practicing veterinaries. It is necessary for every administrator and every practicing veterinary worker to be clearly conscious of the practical importance of having measures planned.

The correct planning of veterinary measures demands above all the good and clear-cut knowledge of zoohygiene, epizootology and particularly of the infectious diseases of swine, with fullest consideration being given to the latest data and achievements of science in the field of the maintenance and management of swine and the prevention of disease among them.

Moreover, planning should be concrete and applicable to the actual circumstances existing in the Rayon or on the farm, and the measures to be adopted should be differentiated in accordance with the sanitary and hygienic conditions and the epizootic situation on each separate farm.

We consider that high-quality planning work should regard as an important element of skilled leadership, not only quantitative indices, but should also envisage the qualitative side of the measures and take account of all the factors above brought out.

The plan should not confine itself to the figures on operations carried out on animals, such as inoculations or diagnostic examinations performed, but should also envisage such important elements as fixed and strictly observed time-limits and methods of inoculation and examination, time-limits and methods for disinfection and sanitary rehabilitation of farms, adequate equipment or construction of new quarantine houses, isolation quarters, hospitals, camps, etc.

The plans must provide special measures for preventing the importation of infection onto the farm (and the Rayon) by animals newly brought in: specifically, selection of market sites, time

limits and methods of examination and inoculation of animals at the places of preparation for delivery (marketplaces), the details of transportation, the place and regulations for quarantine, etc. These important plan measures should be arranged with an ample time margin with the animal technicians of the producers and confirmed by the administrative management of the authorities.

In planning the measures of sanitary rehabilitation after the liquidation of infectious disease on hograising farms, the shortest possible time-limits must be enforced and no dragging out of these measures should be tolerated. Such measures should prescribe, besides the specific measures of control (immunization, examinations) the necessary complex of housekeeping and sanitary-hygiene measures.

II. THE PROPHYLAXIS OF INFECTIOUS DISEASES OF SWINE.

The slogan of Soviet medicine: "It is easier to prevent disease than to cure it" -- should be the basic principle in veterinary art is well.

This vitally important slogan is fully applicable to the infectious diseases. Their prevention, when organized by proper methods, is, beyond the slightest doubt, incomparably more effective, besides being less costly than the control of disease that has already appeared and is spreading.

Very serious difficulties that arise in the course of this control are due to the imperfectly developed methods of diagnosis, to the frequent incidence of mixed infections and the lack of biological preparations fully adequate for preventive and curative inoculation. The generally unsatisfactory veterinary-sanitary

conditions on farms and the neglect of prophylactic questions hampers and not infrequently disrupts the rapid liquidation, in their early stages, of epizootics of hog cholera, erysipelas, influenze and other important infectious diseases of swine.

In addition to further study of the biology of the causative agents of infectious diseases, and of the pathological processes provoked by them in the organisms of swine, together with the perfection of diagnostic methods, Soviet veterinary medicine should in my opinion concentrate its principal attention on questions of prophylaxis.

In this extremely important field, in spite of repeated authoritative pronouncements by the veterinary authorities of the country, and of a number of measures undertaken, matters are still very far from satisfactory. This is indicated by the repeated incidence, year after year, of hog cholera, erysipelas, influenza, bronchopneumonia, and other infectious diseases among swine. The spread of these and other infectious diseases is mainly attributable to lack of attention to questions of prophylaxis on the part of the managers and workers on hogbreeding farms and, undoubtedly, on the part of many veterinary workers as well.

THE CONDITION FOR THE SUCCESSFUL CONTROL OF INFECTIOUS DISEASE

The decisive victory gained by the toiling masses in the USSR under the leadership of the All-Union Communist Party in the matter of the socialist construction of our country has created the necessary preconditions for the mighty expansion of animal husbandry.

Socialist animal husbandry, organized according to plan and developing according to plan, has an immense advantage over the private capitalist stock farms of bourgeois countries.

On the socialist farm the control of infectious disease among the agricultural animals is included in the general operating plan of that farm. On such a farm the management and hygienic maintenance of animals is more readily attainable, thus increasing their general resistance. It is easier to carry out quarantining, isolation, veterinary supervision of the animals.

It is a completely indisputable fact for us that on a properly organized socialist stock-farm, with Bolshevist leadership, there should be no infectious disease at all among the animals.

The socialist organization of the economy of our country, in which not the narrow personal interests of individuals are decisive, but the planning, regulating and organizing activity of the government itself, opens up exceptionally favorable possibilities for the organization and execution of prophylactic measures both on a national scale and in the plan of the separate stock-farms.

It must, at the same time, be emphasized that for the successful realization of the principles of prophylaxis it is necessary firstly to have the systematic, extensive and persistent planned regulating work of the directing veterinary agencies of the country; secondly to have the energetic participation and support of our public -- primarily of our kolkhozes and sovkhozes public -- and of the national economic agencies that conduct animal husbandry in this most important matter; thirdly the provision of

the corresponding organizational and material bases.

The prophylaxis of animal diseases, especially of infectious diseases, cannot be successful when only isolated, assorted measures, inconsistent among themselves, are applied outside of a general plan; but such prophylaxis should have all its elements part of a broadly thought-out system, executed according to plan on the separation farms as well as on the Rayon, Oblast' and Kray scales.

In view of all we have said, it is now necessary to elucidate briefly the most important questions of organization and technique of the prophylactic measures that can be recommended today for use by large-scale hogbreeding sovkhozes and kolkhozes piggeries.

GENERAL SCHEME OF PROPHYLACTIC MEASURES FOR HOG FARMS

In the organization of the territory of a hog farm, stock-taking of the factors of animal hygiene and veterinary sanitation is most indispensable. The site of a hograising sovkhozes or kolkhozes farm should be selected some distance away from highways and main thoroughfares used by the public, in view of the very frequent spread of infection through the ground routes of communication.

Public thoroughfares passing through the territory of such farms or even through their outhouse areas are especially impermissable, and through the cooperation of the RAYISPOLKOMs should be closed or by-passed.

The territory of a pig-farm should, moreover, be isolated as well as possible from other farms, and the pastures and exercise areas for the swine, located on this territory, together with the water sources and reservoirs, should be reserved for the exclusive use of the farm in question, so as to exclude the possibility of contiguity or contact with swine and other animals belonging to neighboring farms or to outside parties.

In order to protect the farm area, especially the outhouses and pigwalks and pastures and watering places of the swine from the intrusion of other animals, the construction of every kind of fence, hurdle, ditch and other barrier may be recommended.

The section of land for a pig-farm should meet the basic demands of animal hygiene, and should be spacious enough to avoid excessive crowding of the outhouses and leave enough room for exercise and pasture grounds. The organizers and builders must bear in mind that unless adequate space is left between the pig-pens, conditions will be unfavorable with respect to epizootics, and the isolation and successful quarantine of separate pens will be very difficult in case infectious disease should appear among the animals.

The presence of marshes and small puddles of stagnant water accessible to the animals is very undesirable and unfavorable from the zoohygienic and sanitary points of view.

The area of a pig-farm should be studied and cleared up in relation to veterinary-sanitary requirements, so that there are no dumps, manure piles, offal or excrement to be found on it. Systematic disposal in these respects must also be kept up in the future.

It is very important to check the sanitary condition of the water sources and natural ponds used for watering places and bathing of the swine on the exercise areas and pastures.

The construction of the pigpens and the specialized buildings should meet zoohygienic and veterinary-sanitary requirements. In this respect correct construction of the drains for solid and liquid wastes, sufficient isolation of the bays from each other, good ventilation and proper heating and lighting are all of substantial importance. Especially serious attention should be paid to the construction of quarantine quarters for swine newly arrived on the premises. These quarters must be constructed in a separate area, on one side from the structures used by the producing herd, and must have a separate hog-lot for the quarantined pigs, together with all the necessary outhouses (barns for feed and material, kitchen, living quarters for the personnel.) The method of delivery of the newly arrived pigs admitted to quarantine should be thought out and organized in such a way as to avoid any possibility of infection occurring en route. Isolation quarters for isolating cases of suspected or actual disease should be constructed as separate buildings of sufficient capacity located a certain distance away from the pigpens. The area of the isolation quarters should be sufficient to accommodate simultaneously not less than 5 percent of the entire herd on the farm. Inside the isolation quarters a number of bays or sections, each hermetically isolated from the other, must be constructed, together with a small room for clinical examinations and post mortems.

The disposal area for the burial of carcasses must be at some distance from the boundaries of the farm (no nearer than 1 kilometer). Carcasses and all types of filth requiring disposition by burning or burial must be conveyed there by special carts or sleds lined with galvanized iron in the form of a box with a cover.

The conditions of management, feeding and breeding of swine are of immense importance for the prophylaxis of infectious and invasive diseases among them. Above all scrupulous cleanliness must be maintained in all quarters for swine by means of regular housekeeping and making up, accompanied by periodic disinfection. A 2 percent NaOH solution, or quicklime, may be recommended for disinfection. Special attention must be paid to the feeding racks, which must be washed with hot water (boiling water) to which 1-2 percent of lye has been added, and, in summer, they should also be dried in the sun. Accumulation of dung in the pigpens or outside them is impermissible. Manure and soiled bedding must be conveyed daily to a separate place set aside for a manure pile, located not less than 100 meters from the pigpengs, where it should become harmless as a result of the spontaneous heat developed in it.

The feeding of swine should be organized on the basis of feed norms and rations, worked out by considering not only nutrient value in calories, but also the need for providing good assimibility of the nutrients and the necessary content of mineral salts and vitamins. As a result of gross violation of the rules of dietetics, gastro-intestinal disorders develop among swine, especially young pigs, and lead to the breakdown

of the barrier of the intestinal mucous membranes. The latter, in consequence, afford passage to the microbes that inhabit the intestinal tract in very large numbers, including also representatives of the coli-paratyphoid group and other pathogenic causative agents.

Diseases of the metabolism and of the gastro-intestinal tract, which originate as a result of wrong feeding, lead to a sharp lowering of the general resistance and to the infection of the organism by the semi-pathogenic bacteria inhabiting the intestines, whose virulence becomes intensified under these conditions. Gastroenteritis prepares the ground and creates favorable conditions for the entry and development of pathogenic microorganisms as well -- the causative agents of erysipelas, paratyphoid, tuberculosis and other infections. In this respect it leads to the saddest results when swine, particularly young ones, are given inferior feed, like rotten vegetables, moldy and stale oil-cake, grain and flour, half-boiled kitchen refuse, not infrequently containing half-decomposed remnants of meat and vegetables.

Such practices, which are still to be observed, as allowing swine to root up every kind of dump, garbage pile, manure heap etc., do an immense amount of damage. This practice should be decisively suppressed in all hogbreeding establishments, for it leads to the maximum possible degree of invasion by intestinal worms and infection of swine by colossal numbers of every possible kind of microbes, including pathogenes.

The most serious attention should therefore be devoted to the feeding of swine as an extremely important link in the chain

of prophylactic measures.

In the matter of breeding, likewise, certain definite factors of prophylaxis of very considerable importance may be noted. Timely elimination from mating of chronic carriers of infection, exclusion of sick or enfeebled animals from coupling, and preliminary examination for brucellosis of all newly acquired sires and dams, and of all suspected cases of disease, before coupling -- all these measures are far from exhausting all the possibilities along this line.

The prophylaxis of the infectious diseases of young swine should commence with the moment of coupling, with the rational management and feeding of the dams and the correct organization of the farrowing, for which the proper hygienic conditions should be assured. The prophylaxis of infectious abortion demands timely isolation of the pregnant sows showing signs of incipient abortion and of those that have aborted and delivered dead or premature farrows. In the interests of creating a healthy herd which is more resistant to every kind of unfavorable influence and infection, it is necessary to avoid too close in-breeding, to freshen the stock with new blood, and not to allow pampering and oversensitivity of the animals.

Specialized Veterinary Prophylactic Measures.

These include:

(1) Thoroughgoing and continuous veterinary supervision of the animals, clinical examination and taking the temperature of all suspected and actual cases of illness, followed by isolation of all adult pigs and sucklings that have fever or coughs, or have aborted or show any other symptoms of disease;

(2) Timely preventive diagnosis of new or assumed infections, by way of post mortem, bacteriological, serological and allergic methods of examination;

(3) Clinical examination and quarantining of all newly arriving animals, using other methods of examination as well where necessary;

(4) Administration of the corresponding inoculations, at the direction of the veterinary and under his supervision, as soon as possible after definite diagnosis;

(5) Periodic disinfection of all quarters used by swine and of all objects of equipment;

(6) Dehelminthization [elimination of deparasitization or intestinal worms] of the entire herd of swine.

Parasitization of swine, which is widespread under the conditions of pig-farms, favors to an enormous extent the lowering of the general resistance of the organism and is responsible for making the barrier of the mucous membranes passable, thus opening the portals to infection (Skryabin). In view of this, coprological examinations should be periodically conducted to reveal the existence of any helminthiases. Dehelminthization of the swine should then be carried out by means of a whole integrated aggregate of medical and sanitary measures, and the worm-eggs expelled by the swine during this process should be painstakingly destroyed (by burning the excrement and disinfecting).

The registration of morbidity and mortality of swine, by separate groups and pigpens, should be organized on every pig-farm

and the causes, examination findings, etc., precisely entered in the veterinary-sanitary journal of the farm.

These measures should be put into effect in the form of a continuously operating system, under the supervision of the senior veterinary specialist of the farm, or of the District or Rayon veterinary.

The rules of internal nature on a pig farm should be formulated with full consideration of the demands of prophylaxis. They should prescribe individual prophylactic measures to be taken by the workmen attending the swine herds on the sovkhozes and by the members of the kolkhozes on their pig-farms, namely: wearing of overalls and special clothing during work in the pigpens, and limitation or complete prohibition of access to the isolation quarters and quarantine areas of the farm by all persons not employed in such quarters and areas.

The access of outside persons to any part of the pig farm should be strictly limited, and, when there are dangerous swine epizootics anywhere in the Rayon, forbidden altogether. The same rules should apply to outside animals as well, but even more strictly -- and particularly to dogs, who often bring in infections.

With respect to the cart and automobile transport serving the farm, certain sanitary measures should be taken on their return from trips outside, especially after they have visited other livestock farms, markets, railroad stations, and other places from which infection might possibly be spread. The wheels and bodies of the machines and the carts, as well as the

horses' feet are washed off with water before they enter the grounds of the farm. This measure is particularly important when there are epizootics of hog cholera, erysipelas, foot-and-mouth disease, anthrax or other diseases in the Rayon. The necessary information about veterinary sanitation and the prophylaxis of the infectious diseases of swine should be imparted, to at least the technical minimum necessary, to all workers on a pig farm, not excluding the subordinate technical personnel, such as chauffeurs, stable-men, cart-drivers, housekeepers, storekeepers, etc.

The questions of prophylaxis should become the subject of discussion at technical and production conferences of the sovkhozes, at the general meetings of workmen, at the board meetings of the kolkhozes and at the general assemblies of their members.

The failure to observe the established measures of prophylaxis should be followed by the appropriate administrative penalties, going as far as discharge and criminal prosecution in especially important cases, if the infection was brought into the farm or spread on it through the fault of definite persons.

Such is the scheme of general prophylactic measures for a pig farm which can be recommended for speediest realization.

In cases of immediate danger of the carriage of infection from very nearby (neighboring) points -- especially in cases involving hog cholera -- the administration of the pig farm, together with the veterinary specialists, should discuss and work out the most effective and concrete measures (applicable to

the conditions of the farm) to protect the farm from the incidence of these diseases and to mobilize all workers of the farm to carry out such measures.

The appearance of hog cholera or erysipelas on a pig farm usually involves such considerable losses and unproductive expense that one should not shrink back even from such measures as these to prevent the transport of such infections onto the farm.

Such a peculiar and characteristic "state of siege" with the object of prophylaxis should prescribe, in such a case:

(1) Complete interruption of all connections with affected points;

(2) Prohibition of access to the farm, or passage through it, to outside persons;

(3) Intensification of all sanitary-prophylactic measures within the farm;

(4) Temporary interruption of pasturage and exercise for the pigs, if the hog-log could possibly prove to be infected;

(5) Intensified veterinary surveillance over all pigs on the farm;

(6) Organization of emergency watch-duty and stationing of posts for surveillance over the observation of the veterinary-sanitary rules.

(7) Administration of preventive inoculations.

We are able to state, from the experience of the most organized and advanced pig farms, that the realization of the entire complex of general sanitary prophylactic measures will not be slow in producing the necessary effect both on the individual farms and the national scale.

PROPHYLACTIC MEASURES ON THE INDIVIDUAL FARM

The implementation of prophylactic measures on the large-scale pig farms should not encounter serious difficulties nor require great expenditures. With the improvement in the general situation and the organizational and economic strengthening of the hograising sovkhozes and kolkhozes, the sanitary-hygienic conditions on them are steadily improving and are creating all the necessary preconditions for the widespread introduction and realization of the basic measures of prophylaxis.

The coverage of the millions of swine now subject to individual use by a single system of sanitary and prophylactic measures involves considerably greater difficulties. It is entirely obvious that the scheme of prophylactic measures we have just considered cannot be applied in this case. The local veterinary agencies should find other forms and develop other requirements to assure compliance by individual citizens who are owners of the swine for private use with the basic veterinary and sanitary rules.

According to the GLAVVETUPR of the Ministry of Agriculture of the USSR, and to numerous communications from the localities, the greatest number of violations of these rules is observed

precisely in the case of such persons, who are either unacquainted with the rules in question or do not understand them, and by their actions sometimes encourage the spread of contagious diseases of swine.

The management of swine on individual farms often fails to meet the requirements of general veterinary and sanitary prophylaxis: the swine sometimes rummage around the streets, dumps and places of common use [latrines?]. Their dung is scattered around and left wherever it happens to fall; the owners frequently fail to declare the cases of disease that they note; sick pigs are not shut in and wander around the village, infecting other pigs and spreading infection.

The compulsory destruction of their swine is often practiced by owners on the farms themselves, without taking any steps to prevent spread of the virus. The carcasses of destroyed swine are, in whole or in part, taken out and sold in the bazaars or on the farms, not infrequently without the knowledge, consent or inspection of the veterinary specialists and without preliminary boiling or disinfection.

The existing District Veterinary system is still, very naturally, unable to eliminate all these abnormal conditions and to exercise supervision and surveillance over the actions of the numerous private swine owners.

It is entirely obvious that to achieve success in this direction will require the aid and cooperation not only of the local authorities but that of the urban and village activists among the owners themselves.

The necessary measures and rules of veterinary and sanitary nature, which are compulsory for all owners of animals, and have been worked out by the organs of veterinary surveillance in conformity with the local conditions, should be widely publicized and explained to general gatherings of citizens, at meetings of activists among kolkhozes members, village soviets, etc. The veterinary workers should not be the only ones to watch over fulfillment of the rules, but the urban and village soviets should also participate in this surveillance through their authorized representatives and members of their livestock sections. Those guilty of violating these rules should be fined and in especially serious cases taken before a court to answer for their actions.

The growth of general and technical literacy and the enhancement of the cultural level of the broad masses of the kolkhozes farmers and of all toilers is creating the necessary preconditions for the successful introduction of veterinary and sanitary literacy among the population.

The following may be noted as basic measures for preventing the spread of infectious diseases among swine under individual use:

(1) Observation of the sanitary and hygienic rules of hog management by the separate owners: good treatment and feeding, maintenance of cleanliness in and around quarters for swine, collection and disposal of dung in one definitely indicate place, keeping careful track of the animals, not allowing them to rummage around places of common utilization or dumps, confining them to quarters whenever infectious disease appears in the village, and periodic disinfection.

(2) Compulsory and timely reporting of disease and death.

(3) Isolation of pigs taken ill, disinfection of swine quarters, fencing etc., to prevent infection from neighbors.

(4) Compulsory submission of the carcasses of pigs that have died, and of the carcasses and organs of pigs that have been destroyed, to veterinary viewing.

(5) Disinfection of the offal and other products of slaughtering after destruction of animals infected with hog cholera, erysipelas and other infectious diseases.

(6) Transportation of swine or the products of their slaughter beyond the village (or city) limits and to the bazaars only with veterinary or village soviet certificate that the locality is free from infectious disease.

(7) Observation of quarantine where imposed.

During the period of origination and spread of a swine epizootic, the veterinary surveillance of bazaars, railroad stations of routes of swine transportation should be intensified to the maximum extent.

IX. HOG CHOLERA. PESTIS SUUM

Schweinepest, Virus-Schweinepest, Peste du pore, Hog cholera, Swine fever, Typhoid fever, Peste porcina.

Hog cholera is a very contagious disease of swine caused by a filtrable virus, and characterized in acute cases by the picture of hemorrhagic septicemia. In the course of more chronic cases,

the primary disease is complicated by inflammatory and necrotic processes in both gastrointestinal canal and lungs, under the influence of bacteria of the paratyphoid group (mostly B. suipestifer) but also B. Suisepticus.

Hog cholera originated in North America. In 1833 it was first noted, in the state of Ohio, and spread more and more every year until by 1855 it had spread over the entire country.

At the beginning of the 60s of the past century, hog cholera began to be observed in England, whence it was spread through pedigreed sires to Sweden, and then to Denmark. Almost simultaneously it appeared in Marseilles, France, to which it had been carried by swine from Algiers. But it possibly may have existed here before this (in 1846). From the south of France, hog cholera rapidly made its way to Italy and Spain. In Germany (Posen and Silesia) it was first observed in 1893.

From Germany, hog cholera gradually spread to the neighboring countries (Austria, Hungary, Russia, Rumania etc.)

Thanks to the successful solution by Soviet veterinary science of a series of theoretical and practical questions and the development, by it, of an effective system of measures for the control of hog cholera, significant successes in liquidating this dangerous disease in the USSR could be achieved.

At the present time hog cholera appears only in the form of isolated epizootics.

ETIOLOGY

Three main periods may be noted in the study of the etiology of hog cholera.

The first period was marked above all by the discovery, in 1885-1886 of the causative agents of two infectious diseases of swine: hog cholera (B. suipestifer) and septicemia (B. Suisepticus), followed by a lively dispute between the dualists, who maintained that septicemia and hog cholera were two independent diseases, and the monists, who held to the opposite point of view.

The first period was concluded with the victory of the dualists.

The second period began in 1903, when a filtrable virus was discovered to be the true causative agent of hog cholera.

The third period may be considered to have commenced with the publication by German and American research workers in bacteriology of communications to the effect that the filtrable virus was nothing else than a spirochete.

B. suipestifer, according to its morphological and cultural-viological properties, represents a bacterium identical with B. paratyphus of man. This bacterium was considered to be the causative agent of hog cholera for about two decades. But gradually many bacteriologists began to have doubts as to the specificity of this bacterium for hog cholera.

These doubts were based on the following facts.

Swine that had been immunized by cultures of B. suipestifer,

and were thus insusceptible with respect to this organism, did not, however, thereby acquire immunity to natural infection during epizootics of hog cholera. Such immunity was acquired only by swine that had had the natural disease. The administration of serum against B. suipestifer did not give particularly great relief in the treatment of hog cholera. Subcutaneous inoculation of B. suipestifer produced infection only on administration of large amounts of the culture, and even then not invariably, while even relatively insignificant amounts of blood from swine that had died of hog cholera were sufficient to cause lethal infection. And, finally, B. suipestifer could not by any means be found in all epizootics of hog cholera.

In view of these circumstances, further researches into the etiology of hog cholera were undertaken on the initiative of Salmon. During an outbreak of a disease resembling hog cholera in Iowa in 1903, de Schweinitz and Dorset conducted experiments in infecting healthy swine with serum and blood from diseased swine, first filtered through a plug of burnt clay. These experiments indicated the existence of an ultramicroscopic filtrable virus as the original cause of swine contracting hog cholera. As for B. suipestifer, the American scientists advanced the hypothesis that it leads a harmless saprophytic existence in the organism of swine before their infection, and only displays its pathogenic activity after the resistance of the organism has been lowered under the influence of the filtrable virus.

In 1905, Dorset, Bolton and Bride published a paper with an introduction by Salmon in which he frankly admitted the incorrectness of his former views on the role of B. suipestifer in hog

cholera. The authors summarized the results of their investigations in the following manner:

(1) The filtered blood of diseased animals, when successively inoculated from one pig to another, acts pathogenically, but the virus apparently loses its power after a certain number of passages through the organisms of swine;

(2) Animals who have once had the disease produced by filtered blood acquire immunity to both natural and artificial infection with it;

(3) Swine who have had the natural disease also become immune to subsequent natural and artificial infection;

(4) Animals quartered together with artificially infected pigs or placed in their piggens fall ill, and display the typical symptoms of hog cholera.

(5) Feeding of the internal organs of diseased animals produces the same symptoms of disease;

(6) The presence of a filtrable virus was demonstrated in all outbreaks of hog cholera investigated;

(7) The picture of the disease induced by intravenous injection or feeding of B. suipesteifer is very similar in its symptoms and pathological anatomy to that observed in natural outbreaks of hog cholera; but efforts to produce the disease by subcutaneous inoculation were not always successful;

(8) The disease induced by artificial introduction of cultures of B. suipestifer is not infectious;

(9) Filtered or even unfiltered blood of pigs infected with B. suipestifer has no pathogenic properties;

(10) No immunity to the natural disease is acquired after recovery from disease artificially induced by bacteria of hog cholera.

Experiments to verify the hypothesis of a filtrable virus of hog cholera were conducted in Germany and then also with favorable results, in Italy and France.

After the etiological significance of the filtrable virus of hog-cholera had been shown, work on methods of immunization against this virus was started, and favorable results soon attained.

The filtrable virus induces a primary disease of hemorrhagic-septicemic character, and the organism thus weakened commences to be attacked by a whole series of other bacteria, mainly from the Typhus-coli group, together with the filtrable virus which also produce corresponding secondary changes in the large intestine.

The croupous-hemorrhagic pneumonia with multiple necrotic foci which is characteristic of acute attacks of hemorrhagic septicemia of swine, is also observed, as is well known, in hog cholera as well. Its occurrence is explained in the same way as the changes in the gastro-intestinal canal. Here too the previous lowering of the organism's resistance under the influence of the filtrable virus is required for B. suisepticus afterwards to be able to manifest its own pathogenic activity.

Figure 46. Cellular inclusions (A) in the cells of the conjunctiva in swine suffering from hog cholera. (After Ulengut)

According to the observations of Ulengut, almost all swine show inclusions in the epithelial cells of their conjunctiva on the 5th or 6th day after their infection with hog cholera. These inclusions are very similar to those found by Provachek in trachoma, and are distinguished from them only by their somewhat smaller size. (Figure 46).

But similar inclusions were also found in the epithelial cells of the conjunctiva in entirely healthy swine (3 percent). Their specificity therefore appears problematical, inasmuch as analogous formations are also encountered in many other diseases induced by filtrable viruses.

From the diagnostic point of view, these inclusions deserve every attention, since they regularly appear in hog cholera between the 5th and 10th day of the disease.

Such inclusions may also be noted in scrapings taken from the conjunctivae of swine that have succumbed to hog cholera, if not more than 24 hours has elapsed since death.

The following method is used to discover them. A scraping is taken from the inflamed conjunctiva with a scalpel or a glass slide, and smears are then prepared on slides. The smears are first allowed to dry in the air, and are then fixed with a mixture of alcohol and ether. They are then stained by one of the methods used for investigating blood parasites.

In 1910 Ryuter expressed a new view on the etiology of hog cholera, namely that the filtrable virus was really nothing else but a spirochete, but found no support among European scientists engaged in the study of hog cholera.

He pointed out that this spirochete is predominantly encountered in swine with hog cholera. It is sometimes also found in healthy swine and in those with other diseases, but only in insignificant quantities and not in the blood, but only in the intestines.

The infection of swine by spirochetae takes place by means of swine lice or round worms. He discovered spirochetae in swine with hog cholera not only in the mucous membranes of the stomach and intestines, but also in the mesenteric lymph nodes and on the affected areas of the skin. He also succeeded in finding them in the blood of animals that had already succumbed to the disease.

According to him, spirochetae in various stages of development are constantly observed in the blood, at the same time as other microorganisms are encountered there only as fortuitous contaminations. The impossibility of finding spirochetae in some cases points not to their absence but to their being in the "ultravisible stage".

A characteristic peculiarity of spirochetae is their polymorphism: in the initial stage of development they must be recognized as very minute round granules, from which forms like commas or the Greek letter epsilon develop, and then from these latter, spirals and spirochetes of varying length and thickness.

At a certain age, or under unfavorable circumstances, spirochetes dissociate again to granules. It is mainly in the granule stage that they are able to pass through the pores of a filter. Ten days after filtration twisted forms appear again in

the filtrates. In old virus (blood) they assume the shapes of delicate spirals and commas. The latter link up with one another to form figures recalling the French letter S, or epsilon ( ). Media of neutral reaction are most favorable to the growth of spirochetes.

In studying virus or cultures in liquid media, the liquid must first be centrifuged and the sediment thus obtained must be examined.

On the other hand, spirochetes can be found in the form of conglomerates in virus or liquid media. For this reason material for filtration must first be agitated in a special apparatus.

Spirochetes are gram-negative, have a low resistance to acid, and take stains rather poorly.

The method recommended for staining spirochetes is, after preliminary fixing with a mixture of alcohol and ether, to use a liquid solution of Giemsa's stain (2-3 drops to 10 c.c. of distilled water) for a period of 2 days. The spirillae are stained a faint violet in this way, while the round corpuscles disposed for the most part in groups (the granular form of spirochete) take a reddish color.

Culture of these spirochetes in artificial mediums (agar or gelatine) to which urine had been added was found possible.

In Ryuter's opinion, the resistance of the organism was broken down by the combined action of the spirochetes and the toxins they produce, together with a large number of accompanying

bacteria, such as cocci, bacilli resembling paracoli, etc.

In 1914, King and Hoffman also published a report to the effect that the causative agent appeared to be -- so they said -- a spirochets (spirochaeta suis) with a strong resemblance to spirochaeta pallida. The authors found this spirochete not only in intestinal ulcers (especially those of the vermiform appendix) and in affected areas of the skin, but also in the blood, particularly during fever. The distinguishing characteristic of spirochaeta suis is its capacity for dissociation into granules, which apparently represent a certain stage of its development. These granules are able to pass filters that hold back bacteria, as was demonstrated by microscopic examination under a dark field.

According to their observations, spirochetes are encountered in the blood of healthy swine only in the granule form.

Similar studies of spirochaeta suis were confirmed by other scientists as well (Andreyev, Bekenskiy, Mikhin and others) but the question of the specificity of this spirochete for hog cholera cannot be considered to have been resolved in the positive sense.

In 1916, 83 carcasses of swine that had died of hog cholera were examined by P. V. Bekenskiy and myself, and spirochetes found in only 59.2 percent of them. During an epizootic of hog cholera on one of the farms, spirochetes were found in the rectums of 12 out of 72 swine, i.e., in 17 percent. During an epidemic of erysipelas on the same farm, spirochetes were not found in a single one of the 80 swine examined; neither did they appear in swine infected with anthrax. Nevertheless, in other cases, when

healthy swine were examined, they were found in the rectum in 7-12 percent of the cases.

Spirochetes were found in 15 out of 18 young pigs inoculated with filtrable virus. In all these cases they were found only in the alimentary tract, but not in the blood. Two types of them were observed: in one of them the width of the comma was 1.42 microns (Figure 47) and in the other it was 2.84 microns (Figure 48).

Spirochetes of the latter type also have greater amplitude of the comma, reaching 1.14 - 1.42 microns. The spirochetes of the former type completely corresponded to the spirochetes found in the alimentary canal of swine. Those of the latter type recalled the spirochetes found in the blood by the above-mentioned authors. Bekenskiy found both types of spirochetes in all parts of the alimentary canal in both healthy swine and those affected by hog cholera (Figures 61 to 66).

He obtained mixed cultures of these spirochetes from material taken from the mucous membrane of the rectums of swine with hog cholera, and by successive reinoculation he succeeded in growing three generations of viable spirochetes under anaerobic conditions.

Figure 47. Spirochetes from the vermiform appendex of swine dead of hog cholera. (After P. V. Bekenskiy).

Figure 48. Spirochetes from mixed cultures. (After P. V. Bekenskiy).

Mikhin examined the feces of swine on farms affected by hog cholera and found large numbers of spirochetes -- 10-20 in the field

of vision -- in 70 percent of the swine, while on farms free from hog cholera spirochetes in swine feces were found only rarely and in the form of single specimens. These observations furnished him with a reason for considering the presence of spirochetes in swine feces as one of the auxiliary means for the diagnosis of hog cholera. He worked out a special technique for examining feces to discover spirochetes.

Obchinnikov (1933) almost invariably found spirochetes to be present in the feces of swine with hog cholera, while in the feces f healthy swine they were either absent or occurred only in occasional animals, and that in small numbers. Upon artificial infection, spirochetes appeared in the feces from the 3rd, 5th or 7th day in all cases and persisted until the 9th day. The author draws the conclusion from these observations that there is a close relation between the presence of spirochetes and affection by hog cholera. He succeeded in growing spirochetes in an infusion of fecal matter and in broth of hog intestine. Clinical and patho-anatomic changes, allegedly characteristic for hog cholera, were observed by the author in suckling pigs infected by spirochete cultures, which gave him occasion to advance the hypothesis that the diphtheric changes that take place in the intestines during hog cholera are caused by spirochetes or their biologic products.

The hypotheses as to the specificity of various microbes for hog cholera are still unconfirmed down to the present moment. Many of the scientific data above presented in this connection are now only of historical interest. It would be expedient to base the diagnosis of hog cholera today exclusively on the finding of

inclusions resembling chlamydozoa or of spirochetes in animals taken ill, but their further study is necessary.

Future scientific search may elucidate their true character and significance for the etiology and pathogenesis of hog cholera.

It may be that some relation of allobiophoria, similar to that found by contemporary scientists to exist between some microbes and ultramicrobes may be established between the spirochetes and the filtrable virus of hog cholera.

At the present time it appears entirely indisputable that the true causative agent of hog cholera is a filtrable virus, to the study of which the greatest attention should be devoted.

THE BIOLOGY OF THE VIRUS

The biology of the virus of hog cholera, like that of the other filtrable viruses, has not yet received adequate study.

At the present time it still remains in dispute whether the virus is like other microorganisms a living agent or is, instead, a peculiar chemical substance.

Kucharenko (VIEV) has succeeded in obtaining the virus of hog cholera in the form of a crystalline protein, a solution of which induced the disease in swine.

According to the researches of Kernkamp, the size of the virus particles does not exceed 25 micromicrons. The virus passes the usual bacterial filters and even some colloidal or ultrafilters. All attempts to examine it under the microscope or ultramicroscope have failed.

The susceptibility of animals other than the pig to the virus has been insufficiently elucidated.

Of the laboratory animals, the guinea pig, and to some extent, the rabbit, are apparently susceptible.

Shyuyton, Mistral' and Dyubreyl' [Dubreille?] (1936) infected guinea pigs intratexturally with hog cholera virus and noted intumescence of the testicles and fever.

They made 18 passages of virus through guinea pigs. At each passage its virulence for these animals increased, while decreasing for swine. In experiments made by Nesterova, rabbits also proved

susceptible to this method of infection.

It is necessary to continue the investigations in this direction. The virus of hog cholera displays a certain amount of activity in the blood stream of horses, though it apparently does not multiply there.

Comparative immunological studies of the viruses of hog cholera and dog distemper have established that the virus of hog cholera proves non-pathogenic on introduction into puppies but protects them against infection from subsequent introduction of distemper virus. On the other hand, distemper virus induced a condition in swine similar to influenza, but did not protect them against the action of hog cholera virus. The author refrained from drawing final conclusions.

According to the investigations of Zhakoto and Tsikhis (193), sheep, goats and calves are to some extent susceptible to hog cholera virus, but with them only an inapparent infection resulted from either spontaneous or experimental infection.

Tsikhis succeeded in making 10 passages of the virus through sheep. The presence of virus in their blood was proved by the infection of swine.

The authors express the belief that these animals may participate in spreading hog cholera.

These data still require serious confirmation.

Nicolle and Balozet (1932) proved experimentally that man

may harbor the virus of hog cholera, showing no symptoms of disease. Two suckling pigs were infected by blood taken from a man 5 days after injection of 5.0 of hog cholera virus. One suckling received a dose of 5.0 and the other 55.0. Both became ill on the 4-5 day and died on the 19-24th day. The authors consider that human beings may be infected by hog cholera under natural conditions and that they are carriers of this disease.

TECHNIQUE OF PREPARATION OF THE VIRUS, AND ITS PROPERTIES

In all work with hog cholera, the first step to be taken is the preparation of the filtrable virus in pure form, free from any of the bacteria that frequently accompany it (especially from B. Suipestifer).

Hog cholera virus is disseminated through the entire organism, but can be most conveniently prepared from blood, either defibrinized or serum.

Defibrinized blood, or extract or juice of organs, is first subjected to preliminary filtration through ordinary filter paper, calcined sea sand or fiber asbestos, to free the liquid from the coarse suspended particles, and is then filtered through a fine-pore filter.

Before defibrinated blood is filtered it is diluted with an equal amount of water, like an extract. Laksvo blood may be used instead of defibrinized. To obtain it the blood is withdrawn not into an empty vessel but into one filled with as much sterile tap water as blood is proposed to be taken.

Serum and urine is not subjected to preliminary filtra-

tration.

To obtain bacteria-free filtrates, containing only the virus, F. Chamberlain or Berkfeld (No 12 and 15) filter plugs are usually used. Chamberlain plugs are made of burnt clay and Berkfeld plugs of infusorial earth. Zeyts filters are also being used successfully at the present time.

The rate of filtration is also important. Experiments have shown that filtration through Berkefeld plates gives best results at the rate of one drop a minute.

The most powerful virus is obtained from animals in the acute stage of the disease. Nevertheless there is a certain loss of potency in the virus at every filtration, owing to adsorption and absorption.

The filtrates are tested for sterility by adding about 6 c.c. of filtrate to 100 c.c. of broth and keeping the flask in a thermostat at 37 degrees. If no bacterial growth is revealed by daily observation over an extended period, the filtrates are considered sterile.

MAINTAINING THE VIABILITY AND VIRULENCE OF HOG CHOLERA VIRUS

Virus obtained from different animals and from different localities may possess different potency. In just the same way, virus taken from the same swine at different times differs in virulence.

Virus in defibrinated blood, with 0.75 percent phenol, still displayed virulence when kept at a temperature of about 5 degrees C. after 135-162 days.

Virus obtained in the pure state by filtration keeps best of all without the addition of disinfectants. For this purpose it is placed under sterile conditions, immediately after filtration, in small brown glass vessels (test tubes or ampoules) which are then sealed.

The virus preserves its potency for a number of months when kept under refrigeration, while at room temperatures its potency sometimes falls off very rapidly. However, the same thing sometimes happens even under refrigeration. Therefore if a fairly potent virus is required, it is administered if possible immediately after preparation.

The virulence of virus weakens when kept for long periods. This weakening is expressed in lengthening of the incubation time and in the less severe chronic course taken by the disease in innoculated animals.

Virus keeps its virulence for longer in serum than in urine, where virulence sometimes disappears already in 14 days. This is apparently explained by the fact that its composition makes serum a better medium for culturing the virus than urine. (There is reason to suppose that virus loses its virulence faster in urine than in blood in connection with the greater degree of saturation of urine by electrolytes, which apparently remove the electric charge from the virus and induce its agglutination,

leading to the loss of its virulence.)

The virus gradually weakens during passage through swine. In exactly the same way it also gradually weakens when passing through the organisms of other species of animals.

THE RESISTANCE OF THE VIRUS TO PHYSICAL ACTION AND TO DISINFECTANTS

The virus shows a very considerable resistance to physical action. This fact is of great epizootological significance. Such unfavorable factors as dessication, heating, sunlight, or high temperature have hardly any influence at all upon hog cholera virus under the usual conditions of the external environment. The virus dies at temperatures of 46 degrees, 55 degrees, 60 degrees, and 78 degrees, respectively, in 48 hours, 24 hours, 10 hours and 1 hour respectively.

The virus does not lose its activity when the serum is kept for two hours at 58 degrees.

The virus displays considerable resistance in blood dried at 37 degrees. It continues to induce disease in swine even after it has been kept for two hours at 65 degrees.

In a protein-free medium it shows less resistance to heat. Thus, for instance, urine containing virus loses its activity already after 1 hour at 65 degrees.

At low temperatures the virus keeps its properties for fairly extended periods. In frozen state the virus (serum filtrate) survives from a few days to three months. Strong freezing does not kill the virus, but rather preserves it, which explains the continued infectiousness of stalls vacant throughout an entire winter. Virus can also keep for over 3 months in meat at low temperature.

The virus survives dessication relatively well. Thus, blood and serum dried to constant weight at 37 degrees, for three days, still maintained their virulence.

Duval (1929) found that virus dried with blood keeps for years, but rapidly loses its virulence after solution.

In the experiments of Missner and Geiger, blood and serum from diseased animals was still virulent 3 weeks after it had been dried to powder, but this virulence had considerably weakened after six weeks. In one experiment scrapings of skin remained infectious for 9 days.

The virus proved less hardy when dried together with earth. Thus, in the experiments of Whiting, a mixture of sterile earth and blood, dessicated in a thermostat, remained virulent for 5 days of drying; a similarly treated mixture of feces and urine containing virus lost its infectiousness in 24 hours of drying.

Irradiation by ultraviolet rays (mountain sun) [quartz lamp?] for one hour failed to kill the virus in filtered serum.

Direct sunlight acting for 5 and 9 hours on filtered hog cholera serum did not deprive it of its pathogenic action.

The virus proved relatively less resistant to hygienic measures. Eight days after burial, virus could no longer be found in the organs of a swine that had suffered from hog cholera. In strongly virulent blood kept under refrigeration, which had rotted for 12 days, the virus was no longer pathogenic.

On addition of swine feces to virulent urine to accelerate its putrefication, the virulence of the urine was already lost after a single day at 22 degrees.

The negative results of attempts to infect young pigs with filtered extracts of the feaes from swine with hog cholera indicate, in Ulengut's opinion, in exactly the same way, that, under the influence of the hygienic processes that occur in the intestinal tract, the virus of hog cholera is subject to rapid annihilation or at least to very great weakening. Nevertheless, in other experiments, the feces of swine with hog cholera may still prove virulent.

The resistance of the virus to disinfectants is also quite considerable. This circumstance not infrequently makes it difficult to carry out reliable disinfection.

A number of investigators have studied the action of various disinfectants on the virus of hog cholera contained in the blood, serum and urine of diseased swine, but most of these disinfectants

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Somewhat better results were obtained by using a 5 to 10 per-

cent solution of cibride of lime, which kills hog cholera virus in 2 hours.

This virus proves to be permanently bound (adsorbed) by albumin, which is coagulated by antiseptics and thereby protects the virus from contact with them. Of all disinfectants tested, the best proved to be a 2 percent solution of caustic soda. After the quarters have first been subjected to careful mechanical cleaning, disinfection with this solution gives entirely satisfactory results.

If short of caustic soda, lye from wood ash may be used instead, to which 5 percent of common salt (NaCl) should be added in winter to prevent the solution from freezing.

It is recommended that solutions of caustic soda or wood-ash lye be used hot for greater disinfecting effect.

David found that a 2 percent solution of NaOH killed the virus in a protein-free medium in 15 minutes, and in blood in 2 hours.

A 1 percent solution of NaOH is enough for disinfecting the hands, and also the surface of the bodies of the swine.

EXPERIMENTS IN CULTURE OF THE VIRUS

In 1932 Hecke conducted successful experiments in the artificial growth of hog cholera virus in tissue cultures. Starting from the fact that in this disease the smallest vessels

of the endothelia are predominantly affected, he used tissues of swine richest in bloodvessels (plexus chorioideus of the stomach wall, the lymph nodes, spinal cord, spleen and kidneys) as substrates for the culture of the virus.

A mixture of equal parts of spinal plasma and extract of swine spleen was the culture medium. The plasma taken from swine 7-9 days after infection by hog cholera virus served as the virus in these experiments.

The drop cultures from the plexus chorioideus in plasma and spleen extract contained virus until the 15th passage; cultures from the spinal column in plasma and Drew's solution until the 10th passage; the cultures from the lymph nodes until the 20th passage (or generations of the culture).

The virus cultured at 37 degrees for a total of 105 days represented the final generation. During this time the original material had been propagated 10^{30} times. He also succeeded in growing 14 passages of the hog cholera virus in flasks in spleen tissue cultures, involving multiplication of the original amount of virus by 10^{20} times.

He did not succeed in growing the virus in kidney tissue cultures.

In the control culture, without tissue, the virus could be found only during 18 days. In passages through test animals it disappeared already in the second generationof tissueless culture in a plasma and spleen extract medium.

No changes in virulence of the virus were noted during culture.

For details of the technique employed by him in preparing tissue cultures, see the original paper (Zentralblatt für Bacteriologie, 1932, Band 126).

The hypotheses of the existance of a number of hog cholera viruses (a number of types of this virus, not mutually conferring immunity) have been rejected after experimental checks made on numerous strains of virus, obtained from various countries and parts of the world.

Kotov (1930) carried out the experimental infection of shoates by Russian, German, and American viruses, and was unable to note any difference in the clinical or patho-anatomic pictures after the infection. Trial of American and German serums on Russian, German and American viruses gave no grounds for indicating the existence of different types, or of a plurality, of hog cholera viruses.

EXPERIMENTAL INFECTION

For the conduct of experiments on hog cholera, animals must be obtained from localities definitely known to be free of the disease, and in doubtful cases a quarantine of at least two weeks is necessary.

The test animals must be strictly isolated. Infection of the animals (young pigs) may be performed by any method of introducing the virus. The effect of infection depends mainly on the

potency of the virus. Inoculation of as little as a few tenths of a c.c. may be enough to initiate infection, but to be certain not less than 10 c.c. of filtrate should be used, as by the use of this quantity the fluctuations in the virulence of the virus will be less noticeable.

The reaction of swine to the introduction of virus can be exceedingly varied, depending on the various individual susceptibilities to hog cholera, the existence of various diseases of the internal organs, metabolic and nutritional disturbances, vitamin deficiency, overfeeding, etc.

Using virus of the same strength, the reaction and mortality among the infected animals may fluctuate sharply.

Many authors note more or less significant fluctuation of the virulence of the virus. Sometimes the virus induces very serious forms of the disease, and sometimes very mild forms. The reasons for such fluctuations in virulence are still unknown. Animals that have passed through a mild infection are in some cases reinfected by more potent virus. This fact deserves great attention from the epizootological point of view.

DISSEMINATION OF THE VIRUS IN THE ANIMAL ORGANISM AND THE ROUTES OF ITS EXCRETION

The virus of hog cholera is preponderantly encountered in the blood and is carried by it throughout the entire organism. Without mentioning the muscles and organs rich in blood, the virus can be found even in the crystalline humor of the eye. It is found in especially large amounts in the urine.

The virus is excreted from the organism in the urine, and the mucopurulent discharge from the eyes in conjunctivitis; and is contained in the pustules in eczema, the nasal discharge in rhinitis, etc.

Attempts to infest suckling pigs by filtrates of fecal extracts have shown that if virus is present at all in the feces, it must be in very insignificant amounts. Obviously the virus entering the intestinal tract is gradually destroyed under the influence of the putrefactive processes that occur there.

The blood of animals infected with hog cholera already contain the virus on the first day after the infection, and the urine, feces and discharges from the eyes and nose on the first to second day.

The presence of virus in the blood could already be demonstrated 16 hours after the artificial infection of swine.

Sometimes, however, the virus appears later in the blood and discharges of diseased swine. The virus of hog cholera is apparently most closely bound to the red blood corpuscles. These corpuscules

still contain the virus even after 6, 8 and 16 washings, at a time when the wash water itself is already completely free of virus. The blood of swine infected by subcutaneous inoculation of the virus registers the maximum virus content on the sixth to eighth day after inoculation. After infection of swine through the feed this period is lengthened by 1-2 days and sometimes even longer. The virus appears later in the blood serum than in the blood cells, spleen, lymph nodes, spinal cord and kidneys. In these organs and tissues, apparently, the virus multiplies, as a result of which it is also contained there for a longer period than in the serum, where it dies in consequence of the destruction of the blood corpuscules or other cells.

It has been demonstrated by specially conducted experiments that the virus is found in blood serum 1 or 2 days longer than in the red blood corpuscles, spleen and kidneys.

The reduction of the degree of infection of the blood serum is also connected with the fact that the production of immunizing substances already commences on the seventh to tenth day after infection.

Thus when the disease is prolonged, the virus content of the blood serum falls sharply. However, after blood-letting, a regeneration of blood takes place, and together with this new quantities of virus appear in the blood serum.

Sometimes the presence of virus in the urine could be shown only on the seventh to tenth day after infection.

The virus appears in the blood and organs at the very beginning of the disease, and can apparently persist for a very long time

in the organism.

THE DURATION OF VIRUS HARBORING AND VIRUS DISCHARGE IN HOG CHOLERA

It may be considered established that, very soon after infection, infected animals already have the virus in their organisms and discharge it into the external medium, at the very beginning of incubation and long before the appearance of clinical symptoms.

The investigations of Dorset, Ulengut and others have demonstrated that the blood of animals with hog cholera already contains the virus 24 hours after infection and can consequently present the danger of spreading this virus already at this time, at the beginning of incubation.

This circumstance is of great epizootological significance, and must be taken into account in the execution of practical measures for prophylaxis and liquidation of hog cholera.

While the time of appearance of the virus in the blood and the discharges of infected animals is sufficiently clear, there is still no complete agreement among the authorities as to the length of time the virus spends in the organism, and of the period during which recovered animals are carriers of the virus.

This question, nevertheless, is of immense scientific and practical interest. A large number of experiments have been conducted to solve it.

At one time it was experimentally established that swine in the

first stages of convalescence from hog cholera already stop excreting the virus three days after fever ends, and, consequently, cease to be dangerous to the surrounding animals.

However, later and more careful investigations along this line by a number of research workers, together with practical observations on farms affected by hog cholera, yielded convincing proofs that there were many exceptions to this rule, since, in a certain number of cases, cure with respect to virus not only does not precede clinical and anatomical cure but, on the contrary, is delayed for a period of undetermined length.

Thus, for instance, it has been shown by experiment that there is a considerable number of virus-carriers, that harbor the virus and excrete it for a long period, both among chronic cases and among swine now clinically recovered from hog cholera (or simultaneously inoculated with it).

Specifically, it proved possible to discover virus-carriers in four out of eight chronic cases examined, on the 24th, 30th, 41st and 95th day after infection, and in 3 out of 43 swine simultaneously inoculated with hog cholera, on the 57th day after such inoculation.

These animals were proved experimentally to be virus-carriers, for their blood infected healthy test swine.

Mikhalka, investigating this question on swine immune to hog cholera (after natural or experimental infection), found that the presence of virus as long as 10 months after infection could be shpwn experimentally in the hemorrhagically infiltrated lymph nodes of these swine in 76% of all cases examined by him.

On the basis of these experiments, Mikhalka reached the conclusion that the immunity originating in swine after their recovery from hog cholera or their inoculation is, apparently, not sterile but "infectious".

Detre (1932) confirmed Mikhalka's observations and attached great significance to the fact that animals who had recovered from hog cholera could harbor the living virus in their lymph nodes for long periods (up to a year).

The infection of some animals by hog cholera 3-4 months after their simultaneous inoculation is explained by this.

The general resistance of the organism and the immunity in such animals is weakened under the influence of unfavorable circumstances, and in consequence the active virus harbored in their lymph nodes again manifests its pathogenic action.

It is necessary under practical conditions to take into account the possibility of the appearance of such endogenic reinfection.

The significance of these very important investigations, which throw light on many facts not previously understood, is in no way diminished by the fact that some other authorities were unable to confirm these data by their own experiments.

Thus, for instance, Manninger and his associates could find virus neither in the lymph nodes of swine 25 days after infection, nor in the blood, urine and feces of swine 3-4 weeks after simultaneous inoculation. Khagueli succeeded in proving the infectiousness of the urine from simultaneously inoculated swine only about 30 days after inoculation.

The long period during which swine that have recovered from hog cholera, and in some cases simultaneously inoculated swine as well, still carry the virus, is also confirmed by immediate epizootiological observations.

Infection is known to have been carried in a considerable number of cases by swine recovered from hog cholera when shipped to another farm that was free of the disease.

Depending on the virulence of the virus, the individual peculiarities of the animals and the surrounding circumstances, the periods of virus harborage and virus discharge may obviously vary considerably, which also explains a number of contradictions in the results of experimental investigations on this subject.

NATURAL INFECTION

Natural infection mainly originates per os, from ingestion of infected feed or water contaminated by the excretions of diseased animals.

Infection may also originate through the conjunctiva, in which case the source of infection may be feed contaminated by urine, mucopurulent discharges from the eyes of diseased swine, etc. In contrast to urine, feces, as we have already noted, possess relatively insignificant infectiousness. When pigs scratch each other, the virus can easily enter wounds on the skin. This occurs even more easily since the lice living on their skins can also cause infection with the virus of hog cholera, although it has not yet been possible to prove this latter statement experimentally. Finally, infection through the

respiratory tract (the respiratory method of infection) may be a route of major importance, especially within an infected pigpen, crowded with swine, in which animals suffering from hog cholera cough and expel large amounts of virus with the mucus.

THE EPIZOOTIOLOGY OF HOG CHOLERA

Contagiosity and dispersability. Hog cholera is a contagious disease which is transmitted by direct and indirect (intermediate) contact. Diseased animals, their excretions and discharges and objects infected by them -- or by blood -- represent the chief source of infection.

The contagiosity of hog cholera, like the virulence of the virus, is subject under natural conditions to a certain amount of fluctuation. The more serious the forms of illness induced, the greater the corresponding contagiosity of the disease and the more sharply expressed the dispersability of the infection.

The lack of uniformity in the infectiousness of hog cholera during different epizootic outbreaks of this disease has been established by many scientific observations.

Besides being influenced by fluctuations in the virulence of the virus, the degree of contagiosity of hog cholera is apparently also affected by the varying degree of susceptibility to it of swine in different regions and farms, according to the varying sanitary and hygienic conditions and the epizootic situation.

It has been noted that in centers of fresh infection, where hog cholera has not occurred for a few years, this disease frequently spreads faster, and its contagiosity is pronounced, in accordance with a high virulence of the virus. In this respect, besides immediate contact, the channels of (indirect) transmission of the virus through infected food, equipment, clothing and shoes of human beings, etc., take on great significance.

In localities and farms that have long been affected by hog cholera, its contagiosity is considerably less pronounced. Many tens of animals, exposed to conditions of possible infection, do not contract the disease, and the spread of the disease proceeds considerably more slowly.

In this connection, besides a certain attenuation of the virulence of the virus (in consequence of its prolonged passage through the organisms of many animals), a certain resistance to the virus develops among some animals of the herd, as a result of "latent epidemization", i.e., the development of a certain degree of immunity to hog cholera because of unnoticed, concealed contraction of the disease and recovery from it.

This phenomenon, which is observed in many infectious diseases, may be the result of repeated entrance of small amounts of attenuated virus into the organism, and cannot be considered an exception to the spontaneous conditions, given the long existence of hog cholera.

Thus, for instance, both Russian and foreign authorities have repeatedly noted, and described in the literature, the

peculiar course sometimes taken by hog cholera on large-scale pig farms, where it manifested itself only in a sluggish, chronic condition of disease in young pigs (the so-called "unthriftiness"), in the absence of any clear-cut cases of disease among the adult swine.

Similar observations have been made on farms long affected by hog cholera, though far from all the susceptible swine population had been subjected to artificial immunization.

The hygienic and sanitary conditions among the herds also exert a strong influence on contagiosity, i.e. on the speed of transmission of the disease from one animal to another, and on the dispersability, of the infection, i.e. on the speed of its spread from one farm to another and from one Rayon to another. It is entirely obvious that the better the hygienic conditions of swine management and the more strictly the rules of sanitation are observed, the fewer the possibilities afforded for the transmission of the virus by diseased animals and its transport with feed and other infected objects, as well as on human beings.

For this reason we must emphatically reject the opinion expressed by some veterinaries to the effect that "hog cholera is so infectious that it is hard to control it and prevent its spread."

In view of the considerable hardiness manifested by the virus, its high infectiousness and pronounced contagiosity, and its potentially high dispersability, it is necessary very strictly to observe the veterinary and sanitary measures prescribed for its control.

On the highly organized socialist animal farm, with energetic and skillful work of veterinarios, animal technicians and all service personnel, and with thorough and careful observation of hygienic and sanitary rules, new cases of hog cholera can be rapidly localized and liquidated, without serious losses among the herds, and also without allowing any possible spread of the disease to other farms.

It may be said with a certain measure of justification that the contagiosity and dispersability of hog cholera are also relative ideas. In practice the degree to which these epizootological properties of hog cholera are displayed depends to a very considerable extent on who carries out the necessary integrated measures of control, and under what conditions and how this work is performed.

It may be admitted that hog cholera is less contagious and dispersable than foot-and-mouth disease, influenza and Aujeszky's disease among swine.

The question of the periodic intensification of the virulence of the causative agent of hog cholera, as with many other diseases, and in connection with this as well the question of the gradual or sudden (mutational) intensification of its contagiosity and dispersability, still remain theoretically unsolved. The available epizootological observations are still inadequate for any definitive pronouncements on this subject.

The "wave" of hog cholera epidemics that from time to time rolls up on some region, may be more readily explained by the violation of the prophylactic veterinary and sanitary rules

and the transportation of large numbers of swine without precautionary measures than by any "sudden" strengthening of the virus. We deem it necessary to emphasize this factor for the information of the leaders of veterinary administrations and of the Rayon veterinaries who are charged with immediate supervision over the compliance with veterinary and sanitary rules.

The channels and methods of the spread of hog cholera are exceedingly diverse.

Live swine infected with the virus, whether ill from apparent or concealed forms, incubating or convalescent -- i.e. virus-carriers and virus-dischargers -- represent the greatest danger of the spread of hog cholera.

On a farm (or point) affected by hog cholera, the animals with the acute form of the disease are most dangerous, for the virus they discharge during the period of intense febrile crisis is distinguished by the highest virulence and infectiousness. In this respect immediate contact between healthy and diseased swine plays the decisive part.

Inasmuch as any transportation of gravely ill animals may be considered almost entirely out of the question as a practical matter, those infected animals that do not display clinical symptoms of disease represent a particular danger with respect to the spread of the virus beyond the boundaries of the affected farm (or point) in question -- that is, to other farms and Rayons. Such animals include those in the incubation stage, those with latent infection, convalescents and some that are chronically diseased but show no clinical symptoms, other than

general cachexia, stunted growth and inability to fatten.

Hog cholera can be spread by the blood, meat, parenchymatous organs and the other products or refuse of the slaughter of swine that are ill of the disease or infected by it. It can also be spread through infected slaughtering places, by the persons who butcher the carcasses, and through the objects near it. This danger is multiplied many times over when meat or other products of slaughter are carried beyond the boundaries of the affected farms, especially to market and other places where human beings and animals congregate.

Infected feed, water sources, pastures and articles used in animal husbandry are also sources of infection which not infrequently continue to be dangerous for very long periods, in view of the hardiness of the causative agent under the conditions of the external environment and on infected objects.

It has, specifically, been proved that hog cholera virus persists for as long as 20 days on bags infected with blood, for 5 days on bags infected by urine, for a week on concentrated feeds.

The infectiousness of the blood and urine of swine ill or dead of hog cholera should be especially stressed, for these fluids contain large amounts of active virus. Dung from sick pigs is far less important, since the virus in it dies in a relatively short time. In rotting manure the virus dies in 42-90 hours.

The danger is increased if for any reason parts of the diseased organs and tissues or blood or other slaughter wastes,

are added to the manure. Parts of the intestines of diseased swine remain virulent as long as 50 days. The virulence of the virus persists up to 14 days in earth. The carcasses of animals succumbing to hog cholera may be immensely dangerous as a source of infection, especially in the first days after death, if their disposal is delayed and not careful enough. If the carcasses are dug up and torn apart by other swine, dogs, birds, wild beasts and rats, infection may be extensively and rapidly spread.

The virus loses its potency after 3-4 days in the decomposing organs of animals that have succumbed, but persists for a longer period in the spinal cord.

The supply of pig farms with various kinds of unboiled refuse and garbage containing meat or internal organs of swine with hog cholera has a definite significance in the spread of hog cholera. In this manner the disease is not infrequently spread in the United States, where the elementary veterinary and sanitary rules for the slaughter and the utilization of slaughter products of swine with hog cholera are often violated.

In view of the long persistence of hog cholera virus in chilled and salt pork, the infection may be transmitted over long distances in these products and even imported from other countries.

Thus, during pre-war years, cases of the importance of virus into Sweden by infected pork from the United States were noted.

The possibility of hog cholera being spread as a result of veterinary workers failing to observe preventive measures in their examinations, post mortems and inoculations of swine also can certainly not be overlooked.

The needles used for blood-letting and inoculation can spread infection if they are not sterilized after use on each animal.

The mechanical transmission of infection on the clothing and shoes of pigpen personnel is of no little importance.

CARRIERS

According to the investigations of American authorities, hog cholera virus may be transmitted by the common house fly (Musca domestica) and by the Stomoxys calcitrans fly. The possible role of swine lice and fleas in transmission of hog cholera still remains experimentally unproven.

Human beings and various animals may act as carriers and transporters of the virus. Experiments have proved this to be true of chickens and rats that eat out of the feed racks of diseased swine and discharge the virus in their feces.

THE INCUBATION PERIOD

The length of the incubation period in hog cholera varies considerably.

The duration of this period depends firstly on the amount and virulence of the virus entering the organism, secondly, apparently on the method by which it penetrates into the organism, and, thirdly, on the degree of resistance or susceptibility to the virus of the animal or group of animals exposed to infection.

Under unfavorable conditions of swine management and the

consequent sharp lowering of the resistance of the organism, the incubation period is shortened and a more rapid spread of hog cholera is observed.

After experimental infection (by inoculation of the virus or by placing healthy swine in infected stalls) the incubation period lasts for an average of 6 to 9 days (with a 4 day minimum), but it can sometimes last as long as 2-3 weeks.

Most frequently of all, the length of the incubation period after natural infection is 6-7 days; it ranges from 4-5 days to 20 days.

The incubation period is really several days shorter than the period that elapses until the first symptoms of illness are discovered, since swine with high fever -- 42 degrees -- frequently seemed perfectly well only a few days before.

THE CLINICAL PICTURE AND FORMS OF HOG CHOLERA

The clinical manifestations of hog cholera may vary over an exceedingly great range, depending on the resistance of the organism, the virulence of the virus and the period during which the farm has been affected by the disease.

By acuteness and duration of clinical manifestations, acute, subacute and chronic forms of hog cholera are distinguished; on the other hand, according to the particular clinical symptoms and anatomical changes that predominate, the septicemic, neurological, pulmonary, intestinal and mixed forms are distinguished.

The acute and neurological forms of hog cholera, usually take the septicemic form, the subacute takes the pulmonary, intestinal and mixed forms, while chronic hog cholera is usually of the intestinal (cachectic) form.

At the beginning of an epizootic, acute forms of the disease are usually observed; they are characterized by the appearance of acute septicemia and terminate lethally in a few days. Later, however, the subacute and chronic forms predominate.

Under the influence of the filtrable virus alone, the septicemic form develops (the pure form of hog cholera from the etiological point of view).

If the action of other bacteria that are the causative agents of secondary infection is joined with the primary action of the filtrable virus, then, according to the nature of these bacteria, either the intestinal form of the disease results (with B. suipestifer) or the thoracic form (B. suisepticus). Under the joint action of both (B. suipestifer and B. Suisepticus) the mixed form develops.

Usually when an epizootic of hog cholera appears on a farm, the septicemic form is first observed, next the thoracic form, and still later the intestinal form.

Mortality in hog cholera is directly proportional to the intensity of the infection, while the duration of the disease is inversely proportional to its intensity.

An attack of any form of hog cholera usually commences with a feverish rise in temperature and a whole series of manifestations

due to fever and indicating disturbance of the general condition (impairment of the appetite, sluggishness, burying itself in the bedding at some point away from the other swine, prolonged lying there, slowness of gait, hanging of head and tail). In severe, acute cases that terminate fatally, the temperature holds at almost the same level throughout the entire period, while in cases where the course of the disease is slower and the outcome favorable, the temperature, in spite of a few slight relapses, falls gradually and finally reached normal.

In contrast to erysipelas, the temperature in hog cholera seldom goes above 42 degrees. Before death the temperature often drops below normal, especially with suckling pigs and young pigs. Other symptoms usually show up 2-3 days after the fever begins.

In some cases of acute hog cholera the other clinical symptoms (diarrhea, for instance) may begin before fever sets in.

In isolated cases no fever at all can be detected in the affected swine, if the temperature is only taken once a day.

The Acute Septicemic form of Hog Cholera.

The particularly grave hyperacute form is rather infrequently observed. It manifests itself in high fever, depression, extreme general debility, especially of the hind legs, flow of blood from the nose and exitus letalis in sometimes only a few hours.

Usually the acute form also takes a rather severe course, but it is far from being as fast.

Besides fever, one of the first symptoms of the acute form is conjunctivitis with a mucous or mucopurulent discharge.

A mucopurulent nasal discharge, occasionally mixed with blood, is also not infrequently observed, which in very acute and grave forms goes as far as a strong flow of blood from the nose. Vomiting, and also constipation, may soon occur after onset of the disease; the constipation subsequently gives way to diarrhea, sometimes with blood in the stools.

Figure 49. Shote with hog cholera.

Blood sometimes flows in the urinary passages, coloring the urine red.

Red spots are noted on the skin. In contrast to erysipelas, they do not turn pale on digital palpation, and are due to hemorrhages located close together.

There is also a rash over the entire body, similar to that in human scarlet fever or in swine erysipelas. The points favored for the appearance of the rash are the ears, trunk and joints. The rash has the character either of small red dots or of larger diffuse areas not sharply defined. The appearance of a red rash or spots is sometimes the first clinical manifestation of hog cholera (Figure 49).

In some cases a general yellow jaundice is observed.

A marked somnolence is also constantly encountered and is a very important clinical symptom of the acute form of hog cholera.

Disturbances in the nervous system may also be observed in consequence of the hemorrhages between the pia mater and dura mater, or even in the medullary substance itself: twitching, involuntary movements, shaking of the hindquarters in walking, etc.

In pregnant sows that contract hog cholera, miscarriages are very often observed. In an infected herd this may take on mass character. It is due to septicemic endometritis.

All the symptoms enumerated usually characterize the septicemic form of the disease. If they are not alleviated with the passage of time, the disease terminated fatally in 4-7 days, sometimes even sooner (24 hours).

Mortality is very high in acute hog cholera -- up to 80 percent -- especially among suckling pigs below the age of 2 months. The neurological form of hog cholera. A large number of investigators have noted a series of clinical symptoms in the acute and hyperacute forms of hog cholera, pointing to a serious involvement of the peripheral and central nervous systems, and consisting of manifestations of irritation or depression. Dizziness, spasmodic twitching of separate muscle groups, movements of exhaustion, paralysis of the hindquarters, nervous excitement going as far as attacks recalling rabies, or, on the other hand, marked apathy and somnolence -- are observed. In some countries and some years, the neurological form of the disease has been the predominating one in epizootics of hog cholera.

In most cases where pronounced neurological symptoms are present, death occurs with extraordinary speed (24-48 hours). In some cases the disease strikes almost like lightning. The

animal gives a sharp scream of terror, falls to the floor as though felled by a blow, and dies.

Cases of recovery from the neurological form of hog cholera are rare. The survivors pass rapidly into a condition of complete emaciation.

THE SUBACUTE AND CHRONIC FORMS OF HOG CHOLERA

The subacute and chronic forms of hog cholera develop more slowly and are unaccompanied by such prolonged and high fever as in the acute form. In the latter stages of the disease there is not invariably fever. The fever lasts a few weeks, sometimes (in young pigs) for months. These forms of hog cholera are mainly characterized by the appearance of complications due to the pathogenic activity of the secondary infections that usually accompany hog cholera.

The development of the secondary infections usually takes place from the 7th to 10th day after infection.

After shotes had been subcutaneously infected with virus, the existence of secondary infections among them was observed as follows: in 33 percent, after 5 days; in 50 percent, after the 6th day; in 71 percent, after 7-10 days; in 83 percent, after 11-15 days.

The following secondary infections were found in 176 shotes examined: paratyphoid in 50, B. suisepticus in 34, B. pyocyaneous in 12, erysipelas in 5, B. coli and other bacteria in 75.

According to locality affected, these secondary complications are divided into intestinal, pulmonary and mixed forms of subacute or chronic hog cholera.

The intestinal form develops slowly and causes less marked indisposition of the animal. The constipation that appears at the outset is replaced in a few days by diarrhea, and in a little while this in turn yields to constipation again.

This alternation of constipation and diarrhea is one of the typical signs of the intestinal form of hog cholera, and does not occur in a few other intestinal disorders of swine (paratyphoid, for instance).

The diarrheal stools are yellow or greenish, though sometimes (from admixture of blood) they may be reddish or dark brown, and are distinguished by their very revolting odor. In severe diarrhea they are ejected in streams. In the area of the mouth, scabs and sores are noted on the lips, tongue and tonsils, indicating the development of croupous-diphtherial processes.

The outcome of the intestinal form of hog cholera may proceed in one of two ways. In some cases the acute symptoms of intestinal disorder gradually disappear, the appetite is reestablished and the animals finally recover.

In the other, more severe cases, owing to the prolonged loss of appetite and the exhausting diarrhea, the diseased animals -- mostly young pigs -- pass into a state of extreme emaciation, and anemia and chronic cachexia develop.

As time passes, not only do the fat and part of the musculature atrophy in them, but even to some extent the skin, which is drawn into folds and covered with scabs.

The young pigs and shotes with the intestinal form of hog cholera are transformed to starvelings, with the outward appearance characteristic of them: hanging head and tail, curved spine, pointed hindquarters hanging flabbily, rear legs tucked under the body. The animals are extremely emaciated, with marked retardation in growth and development, move with difficulty, and are shaky on their legs.

Recovery of starvelings is relatively rare.

The thoracic form of hog cholera corresponds in its symptoms to the acute or chronic form of swine plague and appears as a complication of the septicemic form of hog cholera by a pasteurellosis infection.

Disturbances of the respiratory organs come to the foreground in such cases: rhinitis, bronchitis, bronchopneumonia, manifested by head colds, coughing, difficult respiration and dyspnea.

There are no manifestations in the alimentary canal, or such as there may be are of minor importance.

In the mixed form of hog cholera, together with symptoms of pulmonary involvement (due to the action of B. suisepticus) disorders of the gastro-intestinal tract, induced by paratyphoid infection, are observed.

The skin is very frequently affected in hog cholera. In the acute septicemic form, focal congestive hyperemia and hemorrhage is noted.

In the subacute form of hog cholera, furunculous dermatitis not infrequently develops. In this condition, round swellings the size of a 15-kopek piece first appear on the sites of the congestive hyperemia, and from these, pustules filled with a yellowish infiltrate are developed. Pus is soon mingled with this infiltrate. When the pustules break open, scabs are formed on their sites, and after these have fallen off, scars or sores are left, which are sometimes deep and do not heal for a long time (Figures 50 and 51).

Figure 50. Furunculous dermatitis in a swine dead of the subacute form of hog cholera. Flat round defects in the skin occupy the sites of scabs that have fallen off.

Figure 51. Furunculous dermatitis on the udder of a swine with subacute hog cholera.

In other cases, numerous exanthemata similar to those of pox appear over the whole body, or necrosis occurs on separate areas of the skin (on the ears, tail and legs). The necrosis is due to the prolonged stasis of the blood and infiltration into such areas, or else it arises in localities subjected to prolonged pressure (in lying) or to trauma.

The necrotic parts become dry and touch, and acquire a brownish-red color.

Necrotic sores are sometimes noted on the legs.

The atypical "creeping" form of hog cholera is sometimes

observed on a few pig farms that have long been affected by this infection.

In consequence of a certain attenuation in the virulence of the virus, owing to its prolonged passage through the organisms of many hundreds of animals (including also those artificially immunized), or in consequence of a certain "habituation" of the swine herds to the infection over the longer period of its existence on the farm, and of the influence of the immunization carried out, an epizootic of hog cholera on such a farm assumes a peculiar character, unusual for this infection. In such cases, over a period of some months, it does not induce the acute or subacute forms of the disease, without pronounced symptoms or significant mortality.

But in cases where the resistance of the organism has been lowered in the mass of the animals under the influence of severe colds, digestive disturbances, inoculations against erysipelas, or other reasons, such a smoldering epizootic may be aggravated and result in substantial mortality amont the animals.

Such cases also occur in infected herds that had been entirely healthy for a year and even longer.

The picture of the infection of young pigs by hog cholera on long affected farms is fairly indeterminate. Usually not later than the moment of weaning, almost all the young pigs of the same litter begin to pine and develop eczema, red spots like flea-bites appear on the skin, followed by brown scales and crusts.

Figure 52. Hog cholera. Hemorrhages on the mucous membrane of the stomach in the acute form of hog cholera, together with small ulcers (erosions) on the folds of the mucous membrane. (After Andreev).

Figure 53. Hog cholera. Diffuse hemorrhages in the large intestine. (After Andreev).

Figure 54. Hemorrhagic inflammation of the stomach in the acute form of hog cholera. (After Andreev)

Figure 55. Hog cholera. Punctuate hemorrhages in the small intestine in the acute form of hog cholera. (After Andreev).

Figure 56. Hog cholera. Punctuate hemorrhages in the rectum. (After Andreev).

Figure 57. Hog cholera. Punctuate hemorrhages on the mucous membrane of the bladder. (After Andreev).

Eczema is most often located on the belly, spine, extremities and on the forehead, where separate crusts unite into large scales and scabs, formed over a red background.

Such eczema are sometimes formed as a result of gastro-intestinal disorders and of some other infections.

Except for a skin rash and temporary loss of appetite, young pigs with chronic hog cholera sometimes display no visible symptoms of disease, but their development is a whole month behind that of other pigs of the same age.

Not infrequently a whole litter is affected in this way by the disease. The eczema progresses and takes a malignant course. The skin thickens, becomes gray and puckered and solidly covered with incrustations. Severe, deep necroses are formed on the lips and extremities, the spine becomes curved, the belly is drawn up, empty, the eyelids are stuck together with dried mucopurulent discharges. The animals eat little, lie much and finally die. Post mortems often discloses nothing but the degeneration of the organs, manifesting itself in the pronounced paleness of the mucous membranes of the intestines, kidneys and liver.

PATHOLOGIC ANATOMY CHANGES

In accordance with the varied intensity and duration of the morbid processes, the pathologic anatomical changes found on post mortems of swine that have succumbed to hog cholera are somewhat varied.

The septicemic form of hog cholera is characterized by the typical picture of the hemorrhagic diathesis, namely: appearance of hemorrhage on the serious and mucous membranes, in the lymph nodes and organs, and on the skin.

The hemorrhages on the skin are sometimes located so close together that the skin is reddened to a uniform color as in scarlet fever. Hemorrhages are sometimes observed in the subcutaneous tissues and in the muscles.

Exceedingly small punctuate hemorrhages are found in the mucous membrane of the gastro-intestinal canal, not only in the large intestine, but in the small intestine as well (Figure 52).

They are usually located on the folds of the mucous membranes. Very often they are found in the rectum (Figure 56), in which case the feces may contain admixtures of blood. Besides small hemorrhages, diffuse bleeding of the mucous membranes of the stomach and large intestine and hemorrhagic inflammation of these organs is also noted (Figures 52 and 54).

Fibrin may be deposited in the form of films or thin coatings on the surface of the mucous membrane of the intestine.

Small hemorrhages are also located on the mucous membrane of the bladder (Figure 57) and sometimes also under the serous envelope of the intestines and on the parietal band of the peritoneum.

Large hemorrhages may also be found on the mucous membrane of the larynx and urinary bladder.

Small punctate hemorrhages are very frequently observed in the grey layers of the kidneys. When located only in the glomerules, these hemorrhages sharply project onto the pale background zone of the kidneys. The extravasations on a larger scale in the gray substance of the kidneys proceed much more sharply, and also in the pelvis of the kidney and renal capsule (Figure 58).

Figure 58. Hog cholera. Hemhorrages and atrophic necrosis in the kidneys. (After Andreev).

Figure 59. Hog cholera. Hemorrhagic infiltration of the lymph nodes. (After Andreev).

Figure 60. Hemorrhages on the periphery of the lymph nodes in the acute form of hog cholera.

Figure 61. Colitis diphtheroides superficialis in hog cholera. a: diphtherial false membrane. a1: the same membrane, penetrating more deeply into the tissues of the propriae mucosae. B: Still unchanged tissue of the propriae mucosae. Low magnification. (After Jost).

Hemorrhages in the lungs are usually found under the pleura in the pulmonary parenchymata themselves, and, less frequently, on the costal pleura.

The endocardium and, particularly, the pericardium, are also frequently covered with small hemorrhages. Diffuse hemorrhages as well are observed beneath the endocardium. There is sometimes a large quantity of serous fluid in the pericardial cavity. Both punctate and diffuse hemorrhages may also occur in the dura mater and pia mater. The lymph glands are enlarged and perforated by hemorrhages, giving them a dark red color (Figures 59 and 60). The solitary follicles and Peyer's patches are in a state of inflammatory intumescence, ulceration and crust formation. The cancellous tissue is colored dark red.

Intestinal Form

The changes observed in the intestinal form of hog cholera are primarily localized in the cecum and colon, and in the stomach; and less frequently in the small intestine and oral cavity.

Where the gastro-intestinal canal is affected, the most varied stages and forms of inflammation may be observed: the usual serous catarrh, and hemorrhagic, croupous and diptheritic inflammations (Figures 61 and 62).

Figure 62. Hog cholera. Stomach. Pseudo-diphtherial formations (croupous, s-diphtherial inflammation). (After Andreev).

Croupous (diphtheroid) and diphtherial inflammations are the most characteristic for the intestinal form of hog cholera, and are observed during its subacute and chronic course.

In croupous inflammation (croupous-diphtherial, according to Marek), a coagulable exudate diffuses through the surface layer of the mucous membrane and reaches its surface. When the exudate coagulates, necrosis occurs in the infiltrated area of the mucous membrane (coagulation necrosis), while a false membrane, the diphtheroid deposit, in close connection with the underlying tissue and consisting of fibrin and debris from the necrotized tissues, is formed on its surface.

This croupous inflammation may be observed in various forms, depending on whether it is confined to separate small areas (focal form) or is spread over a large area (diffuse form).

The commonest form of croupous inflammation is the focal form. When pronounced, it gives the most characteristic picture of hog cholera.

The primary centers of focal croupous inflammation usually develop on the site of Peyer's patches, the solitary lymph follicles, or on areas of the mucous membranes already visited by hemorrhage.

The follicles become enlarged, owing to hyperplasia of their tissues and infiltration of exudate (Figure 63). Coagulation necrosis, accompanied by caseous degeneration, then follows

(Figures 64 and 65). The mucous membrane covering the follicles, as a result of the coagulation of the infiltrated exudate, which often contains erythrocytes as well, undergoes necrosis in exactly the same way (Figure 66).

Figure 63. Hog cholera. Intumescence of solitary follicles in small intestine. (After Andreyev).

Figure 64. Hog cholera. Intestinal ulcer. In the center a structureless necrotic mass, with included fatty vacuoles, emerging from the follicle. On the right and left, a fissure between the mucosa and the necrotic formation. In the submucous tissue the necrotic formation is separated from the healthy tissue by an inflammatory ridge of cellular elements. The cellular infiltration into the adjoining musculature is also noticeable. Outside the zones of infiltration there is inflammatory hyperemia in the submucous tissue. (After Iost [Jost?]).

After elimination of the caseous masses from the necrotic follicle, a so-called follicular ulcer, with sharp or intumescent edges, is formed (Figures 67, 68, 69 and 70). The base of the ulcer is sometimes covered by remnants of the caseous debris.

The follicular ulcers so formed are very convenient places for the penetration of B. suipestifer and B. necrosis. Owing to irritation of the surrounding healthy mucous membrane by the products of the activity of these bacteria, the croupous inflammation spreads more and more around the primary croupous focus that has been formed.

In this way, yellowish, brownish or entirely dark raised ulcers are formed, from the size of a lentil to that of a fifty-kopek piece, slightly projecting above the level of the mucous membrane and deep in the middle, at the site of the former follicle. The area of these lesions gradually increases, and they sometimes unite to form a single flat ulcer covering an extensive area. Owing to the thickening of the intestinal walls, the lumen of the intestine becomes more or less constricted. The surface of these ulcers consists in the center of a friable, caseous mass. A reactive inflammation and thickening of the submucous tissue or serous membrane proceeds beneath these ulcers, according to the depth of their penetration. During reactive inflammation, in the serous membrane, inflammation of the peritoneum not infrequently occurs and results in anastomosis of intestinal loops.

Figure 65. Hog cholera. Intumescence and initial stage of necrosis of solitary follicles (formation of follicular ulcers) in the large intestine, with intumescence of the mucous membrane around it in the form of a ridge. (After Andreyev).

Figure 66. Hog cholera. Process of necrosis of solitary follicles and more pronounced intumescence of the mucous membrane around them. (After Andreyev).

Figure 67. Diphtheria follicularis of the large intestine in subacute hog cholera (colitis diphtheroides follicularis). The large intestine has been subjected to inversion of the mucous

membrane outwards. Above: the ileocecal [?] valve. 3/4 natural size. (After Iost).

Figure 68. Hog cholera. Large intestine. Various stages of necrosis of the solitary follicles. In some of the larger ulcers the deepening in the middle is clearly visible. (After Andreyev).

If the necrotized follicle is not transformed into an ulcer but preserves its own shape, then the coagulation necrosis of the mucous membrane that takes place around it provides the basis for the formation of a button-shaped ulcer with concentric layers (Figure 73). Owing to the demarcating inflammation (an accumulation of polynuclear leucocytes), the mucous membranes around these scars is intumesced into a cylindrical form. The demarcating inflammation develops also beneath the necrotized mucous membrane (under the ulcer), in consequence of which the ulcer is raised above the level of the mucous membrane and acquires a resemblance to a button. (Figures 71 and 72). The connection between these button-like ulcers and the mucous membrane is gradually lost, beginning with the edges, and finally they can drop off.

Figure 69. Hog cholera. Superficial necrosis of the solitary follicles in the large intestine. Here and there there are small ulcers on the sites of the solitary follicles. (After Andreyev).

Figure 70. Hog cholera. Small intestine. Pronounced diphtheroidal changes in the solitary follicles with formation of ulcers in various stages of development. The mucous membrane around the ulcers is in the form of an intumescent ridge. Plugs representing the inflammatory product of follicular depressions (pockets) are visible in the centers of most of the ulcers. In the middle is a Peyer's patch that has undergone diphtheroidal change. At the top is the lower portion of the end of that section of the intestinal area which is in a state of diphtheroidal inflammation.

Figure 71. Hog cholera. Ileum and beginning of large intestine. Among the small scars are large ("button-like") ulcers consisting of friable caseous masses; in some of them concentric layer formation may be noted. (After Andreyev).

Figure 72. Hog cholera. Large intestine. Massive button-like ulcers. (After Andreyev).

Figure 73. Hog cholera. Large intestine. Massive ulcers with concentric layer structure. (Original).

Figure 74. Hog cholera. Diffuse diphtheroidal inflammation of the large intestine. (After Andreyev).

Figure 75. Hog cholera. Hemorrhagic-diphtherial inflammation of the rectum. (After Andreyev).

Figure 76. Cross-section through changed walls of vessels in hog cholera. Semi-schematic presentation. Various stages of thickening. Hyalinization and karyorrhexis.

On the site of ulcers that have dropped off, granulation tissue develops, followed by a cicatrix, the surface of which is gradually covered by the epithelia. The smooth, shiny and reddish mucous membrane in this place is slightly raised, though sometimes it is slightly depressed.

The process of necrosis is sometimes not confined to the mucous membrane, but spreads deeper, down to the muscular layer and even to the serous membrane itself, as a result of which adhesive intestinal inflammation may develop.

In the diffuse form of croupous inflammation of the intestines (Figure 74), the process of coagulation necrosis attacks not the follicles, but immediately attacks a great length of the mucous membrane itself in the cecum or colon. The intestinal wall in these places is considerably thickened (0.5-1 centimeter) while the mucous membrane is folded along the transverse folds.

Diphtherial or necrotizing inflammation (what Marek calls "simple necrosis") of the gastro-intestinal canal is for the most part observed simultaneously with croupous or hemorrhagic inflammation (Figure 75). In diphtherial inflammation, as in croupous, coagulation necrosis is occasionally preceded by infiltration of the mucous membrane by a slightly coagulating exudate, which never reaches the surface of the mucous membrane,

however. Therefore, too, no false membranes, intimately joined to the underlying tissues, are formed in this case. Necrosis here occurs in the mucous membrane itself, and this necrosis (Marek's "simple necrosis") may be confined to the epithelia and surface layers of the mucous membranes, but it can also penetrate more deeply, down to the submucosa and beyond. The latter form of necrosis is more typical for hog cholera.

A bran-like coating forms on the surface of the necrosis, while inside of it dark-colored, dry, friable ulcers of round or oval shape are formed. When these ulcers fall off, sores result, which heal by developing granulation tissue in themselves, covered by epithelia.

The Thoracic Form

Affection of the organs of the thoracic cavity (pleura and lungs), just as in hemorrhagic septicemia of swine, may sometimes be the only change in pathological anatomy observed on post mortem of swine with hog cholera.

Acute and chronic catarrh of the bronchi, with atelectasis of separate lobules of the lung, and also various forms of inflammation of the lungs (catarrhal, hemorrhagic, croupous, necrotizing), pleura and pericardium, usually develop owing to secondary infection by B. suisepticus, but sometimes, besides B. suisepticus, B. pyogenes or a large number of other bacteria (diplococci, streptococci, bacteria of the Typhus-coli group, etc.) are found in the affected areas.

Finally, serous catarrh of separate parts or even of whole lobules of the lungs can apparently be induced only by the filtrable virus. The affection of the lungs in hog cholera is, most often of all, of the nature of a catarrhal pneumonia, which is primarily localized in the anterior lobes of the lung.

Thus, for instance, out of 171 cases of pneumonia observed in hog cholera, 120 were catarrhal pneumonia, 23 acute fibrous necrotizing pneumonia and 18 gangrenous pneumonia.

The character of lung affections is apparently dependent to a very great extent not so much on the virulence of the hog cholera virus and of the secondary microflora spreading through the lungs as on the condition of the diseased animals. The better this condition is, the more rarely do fibrous and necrotizing pneumonia develop. [The author evidently is thinking of a milder degree of necrosis than that indicated by the American term "necropneumonia", which is, of course, synonymous with gangrenous pneumonia.]

The lymph nodes may be increased in size (hyperplasia), or in a state of hyperemia, or punctured by hemorrhages.

Necrotic foci are formed in the lymph nodes only in cases of secondary infection by B. paratyphi suis or B. enterit. Gartneri.

Figure 77. Scheme of the lymph node in hog cholera.

a. Adenoid tissue of the parenchyma

b. Cell-poor parenchymatic substance

c. Trabecluae

d. Follicles

e. Peritrabecular sinus

f. Cortical (marginal) sinus

g. Capsule

h. Connective tissue envelope

The distribution of hemorrhages in the parenchyma of the lymph node (in the early stage) is shown by small circles.

In the liver, kidneys, heart and musculature, parenchymatous degeneration is rather often observed, as a result of a prolonged state of fever. In addition, there is often a congestive hyperemia in the liver, accompanied by atrophy of the tissue. Small hemorrhages may also occur in all these organs during a more acute course of the disease.

Figure 78. Infarcts in the spleen in hog cholera. (Original).

Figure 79. General view of an infarct at the edge of the spleen, with central necrotic foci and hemorrhagic marginal zone. A changed vessel runs at the base of the infarct in the direction of the edge of the spleen. 1:38.

Figure 80. Infarcts in the spleen. On the horizontal section -- the lighter area of superposition -- are the sites of the necrosis. (VIEV).

The SPLEEN in hog cholera may be either unchanged or display intumescence, (resulting from hyperemia or hyperplasia) which is in no way distinguished from that in other infectious diseases. But in some cases, mainly in subacute cases, anemic and mixed infarcts, which are of great pathognomonic significance, may be observed. These infarcts are more frequently formed after artificial inoculation with hog cholera virus than after naturally contracting the disease. (Figure 78).

The formation of infarcts takes place under the influence of the action of the virus on the walls of the terminal vessels. After subcutaneous inoculation with highly active virus, more extensive infarcts of hemorrhagic character are formed, but after natural infection by normal virus per os, anemic and less extensive infarcts result.

Macroscopically these infarcts appear in the form of dark red, more or less sharply defined foci on the surface of the organ and attain a diameter of 1-2 centimeters. In a transverse section they are also distinguished sharply from the surrounding tissue.

The infarcts are wedge-shaped in most cases, but they are often irregularly serrated at the edges, with spices pointing towards the center (Figure 79). In their form and location they correspond to the areas supplied by profoundly modified follicular arteries.

Infarcts are usually formed in large numbers and distributed mainly along the edges of the spleen (Figure 78).

Infarcts are also observed, though in lesser numbers, in the spleen parenchyma itself.

In some infarcts secondary necrotic foci, induced by secondary infections, mainly by B. paratyphi suis, are encountered.

Figure 81. Diphtheroidal colitis in hog cholera.

a. Mucosa
b. Muscularis mucosae
c. Submucosa
d. Internal muscular layer
e. External muscular layer
f. Infiltrate of round cells between glandular epithelia, penetrating deeply into the submucosa
g. Coagulation necrosis of the mucous membrane, with demarcation ridge at h
i. Adipose tissue
k. Bloodvessels in the submucosa

HISTOLOGICAL CHANGES

A detailed description of the histological changes found in hog cholera was presented by us in the last edition of this book (1936), to which we refer specialists interested in this question. At this place we shall give only sketches illustrative

of these changes. The histological changes may be summarized as follows:

The principal changes which may be utilized for the purpose of the differential diagnosis of hog cholera and for the elucidation of the pathologic changes observed in that disease are found in the bloodvessels, lymph nodes, kidneys, spleen and central nervous system.

The capillaries and larger vessels undergo gross changes very early. Under the influence of the virus, multiplying in the blood, degenerative changes in the endothelial cells take place, together with hyaline degeneration and necrosis of the walls of the bloodvessels. The latter condition easily spreads and causes hemorrhages. Owing to edema and the multiplication of adventitious cells, the walls of the bloodvessels become thickened, and not infrequently thrombi are formed. It is these changes in the bloodvessels that are also mainly responsible for the patho-anatomical changes characteristic for hog cholera; hemorrhages, necrotic foci in the organs and anemic infarcts in the spleen.

In the lymph nodes, which are intumescent and hyperemic, there are not infrequently hemorrhagic infiltrations, with localization of the extravasated blood along the peripheries and in the parenchymata of the nodes, and necrotic foci in chronic cases. Pronounced atrophy of the adenoid tissue of the lymph nodes and spleen is also noted, which induces the leukopenia almost regularly observed in hog cholera.

This picture of hemorrhagic lymphadenitis is characteristic for hog cholera.

Figure 82. Glomerular and periglomerular hemorrhages in the acute form of hog cholera.

a. Hemorrhage with pyknotic nuclei in the glomeruli
b. Extensive periglomerular hemorrhage
c. Debris of the nuclei of the endothelia of the entrance to the vessel
d. Degeneration of the epithelia of the canaliculi of the vessel.

The kidneys are relatively seldom affected in other infectious diseases, but suffer greatly from the action of hog cholera virus, which induces a serous or hemorrhagic diffuse glomerulonephritis (B. Bol' and Rybinskiy). Hyaline and fatty degeneration is noted in the epithelia of the winding canaliculi, together with a pronounced regressive change in the bloodvessels, accompanied by hemorrhage, thrombosis, stasis and, finally, necrosis of their walls. Endovasculitis and perivasculitis is observed in some cases (B. Bol' and Rybinskiy).

In acute cases of the neural form of hog cholera, diffuse, nonsuppurating encephalitis is found in the central nervous system, with marked degenerative changes of the nerve cells and of the walls of the bloodvessels in the brain, together with cellular accumulations in the form of sleeve-shaped formations in the perivascular lymphatic areas and in the areas surrounded by the hemato-encephalic barrier. Vessels which are hardly

noticeable in normal cases, now stand out in the form of a braid of vessels of various thickness. Hemorrhages are noted in the medullary substance and in the meninges. In addition, tissue reactions in the form of proliferation of the neuroglia and formation of "gliogenous nodules" are also observed.

Figure 83. Transverse section of the central portion of the brain. Schematic representation. Black dots indicate distribution of encephalitic lesions in hog cholera. (After Zayfrid [Seifried?]).

THE QUANTITATIVE AND MORPHOLOGICAL CHANGES IN THE BLOOD

In the red blood elements, the development of anemia is observed. This is expressed in a fall in the number of erythrocytes and in the hemoglobin content; polychromatophilia, poikilocytosis and increase in the number of blood platelets is also observed.

Changes in the number of reticulocytes (granulofilocytes) are highly characteristic.

These are erythrocytes containing granular-fibrous matter which are residues of the embryonic protoplasm.

In the blood of normal swine, up to the age of 3 months, they constitute from 1.1 percent to 13.8 percent of the total of number of erythrocytes and from 0.2 percent to 4 percent in swine over 3 months of age.

In hog cholera, the number of reticulocytes falls when fever first appears, and they disappear completely from the blood when the characteristic clinical signs manifest themselves. During convalescence the reticulocyte count again rises sharply.

In the white blood elements as well, great changes are noted. Pronounced leukopenia has been noted in hog cholera by both Russian and foreign authors. A fall in the leukocyte count below 8000 per cubic millimeter is a true sign of hog cholera.

It has been possible to note certain shifts in the composition of the white blood corpuscles. In the initial stages of the acute form of hog cholera, appearance of neutrophilia [levorotary ?], eosinopenia, increased basophile count and lymphocytosis are regularly observed.

On complication of the disease by secondary infections, or when the acute process changes over to the chronic form, the white blood count changes: appearance of eosinophiles and basophiles or increase in them, and pronounced lymphocytosis. (Bel'kov, 1939).

DIAGNOSIS

The diagnosis of hog cholera is based on the epizootological, clinical and patho-anatomical findings, and should as a rule be made on the spot, at the farm where the disease occurs.

Bacteriological examinations, biological tests and histological examinations play a subordinate role and are useful chiefly for differential diagnosis.

The timely (early) diagnosis of hog cholera is exceptionally important: not infrequently the success of the measures for localizing and liquidating an outbreak depends on it. Each additional day of delay in the diagnosis costs the affected farm dearly, especially when measures to prevent transmission of the infection and localize it are not taken as soon as the first suspicions of the presence of hog cholera arise.

The epizootological data concerning the conditions under which the infection appears and spreads, and its character, may in numerous cases be decisive for the diagnosis.

Above all, it is exceptionally important to discover the possible source of the infection, so as to prevent further infection of the herd from this source.

The characteristic epizootological features of hog cholera are: swine of all ages are susceptible to it; it may appear at any time of the year, regardless of definite predisposing factors (such as are represented by head colds in influenza or hot weather in swine erysipelas); rapid development of an enzootic where there is close contact between the animals, or there is a common source of infection for a large number of animals.

The clinical signs of hog cholera are fairly well marked at the beginning of an enzootic, when the first cases of the disease appear in the acute septicemic form, with high fever, intense depression, loss of appetite and not infrequently weakness in the hindquarters.

dry necrosis of the intestinal mucous membranes, and numerous hemorrhages in the kidneys together constitute the syndrome of patho-anatomical alterations which may serve as a true indicator of hog cholera, at least insofar as concerns the disease in adult animals.

However, such more or less pronounced patho-anatomical alterations (especially the picture of hemorrhagic septicemia) are mainly observed only at the beginning of an epizootic. Afterwards, when the less susceptible animals are affected, the diagnosis already becomes more difficult, inasmuch as very often post mortems disclose only the changes in the thoracic cavity which are characteristic for septicemia of swine (catarrhal-croupous, hemorrhagic-croupous or necrotizing pneumonias, serofibrinous pleurisy, pericarditis), or, in addition to these, the ordinary (serous) or often the diphtherial catarrhs of the gastro-intestinal tract which are not very characteristic for hog cholera.

If the intestinal changes characteristic of hog cholera are present simultaneously with the typical picture of swine septicemia, the diagnosis of hog cholera may be made with assurance.

It is sometimes necessary to employ biological tests before a final decision on the character of the disease can be made, in cases where the first and best period for the diagnosis has already passed, and subacute and attenuated forms of the

disease are observed, recalling now paratyphoid, now enzootic bronchopneumonia, now the subacute forms of swine plague, and affording no possibility of amplifying the diagnosis on the basis of clinical and anatomical findings alone.

Filtered material must be used for biological tests -- blood serum or suspensions of material from parenchymatous organs or infected lungs -- and tested on a healthy shote, free of hog cholera and weighing not less than 40 kilograms.

A biological test gives a definite answer only when it is positive, and infection results.

Biological tests must be conducted under conditions that completely exclude the possibility of the test animals contracting any other infections collaterally, or an entirely confused picture may be obtained.

For this purpose a well-constructed pigpen must be available. It must have no other animal occupants, and must be served by separate, well-trained personnel. The sanitary rules must be strictly observed. A biological test by itself requires about two weeks.

All these factors make the method of biological tests very expensive and excessively slow.

Serum tests. The considerable difficulties not infrequently involved in the organization of biological tests make it possible to use them relatively seldom. The serum test, which is much easier to perform, may be recommended as a substitute.

Three groups of young pigs (two in each group) are selected for this purpose. The first group is passively immunized against hog cholera, the second against swine plague, while the third is left uninoculated. All the animals are kept together.

On the following day all six young pigs receive subcutaneous inoculations of unfiltered blood taken under aseptic conditions from pigs that have contracted the disease naturally. The diagnosis is made in accordance with the results.

Finally, the immunizing serums against hog cholera, septicemia and erysipelas, which are administered on a farm for curative and prophylactic purposes at the very onset of an enzootic, may also be used for diagnostic purposes.

The character of the infection in question may be judged by the effectiveness of one serum or the other.

Histological examinations. The veterinaries of the affected farms should remove small samples of the organs and brains of the fresh carcasses for histological examination for hog cholera; and should preserve these samples in a 10 percent formalin solution.

In the whole syndrome of clinical, patho-anatomical, bacteriological and epizootological findings, the histological examination of the central nervous system may be of a certain amount of service in formulating a diagnosis of hog cholera. It must be borne in mind that the inflammatory changes in this disease

are localized in definite portions of the brain, namely in the neighborhood of the inner and outer surfaces of the brain. They are particularly pronounced in the neighborhood of the ventricles, in the venous plexus and in the zones of the outer surface.

Changes in the bloodvessels and the related changes in lymph nodes, kidneys and spleen, are more important for diagnosis, since they are almost regularly observed. Infarcts in the spleen are entirely specific, but, unfortunately, are encountered in only 40-50 percent of all cases.

Sarnovich has suggested using the allergy reaction in the diagnosis of hog cholera. He used, as an allergen, blood from pigs with this disease, mixing it with an equal quantity of castor oil. To render the virus harmless, 0.2 percent of formalin was first added to the defibrinated blood, which was then kept at room temperature for three days. After this, the amount of blood required for inoculation was mixed with an equal volume of castor oil, and the remaining blood kept under refrigeration.

The allergin so prepared was inoculated in doses of 0.25-0.5 cubic centimeters intradermally on the external surface of the haunch.

If a general reaction -- increased temperature and depression -- occurs in the test pig, besides the local reaction at the site of inoculation -- swelling and redness -- then,

according to Sarnovich's communication, a positive diagnosis of hog cholera may be made.

Injection of a triple dose -- 1.5 cubic centimeters -- of allergin into healthy pigs induces neither fever reaction nor any other symptoms of disease over the period of a month.

Check experiments made by other investigators showed that the allergic reaction is far from manifesting itself as regularly as in the experiments of Sarnovich himself. Nevertheless, the check experiments showed that it might have a certain value as a group reaction. The application of this reaction to a group of 6-10 suspected cases of hog cholera, the experimenters considered, might make it possible to render a diagnosis of hog cholera if a positive reaction were obtained, even though only from a few of the animals inoculated.

But, as has been shown by subsequent detailed experiments, the method of allergic reaction proposed by Sarnovich yields a negative result not only with healthy animals, but also with those affected by hog cholera. A positive allergic reaction was observed only in animals that had either recovered from hog cholera or been immunized against it.

Thus we observe the same phenomenon with respect to the allergic reaction in hog cholera, as in sheep-pox and cowpox: injection of antigen induces an allergic reaction in animals possessing active or passive immunity, and not in animals having the disease.

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Thus we observe the same phenomenon with respect to the allergic reaction in hog cholera, as in sheep-pox and cowpox: injection of antigen induces an allergic reaction in animals possessing active or passive immunity, and not in animals having the disease.

Donas'yen and Lestokar took these observations as a starting point, and fundamentally modified the method of intradermoreaction proposed by Sarnovich. They recommend subcutaneous injection of 1 cubic centimeter anti-hog cholera serum per kilogram body weight into the suspected animal before administration of the allergen. They also propose an original method for evaluating the local reaction obtained, which consists in determining the ratio between the size of the swelling (nodule) immediately after administration of the allergen and its size after 24 hours. The swelling on the site of the inoculation is usually oval in shape, and for determining its area they take the product of its major and minor diameters -- its length and its width.

They judge the result of the reaction, i. e., the extent of the increase in the swelling in the skin after a day has elapsed, by the ratio $\frac{A \times B}{a \times b}$, where A and B indicate the major and minor diameters of the swelling after 24 hours, while a and b are the major and minor diameters of the swelling immediately after injection of the allergen.

The reaction may be considered positive if the ratio

$$\frac{A \times B}{a \times b} = 3 \text{ or} > 3.$$

Numerous experiments conducted on animals that were healthy, diseased, naturally immune, passively immunized with serum alone, and, finally, hyperimmunized against hog cholera brought these authors to the conclusion that the intradermoreaction in hog cholera is an immunity reaction.

Bridre has advised that this new and original method of in vivo diagnosis of hog cholera be termed xenoreaction.

If, for any reason, the xenoreaction cannot be carried out by the veterinary on the spot, it is sufficient to send blood samples taken, under sterile conditions, from swine that have high fever and are suspected of having the acute form of hog cholera, to the nearest laboratory. The laboratory can then make this test, giving the supplementary administration of serum to the immune swine before they are inoculated with the castor-oil emulsion of the defibrinated blood, sent to it.

Antigen from blood taken from swine in the acute stage of hog cholera, that have succumbed to the disease or been destroyed, gives better results than antigen from the organs of the same swine, but, on the contrary, antigen from the organs of swine that have suffered from the disease for a long time -- i. e., from chronic cases -- gives better results than antigen from their blood.

After making a thorough study of the reasons that may lead to erroneous results when the xenoreaction is used, Donas'yen and Lestokar declare themselves compelled to modify their original view that this method is of extraordinary simplicity. It has developed that there are a number of reasons that could lead to mistaken diagnoses.

The main reason for mistakes is inaccurate measurement of the area of the swelling formed at the site of inoculation. When the reaction is positive, the swelling consists of two concentric zones: a central, erythematous portion and a peripheral, edematous portion. Both these zones must be measured together. To determine the boundaries of the edema, palpation of the inoculation site must under all circumstances be resorted to, instead of merely determining the limits by ocular inspection.

Selection of the test animals also proved to be of great importance. First of all, the swine used for the tests must have a thin, elastic skin. Besides this, their capacity for reaction should be explored by preliminary tests, and only animals giving the highest index on inoculation with one antigen or the other of known activity used for the reaction.

It should also be borne in mind that after some weeks or months the reactive capacity in some of the actively immunized swine may be considerably impaired. Besides this, repeated inoculations produce a thickening of the skin that gradually renders the pig unsuitable for further use as a test animal.

The activity of the serum administered to the test animal also shows great influence on the result of the reaction. Only highly active serum, capable, in doses of 0.5 cubic centimeters per kilogram body weight, of protecting swine from infection by hog cholera virus, should be used for the intradermoreaction.

The antigen value of the virus contained in the blood being tested is also a factor that deserves attention and consideration. So that the virus should have a sufficient antigenic activity and be powerful enough (contain the maximum number of units of virulence), the blood should be taken from sick pigs with the highest temperature and with the acute form of the disease, not from those that have been ill for a long time, in which the virus may already have disappeared from the blood.

Thus, three factors bear on the results obtained by the xenoreaction: the reactive capacity of the test pigs, the quality of the anti-hog cholera injected, and the antigen value of the blood being tested. If one of these factors is defective, a negative reaction may be obtained. To find out what viruses are weak antigenically, it is necessary to dispose of swine with pronounced reactivity, and also of serum of high activity.

Since the results of the xenoreaction depend on a number of conditions, this method can yield true indications only in laboratories that strictly observe the rules for carrying it out.

The serum diagnosis of swine cholera has been studied by a large number of investigators, but up to the present it has still not been possible to work out a method that could be introduced into practice.

Various authors have studied the formalin test (jelling effect), the lipoidal reaction, RSK [Complement Fixation Test], the precipitation reaction, etc.

The reason for the failure in the application of serum reactions to the diagnosis of hog cholera has been the difficulty of preparing an antigen containing the virus of hog cholera in relatively pure form without the normal ballast proteins of swine. The latter are contained in large amounts in the blood, serum and organs of swine, and, when these liquids and organs are used as precipitogens, are responsible for the development of numerous non-specific precipitins in the sera of the animals being processed.

During recent years a number of Soviet scientists (Tsuverkalov, Kucherenko, Popov, Rostov, Ayrapet'yan) have used urine of animals with hog cholera instead of blood for precipitation reactions. These studies, however, also yielded no definite results. The study of this method of diagnosis should be continued.

Differential Diagnosis

A considerable number of other diseases -- paratyphoid and swine plague, influenza, erysipelas, anthrax, and others -- may be confused with hog cholera.

To distinguish these diseases from hog cholera, the attention must be directed to the following characteristic signs of these diseases.

Swine paratyphoid, as compared with hog cholera, occurs more seldom and is a chronic disease that exclusively affects young pigs 3-4 months old. Eczema on the skin is often only of the diffuse form, while hemorrhages there are not observed. The diarrhea does not usually alternate with constipation but continues throughout the attack without interruption.

Although the patho-anatomical alterations here, too, are localized primarily in the large intestine, they are substantially distinguished from those in hog cholera by their caseous character. Thus, in the more acute cases, small-cell infiltration of the intestinal walls occurs, resulting in marked thickening and giving them a suety look in transverse section. In chronic cases enlargement and caseous degeneration of the lymph follicles is also noted, but according to many authors the raised ulcers formed on their sites never have a concentric layer structure, and consist of caseous masses, at first of a homogenous, tallowlike character, and subsequently taking on more dense consistency. The intestinal mucous membrane is frequently subject to superficial necrosis over a great length, while beneath it there is an energetic proliferation of connective tissue, resulting in marked thickening of the intestinal walls. The lymph nodes are either simply intumesced (in acute cases) or also contain caseous foci (in chronic cases).

The inflammation of the lungs in paratyphoid is of a caseous character, and not croupous, as in hog cholera and swine plague. Caseous foci are also encountered in the spleen, kidneys and epiploon.

Swine plague [pasteurellosis of swine, hemorrhagic septicemia] is distinguished from hog cholera by its less acute course and its predominantly sporadic character.

Among the clinical symptoms, those indicating functional disturbance of the respiratory organs are predominant.

Neither numerous hemorrhages (Numerous hemorrhages are sometimes in evidence in the more acute cases of the disease, but it is relatively very seldom that swine plague assumes such a character.) nor pox-like rashes are observed, but all the more frequently, for that, does diffuse or focal, crustal eczema (eczaema crustosum) develop. Crustal eczema in hog cholera may therefore serve as an indication of its complication by infection with B. suisepticus.

In very acute cases of swine plague, as well as in chronic swine plague of young pigs, great difficulties may be encountered in making a post mortem diagnosis, since in such conditions, especially when young pigs are affected, serous catarrhs of the gastro-intestinal canal, hemorrhages and superficial necroses of its mucous membrane (bran-like coatings) are not infrequently observed. In this case, in order to prevent mistakes in the diagnosis, it is necessary to pay particular attention to the

character of the course of the enzootic, and also to carry out as many post mortems as possible. Failure to find B. suisepticus in the bacteriological examination excludes the possibility of septicemia. But the finding of B. suisepticus is still no proof of the absence of hog cholera. In doubtful cases it is recommended that young pigs, too, should be inoculated with the blood of the swine being examined.

Erysipelas, both in its septicemic form and with urticaria, may give cause for confusing it with hog cholera.

The septicemic form of erysipelas is distinguished from that of hog cholera by the more intense redding of the skin and the absence of hemorrhage on it. The gastro-intestinal catarrh observed in erysipelas does not usually spread beyond the small intestine. Small hemorrhages are more often found only in the kidneys, in which case the kidneys themselves are colored dark brown.

Finally, the question as to whether erysipelas is present in this case or in that can always be answered by a bacteriological examination.

The swellings of the skin in urticaria are distinguished from those in hog cholera by their rectangular shape (in hog cholera they are usually round), by their larger size and localization on the spine and along the sides of the body, while in hog cholera they are located on areas with more tender skin.

The accuracy of the diagnosis may be confirmed by further observation of the diseased animals, and by the mortality (which is insignificant in urticaria), by post mortems, and finally, by bacteriological examination of material taken from the swellings on the skin.

While, in hog cholera necroses of the skin are confined to the peripheral portions of the body (ears, end of the tail), in erysipelas they are substantilly more widespread, especially on the spine.

Bacteriological examination of material taken from the deep layers of the necrotic area, is always able, in cases of erysipelas, to disclose the presence of B. erysipelatis suis.

Swine influenza may be confused with hog cholera, especially with the thoracic form of hog cholera. The predominantly seasonal character of influenza attacks (in rainy, cold weather), its benign course, the shorter period of illness, terminating in most cases with recovery, are the essential points for differential diagnosis. Post mortems of swine succumbing to influenza show all the characteristic changes mentioned to be localized in the lungs (areas of atelectasis, exudative bronchitis), while in hog cholera the intestinal affections described above are also found very often.

The discovery in the lungs of Haemophilus influenzae suis, which plays the important etiological role in influenza, may also be of substantial service in differentiating this disease from hog cholera.

Anthrax, specifically in its intestinal form, may be confused with acute hog cholera. But the patho-anatomical changes in the intestinal form of anthrax are localized predominantly in the small intestine, and consist in hemorrhagic or hemorrhagic-diphtheritic inflammation of this organ.

Numerous small hemorrhages are found neither in the intestines nor elsewhere.

The lymph nodes in the affected area of the intestine or throat are in a state of hemorrhagic-necrotic inflammation.

The spleen is considerably enlarged as a result of hemorrhagic or carbunculous inflammation, and its pulp is tarry-black in color.

In doubtful cases, the result of bacteriological examination (presence or absence of B. anthracis) will be significant.

The differential diagnosis of hog cholera according to the epizootological data is presented in a special table (see Appendix).

A carefully conducted examination of the blood may be of a certain value for differential diagnosis.

In serious cases of hog cholera, there is a reduction in the hemoglobin content and erythrocyte count, accompanied by the specific changes in the blood count above pointed out, and an especially pronounced leukopenia. Hog cholera may be distinguished

by this important differential diagnostic sign from septicemia, influenza, ordinary enteritis and ascaridiasis, in all of which, on the contrary, a considerable leukocytosis is noted.

The number of reticulocytes diminishes in hog cholera, and falls almost to zero after the characteristic clinical symptoms have appeared. In septicemia and swine erysipelas, the number of reticulocytes not only does not diminish, but even increases, in spite of fever.

These data may also be used for differential diagnosis.

The serum test above discussed may be used for differential diagnosis as well, and, finally, in specially equipped laboratories, the method of histological examination.

IMMUNITY AND IMMUNIZATION

I. Natural Immunity

All domestic animals except swine possess a natural immunity to the virus of hog cholera. Even in swine, however, the susceptibility to the virus is not always the same: young pigs are more susceptible, and then come swine of the more cultivated races. Wild swine are also susceptible to hog cholera.

At one time, in Germany, there was a hubbub about reports claiming that hybrids more resistant to hog cholera had been obtained by crossing wild boars and German swine. However, when the results were checked, all the hybrids taken for the test died of hog cholera.

Ladai and Legkiy made some exceedingly interesting observations in the USSR. On one pig farm the pure breed English white pigs contracted hog cholera far more rapidly than the Kuban' swine, which recovered much more easily from this disease, with low mortality.

During a period of two years, almost all the English swine on this farm died of hog cholera, and almost all the Kuban' swine survived.

The authors made analogous observations on another farm, where two groups of 8 shotes, 5 months old, were experimentally infected with hog cholera: one group contained shotes of Kuban' stock and the other group shotes of hybrids between wild boars and German swine. 3 of the 8 Kuban' shotes survived, while the hybrids all succumbed. Both incubation period and duration of the disease were considerably shorter in the hybrids than in the Kuban' shotes.

This work, commenced by these authors with the object of discovering the strains of Kuban' swine more resistant to hog cholera, a question of great scientific and practical interest, was interrupted by World War II.

The following observations have been made on the influence of age on the ability of swine to contract hog cholera. When this disease appears for the first time in any locality, swine of all ages will contract it during the first years. Subsequently, however, it will be contracted mainly by the young animals.

The greater resistance of adult swine in such cases is explained by their having already recovered from mild cases of the disease at an early age, and not by any special immunity of adults.

II. Acquired Immunity

It has been definitely established by numerous researches of Russian and foreign authors that a sufficiently enduring acquired immunity lasting some years is developed in animals by recovery from natural attacks of hog cholera, or by active (simultaneous) injections which induce a mild attack of the disease and immuno-biological adaptation of the organism.

Only in relatively rare cases, where environmental conditions are especially unfavorable and sharply lower the resistance of the organism of an immune animal, can it again contract the disease.

Under practical conditions the method of passive immunization with hyperimmune serum against hog cholera is also widely used. The acquired immunity developed in such cases is passive and short-lived (10-20 days).

The question whether acquired immunity can be transmitted to the offspring is still open.

It is well known that the suckling pigs of immune dams are also immune so long as they are being suckled by their dams,

in consequence of which they undergo inoculation with the virus or simultaneous inoculation without harm. Fluctuation is apparently observed in the power of this passive immunity, which depends on the individual susceptibility of the sucklings and on the ability of the dams to develop the antibody. In the experiments of Ulengut, some of the suckling pigs contracted the disease when virus was injected.

The facts of the insusceptibility of pigs suckling immune dams to the virus of hog cholera were noted and confirmed, in the USSR, by Tomashev, Kotov and Gromov, who experimentally confirmed the safety of inoculating such sucklings with virus alone. As the sucklings grow and the amount of other feed consumed increases, this immunity is weakened, and vanishes completely by the time they are weaned.

The degree of resistance of young pigs to the virus also depends on their state of health and on the amount and condition of the mothers' milk. Thus the resistance of young pigs to hog cholera is lowered by lung and paratyphoid diseases. (Kotov and Gromov, 1932).

Professor Shaburov and Sokk conducted observations and experiments that revealed the possibility of healthy farrows, immune to hog cholera, being born in the same litter with stillborn farrows that had succumbed to hog cholera in utero. The immunity of the former and the presence of the virus in the organs of the latter was confirmed by biological tests.

Observations were made on actively inoculated swine on farms affected by hog cholera.

Analogous observations have also been made by a few other specialists.

It follows from the data presented by Shaburov and Sokk that the phenomenon of immunity on one hand and infection on the other may be simultaneously observed to exist side by side, after a fashion, in the organisms of the different suckling pigs on farms affected by hog cholera.

The death in utero of some farrows, caused by the active virus, and the simultaneous normal birth of the others possessing congenital immunity, is a paradoxical and still unexplained fact which is of great scientific interest.

Passive Immunization

When swine contract hog cholera, their organisms produce protective substances which, when introduced with the serum into healthy pigs, can protect them from subsequent infection by hog cholera. The amount of protective substances in the serum of swine that have recovered from natural infection, however, may fluctuate considerably, according to the varying severity of the attack, and may often be entirely insufficient for the purpose of artificial immunization.

Laboratory experiments in America have shown that swine that have recovered from an attack of naturally or artificially induced hog cholera acquire so strong an active immunity that they can undergo repeated injections of large quantities of highly virulent blood of swine with hog cholera.

After such hyperimmunization, the quantity of protective substances in their serum increases to a very significant extent, thanks to which fact a small amount of such serum can protect healthy swine from the pathogenic action of virus simultaneously injected, or from infection by hog cholera under natural conditions.

But, as with every other immune serum, anti-hog cholera serum, when inoculated into healthy swine, confers passive immunity only for a relatively short time, approximately 2-3 weeks.

Preparation of the Serum

Swine are the only animals that can be used in the preparation of anti-hog cholera serum.

Attempts to use other domestic animals for this purpose have been unsuccessful.

To prepare the serum, entirely healthy swine are subjected to active immunization (simultaneous inoculations) by subcutaneous injection of 1-2 cubic centimeters of virus and a corresponding amount of anti-hog cholera immune serum, the activity of which has been checked by preliminary tests.

Inoculation of a small amount of the virus alone with the object of inducing a mild attack of the disease is always attended by the risk of losing the animal.

For hyperimmunization, larger, fully grown animals, half fattened, are usually selected, for a large quantity of serum may then be obtained from them.

Defibrinated blood or serum obtained by bleeding the animal to death is usually used as the antigen. To obtain the most active serum from the hyperimmunized swine, virus of the proper potency must be injected. Moreover, for hyperimmunization it is necessary to employ not a single virus, but as many different strains of virus as possible, which have been isolated at various localities during hog cholera epizootics.

The virus is apparently most potent when taken on the third day after the fever has reached 40 degrees to 41 degrees Centigrade. (On the 7th to 8th day after infection), or 24 hours after the discovery of clear signs of the disease, when the post mortem of the swine bled to death shows a picture of hemorrhagic septicemia pointing to the acute character of the attack.

Virus is unsuitable for use in hyperimmunization if clear symptoms of the disease are manifested too early -- on the 4th day after inoculation or even earlier -- by the shotes infected by the virus, since this indicates contamination of the virus or other causes for the shote's condition.

Dorset proposes two methods for the preparation of the anti-hog cholera serum: a rapid method and a slow one.

To reinforce the basic immunity already acquired by animals as a result of a naturally or artificially induced attack of the disease, a preliminary injection of 20 cubic centimeters of virus is given, and only thereafter is hyperimmunization proceeded with.

With the rapid method, an immune swine weighing not less than 80-100 kilograms is injected subcutaneously with 10 cubic centimeters of defibrinated blood per 400 grams of live body weight of the animal. Half that amount, i. e., 5 cubic centimeters per 400 grams body weight, is also injected intravenously or intraperitoneally. After three weeks, the largest possible amount of blood is drawn through the tail. The same operation of bloodletting is repeated two more times at intervals of 7-8 days. The final blood is drawn in the same way about a month after the third time.

By the slow method, 5 cubic centimeters of defibrinated blood per 400 grams body weight is injected subcutaneously, or three increasing doses -- 1 cubic centimeter, 2.5 cubic centimeters and 5 cubic centimeters per 400 grams body weight -- are injected at intervals of 10 to 14 days.

Swine usually make a good recovery from injection of the virus. Their reaction is confined to a short period of fever, impaired appetite and slight depression for a day or two.

9-10 days after the last virus injection blood is drawn from the tail. This is subsequently repeated two or three times at 4-5 day intervals.

After the blood has been drawn, the swine are either once more immunized with the virus, or withdrawal of blood is continued at intervals until only a short stump of the tail is left. In either method, after this has occurred, the swine is then bled to death.

While the Americans consider both these methods entirely suitable for preparing a sufficiently active serum, they prefer the rapid method as cheaper and leading sooner to its objective.

Gutir, who finds it impossible to state categorically that one of these methods or the other is superior, assumes, on the basis of observations in the preparation of other immune serums, that preference should be given to the slower method of preparing serum, since it involves less risk of using a virus of insufficient potency for immunization.

The latter method (repeated injections of virus) is used in the USSR for the hyperimmunization of swine.

The first anti-hog-cholera serum was prepared in Russia in 1912 by P. N. Andreyev, in the Veterinary Laboratory of the Ministry of Internal Affairs, at St. Petersburg, and was then prepared by the technique proposed by him in a number of Zemstvo laboratories.

After the October Revolution the preparation of anti-hog-cholera virus was centralized in anti-hog-cholera stations set up for that purpose (at Sumakh, Armavir, Kashintsev, and elsewhere), which were subsequently converted into factories for biological preparations.

At the present time the production of this serum, like that of other biological preparations, occupies a number of biological factories of the GLAVBIOPROM of the Ministry of Agriculture.

Detailed information on the procedure for preparing and testing of anti-hog-cholera serum is contained in the preceding edition of this book, and also in the book by Alekseyev and Likhachev "Chuma Sviney" [Hog Cholera] to which we refer those interested in this question.

The Properties of Immune Serum

Hyperimmune anti-hog-cholera serum possesses not only preventive properties, but therapeutic powers as well.

The therapeutic action of anti-hog-cholera serum is very insignificant. It is manifested only when the serum is administered at the very inception of the disease. The following experiment was made to test it. 12 swine were infected by hog-cholera virus and then given serum in doses of 15-25 cubic centimeters after a varying number of days. It developed that only serum administered during the first four days after

infection had any curative action; later administration, even in doses of 35-50 cubic centimeters, could not save the animals from death.

Serum can manifest therapeutic action only if used not later than 5 to 6 days after infection.

The therapeutic effect of serum is directly proportional to its activity and the dosage.

In the opinion of N. F. Gamaley, the relatively weak curative effect of immune serums in virus diseases may be explained by the fact that the ultraviruses are intracellular parasites that multiply within the cells of the organism, where they are inaccessible to the action of the immune bodies contained in the serum. Some effect from using the serum can be obtained only when the virus has not yet succeeded in attaining a fairly wide spread throughout the organism. In this case introduction of the serum into the organism succeeds in creating a barrier against the penetration of the virus into the cells. If the immune serum is introduced before the virus has succeeded in disturbing the activities of the most important cell-groups in the organism, then the animal will recover from the infection, otherwise it dies.

The anti-hog-cholera serum administered for prevention favors the establishment of a passive immunity, which, however, is not absolute and does not confer complete insusceptibility to infection by hog cholera.

The essence of this immunity still remains insufficiently elucidated.

If immune serum is mixed in vitro with the virus, the latter is not inactivated. Attempts to demonstrate the virulenticidal action of serum in vivo have also been unsuccessful, for examination of the blood and urine of swine that had been cured of hog cholera by serum injection showed that both still contained active virus 3-4 weeks after recovery.

The virus, however, does die rapidly in the organism of a hyperimmune swine. In a certain proportion of the cases, where the virus has entered the organism of a passively immunized swine under conditions of natural infection, the disease takes a relatively mild course (sometimes clinically imperceptible) and develops a stable, active immunity. In many other cases, however, this does not occur, and 2-3 weeks after administration of the serum, passively immunized animals exposed to an infected environment become susceptible to the disease again and contract it. This very important circumstance must be taken into account when passive immunization is done on farms infected with hog cholera.

The anti-hog-cholera serum turned out by a biological factory bears a label showing series number and date of preparation. Dosage, method of administration and storing are indicated in the instructions for use. When kept under the proper conditions (in dark, dry and cold rooms, with temperature no higher than 10 degrees Centigrade), the serum maintains its immunizing power for 2 years.

The following doses of serum are recommended for practical use at the present time, by the biological factories of the USSR:

Suckling pigs up to 8 kilograms live weight								15	cubic centimeters
Shotes from	8-16	kilograms	live	weight				15-25	" "
" "	16-30	"	"	"				25-35	" "
" "	30-45	"	"	"				35-45	" "
" "	45-60	"	"	"				45-60	" "
Pigs from	60-80	"	"	"				60-75	" "
" "	80	"	and	over	"	"		75-100	" "
" "	80	"	and	over	"	",	maximum dose	120-150	" "

Practical Application of Serum

During the past 15 years, an extensive experience of the practical application of immune serum against hog cholera has been accumulated in the USSR. The serum has proved to be of exceptional value for the prophylaxis of hog cholera and its liquidation in centers affected, and has assured the success of measures for sanitary rehabilitation in a large number of Oblasts of the USSR.

To a considerable extent this success has been favored by the well organized technological process of production of this serum at the state biological factories, together with the use of superior, highly active viruses for hyperimmunization, and careful control of the serum put out by tests of its activity in accordance with the standards that have been worked out.

In connection with this, another type of mistaken conception in the use of the serum has been ended. This type of misunderstanding was observed formerly, when the serum was prepared in laboratories unequipped for the purpose, by an arbitrary technique and without proper controls.

Foreign scientists also render a high appraisal of the anti-hog-cholera serum.

The method of passive immunization, in conjunction with energetic and carefully executed sanitary and hygienic measures, proves highly effective. Testimonials of foreign and Russian scientists and veterinary leaders testify to this.

At the XI Veterinary Congress in London (1930) it was noted that inoculation with the serum alone yields a good result only when its administration is timely (soon) and only when all veterinary, sanitary and zootechnical rules are carefully observed.

Curative inoculation of swine with fever, using two doses, saves 50-75 percent of the animals treated.

In 1929, an epizootic of hog cholera that occurred in Maryland (United States) in 1928 was described. Of 1897 uninoculated swine on 310 farms, 1854, or 98 percent, succumbed, while 90 percent of all the inoculated swine in 529 herds could be saved.

There is a report of the successful inoculation with serum alone, which saved 93.6 percent of the healthy animals on a pig farm affected by hog cholera, together with 13.7 percent of the animals that already had the disease when inoculated.

An interesting experiment in liquidating hog cholera centers must be mentioned: it was by means of "encircling" inoculations with serum on the farms surrounding the center of infection. This method has found wide application and given excellent results in Canada, where it is carried out by plan, with simultaneous destruction of all the animals at the affected point and careful execution of sanitary measures.

As the experience with the passive immunization method in the USSR has shown, its effectiveness is the higher, the earlier it is carried out on the farm stricken by hog cholera and the better the sanitary and hygienic conditions are.

When centers of the virus persist for a long period on a farm, which is usually the case in practice, on account of the long drawn-out period of illness and the existence of chronically diseased animals and virus-carriers, the short duration of the immunity conferred by serum represents a great practical inconvenience and compels the repeated injection of serum into a considerable number of swine. This circumstance requires large repeated expenditures of time and energy by all personnel and large new non-productive expenses.

Moreover the effect of repeated injections is unsatisfactory in some cases, and the renewed injection of serum proves ineffectual to prevent many swine who are already virus-carriers or incubating the disease from developing it.

Some practicing veterinaries have observed the prophylactic effect of serum on young pigs to be, in many cases, unsatisfactory.

During the pronounced hog-cholera epizootics in 1930-1932, there were some farms on which even the timely inoculation of young pigs with serum could not save them from infection, and the mortality from hog cholera among young pigs was very considerable.

This type of occurrence, however, should be attributed mainly to the unsatisfactory conditions of young pig managements (insanitary and inadequate feed, avitaminosis, mineral starvation) which has a sharp negative effect upon any immunization.

This method has attained extensive practical application as a preventive measure for the prophylaxis of hog cholera on the farms that are most threatened, and for inoculation of animals dispatched from hog-cholera free farms for exhibition or sale, to prevent their contracting the disease.

The IX plenum of the veterinary section of the Academy of Agricultural Sciences imeni Lenin, when discussing the problem of the control of hog cholera, observed that the method of passive

immunization should be applied on farms operated by individuals, and also at the first, or recent, appearance of the disease on sovkhozes and holkhozes hitherto free of it. This takes into account the inconsiderable spread of the disease, the small number of diseased swine that had to be destroyed or succumbed, and the possibility of rapid annihilation of the centers of virus infection on a farm where new outward transport of infection is prevented.

The method of passive immunization is in essence a comprehensive method of hog-cholera control and consists of the establishment of a quarantine, with the isolation and destruction of diseased and suspected swine, the execution of the veterinary and sanitary measures for the annihilation of the virus on the farm, the transfer of all healthy swine to an uninfected building or to open-air quarters, and their inoculation with one and one-half times the dose of serum, or even a double dose of it (from the resolution of the IX plenum of the Veterinary Section of VASKhNIL, 1937).

As Professor A. P. Uranov informed this plenum, the method of passive immunization, in conjunction with the above-mentioned measures for sanitary rehabilitation, of affected farms, was extensively used in Western Siberia in 1934-1936 and allowed the attainment of great successes in the liquidation of hog cholera. The organization of open-air summer quarters or camps for swine received especially great attention as a method of

favoring the strengthening of the organisms and at the same time made it possible to carefully rehabilitate the sanitary condition of the pigpens by summer work.

Simultaneous Inoculations

Objects and conditions of simultaneous inoculation. As has already been said above, the preventive effect of immune serum is limited to 10-14 days, and only rarely lasts as long as 8 weeks. The short-term passive immunity may be converted to an active immunity if virus also enters the organism of the inoculated animals at the time of the serum injection or shortly thereafter. But it is far from always possible to do this under the conditions of practical life.

Attacks of hog cholera not infrequently originate in a herd after inoculation with serum alone, since the virus, if it enters the organism per os at the same time the serum is found there, often does not result in active immunization. Furthermore, if the virus enters the organism of passively immunized swine after only 2-3 weeks have elapsed, it can induce a fatal attack in spite of the preceding passive immunization. To eliminate this possibility, the injection of the serum should be repeated after a certain interval, or, in the alternative, a certain quantity of virus may be administered simultaneously with the serum; that is, simultaneous inoculation may be employed.

For the success of simultaneous inoculation high-activity virus must be used, and also serum of high titre, in the doses indicated by the biological factory putting out the preparation in question.

Defibrinated blood containing 0.25 percent or 0.5 percent phenol is usually used for the virus. If kept in the dark at temperatures no higher than 12 degrees Centigrade, virus will remain active for 40-60 days.

The virus should be of such potency that 1 cubic centimeter will induce an attack of the acute form of hog cholera in 4-6 days on subcutaneous inoculation into a young pig weighing from 16 to 40 kilograms.

The serum and virus are injected into different parts of the body and should be used in such quantity and such potency as to induce only mild attacks of the disease in the animals.

In this case the reaction of the organism consists in an insignificant rise of temperature, accompanied by impaired appetite and weakness, beginning on the fifth day after inoculation. By the end of the second week after infection the inoculated animals already appear completely well and have a normal temperature.

The use of weak virus with fairly active serum in simultaneous inoculation may prolong the incubation period to three weeks and even up to eight weeks, and since the passive immunity from the serum injection will have already ended by that time, the inoculated swine can develop hog cholera, with resultant mortality just as great as among uninoculated animals contracting the disease naturally.

Thus if inoculated swine develop hog cholera 20 days after inoculation, this indicates weakness of the virus used. On the other hand, if illness develops in inoculated swine during the first days after inoculation, it is due to the serum having been used too weak and the virus too potent.

To attain favorable results from simultaneous inoculation and to diminish the percentage of possible complications and deaths following it, it is very important to have a favorable sanitary and

hygienic environment for the pigs inoculated.

A more or less marked attack of illness in the inoculated pigs as a result of the injection of hog cholera virus weakens their organisms and reduces their resistance, and thus creates favorable conditions for the subsequent penetration and development of secondary infections by some microbe that is usually non-pathogenic for swine, or not very pathogenic for them.

To a considerable extent this circumstance explains why swine contract a whole series of infections after simultaneous inoculation: infections induced by B. paratyphus, B. suisepticus (the usual accompaniments of hog cholera), B. coli, B. pyocyaneus, staphylococci, etc. Graham found bacteria of the paratyphoid group, B. necrophorus, etc, in swine taken ill after simultaneous inoculation.

Manninger noted the development of severe cases of paratyphoid in adult swine on the basis of simultaneous inoculation from which they had recovered.

In this connection, it will be realized why general sanitary measures to eliminate or reduce to a minimum the possibility of infection of inoculated swine are so immensely important. Good general hygienic conditions are no less important: proper management, correct feeding, which assure a higher general resistance of the organisms of swine undergoing inoculation.

The worse the sanitary and hygienic conditions, the higher the percentage of complications and mortality following inoculation.

It is for this reason that a basic general clean-up and

disinfection of pigpens with soda lye during the first weeks after inoculation contributes to its success, as does the immediate removal of all swine becoming ill after inoculation, and the implementation of general hygienic measures with respect to management and feeding of the animals. A disproportionate amount of grains should not be fed, while the animals should not be allowed to catch cold or be excessively fattened. Concentrated feeds in the ration should be cut in half, and a certain amount of green fodder or fresh vegetables added to make up for this cut.

Finally, the inoculated animals must not be allowed to suffer hunger, for this can exert a sharp unfavorable influence on the development of immunity and can lead to an attack of hog cholera.

The procedure for giving simultaneous inoculations in the USSR is prescribed in the instructions relative to the control of hog cholera issued by the Ministry of Agriculture of the USSR. They are to be carried out only at points stricken by hog cholera as a compulsory measure of control against that disease. Preventive inoculation by this method is forbidden at points free of the disease (and even at points threatened by it).

Simultaneous inoculation should not be performed on farms where there are other acute infectious diseases of swine besides hog cholera: erysipelas, foot-and-mouth disease, swine pox, influenza and acute outbreaks of paratyphoid, until they are liquidated.

In such cases passive immunization against hog cholera is recommended, in conjunction with the aggregate of comprehensive general veterinary and sanitary measures for the liquidation of these infectious diseases.

The plenum of the veterinary section of Vaskhnil (1937) recommended using the technique of simultaneous inoculation on large-scale farms with a large number of swine, and also on large-scale farms with a large number of swine, and also on those farms where the initial period of the epizootic is already past and hog cholera has taken on a lingering character or where it presents a constant threat of new importation of infection. This method is recommended for use together with passive immunization where the veterinary, sanitary and zoohygienic environment of the farm is unfavorable and it is difficult to count on its early improvement.

Simultaneous inoculation must be performed by qualified veterinary workers.

The Technique of Simultaneous Inoculation

On the basis of superficial clinical examination and of two temperature readings, those swine with fever and suspected of disease are separated from the herd (as soon as the first symptoms appear) and given a curative dose of the serum alone. Those that are clearly and gravely ill are removed and destroyed, followed by disinfection of the products of the slaughter.

Simultaneous inoculation is not recommended for pregnant sows with less than a month before farrowing time, for suckling dams and suckling pigs, nor for badly emaciated animals. Simultaneous inoculation of animals in the last stage of fattening is also inexpedient. All these groups are passively immunized with preventive doses of serum. To avoid their subsequent infection by the simultaneously inoculated animals, they must, as far as possible, be isolated from the main group subjected to simultaneous inoculation.

All the remaining swine, healthy and with normal temperature (not over 40 degrees) undergo simultaneous inoculation. All these animals are then placed under veterinary observation and their temperature is taken daily. Condition and reaction to inoculation are carefully followed up.

The normal reaction to inoculation should commence in 4 to 5 days, and is expressed in moderate fever (not over 41 degrees), which is not prolonged (it lasts 3-4 days), without perceptible change in the general condition and without impairment of appetite. If the fever is higher and more prolonged, or if even the first signs of more serious indispositions appear in the inoculated animals (impairment or loss of appetite, somnolence, neural symptoms, etc) anti-hog cholera serum in therapeutic doses must be administered without delay.

In view of the short period of action of the anti-hog cholera serum introduced into the organism at simultaneous inoculation, great care should be taken to avoid delayed reaction to inoculation, which may occur if the virus used is too weak and has an incubation period of as long as 3 weeks and even as long as 8 weeks; for such reactions take a more severe course and may end in death.

For this reason animals in which fever develops only on the tenth day or later must receive a second serum injection, this time in curative dosage. If the reaction to the inoculation is delayed in most of the animals undergoing simultaneous inoculation, administration of a second injection of serum, this time in therapeutic dosage, is recommended for all of them (except those that have reacted earlier and are already recovering).

The absence of a reaction to the inoculation for 10 days or longer, or the appearance of a delayed and weak reaction up to this time in only an insignificant number of the animals, should be evaluated as the result of using weak, inactive virus. In such cases a second inoculation with another series of virus is recommended.

Animals in which the illness after inoculation takes on a lingering character in consequence of complication of hog cholera by secondary infections should be segregated and destroyed.

Pursuant to the instructions, suckling pigs are subject to simultaneous inoculation beginning with the 20-30th day of life, and their dams (if they have not already received simultaneous inoculations) are given repeated serum injections up to the time when the reaction in the sucklings has terminated, at which time the dams also receive simultaneous inoculations.

In view of the cases noted in the literature of loss of immunity by simultaneous-inoculated suckling pigs, near weaning time or somewhat later, a second simultaneous injection is recommended in cases where hog cholera appears among them.

During the entire period of combined inoculations and actual existence of hog cholera on a farm, the animals that have been passively immunized should receive repeated inoculations of serum at intervals of 10-14 days, continuing until complete liquidation of the disease on the farm, in order to maintain their passive immunity. If the disease lasts for a longer period, simultaneous inoculation of most of the animals in this group as well is recommended (dams only after they have farrowed and their farrows have received simultaneous inoculations).

The active immunization of young pigs should be discontinued after liquidation of the hog cholera outbreak and the execution of the necessary measures of veterinary and sanitary rehabilitation. Young pigs born after this time are given to their dams for suckling, but isolated from the rest of the herd.

The careful and repeated cleaning and disinfection of the pig-pens and all articles of equipment both before and after the inoculations is absolutely essential for the success of the inoculations and for the most rapid liquidation of hog cholera.

Vereshchagin gives examples in which the immunity conferred by simultaneous inoculation was considerably weakened as a result of extremely unfavorable conditions of management, combined with hunger, and the inoculated swine again developed hog cholera.

The dosage of serum and virus to be used in simultaneous inoculation must conform to the instructions of the biological factory putting out the preparation in question.

Thanks to the standardized properties of these biological preparations in the USSR, and their titration against each other at the biological factories, post-inoculation complications due either to inadequate activity of the serum (excessively severe illness induced by inoculation) or inadequate virulence of the virus (development only of passive immunity, followed by an attack of the natural disease) are now very rarely observed. The dosage of serum may be somewhat increased if desired. It is, however, apparently necessary, in order to obtain active, stable immunity from simultaneous inoculation, to have a certain excess of virulent material, or, in other words, to have a certain predominance of the active properties of

the virus over the defensive forces of the serum in order to induce a specific reaction on the part of the organism -- a kind of a shock to set the immunizing forces of the organism in motion (ictus immunitorius).

Simultaneous inoculation induces a prolonged active immunity in all inoculated swine over three months of age, even in cases where there has been no appreciable reaction to the inoculations.

The extremely widespread application of the method of simultaneous inoculation in the USSR during the past 10-15 years, together with the method of passive immunization, has allowed the attainment of positive results in the sense of liquidating many centers of hog cholera.

This method can also be recommended for future use, although we cannot but recognize that, at the present stage of development of socialist animal husbandry, with the general improvement everywhere in the conditions of swine management and breeding, and the normalization of the sanitary and hygienic environment in pig farms, it will doubtless be employed less and less and will be displaced by the method of passive immunization and by vaccination with avirulent vaccines.

From the epizootiological point of view, the method of simultaneous inoculation has the following substantial drawbacks, which must under all circumstances be taken into account under practical conditions.

1. To perform these inoculations, live, unattenuated virus is introduced into the farm, which may lead to its dissemination and

turn the farm into a stationary center of hog cholera.

2. The application of simultaneous inoculation is possible only on pig farms that are infected by hog cholera.

3. Some of the swine inoculated by this method develop hog cholera, sometimes with lethal termination.

4. In some cases inoculated swine may remain virus-carriers and virus-dischargers for as long as 90 days after inoculation.

5. A farm must be placed under prolonged quarantine after simultaneous injections have been given.

6. The entire herd of swine cannot be inoculated by the simultaneous method (sows in farrow and suckling are not inoculated).

7. In some cases simultaneous inoculation may be the cause of spreading hog cholera (errors in diagnosis, failure to observe quarantine rules, etc).

8. Simultaneous inoculation does not always confer immunity upon suckling pigs.

9. This method, besides the expenditure of virus, requires a considerable amount of expensive serum both for the inoculation itself and for supplementary injection in case the reaction is violent.

10. The reaction to the inoculations, even in normally reacting swine, takes too long, and return to the normal state commences only after 10-15 days have elapsed.

11. In many cases the reaction is long drawn out, and return

to normal commences only after 20-25 days.

12. A long period of veterinary observation is necessary after the inoculations, taking the temperature of each inoculated animal daily, clinical inspection, etc.

13. The technique of carrying out simultaneous inoculation on the non-socialized sector has not yet been developed, and the administration of such inoculations on separate farms where veterinary supervision and strict quarantine would be impossible may lead to the dissemination of hog cholera infection.

Taking these fundamental drawbacks into consideration, and bearing in mind a number of attendant circumstances, it is necessary to draw the conclusion that the method of hog cholera control by means of simultaneous inoculation is a palliative measure, which is not capable of leading to the complete liquidation of hog cholera. (Korotich).

VACCINATION

The above enumerated disadvantages involved in the method of simultaneous inoculation forced scientific workers in many countries to direct their efforts towards finding a vaccine that, without containing the active virus of hog cholara, would still be capable of conferring a stable and long-lived immunity.

As such a vaccine, some investigators have proposed formol vaccine from the blood or parenchymatous organs of swine killed during the acute feverish stage of hog cholera, others have prepared such a vaccine from the tissues, killing the virus in it with eucalyptus oil, and finally, trials have been made with a saponified vaccine.

In the USSR, a formol vaccine has been prepared by Korotich and Alekseyev from the organs and blood of swine with hog cholera; it has also been tested by them.

The results from all these vaccines, however, have proved inadequate and unsatisfactory, either because the virus has not been rendered completely harmless or because of the insufficient immunogenic properties of the vaccines.

Formol vaccines achieved a certain degree of general use in Japan, although, as the authors themselves admitted, they still possess a number of disadvantages.

The greatest difficulties in the preparation of vaccines are mainly in finding a superior strain of virus with stable antigenic properties that are not subject to subsequent impairment during prolonged passages and attenuation of the virus.

Crystal-Violet Vaccine

Dorset, who discovered the filtrable virus of hog cholera and developed the method of simultaneous inoculation, was also the initiator of the development of the new type of vaccine against hog cholera.

A fifteen-year search in this field under his direction was crowned by complete success, still attained during his lifetime. The crystal-violet vaccine proposed by him has proved to be a highly effective immunizing preparation. It is prepared from the defibrinated blood of virus-affected swine, bled to death on the 7th and 8th day after infection. 100 cubic centimeters of 0.5 percent solution of the dye crystal-violet are added to 800 cubic centimeters of blood. To intensify the bactericidal action of the dye, 100 cubic centimeters of a 3 percent solution of dibasic sodium phosphate are also added to the mixture (to alkalinize the medium).

The swine used for the virus should have the typical clinical picture, and post mortem should show no signs of secondary infection. This should be confirmed by bacteriological examination.

The mixture of blood and dye so prepared is kept for two weeks at 37.5 degrees, after which it is tested for sterility, lack of toxicity, and immunogenic properties. Each series prepared is tested on 4 swine.

The latest modification (1944) is the crystal-violet-glycerin vaccine, in which the sodium phosphate is replaced by glycerin, which

favors the complete sterility of the vaccine and prevents bacterial contamination.

Careful control studies have shown the vaccine to be completely free of any danger of spreading the virus through the animals inoculated with it. The virus contained in it is so extremely attenuated that it no longer possesses virulent properties.

The vaccinated animals display neither general nor fever reaction to the inoculation. Injection is recommended as deep as possible under the skin on the inward surface of the haunch. The dose of vaccine is 5 cubic centimeters for weights up to 30 kilograms and 10 cubic centimeters for heavier animals. The crystal-violet contained in the vaccine induces a certain local reaction at the place of inoculation, in the form of a rapidly passing swelling, without lameness or other pathological phenomena. No post-vaccination complications have ever been observed.

Vaccination results neither in lowered resistance nor in aggravation of any other infections in the organisms of the vaccinated animals. The vaccine can be used with perfect safety on farms that are free from hog cholera.

The vaccine still remains suitable for use even after 4 years of storage under refrigeration, and can withstand a long stay (up to 8 weeks) in a thermostat at 37 degrees Centigrade. One of the series of vaccines withstood intentional application of a temperature of 50 degrees Centigrade for two weeks without losing any of its properties.

Immunity is developed in the vaccinated animals at the end of 3 weeks. It continues to increase for 2 to 3 months after inoculation. The, after 6 to 8 months, it commences to decline.

The immunity conferred by the vaccine proves to be so powerful that the vaccinated animals successfully withstand the injection of highly virulent virus in doses of 1 to 2 cubic centimeters.

Thus, when the immunogenic properties of the first 11 series of crystal-violet vaccine were tested on 22 swine, all these animals proved insusceptible to the virus three weeks after vaccination with doses of 5 - 10 cubic centimeters of this vaccine.

A wide practical test of the effectiveness of crystal-violet vaccine was carried out on 398 herds from 1936 - 1943. During this period about 23,000 swine were vaccinated. The inoculations were performed on farms that had been carefully checked for freedom from hog cholera at the moment of inoculation.

Special measures were adopted to prevent the transmission of hog cholera before the three-week period after vaccination had ended, that is, before the acquisition of immunity. The results of these preventive inoculations were excellent.

In only one single herd the immunity of some of the vaccinated animals was destroyed a month and a half after vaccination in consequence of the simultaneous action of influenza, paratyphoid and hog cholera.

Laboratory tests of immunity were made on the vaccinated animals

on a broad scale, over a number of years. After interviews with the farmers, four vaccinated swine out of each herd were purchased and taken to the experiment station for tests of the immunity by infection with virus. The first large-scale experiment to check the immunity yielded the following results. Of the 535 swine taken from the farms on which they had been vaccinated, 83 percent remained healthy or displayed only a weak reaction to the injection of virus, about 11 percent showed a strong reaction, but recovered, and about 6 percent succumbed or were destroyed in a serious condition.

A careful study of this experiment showed that the check covered swine of market age (about 8 months), that had been vaccinated at various ages, both before and after weaning. Further experiments established that the results of vaccination were less satisfactory when suckling pigs were vaccinated before weaning, especially when they had been farrowed by immune dams. Based on these studies, the vaccination of unweaned suckling pigs was discontinued, and vaccine was administered only to young pigs aged 10 weeks and older. After this change, the percentage of vaccinated animals that succumbed to hog cholera, on checking their immunity to the virus, fell sharply. It was also established that vaccination confers a stable immunity on swine only over a period not exceeding 8 months.

In accordance with the new arrangements, a second mass check of immunity was organized, and 214 swine of market age, vaccinated at 55 different farms at ages not less than 10 weeks, were tested. No longer than 8 months had elapsed since their vaccination, in any case.

Of these 214 vaccinated swine, 89 percent remained unaffected by injection of virus or displayed only a feeble reaction, 10 percent displayed a strong reaction, and only 1 percent of the vaccinated swine died of hog cholera as a result.

Although even better results were given by two vaccinations at an interval of two weeks, it was nevertheless decided to limit the vaccination, in practice, to a single time, to avoid increasing the cost of vaccination and imposing greater financial strain on the farmers.

In the opinion of the Americans, crystal-violet vaccine has the following advantageous qualities: it does not induce any appreciable reaction that lowers the resistance of the inoculated animals; it involves no danger of spreading the virus; and it is considerably cheaper than simultaneous inoculation.

The disadvantages of the vaccine are as follows: slow development of immunity and shorter duration of immunity in comparison with that conferred by simultaneous inoculation.

Research has recently been initiated in the intradermal application of the vaccine, which would allow reducing the dose to 1 cubic centimeter and less.

Boyton too, has succeeded in achieving entirely satisfactory results with the tissue vaccine prepared by him, which consists of a 20 percent suspension of the organs of swine with hog cholera. The virus in this vaccine has been deprived of virulence by the addition of eucalyptus oil and long standing of the mixture in a thermostat.

The attempts to use the strains of British virus, obtained from spontaneous hog cholera outbreaks, for preparing vaccine, were unsuccessful.

The series of crystal-violet vaccine prepared from these local strains did not communicate the necessary immunity to the vaccinated swine, and especially not against the American strains of virus.

As a result of numerous, many-sided and carefully conducted experiments in the laboratory, using a large number of swine, the conclusion was reached that crystal-violet vaccine reliably protects swine against hog-cholera for a period of not less than 10 months, and that the vaccinated swine do not disseminate the infection and are therefore harmless to the uninoculated swine coming into close contact with them.

The experiments also showed convincingly that when the vaccine was prepared according to the accepted procedure, all series were uniform and possessed standardized properties.

Attenuation of the virus already takes place after the vaccine has been kept 3 to 5 days at 37 degrees Centigrade.

The vaccinated swine displayed neither temperature rise nor any other reaction to the vaccination. Immunity already commenced 12 days after vaccination.

It was experimentally demonstrated that injection of 3 cubic centimeters of vaccine in all was sufficient to confer immunity.

To supplement this project, another project was conducted to investigate the suitability of the vaccine for use on private pig

farms affected by hog cholera. The vaccinated swine were transferred for this purpose from the laboratory to these farms, where they were placed under conditions of maximum potential contagion and unfavorable hygienic and sanitary conditions. The results were completely satisfactory. Even under the trying conditions of the experiment, only one of the 86 vaccinated swine succumbed to the acute form of hog cholera, and another one contracted the disease but recovered, three displayed only insignificant reactions, while 31 remained entirely healthy and unaffected.

At the same time, of the 302 unvaccinated swine on these farms, 96.5% contracted hog cholera, of which 90% died, and only 3.5% resisted infection.

The vaccine is being used more and more extensively in Great Britain.

In the USSR, the first experiments in preparation and testing of crystal-violet vaccine, according to the Dorset technique, were undertaken by Agapov (of the VIEV) before World War II, but were unsuccessful. The swine vaccinated on one of the large-scale pig farms proved when tested to be non-immune to hog cholera. This failure is apparently to be explained by the inadequate and unsatisfactory antigenic properties of the virus strains selected for preparation of the vaccine.

Experiments on a considerable scale were then undertaken, for the preparation of crystal-violet vaccine, by the Ukrainian Institute of Experimental Veterinary Science (Kulesko).

The antigenic properties of the first three series of the vaccine were tested on 145 shotes, 6-10 months old, weighing 20-50 kilo-

grams. The vaccine was administered twice, with an interval of 15-20 days, in doses of 10 and 15 cubic centimeters. The vaccination induced perceptible fever and local reactions. 1 cubic centimeter of virus was subcutaneously injected, 15 or more days after vaccination. Since each series consisted of 10 samples of vaccine, obtained from 10 different virus donors, it was possible to test each of these "individual" vaccines separately.

Infection of the vaccinated swine by the virus showed that only about 50 percent of the "individual" vaccines communicated a sufficiently stable immunity to the inoculated animals. This indicated that a virus satisfactory immunologically had been obtained from only about half of the virus donors. Further progress of the investigation developed the fact that it was possible by doubling the dose of vaccine (to 40 cubic centimeters or more) to confer immunity even with these immunologically weaker vaccines.. The same phenomenon was repeated in numerous subsequent experiments with new series of vaccines prepared in the meantime. The attempted reduction of the dosage to the American level (5 cubic centimeters) proved successful, but larger doses induced strong reactions in the vaccinated animals.

This is undoubtedly to be explained by the inferiority of the usual strains of virus in production, which were received from the biological factories, and by insufficient work in the study and selection of the strains.

At the same time, Kulesko arrived at certain conclusions that directly contradicted the clear results of the British and American authors.

Thus, he observes, some "individual" vaccines, first, still contained active virus after being kept in the thermostat for 7 and 10 days (while in Doyle's experiments no virus showed up after the vaccine had been kept in the thermostat for only three days); secondly, that in some cases vaccines from low-activity strains lost t their immunogenic properties after 12 days in the thermostat, while according to the Americans the vaccine stands 8 weeks in the thermostat without any weakening of these properties.

Consequently Kulesko recognized the insufficiency, from the viewpoint of safety, of keeping the vaccines in the thermostat for only 12 days and decided in future to prepare two vaccines of varying "attenuation", by keeping one -- the weaker -- for 20 days in the thermostat, and the other -- the stronger -- for 14 days.

Further persistent research enabled this author to achieve improvements in the technology of producing crystal-violet vaccine.

After a few years of trials under the conditions of widespread experiment (using over 70,000 swine) this vaccine was approved for mass administration in 1947. I. I. Kulesko received the Stalin prize for his work on this vaccine.

The favorable solution of the vaccination problem in the USSR will have an immense national-economic significance, will greatly simplify the methods of control and accelerate the complete liquidation of this dangerous disease.

PROPHYLAXIS AND MEASURES OF HOG CHOLERA CONTROL

Detailed instructions for the prevention and liquidation of hog cholera are provided in special instructions of the NARKOMZEM of the USSR.

The basis of all measures for the prophylaxis of hog cholera must be to prevent the virus from being transported onto the farm. With this object all pig farms (Sovkhozes, kolkhozes and pig farms of kolkhozes) must, under all circumstances, quarantine all swine and young pigs newly purchased or acquired anywhere outside their own boundaries.

Swine and young pigs should be purchased only from farms known to be free of hog cholera, and this should be certified by the veterinary inspection authorities.

The animals in quarantine should have their temperatures taken daily and should be inspected daily to reveal clinically suspicious cases.

Experience shows that infection is very frequently brought onto a farm with feed, which is bought anywhere, at random, without considering questions of prophylaxis. For this reason pig farms must stock up and acquire feed and bedding for swine only from Rayons and farms that are free from hog cholera. Particular caution is necessary with respect to obtaining and feeding all possible kinds of waste and garbage, which is often infected.

Taking due account of the role of mechanical carriers of hog cholera virus, which may be played by human beings as well as dogs and other animals, their access to the territory of the pigpen should

be limited to the maximum possible extent. This measure should be especially strengthened if centers of hog cholera have already appeared in the Rayon. In this case all possible measures must be adopted to cut off communications with the points afflicted, going so far as the complete prohibition of trips to such points by the cart and motor transport vehicles of the farm, the erection of special fences and other barriers to prevent travel from afflicted points across the territory of a disease-free farm, temporary closing of roads and rerouting of traffic, etc. Under the conditions of a socialist farm, operated according to plan, these measures, agreed on with the Rayispolkomi, are capable of exerting an immense effect in reducing the damage caused by hog cholera and preventing its spread.

Large-scale, properly organized pig farms should work out, and assure the execution of, a permanent system of measures to prevent the introduction of all infectious diseases of swine, especially of hog cholera. The most important of these measures is the proper organization of the hog lot, including exercise grounds, bathing and watering places, so as to allow the management and breeding of swine under conditions that completely exclude contact with all outside persons and animals, especially with swine of other farms and of individual (private) owners. It is also an extremely important permanent measure of prophylaxis on such farms to provide the best zoo-hygienic conditions for the swine, a well organized regular and careful housekeeping service, with periodic disinfection of all quarters used for pigs, feed racks, etc.

The systematic and attentive veterinary surveillance of the

swine, the timely adoption of veterinary and sanitary measures also plays an important role in the system of measures for permanent prophylaxis. These measures include: proper arrangements for isolation quarters and immediate removal thereto of all animals suspected of being diseased; provision of rapid and qualified diagnosis of all disease that appears; and careful execution of veterinary and sanitary measures for rehabilitation in cases where any infectious disease appears (determination and isolation of the infected group, radical disinfection of the infected premises, administration of serum, etc.)

The personnel and transport serving the swine, if they leave the limits of the farm (to visit markets, other farms, railroad stations, etc.) must be subjected to sanitary processing before being admitted to the swine again (washing the carts, automobiles and horses' feet with disinfectants, changing of clothing by the personnel, etc.)

The aggregate of all these measures, which require no special outlays, but are rather a question of observation of veterinary and sanitary discipline on the farm, should be most speedily put into effect on sovkhozes and the large-scale pig farms of the kolkhozes.

If these prophylactic measures are carried out, an almost complete guarantee against the bringing in of hog cholera is provided. These general measures of prophylaxis may be intensified, in case of special danger, by prophylactic injection of anti-hog cholera serum, either on the whole herd or that part of it that is most threatened.

Dorset (1930), at the London Veterinary Congress, also noted

the great importance of the veterinary and sanitary measures in the control of hog cholera. In his opinion, the creation of a proper hygienic and sanitary environment on pig farms is the necessary basis for the liquidation of hog cholera by way of inoculations.

In the opinion of the American authors, it is impossible to liquidate hog cholera by inoculations alone.

The immense experience accumulated in the United States during a considerable number of years speaks for this view. The colossal number of simultaneous inoculations annually administered in that country (about 12,000,000) has not had the necessary effect in the sense of the complete liquidation of hog cholera in the United States, due to the fact that the private owners of swine -- the farmers -- disregard the general veterinary and sanitary measures (quarantine, disinfection, destroying the chronic cases, etc.) The violation of veterinary and sanitary rules leads to the prolonged existence of centers of hog cholera infection and to the transmission of this infection to new points in the United States. Analogous reasons hinder the liquidation of this disease in many other bourgeois countries as well.

The socialist organization of animal husbandry in the USSR gives us great advantages in the control of infectious diseases and allows the liquidation, in incomparably shorter time, of the epizootic outbreaks that sometimes occur.

The planned nature of measures, their obligatory character for all government agencies, all farms and all private persons without exception, state control over preparation and quality of biological preparations, the existence of a widespread net of diagnostic

laboratories and state veterinary and sanitary surveillance of the purchase and movement of livestock, and over the storage and processing of raw animal products -- on all of these depends the success of the prophylactic and rehabilitation measures in socialist animal husbandry.

MEASURES FOR SANITARY REHABILITATION OF A FARM AFFLICTED BY HOG CHOLERA AND FOR LIQUIDATION OF THE DISEASE

A definitive diagnosis of hog cholera, rendered by a qualified veterinary specialist, is very important. When there are only suppositions and suspicions of hog cholera, measures like simultaneous inoculation and destruction of diseased animals, etc, cannot be taken. Experience shows, however, that this factor is not infrequently underestimated by the practitioners, and extensive anti-hog cholera measures may turn everything upside down at a time when a precise, scientifically founded diagnosis has not yet been rendered. The serious consequences of such excessive haste will be unavoidable if the suspicions of hog cholera are not confirmed, and the hog cholera virus brought into the farm for the simultaneous inoculations will have already been put into circulation.

Without waiting for the results of the definitive scientific diagnosis (which may in some cases be somewhat delayed), decisive veterinary and sanitary measures must be put into effect immediately upon the appearance of illness suspected to be hog cholera: careful isolation of ill and suspected cases, quarantine of the afflicted pigpen, and radical disinfection of all premises used for swine, especially of those which were occupied by the swine taken ill.

The veterinary in the service of the farm should analyze the situation to find the possible locations from which the virus might have penetrated to the farm, what number of animals, and which, may be already infected, and to what points on the farm the virus can be transmitted.

In accordance with this, measures for stopping any new entrance of the virus from outside should be adopted (for instance, breaking off all contacts with points afflicted by hog cholera, discontinuance of feeding with fodder proving to be infected, etc). The group of swine found to be suspect of being diseased should be isolated from the others and inoculated with serum. All places to which the virus might have penetrated should be radically cleaned and disinfected. Infected feed or bedding should be destroyed or disinfected. Swine that are taken ill or suspected of illness are given therapeutic doses of serum. The clinical course of the disease must be observed, and in case of death a detailed post mortem must be conducted and the organs of the dead animals sent to the laboratory. The Rayon veterinary and the neighboring farms are informed of the suspicion of hog cholera on the farm.

After the definitive diagnosis of hog cholera on the farm, simultaneous inoculation of the swine herd must be carried out in accordance with the instructions for this operation; or else passive immunization must be performed; a strict quarantine is established, thus excluding the possibility of the virus being transported beyond the limits of the farm, and measures of sanitary rehabilitation are taken according to the instructions on hog cholera control, to assure the maximum disinfection of the virus, the localization and liquidation of hog cholera: the creation of a cordon

sanitaire around the infested pigpens, improvement of the management, treatment and feeding of the swine, periodic disinfection, disinfection of the manure, destruction of infected articles of trivial value, separation and destruction of the seriously diseased, chronic starvelings and virus-carriers.

There can be no doubt whatever of the immense importance of veterinary and sanitary measures in the rapid liquidation of hog cholera. The execution of these measures should not be done in a stormy and fortuitous manner, but should represent a definite, thought out and continually operating system of measures from which there should be no deviations. Experiments in the sanitary rehabilitation of pig farms afflicted by hog cholera by means of such planned veterinary and sanitary measures have been conducted by Agapov, Solomkin and Popov'yants.

K. I. Rostov and L. F. Popov (1934) give very interesting and significant examples of the manner in which sanitary and hygienic conditions are reflected in the appearance and spread of hog cholera on farms. On the hog breeding sovkhozes "Kolos" and imeni Lobkov, of the Omsk hog breeding trust, the herds were never once given either passive or active immunization against hog cholera since their organization in 1930-1931. Nevertheless, not a single case of this disease was ever observed on them, thanks to the skilful organization of the sanitary and prophylactic measures on these farms and the good conditions of hog management. The sovkhozes are located in a Rayon that is annually visited by hog cholera. The farms that surround them have repeatedly suffered from outbreaks of the disease, and annually administer simultaneous inoculations.

It was established by these authors that in one of the farms located in the same Oblast, infection was being systematically brought in from the outside over and over again, because the hog breeding farms had no fencing of any kind, persons from the outside had unhindered access to the farm area and the pigpens, swine in private hands wandered around the farms and browsed on their outskirts quite at will. There was a mill in the center of the courtyard of one of the farms, and the population from the surrounding kolkhozes came together for the grinding and walked around the farm and into the quarters of its inhabitants.

The area of the farm, especially near the pig houses, was covered with heaps of manure and of every kind of garbage, and was extremely filthy. The hog quarters were in an unsanitary condition: exceedingly crowded, neglected and dirty. It was not surprising that under such conditions all efforts to liquidate hog cholera were unsuccessful. It continued from year to year.

- The energetic measures for the sanitary rehabilitation of this farm, undertaken under the direction of Rostov and Popov, in the summer of 1934, assured the speedy termination of the losses from hog cholera. The access to the farm by outside persons and animals was stopped; all the healthy swine, after their temperatures had first been taken, were given hot soap and creolin baths and transferred to a newly constructed camp. The pigpens and the area around them were cleaned of the accumulation of manure and garbage. All shelters for the swine were taken apart and twice whitewashed with chloride of lime and ordinary lime, not excepting the floors as well. The feed troughs were washed out with hot lye and scraped clean. The ground

was plowed up and subjected to the action of air and sunlight. The sick pigs collected in the isolation quarters were killed and the meat used for food after thorough boiling. The swine with fever and those suspected of disease were treated with serum. The fodder ration was improved and diversified.

A model scheme for the liquidation of hog cholera on a large-scale pig farm, worked out by K. P. Andreyev, envisages all the necessary measures in this direction and may be recommended to the practicing veterinaries for guidance in their activities.

For the correct organization of these measures, it is first of all necessary to analyze the epizootic situation, and take into account all factors and circumstances that facilitate or complicate the work of liquidating hog cholera. The technique of such an analysis is indicated in the scheme.

In elucidating all the necessary factors as far as possible and formulating a clear idea of the sanitary and epizootic situation, the veterinary carrying out the measures should direct his principal efforts towards making harmless the centers of the virus (and of the virus dischargers) and the localization of the hog cholera, continually bearing in mind that the measures of sanitary rehabilitation are decisive for the liquidation of the disease. The selection of the method of immunization should depend on the situation.

SCHEME OF MEASURES ON THE INDIVIDUAL PRIVATE FARM

In points (villages) afflicted by hog cholera, that have large numbers of swine in private hands, which are kept on peasant farms,

the conditions for the campaign against hog cholera will naturally be different from those in the farms of the socialist sector.

While still making use of the basic principles we have indicated above for the arrangement of the measures, the technique of their implementation may if necessary be simplified and somewhat changed in a campaign to liquidate hog cholera on afflicted individual farms.

It is recommended that villages [hamlets] affected by hog cholera be divided into groups of ten farms each, and that responsibility for the observation of the sanitary measures be placed in the hands of the citizens delegated by the village soviet (members of the soviet and activists). After inspection of all swine, head by head (on the farms), those clinically suspect of disease and those that are plainly diseased should be liquidated for their meat at the slaughter point at the slaughter point (whether existing or set up specially for the purpose), under the observation of a veterinary specialist and with the use of measures for rendering the blood, dung, entrails and other slaughter products harmless. The meat, after it is thoroughly boiled in boiling water for not less than one hour, may be used by the owners.

It is expedient to administer passive immunization to the remaining swine without delay, and to carry out disinfection on the farm houses and quarters for the pigs. Until the expiration of a certain fixed period, allowing the pigs on the street or the pasture should be forbidden. All owners of animals should immediately notify the village soviet of any illness observed among their swine or of any death among them, and should be required to obtain its

permission for killing any pig (indicating the time and place of slaughter so that veterinary control may be exercised over the slaughter and the butchering of the carcass).

The village as a whole is quarantined, and the inbound and outbound transport of swine, feeds and raw animal products of swine is forbidden, and the entire population notified.

The slaughter of especially valuable pedigreed animals with hog cholera (sows in farrow, nursing sows, pedigreed hogs) may be dispensed with, and curative serum administered instead, if the necessary conditions for this exist (complete isolation of the diseased animals, excluding the possibility of any transmission of the virus).

Special precautionary measures should be taken to prevent the transmission of virus infection into the adjoining pig farms.

I. Clarification of epizootic situation

Elucidation of the stage of dissemination of hog cholera on the farm (point).

Inspection of herd, one by one, and taking of temperature.

Disclosure of ill and suspect cases

Discovery of the animals infected by hog cholera or suspected of such infection and of the pigpens and groups of animals threatened.

Elaboration of the diagnosis

Presence of other infections (erysipelas, foot-and-mouth disease, swine pox, influenza, paratyphoid

Discovery of source of infection (from where hog cholera was transmitted) ← Time hog cholera appeared

Existence of hog cholera in the Rayon

II. Clarification of veterinary and sanitary and of zoohygienic conditions on the farm

- Adequacy of veterinary cadres and service personnel
- Conditions of pigpens and farm grounds
  - Possibility of carrying out radical cleaning and disinfection of the pigpens
- Existence, character and amount of feeds
- Existence of isolation quarters and possibility of isolating individual groups of animals and pigpens

III. Characteristics and distribution of the swine population

- Number of swine and young pigs and their breeds
- Presence of immune animals (previously inoculated)
- Distribution of the herd among the farms and pigpens
- Distance between farms and pigpens, and connections between them.

A. Elimination of the sources of infection

1. Interruption of connections with afflicted point or points

2. Removal of infected feed

3. Closing of through roads (if there is hog cholera in the rayon)

4. Isolation of virus-discharging animals (with hog cholera or suspected of it)

5. Destruction of diseased animals and disinfection of the slaughter products (boiling the meat)

B. Quarantine

Stoppage of ingoing and outgoing transport of swine and raw products

Stoppage of outgoing transport of forage and feeds

Closing of passage through farm

C. Localization of hog cholera

Measures in pigpens infected with hog cholera and in infected groups of animals

1. Complete isolation of pigpens (or farms) afflicted with hog cholera and of the infected groups of animals fromthose free of infection

2. Radical housekeeping measures and repeated disinfection in and around infected quarters

3. Detachment of separate service personnel

4. Passive immunization of all swine in an afflicted pigpen

5. Discontinuance of the waling of such swine

6. Temperature to be taken daily, and daily inspection

7. Segregation and destruction of diseased animals

IV. Measures for localization and liquidation of hog cholera on the farm (or point)

D Measures to protect the uninfected swine

Improvement of management and feeding

Establishment of a strict veterinary and sanitary regimen in the pig pens and on the pig farms:

1. Prohibition of access to all outside persons and animals
2. Disinfection of legs before entrance to the pigpens
3. Daily inspection of animals and isolation of the suspicious cases

Interruption of all communication and contact with afflicted farms and pigpens

Housekeeping and sanitary rehabilitation of all pigpens and grounds

Prophylactic disinfectant (repeated)

Setting up of a cordon sanitaire between the farms and pigpens infected by hog cholera and those free from it.

Establishment of sanitary guard-posts for supervision of the observance of the veterinary and sanitary rules.

V. Immunization

The method of immunization and the number of animals to be inoculated is to be determined on the spot, in accordance with the sanitary and epizootic situation on the farm (observance of the current instructions of the Ministry of Agriculture, USSR).

VI. Final Measure

1. Destruction of chronic cases and starvlings
2. Final disinfection

XIX. MIXED INFECTI NS

The following data on mixed infections in the specific infectious diseases of swine is given in the literature. It is based on the results of examination of 985 cases of swine disease by three bacteriological laboratories in Switzerland.

In each infectious disease a different percentage of accidental bacteria are found under certain circumstances, also including pathogenic bacteria. Thus other specific causal agents of infection, and alsostreptococci, staphylococci, cocci and other not precisely identified bacteria. For instance, in erysipelas, B. coli, B. subtilis and B. pyogenese suis were found; in septicemia B. pyocyaneus; in hog cholera, almost all bacteria known (including listerelli -- P. N. Andreyev).

83 percent of the hog cholera cases observed were in the pure form. In other infectious diseases of swi e, the presence of other bacteria in varying numbers was also established bacteriologically, as may be seen from the tables presented below.

In mixed infections there are found:

[Table A, B, C, D, E, AND F follow]

In summarizing the data obtained, Flyukiger points out that mixed infection was found in 170 of the 687 positive results of bacteriological examination, i.e., in 24 percent.

However the author did not yet succeed in designating any

A. IN ERYSIPELAS

In Addition to the Bacteria of Erysipelas	Percent of Cases Diagnosed as Erysipelas	Percent of Cases of Mixed Infection
1. B. suisepticus	in 2 cases = 1.4 percent	1.2 percent
2. B. Coli	12 cases = 8.6 percent	7.0 percent
3. Streptococci	4 cases = 2.8 percent	2.4 percent
4. B. coli + streptococci	2 cases = 1.4 percent	1.2 percent
5. Streptococci + staphylococci	1 case = 0.7 percent	0.6 percent
6. B. coli + B. subtilis + unidentified cocci	1 case = 0.7 percent	0.6 percent
7. B. coli + B. pyogenes suis + cocci	1 case = 0.7 percent	0.6 percent

B IN HEMORRHAGIC SEPTICEMIA

In Addition to the Pasteurelli [1]	Percent of Cases Diagnosed as Pasteurellosis [2]	Percent of cases of mixed Infection [3]
1. B. coli	in 13 cases = 16.0 percent	7.6 percent
2. Streptococci	in 6 cases = 7.4 percent	3.5 percent
3. Diplococci	in 1 case = 1.2 percent	0.6 percent

[1]	[2]	[3]
4. B. coli + streptococci	in 3 cases = 3.7 percent	1.8 percent
5. B.coli + staphylococci	in 2 cases = 2.4 percent	7.6 percent
6. B. coli + B. pyogenes suis	in 1 case = 1.2 percent	0.6 percent
7. B. coli + B. pyogenes suis + unidentified cocci	in 1 case = 1.2 percent	0.6 percent
8. B. coli + B. pyogenes suis + unidentified cocci + acid-resistant bacilli of unidentified nature	in 1 case = 1.2 percent	0.6 percent
9. B. coli + streptococci + staphylococci	in 1 case = 1.2 percent	0.6 percent
10. Streptococci + diplococci	in 3 cases = 3.7 percent	1.8 percent
11. Staphylococci + diplococci	in 1 case = 1.2 percent	0.6 percent
12. streptococci + B. pyocyaneus	in 1 case = 1.2 percent	0.6 percent
13. Bacilli of unidentified nature + gram-positive bacteria	in 1 case = 1.2 percent	0.6 percent
14. Mixed unidentified bacterial flora	in 2 cases = 2.4 percent	1.2 percent
Pure hemorrhagic septicemia	in 44 cases = 54.0 percent	

C. IN HOG CHOLERA

Filterable Virus +	Percent of cases Diagnosed as hog cholera		Percent of cases of mixed infection
	Cases	Percent	Percent
1. Bacteria of erysipelas	1	0.4	0.6
2. B. suisepticus	10	4.3	6.0
3. B. suisepticus + streptococci	1	0.4	0.6
4. B. suisepticus + B. coli	1	0.4	0.6
5. B. coli	5	2.1	3.0
6. B. coli + streptococci	1	0.4	0.6
7. B. coli + unidentified cocci	1	0.4	0.6
8. B. coli + streptococci + bacilli of unidentified type + Gram-positve bacteria	1	0.4	0.6
9. Streptococci	1	0.4	0.6
10. Staphylococci + streptococci	3	1.2	1.8
11. Staphylococci	2	0.8	1.2
12. Unidentified cocci	4	1.7	2.4
13. Unidentified gram-positive bacteria	3	1.2	1.8
14. Bacilli similar to B. coli	2	0.8	1.2
15. Abundant unidentified bacterial flora	3	1.2	1.8
Pure form of Hog Cholera	194	83.0	

D. IN PARATYPHOID

Findings	Percent of cases diagnosed as Paratyphoid		Percent of cases of mixed infection
	Cases	Percent	Percent
1. B. suipestifer + B. suisepticus	1	25	0.6
2. B. paratyphys B + B. coli	1	25	0.6
Paratyphoid in pure form	2	50	

E. IN PYOBACILLOSIS

Findings	Percent of cases diagnosed as Pyobacillosis		Percent of cases of mixed infection
	Cases	Percent	Percent
1. B. pyogenes suis + B. coli	1	25	0.6
2. B. pyogenes	3	75	

F. IN EPIZOOTIC BRONCHOPNEUMONIA

Streptococci	Percent of cases diagnosed as Epizootic Bronchopneumonia		Percent of cases of Mixed infection
	Cases	Percent	Percent
[1]	[2]	[3]	[4]
1. Unidentified cocci	1	12.5	0.6
2. B. coli	2	25	1.2
3. B. pyogenes suis	1	12.5	0.6

[1]	[2]	[3]	[4]
4. B. coli + B. pyogenes suis	1	12.5	0.6
5. B. suisepticus + B. coli + B. pyogenes suis	1	12.5	0.6
6. B. coli + diplococci + unidentified cocci	1	12.5	0.6
Streptococci alone	1	12.5	0.6

form of mixed disease as that most frequently encountered in invariable combination.

The following combinations of bacteria composed the greater part of those observed in swine diseases:

[Table follows]

These experiments of Flyukiger show how complicated the differential bacteriological diagnosis of the infectious diseases of swine may be in some cases and how difficult their control is with so great a frequency of mixed infections.

Rostov conducted a few experiments to elucidate the question of the mixed infectious diseases of swine. First of all he tested the simultaneous artificial inoculation of swine immune to hog cholera with hog cholera virus and a culture of erysipelas bacteria. There was a short period of fever reaction, but no clinical symptoms of disease.

Simultaneous inoculation of swine susceptible to hog cholera with hog cholera virus and a culture of erysipelas bacteria shortened the incubation period and induced a mixed acute infection. Thus the appearance of a mixed infection by hog cholera and erysipelas is possible. For the diagnosis of such mixed infections, the manifestation of clinical and patho-anatomical changes characteristic of each of these diseases separately may serve in part; but only a bacteriological examination and the inoculation of test animals can furnish a sound and precise foundation for the diagnosis.

Found	Number of Cases	Percent
1. B. suisepticus + B. coli	13	15.0
2. B. rhusiopathiae suis + B. coli	12	14.0
3. B. coli + staphylococci	11	13.0
4. Filtrable virus of Hog Cholera + B. suisepticus	10	11.5
5. B. coli + streptococci	9	10.0
6. B. Streptococci + cocci of unidentified nature	8	10.0
7. B. suisepticus + streptococci	6	7.0
8. B. coli + unidentified cocci	6	7.0
9. B. coli + streptococci + unidentified cocci	6	7.0
10. B. rhusiopathiae suis + streptococci	4	5.5

In view of the fact that in the positive case of combined inoculation with hog cholera virus and erysipelas bacteria culture the two morbid processes ran their course independently of each other, and their clinical course showed no new manifestations whatever, it may be concluded that the virus of hog cholera and the bacteria of swine erysipelas, when simultaneously present in the organism of swine neither suppress nor activate each other.

In the same way precisely, in cases of combined infection by the bacteria of erysipelas and hemorragic septicemia, neither mutually inhibitory nor mutually activating action of these bacteria is observed when simultaneously present in the organism.

APPENDIX

TABLES FOR THE DIFFERENTIAL DIAGNOSIS OF THE INFECTIOUS DISEASES OF SWINE

1. The Clinical Picture
2. The Patho-Anatomical Picture
3. The Various Forms of the Infectious Diseases of Swine
4. The Differentiation of the Most Important Infectious Diseases of Swine, by their Epizootological Characteristics.

I. THE CLINICAL PICTURE

Swine Erysipelas

Urticarial Fever

(mildest form)

[1]

Indisposition 1 - 2 days

Dark red or violet spots on the skin

Pustules with serous liquid scabs

Fever: temperature up to 42.8 degrees

After exanthema has broken out, the fever diminishes, the rash disappears, and recovery commences

Sometimes there are malignant changes in the skin

Necrosis of ears, tail, hoofs and sometimes of large areas of the skin

Erysipelatous endocarditis

Swine Plague (Pasteurellosis)

(Hemorrhagic Septicemia of Swine)

Very accute cases

[2]

Typical cases of hemorrhagic septicemia

Fever over 40 degrees. Marked disturbance of general condition.

Red spots that sometimes do not disappear under pressure

Flow of blood from nose, intestines, and urinary organs

Accelerated respiration. Sometimes there is accute pharyngitis.

Death in 1 - 2 days, sometimes in 12 hours.

Acute cases

Symptoms of acute pulmonary inflamation

Fever steady around 41 degrees throughout

Hog Cholera

Pure form of Hog Cholera

(septicemic form)

[3]

Very accute cases. Symptoms of acute hemorragic septicemia

Acute cases: symptoms develop more slowly, apetite is impaird and the animals hide in a corner of the pigpen or lie down in standing grain.

Acute Conjunctivitis

Vomitting, constipation, diarrhea, weakness

Death on the 4th to 7th day

Intestinal form

(develops more slowly)

Stools are yellow or green, with revolting odor

[1]

Septicemic form

(most frequent)

Fever: remains at 41 - 42 degrees for a long time

Conjunctivitis

constipation or diarrhea

Reddening and intumescence of skin on the second day. Redness vanishes under pressure

In serious cases: weakness of hindquarters, cyanosis of the mucous membranes, signs of pulmonary edema

Chronic Bacillary Erysipelas

After the acute stage come the symptoms of chronic bacillar endocarditis

The acute symptoms disappear, and the young pigs appear to have recovered, but their development is tardy

[2]

Short, dry, morbid cough.

Accelerated dyspneic respiration. (Posture of sitting dog. Legs separated, mouth open)

Cyanosis or bloody diarrhea

Red spots on skin towards end of disease. Marked after 1 - 2 weeks. Recovery is rare.

Chronic form

(follows acute stage)

After attenuation of the acute symptoms, signs of pulmonary affection remain for an extended period

Shallow, racking cough and dyspnea, especially after movement

Conjunctivitis, eczema, with diarrhea, towards the end of the disease

After 3 - 6 weeks the animal is completely emaciated and succumbs

[3]

Inflamation and diphtheritis of oral mucous membranes

In serious cases there are symptoms of disturbance of the function of the gastro-intestinal tract

Loss of appetite; constipation or diarrhea, progressive emaciation, weakness and scurvy

Death after 2 - 3 weeks, or on the 11th day at the earliest, in a state of pronounced emaciation

Thoracis form

The symptoms of the pure form of hog cholera are combined with symtoms of acute pneumonia or pleuropneumonia

Mixed form

(peritoneal and thoracis)

[1]

After 6 - 12 weeks: poor appetite, weakness, coughing, accelerated and shallow respiration, bright red coloration of skin. Dyspnea and cyanosis when forced to move. Verrucous endocarditis. Stenosis of orfices

Symptoms of chro ic cachexia are intensified

Eczema, edema and necrosis of the skin. The bristles fall out, hindquarters become paralyzed and death follows in a few weeks

[2]

Sometimes the process in the lungs is halted (encapsulation) and the animals are then even able to fatten up well and develop normally

[3]

In conjunction with the general symptoms of hog cholera infection, there are also symptoms of affection of both gastro-intestinal canal and the thoracic organs

On the skin: urtiearial exanthema (red spots on the tenderer localities), and sometimes necrotic changes as well.

II. THE PATHO-ANATOMICAL PICTURE

Swine Erysipelas
[1]

I. Acute Form

Blood vessels on skin enlarged

Edema and small hemorrhages in subcutaneous connective tissue

More seldom, necroses of separate parts of the body (ears, tail, nasal lobes) and superficial parts of the skin.

Small hemorrhages in serous and mucous membranes (especially under epicardium and endocardium).

Delicate fibrinous deposits (cobweb) on the serous membranes.

The lymph nodes are intumescent, hypermatized and edematous.

Mild hypermias and edemata:

Gastro-intestinal tract: inflammatory intumescence, hypermia, many hemorrhages and much viscous phlegm.

Hemorrhagic Septicemia of Swine
[2]

I. Very Acute Cases

Typical picture of hemorrhagic septicemia: many small hemorrhages on skin, in fatty tissue, on serous and mucous membranes, in kidneys.

Extensive hemorrhages in the perinephric connective tissue, on the mucous membranes of the pelvis, of the kidney, of the urinary bladder and on the meninges.

The lymph nodes are hemorrhagic and intumescent.

Gelatinous-serous infiltration of the subcutaneous connective tissue (neck).

II. Acute cases

Affections of the thoracic organs.

Lungs. Croupous-hemorrhagic, or numerous necrotizing pneumonias: dark-brown to red

Hog Cholera
[3]

I. Septicemic Form.

(Pure form of hog cholera)

Picture of acute hemorrhagic septi-septicemia: hemorrhages on serous and mucous membranes (pharynx, stomach, intestines, in the intumescent lymph nodes and kidneys.

The spleen is intumescent. Croupous false membranes on the peritoneum.

Croupous false membranes on the intumescent and hyperemic mucous membranes of the stomach and intestines, and sometimes also difused superficial necrosis ("bran") or isolated yellow crusts

II. Intestinal Form.

Intensive changes in intestinal area (cecum and large intestine). Round

[1]

The solitary follicles and Peyer's patches are intumescent and the mucous membrane under them may sometimes be covered with small raised ulcers.and sores. The spleen is slightly intumescent and is engorged with blood.

Liver: badly swollen

Kidneys: badly swollen, with red dots on the cortical layer (glomerulonephritis).

The kidney tissue is hyperemic.

II. Chronic form

Endocarditis verrucosa or ulcerosa. There are small papiliform elevations or ulcers on the convex surfaces of the enlarged cardiac valves, and clots of fibrin "cauliflower" constricting the orfices.

Secondary changes due to disturbances of cardiac function: hydrothorax congestive hyperemia of lungs, liver and spleen

More rarely: chronic enteritis, hypertrophy of

[2]

and light gray hepatized areas alternate with pale yellow necrotic areas.

The interlobar connective tissue is expanded and infiltrated by serum or blood. The lungs have the appearance of marble.

Fibrinous films, under which there are many small hemorrhages or hematic infiltrations, aprear on the affected parts of the pleura.

Serofibrinous esudate in the thoracic cavity and on the pericardium. The peribronchial lymph nodes are intumescent and have small hemorrhages. Catarrhal intumescence of the mucous membranes of stomach and intestines, with numerous suffusions of blood. Occasional delicate croupous membranes. Epithelial necrosis in the large intestine . The solitary follicles and Peyer's patches are intumescent or may even show superficial lesions.

Kidneys hyperemic. Whitish-gray apex.

[3]

nodules or uniform thickening in the walls of the large intestine.

Anastomoses of intestinal loops.

(a) acute cases

Flat, round, dry crusts; serous infiltrations and thickening of the submucous and muscular layers beneath them.

The follicles are swollen, with caseous degeneration or ulceration.

(b) chronic cases.

Thick, hard crusts -- "buttons" -- on the internal surfaces of the intestines.

Necrosis of the mucous membrane of the large intestines (at first "bran" and then "gruel").

Constriction of the lumen of the large intestine (by thickening of the outer walls).

[1]

of lymph nodes (without necrotic foci).

Necrotic foci in kidneys, chronic inflammation of serous membranes and of individual joints.

[2]

III. Chronic form

In the lungs: extensive necrotic foci (sequestra) in the thick-walled cavities, and also many small necrotic foci among the extensively hepatized areas of the lungs.

Caseous foci in the peribronchial and mesenteric lymph nodes, tonsils, joints, bones, and in the subcutaneous connective tissue. In the large intestine: croupous inflamation of the mucous membrane in the form of a dry, viscous mass.

[3]

The lymph nodes are always changed: in acute cases, intumescence, hyperemia or hemorrhage, later followed by small gray dots on a reddish background, and in more severe cases, by hard swellings caseous degeneration and necrosis).

Occasionally there are also foci in other organs.

The mucous membrane of pharynx, tongue and larynx is hemorrhagically inflamed and has croupous false membranes and sores (necrosis). Limited or estensive necrosis of skin and mucous membranes of gall bladder, urinary bladder and vagina.

III. Thoracic form

Acute croupous pneumonia, more rarely catarrhal pneumonia, passing over into the polynecrotic type. Fibrinous or serofibrinous pleuritis, less often pericarditis.

[1]

[2]

[3]

Diphtherial inflammantion of the mucous membrane of the stomach.

IV. Mixed form

In the vast majority of cases there are changes in the organs corresponding to those noted in the peritoneal and thoracic forms.

III. THE VARIOUS FORMS OF INFECTIOUS DISEASES OF SWINE

Septicemic form

Picture of Hemorrhagic septicemia or serous-hemorrhagic inflammation with intensely feverish condition

[1]	Erysipelas [2]	Hemorrhagic Septicemia [3]	Hog Cholera [4]	Paratyphoid [5]	Anthrax [6]
Infection occurs:	From 3rd to 12th month in hot season of year Epizootic	At all ages -- At all times of year Sporadic or epizootic where predisposing factors exist	Epizootic	Up to 3rd - 4th month (rarely up to 6 months Epizootic where predisposing factors exist	At all ages Sporadic
Skin	Inflammatory hyperemia	Congestive hypermeia	Congestive hyperemia and hemorrhage	Congestive hyperemia	Congestive hyperemia and hemorrhages
Subcutaneous cellular tissue	----	Edema without hemorrhage in region of throat	Hemorrhage	--	Edema with hemorrhage in throat region
Hemorrhages	Slight or very small in stomach, small intestine and kidneys	None, or few and slight	Numerous and distributed everywhere	Small and few: on serous and mucous membranes and in kidneys	numerous

[1]	[2]	[3]	[4]	[5]	[6]
Lymph nodes	Intumescence and reddening	Intumescence and reddening	Intumescence and redening	Intumescence and reddening	Intumescence and reddening
Causal agent	P. erysipelatis suis, immotile; + gram-positive + blue - guinea pig	P. suiseptious, immotile; gram-negative - blue + guinea pig	Primary agent is filtrable virus; seondary agents are P. suiseptious and P. suipestifer	P. paratyphi suis A, paratyphi suis P. Bacteria are motile, gram-negative; - guinea pig (subcutaneous innoculation)	P. anthracis

[Translator's Note: Presumably + and - blue mean positive and negative indicator reaction with methylene blue.]

INTESTINAL FORM

(Changes in the gastro-intestinal tract)

Erysipelas	Hemorrhagic Septicemia	Hog Cholera	Paratyphoid	Anthrax	Dysentery
[1]	[2]	[3]	[4]	[5]	[6]
1. Gastric Catarrh	Angina	Hemorrhagic and diptheroidal inflammation of the stomach	Thickening of intestinal walls due to small cell infiltrations; caseous inflammation of lymph follicles of large intestine, sometimes passing over into diffuse necrosis. Crusts without concentric layer structure which do not appear on mucous membrane and are surrounded by flat spindle.	Hemorrhagic Pharyngitis with sores on tonsils	Hemorrhagic gastrocolitis with superficial epithelial necrosis.
Catarrhal or hemorrhagic inflammation of the small intestine	Serous catarrh and hemorrhages in the gastro-intestinal tract	Hemmorrhagic, diptheroid or diptherial inflammation of the large intestine (diffuse necrosis, follicular ulcers and buttonlike ulcers with concentric layer structures)	Caseous foci in mesenteric lymph nodes, more rarely in spleen,	Hemorrhagic or hemorrhagic-diphtherial inflammation of small intestine (carbuncle of intestine)	Walls of large intestine are edematous, hemorrhagic and puckered.
Occasional superficial diptherial changes and erosions	Superficial necrosis of the mucous membrane (bran-like coating, fibrinous layers)	Hemorrhages in the lymph nodes (marbleizing)		Mesenteric nodes are hemorrhagic with necrotic foci	Mucus and hemorrhage.
Mesenteric nodes enlarged and hyperemic (bluish red), more rarely hemorrhagic				Spleen shows strong hyperemia and intumescence, or is in state of hemorrhagic- necrotizing inflammation	The solitary follicles are enlarged. Neither caseous degeneration nor necrosis.
Hyperplasia of the spleen					Enlargement, hyperemi a and edema of mesenteric lymph nodes. Mild

[1]	[2]	[3]	[4]	[5]	[6]
Hemorrhagic glomerulonephritis		Infarcts in the spleen	kidneys and epiploon. In acute cases picture of hemorrhagic septicemia	(formation of carbuncle).	hyperemia of spleen Kidneys are reddish brown. Sometimes punctate intestinal hemorrhages Toxic dystrophy of liver (mosaic liver)

THORACIC FORM

(Changes in organs of thoracic cavity)

Influenza	Epizootic pneumonia or grippe	Hemorrhagic Septicemia	Hog Cholera	Paratyphoid	Pyobacillosis
[1]	[2]	[3]	[4]	[5]	[6]
Exudative tracheitis and bronchitis or peribronchopneumonia	Bronchitis and catarrhal bronchopneumonia	Edema of the interlobar connective tissue	Hyperemia and hemorrhages	Bronchopneumonia with caseous foci	Catarrhal pneumonia with disseminated necrosis (encapsulated abcesses), and also serofibrinous pleuritis and pericarditis (purulent foci)
Vitreous, viscous phlegm in larynx, trachea and bronchi	Predisposing factors (unfavorable hygienic conditions) and various microflora without specific significance [Not specific for the disease]	Catarrhal or hemorrhagic-croupous pneumonia with polynecrotic foci		Caseous or tallow-like foci in lungs and lymph nodes are not calcified [?]	
Purple or dark-red areas of inflammation on collapsed portions of lungs (atelectasis), together with emphysema and interlobular edema of the lungs	Filtrable virus and B. influenzae suis with 6-week piglets	Serofibrinous pleuritis and pericarditis. Lymph nodes are intumescent and hemorrhagic		B. paratyphi suis A or B B. enteritidis Gärtneri and Breslau	B. pyocyaneus.
Enlargement, edema and hyperemia of the lymph nodes		Absence of B. suisepticus excludes pasteurellosis [swine plague] Presence of B. suisepticus is not of decisive etiological significance			
In severe cases, exudative-		It is necessary to inoculate shotes with filtered material, and only a positive reaction is indicative of hog cholera With a negative reaction to this in-			

[1] [2] [3] [4] [5] [6]

fibrinous pleuritis and pericarditis, as well as hemorrhagic edema of the lungs.

In secondary infection with B. suisepticus, there is croupous pneumonia and the picture of hemorrhagic septicemeia.

Filtrable virus and B. influenzae suis

inoculation, the presence of B. suisepticus indicates pasteurellosis [swine plague]

MIXED FORM (THORACIC + INTESTINAL)

Hog Cholera

Catarrhal or hemorrhagic-croupous necrotizing pneumonia with diptheroid of the large intestine

In swine of all ages

Paratyphoid

Caseous pneumonia and caseous inflamation of the large intestine and lymph nodes;

BONE FORM

(Changes on the skin, frequently with other forms of the disease)

Erysipelas	Hemorrhagic Septicemia	Hog Cholera	Paratyphoid	Pyobacillosis	Anthrax
In the septicemic form there is spotty hyperemia of the skin (which disappears on pressure). In urticaria there is exanthema in the form of rectangular swellings; in the chronic form there is extensive necrosis of the skin.	Diffuse or multifocal squamous eczema Cyanosis of a large area in the region of the throat.	Pox-like swellings of round shape or multiple hemorrhage throughout the entire trunk Necrosis of small sections of the skin (ears, tail, etc.)	eczema	Eczema (encapsulated abscesses in the thick parts of the skin).	Cyanoisis in the throat region and carbuncles on the skin

NEURAL FORM

Aujeszky's Disease	Teschen Disease [Infectious encephalomyelitis of swine]	Listerellosis	Hog Cholera
[1]	[2]	[3]	[4]
Encephalomyelitis	Encephalomyelitis. Neurotropic filtrable virus, non-pathogenic for other domestic and laboratory animals. Infection is a subdural, in brain and nose. Acute, subacute and chronic course. Latent infection is possible.	Meningo-encephalitis. Listerelli. Cultures are isolated from brain, blood and cerebrospinal fluid. Laboratory animals are infected.	Inflammatory changes in the grey and white matter of the brain, to a considerably lesser extent
Neurotropic filtrable virus	Acute form. Excitement of central nervous system, with disturbance of motor coordination, and tonic and clonic spasms. Increased sensitivity of separate parts of skin and muscles. Consciousness is unaffected. No symptoms in other organs.	The infection is of neurotropic character. Disturbance of motor coordination, muscular tremor, stilted gait with rear legs. Hemiplegia of rear part of body.	Shakiness of hindquarters, spasms, compulsive motions, depression, more rarely paralysis
Very varied picture of neural symptoms	Subacute form. Less pronounced symptoms of excitement. Paralysis of legs, especially hind legs, and also of the esophagus and vocal chords. Mortality is 40 percent.	General weakness, especially in the younger animals (up to 25 kilograms).	Other clinical symptoms are found in some animals, and also the patho-anatomical changes characteristic for cholera
Brain symptoms are pronounced and accompanied by fever	Chronic form. Rare spasms, sluggishness, weakness of hindquarters, staggering gait. Paralysis (for weeks or months) at end of	Shotes of 20 - 25 kilo-	Severe feverish course and mass death among animals of all ages.
This disease afflicts not only swine but also other species of domestic and wild animals, together with the laboratory animals.			
Scabies (mainly at the sight of inoculation) is produced in all animals except swine			
It takes a milder course in adult swine and mostly shows the clinical picture of influenza			
Degenerative changes in the gray and white matter of the brain			

[1]

[2]

attack.

Mortality is 20 percent.

Degenerative changes in the motor ganglions, especially in the lumbar region of the spinal cord. Sleeve-like formations are mainly in the grey matter

Meningitis

[3]

grams may have no neural symptoms, but develop instead a septicemia, with coughing, diarrhea, pox-like rash and squamous eczema

Monocytosis, lymphocytosis and neutrophilia.

[4]

IV. DIFFERENTIATION OF THE MOST IMPORTANT INFECTIOUS DISEASES OF SWINE ACCORDING TO THEIR EPIZOOTOLOGICAL CHARACTERISTICS

Formulated by K. P. Andreyev

Epizootological Characteristics [1]	Hog Cholera [2]	Erysipelas [3]	Hemorrhagic Septicemia (pasteurellosis) [4]	Paratyphoid [5]	Influenza [6]
Character of Propagation and course:	Rapid epizootic propagation to swine of all ages and at all seasons. Its course is acute, with mortality running up to 90 percent	Epizootic propagation during hot season, mainly among young swine 3 to 12 months old, with mortality up to 90 percent.	Observed very seldom as an independent disease, sporadic or enzootic, on the basis of colds and unfavorable conditions of management. In very acute	Sometimes enzootic among young pigs up to 6 months old, if factors are present which weaken the resistance of their organisms (unhygienic and unsanitary con-	Rapid enzootic spread among swine of all ages, primarily during the cold and rainy season. It takes an acute, septic form with typical inflammation of the lungs.
(a) In newly originating centers of disease	Hog cholera appears for the first time in acute form, then appears in sub-	Most often in the acute septicemic form. More rarely in the subacute benign form: urticaria	septicemic form in the animals with lowest resistance. In others it occurs in acute and chronic forms. Often as a complication of hog cholera	ditions of management and feeding) More rarely under normal conditions of young pig management (presence of es-	Mortality runs up to 10 percent (up to 30 percent among shotes). Sometimes in the pulmonary form of a benign "filtrate disease"

[1]	[2]	[3]	[4]	[5]	[6]
	acute and chronic forms			pecially pathogenic strains of pestifer	
(b) In centers long afflicted (stationary foci)	In stationary centers: concealed, creeping character of an enzootic, primarily affecting shotes (from 2 - 6 months) with the chronic, intestinal form -- unthriftiness. Rare outbreaks of disease also occur among adult animals,	Annually (sometimes with interruptions of 1 - 2 years), summer outbreaks of erysipelas among swine 3 - 12 months old. Besides the acute form and urticaria, there are also chronic forms of arthritis, endocarditis and dermal necroses.	Seldom is an independent disease in the very acute septicemic form, more often in the acute and chronic forms as an sequal to colds and lowering of the general resistance, and to a preceding attack of erysipelas, hog cholera, or influenza. It is not infrequent in young pigs in the form of enzootic	Seldom in acute forms, usually in chronic forms. Mortality runs up to 70 percent. The same Frequently in a less pronounced form, with the creeping character of an enzootic, and a lower mortality rate.	Course is prolonged in the chronic form, and is frequently complicated by hemorrhagic septicemia (chronic pulmonary inflammation.)

[1]	[2]	[3]	[4]	[5]	[6]
	especially in the cold and damp season or when the weather is extremely hot, among non-immune animalsor, in consequence of weakened organisms, also among animals that have previously had the disease or have been inoculated.	In addition there is the symptomless chronic and latent form of infection and of bacillus-harborage by carriers	pneumonia following colds, malnutrition, unhygienic conditions and the action of a filtrable virus.		
Causal Agent	The filtrable virus of hog cholera (plus secondary infection by B. suiseptious or B. suispestifer).	B. rhusiopathiae suis.	B. suisepticus	B. Paratyphus B. suis (suipestifer) B. paratyphus A suis (suipestifer Voldagsen) B. enteritidis Gärtneri	Filtrable virus of influenza + B. influenza suis.

[1]	[2]	[3]	[4]	[5]	[6]
Contagiosity	High	Fairly high	Almost none	There is some	High
Specific predisposing factors	Originates and spreads under all conditions	In the warm season, on infected lands (ground) or as a result of the transport of the infection	Lowering of resistance of swine in consequence of colds and unhygienic conditions of management	Poor sanitary and hygienic conditions of management and feeding.	Colds
General prophylaxis	Creation of favorable hygienic conditions of management and feeding and compliance with the basic veterinary and sanitary rules on the farms.				
	Caution in acquisition of bedding and feed. Scraps of slaughter products and table refuse should be fed only after thorough boiling. Regular disinfection of quarters with 2 percent caustic soda or 5 percent	Do not use infected pastures. Remove a layer of earth from the hog lots and change the floors during enzootics. Discovery and removal (by destruction) of animals chronically infected with erysipelas.		Creation of hygienic conditions of management and feeding. Creation of hygienic conditions for the young pigs (cleanliness, periodic disinfection). Separation and isolation of the starvelings and virus-carriers.	Protection of swine from the elements (rain, wind, dampness, cold).

[1]	[2]	[3]	[4]	[5]	[6]
Special measures of prophylaxis (inoculations)	chloride of lime Passive immunization of swine on the farms threatened by hog cholera	Immunization of swine before they are turned out to pasture in rayons and farms infected with erysipelas.	Preventive inoculation with serum (if there is immediate danger of infection		none
Methods of liquidating the disease	Careful, repeated cleaning and housekeeping and radical disinfection of hog houses and pig pens. Isolation of diseased and suspect cases and destruction of severely (hopelessly) ill. Complete isolation (quarantine) of the infected groups of animals, hog houses and farms from the uninfected herds, and infection-free hog houses and farms.				
(a) Sanitary and prophylactic measures					
(b) Inoculations	Curative inoculations of serum for animals running a temperature or otherwise suspect.	Curative serum inoculations of feverish and ill animals. Preventive serum inoculations of the remaining pigs. Subsequent	Preventive inoculation with serum, of the swine in the infected hog house.	Inoculation with serum and vaccine. Use of a bacteriophage.	

[1]	[2]	[3]	[4]	[5]	[6]
	Active and passive immunization of the herd. Destruction of chronic cases of virus-carriers	active immunization of the latter group			
Period of final quarantine from moment of last new case (or death)	3 months	14 days	14 days	14 days	14 days

THE DEVELOPMENT OF VIEWS ON THE ETIOLOGY OF THE INFECTIOUS DISEASES OF SWINE

"Anthrax" [literally "Siberian Ulcer"]

Anthrax
B. anthracis

"Erysipelas"

Erysipelas
(B. erysipelatis suis)
(Pasteur, 1882)

Pneumo-enteritis
Hemorrhagic Septicemia

Acute Form

Septicemic form

Urticaria
Chronic form

Septicemia
Thoracic form of swine disease
(B. suisepticus. Loffler, 1882)

Cholera (American) =
Plague (European)
Intestinal form of swine disease
(B. suipestifer)

Septicemia = hog cholera
(B. suisepticus = B. suipestifer)

Influenza
(filtrable virus +
bacillus of swine influenza)

Septicemia
B. suisepticus

Hog Cholera
(B. suipestifer)

Hog Cholera
(B. suipestifer ± B. suisepticus ± (septicemia)

Pyobacillosis
(B. pyogenes suis)

Septicemia
A disease which is dependent of hog cholera and takes a chronic course. (Catarrh and suppuration in the alimentary and respiratory tracts.
B. pyogenes ± B. suisepticus (± acute form of septicemia)

Hog Cholera (filtrable virus

Hog Cholera (Viruspest)

Septicemia = hog cholera
(B. suisepticus = B. suipestifer)

Influenza
(filtrable virus +
bacillus of swine influenza)

Septicemia
B. suisepticus

Hog Cholera
(B. suipestifer)

Hog Cholera
(B. suipestifer ± B. suisepticus + (septicemia)

Pyobacillosis
(B. pyogenes suis)

Septicemia
A disease which is dependent of hog cholera and takes a chronic course. (Catarrh and suppuration in the alimentary and respiratory tracts.
B. pyogenes ± B. suisepticus (± acute form of septicemia)

Hog Cholera (filtrable virus

Hog Cholera (Viruspest)
(filtrable virus)

pure form
(filtrable virus)

Intestinal form
(filtrable virus + B. suipestifer)

Thoracic form
(Filtrable virus + B. suisepticus)

Mixed form
(thoracic + intestinal)
Filtrable virus + (B. suipestifer + B. suisepticus)

Dysentery
Hemorrhagic-necrotic gastrocolitis
(Bloody black diarrheal discharge)
Filtable virus or complex etiology:
various bacteria
B. suipestifer, B. necrophorus, enterococcus, B. perfringens, spirochetes, vibrios) of the B. coli aerogenes group.
Sometimes in symbiosis with filtrable virus
Balantidium coli.

Bacillogenous hog cholera (1907 - 1909)
(B. suipestifer Voldagsen)

More often chronic septicemia
Catarrhal pneumonia of young pigs
B. suisepticus ± B. pyogenes
(± suppurative foci)

Paratyphoid
B. paratyphi suis
B. paratyphi B or
B. suipestifer
B. paratyphi suis B

Typhoid
B. typhi suis
B. suipestifer Voldagsen B. Typhi abdominalis
but close to being B. paratyphi B
B. paratyphi suis A

With discovery of the filtrable virus of hog cholera some renewed doubts as to whether septicemia is really an independent disease

Epizootic bronchopneumonia
or grippe of young pigs
Filtrable virus + B. influenzae suis

Paratyphoid of young pigs

Intestinal form
(filtrable virus + B. suipestifer)

(Filtrable virus + B. suisepticus)

enterococcus, B. perfringens, spirochetes, vibrios) of the B. coli aerogenes group.
Sometimes in symbiosis with filtrable virus
Balantidium coli.

Mixed form
(thoracic + intestinal)
Filtrable virus + (B. suipestifer + B. suisepticus)

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(B. suipestifer Voldagsen)

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Epizootic bronchopneumonia or grippe of young pigs
Filtrable virus + B. influenzae suis

Paratyphoid of young pigs

Septicemia
predisposing factors + B. suisepticus=
continually recurrent disease, more rarely independent

Predisposing factors ± various bacteria:
B. suisepticus
B. pyogenes, Streptococcus, Staphylococcus, B. coli, B. paratyphys, B. proteus, B. pyocyaneus

Acute Paratyphoid
B. paratyphi suis B =
B. suipestifer

Chronic paratyphoid
B. paratyphi suis A =
B. suipestifer Voldagsen,
B. enteritidis Gärtner
B. paratyphi Flügge-Koensche;

Septicemic form
Picture of hemorrhagic septicemia

Acute form
Extensive hemorrhages, and polynecrotic pneumonia

Chronic form
(complications following acute form of septicemia)

Paratyphoid of young pigs
Acute and chronic forms
Various representatives of the paratyphoid group

PATHOLOGICAL MATERIAL TO BE FORWARDED FOR DIAGNOSTIC EXAMINATION TO THE VETERINARY-BACTERIOLOGICAL LABORATORY

1. Anthrax. Affected lymph nodes; smears of affected parts on slides.

2. Erysipelas. Entire carcass or spleen, altered parts of organs (kidneys), and the tubular bone, with all flesh removed. In summer, bits of kidney, spleen and the entire lymph nodes are forwarded in 30-40 percent glycerin, or in a saturated solution of common salt.

Blood in a sealed pipette. The affected parts of the skin. The tubular bone and skin are packed in dry salt for shipment.

3. Hemorrhagic septicemia and epizootic bronchopneumonia. Smears of blood or exudates on slides. Blood or exudate in a test tube, closed with a stopper of cotton-wool soaked in paraffin, or still better, in a Pasteur pipette, sealed at both ends.

Altered lymph nodes are forwarded whole, and also bits of the affected lungs and spleen, in 30-40 percent glycerine or a saturate solution of common salt. The tubular bone, freed of flesh (see under "erysipelas").

4. Pyobacillosis. Blood in sealed Pasteur pipettes. The content of abscesses in test-tubes. Smears of pus on glass slides. Bronchial and mediastinal nodes from affected lungs.

5. Influenza. Lungs and spleen. 20-50 cubic centimeters of blood drawn under sterile conditions. Where young pigs are involved, the entire carcass is forwarded.

6. Hog cholera. The entire carcass if forwarded if possible, or the lungs, heart, entire gastro-intestinal tract, spleen and kidneys. When there have been neural symptoms, the head is also sent. The affected lymph nodes, whole, in 30 percent glycerin. On the third to fourth day of the disease, 50 cubic centimeters is drawn from the tail during life.

7. Paratyphoid. The mesenteric lymph nodes, whole, in 30 percent glycerin. Lungs showing changes, and especially the sections of intestine showing lesions, are sent. Spleen, liver, tubular bone. Blood in sealed Pasteur pipettes.

8. Swine pox. Scrapings of pustules and scabs. Blood drawn during life from the tail, in a sterile test tube or a few large sealed Pasteur pipettes.

9. Brucellosis. The affected organs. Testicle removed by castration. The swollen joints. The swellings. The aborted fetus and placenta, and the discharges from the dam. The milk. Blood in test-tubes for the agglutination reaction.

END