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INTRODUCTION TO A DISCUSSION

ON

TUBERCULOSIS IN ALL ITS RELATIONS.

At the International Congress of Hygiene and Demography.

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THE subject which I have undertaken to bring under your notice for discussion is one of the gravest importance, for there is no disease, acute or chronic, which is so productive of human suffering or so destructive of human life.

In a Congress of Hygiene the subject of tuberculosis can only be considered in relation to its causes, for the aim of hygiene is to prevent disease, not to cure it. Even when thus limited our field is of large extent and includes many difficult questions. What I have specially undertaken is to direct your attention to those which relate to the dangers which are alleged to arise from the use of tuberculous food.

1. Does general tuberculosis in man originate from intestinal infection? 2. If it does, is it possible to guard against so fearful a danger?

You will see at once that the first of these questions is pathological, for it concerns the mode of origin of the disease itself; the other is practical, for it has to do with the use we can make of whatever pathological knowledge we may possess for the protection of the community.

For the purpose of avoiding useless discussion on subjects on which there ought to be perfect agreement of opinion, I will ask you to accept certain fundamental propositions as settled, such as, for example, the existence of a *materies morbi* in the form of the tubercle bacillus, its constant association with the tuberculous process, and the identity of human with bovine tubercle.

I would ask you also to allow it to be assumed that any part of the body of a tuberculous animal, or any secretion of such an animal, would, if it contained tubercle bacilli, be a source of danger, and that the use of such liquid or part ought to be prohibited or avoided. This being understood, we are in a position to enter without further introduction on the questions which require answers, some of which are pathological, or, if you prefer it, etiological, the others practical or administrative. The etiological questions relate to the three possible ways in which a human being may be infected by tubercle—namely, inheritance, pulmonary inhalation (atmospheric infection), and food (enteric infection). The practical issues are—(1) Is the risk to the individual consumer of such a nature that it can be detected and estimated? (2) Is it of such a nature that it can be counteracted? (3) Is the collective risk to which the community is exposed sufficient to demand the interference of the State? and (4) if it is, how can the State interfere with effect? I do not propose to discuss all of these questions myself, but I commend them to the attention of the Congress as questions which require discussion.

Of the two practical questions which concern us, which relate respectively to infection by milk and to infection by meat, the latter was very largely discussed at a congress on the subject of tuberculosis held in Paris in 1888, and has been again discussed very recently. In the first of these debates the medical profession did not take a very prominent part. The question whether the flesh of tuberculous animals is dangerous or not was regarded chiefly from the point of view of the veterinarian.

The reasoning employed by my friend M. Arloing in 1888 was straightforward and logical. Following out the principles enunciated by another gifted pathologist, the late M. Toussaint—that tubercle is a disease *totius substantiæ corporis*—he maintained that the time had come to act “conformément

à la logique.” One out of every six carcasses had been shown, he said, to be infective when tested by administering it to test animals as food. He calculated that over 1,000 persons joined in the consumption of every such carcass, and consequently that one-sixth of this number—that is, about 170 persons—must be subjected to the risk of infection for every animal sent to the shambles! If I thought that this reasoning were true; if it appeared to me that we could measure the danger to the human consumer by the prevalence of tuberculosis among animals used for food, irrespectively of other considerations, then I would heartily go in with M. Arloing in his practical deduction from it that, whatever interests conflict with public health, they must give way. It is our duty to insist on the right of science to dictate; but in doing so we must be careful not to do so until we have looked at the question from all sides and heard the whole evidence.

In some of these discussions it has not been sufficiently considered that the question is not whether the consumption of tuberculous meat is in itself attended with risk, but whether the prevalence of tuberculous diseases among ourselves is in any way due to the fact that we occasionally eat meat which contains bacilli. It is not sufficient to show that on the one hand there is a fearful mortality from tuberculous diseases, and that on the other there exists a cause to which this calamity might be attributed. It must also be shown that the effect is actually produced by the cause, in such sense that if the cause were removed we might hope that the effect would disappear. Are we or are we not in a position to say that, if the use of meat of tuberculous origin were effectually restricted, the prevalence of tuberculous diseases would be diminished? Before entering on this question, let me place before you very shortly the evidence as to the communication of tubercle to animals by feeding.

Twenty-three years ago M. Chauveau¹ fed three heifers with tuberculous material from the body of a cow, and obtained positive results. At that time the notion that tuberculosis is a virulent disease was new. M. Villemin had made his great discovery, but it had not yet been accepted; and consequently M. Chauveau's results were severely criticised, and were the subject of discussions which extended over several years (1868 to 1874), during which he repeated his observations, effectually silenced his opponents, and determined with the greatest exactitude all the conditions which are required to insure success in the experimental production of tuberculosis by feeding. About the same time Professor Gerlach,² also a distinguished veterinary pathologist, made similar experiments in Germany, which led him to advocate in the most energetic manner the restriction of the sale of tuberculous meat.

These two initial investigations were followed by others far too numerous even to mention, of which an excellent summary is given by Dr. Wesener of Freiburg in his book on “Tuberculosis by Feeding,” published in 1884. Up to that time the experimental work had been done almost exclusively by veterinarians, but it then acquired a new interest in its purely scientific relation to the etiology of tuberculosis; for the discovery of the tubercle bacillus had rendered it possible to investigate all the processes by which the tuberculous virus enters the organism, with an exactitude which was before unattainable. In 1884 Baumgarten³ showed that a couple of ounces of milk to which a pure culture of the tubercle bacillus had been added was sufficient to produce characteristic tuberculous lesions in the intestine of a rabbit; and that the effect of such feeding was so constant, that by examining the animals so fed at successive periods, all the

¹ Chauveau: Démonstration de la virulence de la tuberculose par les effets de l'ingestion de la matière tuberculeuse dans les voies digestives. *Bull. de l'Acad. de Med.*, xxxiii, 22. 1868.

² Gerlach: Die Uebertragbarkeit der Perlsucht d. Impfung u. Fütterung. *Jahresb. d. k. Thierarzneischule zu Hannover*. 1869.

³ Baumgarten: “Ueber Tuberkel u. Tuberculose,” p. 113.

stages of the process could be thoroughly investigated, the most important result being that after a period of latency of about a fortnight, during which no traces of infection are visible, the lymphatic follicles of the mucous membrane and the mesenteric glands begin to enlarge simultaneously without any change whatever in the intestinal epithelium.

It was thus shown with a precision which, as I have said, was not before attainable, that the initial phenomenon of tuberculosis is primarily proliferation of the adenoid tissue of the lymphatic system, and that the bacillus is capable of finding its way into the lymphatic system without leaving behind it any appreciable traces of its presence at the portals by which it has gained admission. Since 1884 our knowledge of the subject has been still further advanced by Cornil, under whose direction two very important researches, confirming and extending Baumgarten's results, have been recently published. These are indeed so complete that we may now consider that, so far as concerns the anatomical characters and development of the process, we are fairly informed; the main points being that when the tubercle bacillus is absorbed from the intestine it follows the course of the lacteals, and that the lesions which it produces correspond closely with those which present themselves in those rare instances in which it is possible to observe the first beginnings of enteric tubercle in the human subject.

It must not, however, be supposed that nothing further can be learnt by the experimental method. We still require a better knowledge than we at present possess of the conditions which determine its origin—information which can only be gained by observations on animals. According to those who regard tuberculosis as necessarily a disease *totius substantiæ corporis*, in which every part of the body is contaminated, all meat derived from the body of a tuberculous animal ought to be condemned, whether it appears healthy or not; for they argue that in every such animal, wherever the disease may be, bacilli circulate in the blood, and are so universally distributed. Now it is not an adequate answer to this reasoning to say that it is exaggerated. Reasoning that is true can never be exaggerated. I believe that it is not true: that is, that we are not entitled to assume that the flesh of every tuberculous animal is infecting, unless it be proved to be so. As against the probability of its being so, it is to be noted that the tuberculosis of cattle, although it is the product of the same bacillus, is, by comparison with tuberculosis in man, a disease of very slow progress. It localises itself in structures which are not essential to life—for example, the serous membranes—and may subsist in them for years without materially compromising the organs which they cover. When this is the case the nutrition may be so little interfered with that the animal can be readily fattened for the market. There is no doubt that the flesh of such an animal may be, to all appearances, in good condition, and may be offered for sale as meat of prime quality, and as yet we have no evidence that it is infecting.

Let us now turn from the source of infection to its effects; from the bacillus which we all admit to be the *materies morbi* to its field of disease- and death-producing action.

From statistics we learn that in this and other countries tuberculous diseases contribute something like 14 per cent. to the total of deaths from all causes. We also know that during childhood, as distinguished from adult life on the one hand, and from infancy on the other, the tuberculous mortality scarcely amounts to a quarter of this percentage, whereas in infancy it only falls a little short of it, and in early adult life, it very far exceeds it.

This rough result of mortality statistics is only so far of value, as it serves to draw one's attention to facts which are familiar to every clinical pathologist, namely—first, that there is a marked increase of liability to consumption (the representative form of tuberculosis in the adult) at puberty, and that this liability attains its maximum during the earlier years of adult life; and secondly, that many of the acute diseases of infancy acquire by their association with tuberculosis a fatality which they would not otherwise possess.

These are the obvious facts, and what we have now to inquire is, whether the recognition of the consumption of meat derived from tuberculous animals, as a source of infection, serves to explain any of them.

As regards the mode of origin of pulmonary tuberculosis there are certain points as to which all pathologists are

agreed. Before it was known either that tubercle could be communicated to animals, or that it was always associated with a particular microphyte, it was as clearly recognised as it is now that it spread in the organs of the tuberculous person by a process in which healthy parts were infected from diseased parts; and accordingly we distinguished then just as we do now, between primary and secondary lesions, and it was admitted that, in the adult, the respiratory organs were affected primarily. This doctrine has not been modified in consequence of the more exact observations of the twenty years which have elapsed since Villemin's discovery. In the ordinary form of phthisis, that in which the apex is the seat of the most advanced lesions, the disease begins in the form of disseminated nodules of broncho-pneumonia. That these may originate by the introduction, that is, the inhalation of particles suspended in the atmosphere in which bacilli are contained, can scarcely be disputed, for we know that lesions which correspond with them in anatomical characters can be produced in animals with certainty by the inhalation of such particles, even though they are inhaled in very small quantity. But no proof exists that in every case what appear to be primary tuberculous nodules are products of inhalation. On the other hand, my own early experiments showed me that peribronchial nodules were among the most constant and the earliest of the lesions in artificial tuberculosis of guinea-pigs as produced by subcutaneous inoculation. In this case the virus is unquestionably not inhaled, but brought to the affected organ by the blood stream. There is reason, therefore, for supposing that however the blood stream is contaminated, the tubercle germ will find its way to the lungs, and to the part of the lungs which we know to be its habitual seat. This consideration might for a moment suggest that the origin of tuberculosis in the adult arises from enteric absorption—that is, from the ingestion of infected food—were it not that pathological experience very distinctly indicates the improbability of such a view.

As I have already stated, we have evidence that under certain conditions the virus of tubercle is absorbed by the lymphatic system from the small intestine in man, and that when this happens it gives rise to lesions of the same nature as those which are produced in animals by the injection of liquids in which bacilli are suspended, that is, to lesions which originate in the lymphatic system. Now, tuberculous disease of the intestinal mucous membrane, although very common, occurs very rarely in the adult and is not common even in infancy as a primary disease. In the adult we are familiar with it as an ulterior consequence of pulmonary consumption, and the way in which it occurs is very plain. In the advanced stages of that disease muco-purulent liquid is discharged in quantity from the softened parts. This material is charged with virulent bacilli, and infects the mucous membrane along which it passes, so that it is easy to distinguish bronchi which lead from vomicae, by the tuberculous nodules with which they are more or less beset. In advanced phthisis the sputum is so abundant that a certain proportion of it is from time to time swallowed. It produces no effect in the oesophagus or stomach, for along the former it passes too rapidly, while in the latter the mucous membrane is effectually protected by the gastric juice, which although it is incapable of devitalising the bacillus of tubercle, yet arrests its development. In the alkaline contents of the small intestine it finds a condition more favourable to its development, and is there absorbed, just as any other particle of similar size might be by the lymphatic follicles. It is by this process—and so far as can be learnt from pathological anatomy by this process alone—that tuberculous disease of the small intestine in the adult arises. It is always a secondary result of pulmonary phthisis.

In childhood the case is different. Tuberculosis does not begin to assert itself as a cause of death until the third month of extrauterine life, but after this there is good reason for supposing that the bacillus plays an important part as a cause of mortality. As to the extent to which this is the case public statistics afford very inadequate information, for in infancy the greater number of the deaths which are caused by tuberculosis are returned under other titles. Hospital records, however, serve more or less completely to fill up the blank. From such sources we learn, first, that tuberculosis is more fatal in early childhood than during the period of lacta-

tion, and probably more fatal than in adult life; for one-third of the young children who die in hospitals die of tuberculous diseases. And when we inquire into the nature of these diseases we find that the organs primarily affected are first the lymphatic glands, and secondly bones, so that although by far the largest number of deaths are caused by pulmonary tuberculosis, this disease usually presents itself in connection with previously existing tuberculous disease of the bronchial glands. As regards tuberculosis of bone, it seems also to be made out from the observations of Dr. Müller⁴ in the hospital at Munich, as well as from those of Lannelongue⁵ in Paris, that it is in very many instances primary, so that we should probably not be far wrong in saying that, whatever may be the original mechanism of infection in early infancy, the lesions of bone and lymphatic glands are in the majority of instances primary, that is, antecedent to lesions of other organs, and that the reason why the acute infective diseases of infancy, particularly measles and whooping-cough, are followed by tuberculous broncho-pneumonia is not that bacilli are inhaled, but that the subjects of these diseases already carry in their bones or lymphatic glands foci of infection, which only require the aid of an acute disease to become generalised.

To the pathologist the question how latent tuberculosis of the lymphatic system or of bone originates—that is, how the bacilli which produce them are introduced into the blood stream—is one of great interest. I may as well confess it to be my own belief that in a certain proportion of cases these cryptogenetic tuberculous are due to causes which operate before birth. It concerns the present inquiry only in relation to the infection of the lymphatic system by the lacteals. On this subject, notwithstanding that the terms intestinal phthisis and tabes mesenterica are often used as if they expressed some well defined form of disease, further investigations are much wanted. The Munich statistics show that in less than half of the cases in which the lymphatic glands are found to be tuberculous, the affection has its seat in the mesentery, and that the mucous membrane of the intestine is tuberculous in a still smaller proportion—less than a quarter. In many of these cases the mucous membrane is no doubt affected consequently on tuberculous disease of the lungs, but in the remainder the disease appears to be primary. What is required is a careful investigation of this residue, for if it could be proved that such cases exist, the fact would afford clearer evidence than any we now possess of the enteric origin of tuberculosis. In the absence of such proof, human pathology has very little indeed to say in favour of the belief that human tuberculosis owes its origin to the consumption of tuberculous food, and even if it were proved that the absorbents afforded a channel of entry for the tuberculous virus in children, it would have little significance as regards the consumption of meat.

I hold, therefore, that in asking for the interference of the State, we must not base our demand on the ground that the community *actually suffers from the consumption of tuberculous meat*, the evidence that it is so being too weak to be insisted on; but, on the other hand, I maintain that the consumption of tuberculous meat is attended with some danger, and that on that ground its consumption ought to be watched over by the State and avoided by the individual.

This being admitted, the only question that remains is the administrative one. If we had to-morrow a law forbidding in express terms the sale of any meat containing the bacillus of tubercle, it could not be carried out unless those charged with its administration were able to distinguish such contaminated meat from healthy meat, so that the efficiency of the law would depend on the question whether the art of discriminating between infecting and non-infecting meat had attained to such perfection as to enable an adequately trained inspector to exercise his function with effect.

The practical result to which we have come is this. Everything turns on diagnosis. The Legislature might direct that all meat intended for consumption should be subjected to inspection, might appoint inspectors, impose penalties, and provide just and adequate compensation, but all this would be of no use unless the principles on which the discrimination

of infecting from non-infecting meat is to be founded, could be laid down, and the services of skilled persons of sufficient intelligence to apply them could be secured. We may consider it quite certain that in this country, at least, it would at present be extremely difficult to find such persons. Not that the veterinarian is less capable than the doctor of making a scientific investigation, but that he does not possess, and has as yet had no opportunity of acquiring, the sort of skill which is necessary for making what the French call the "*diagnose précoce*" of tuberculosis. Two things, in short, are required, neither of which we have at our disposal—special scientific knowledge and technical skill. In my judgment the former must be acquired first. Science must determine, much more definitely than has been done as yet, what are the earliest changes which have their seat in the parts of animals used for food, and which of these indicate danger to the consumer. This knowledge can only be acquired by experiments specially made for the purpose. Having been attained, it can only be applied by technically trained persons. I cannot better illustrate the sort of skill required, than by comparing it to that possessed by the professional tea-taster as regards the commercial value of tea. I believe I am right in stating that the gustatory judgment of the tea-taster is so implicitly relied on that the largest transactions are regulated according to it. Why is the judgment of the expert reliable? It is because he is responsible for it and paid for it. It would be the same as regards the early recognition of tubercle in cattle if skill and discrimination were paid for; and the moment that this skill is required it will come into existence. What is wanted in the inspector is not that he should be a pathologist, or even a bacteriologist, but a trained expert; for although the rules unconsciously used by him may be based on scientific principles, it is not by these principles he is guided in each case, but by practical skill.

For the convenience of discussion I have thrown the views I have ventured to express into the form of propositions, and will now ask permission to submit them to the Section:

There is no sufficient reason for supposing that in the human adult the introduction of the bacilli of tubercle by enteric absorption is the efficient cause of tuberculosis. In infancy a large proportion of the apparently idiopathic tuberculous diseases of the lymphatic system are probably due to the penetration of bacilli into the organism from the intestine; but the evidence which we at present possess on this subject is not sufficiently precise or extended to serve as a basis for prophylactic action. For this reason the origin of tuberculosis in infancy is a subject which urgently requires investigation.

It has been proved that the ingestion of any material which contains the bacilli of tubercle is a source of risk to the consumer, but the conditions which limit this risk are insufficiently known. It would, therefore, be unjust to enforce the destruction of any specimen of meat apparently healthy, even though it were known to be derived from a tuberculous animal, excepting on evidence given by an expert as regards the particular case that it would be infecting if administered to test animals.

As regards the duty of the State in relation to the prevention of tuberculosis, what is immediately required is, first, that tuberculosis should be added to the list of diseases regarded by the law as contagious; and secondly, that an efficient system of skilled inspection should be created. This is desirable, not merely as a first step towards the prevention of the sale and consumption of tuberculous meat, but as an indispensable means of acquiring better information than now exists. To be of use it must be carried out on the principles I have already set forth. It must be conducted by men of technical skill acting under scientific guidance.

In conclusion, I would beg you to notice that I have limited myself to the question of the consumption of meat. Although I have purposely left the milk question out of consideration, I have referred to facts which bear upon it. We have seen it to be exceedingly probable that about 40 per cent. of the children that die in hospital die tuberculous. I have already expressed my belief that in some of these cases the disease is congenital—that is, dependent on causes which have operated before birth. Some infants are probably infected by inhalation of the tubercle bacillus from the atmosphere, notwithstanding

⁴ O. Müller: "Zur Kenntniss der Kindertuberculose," München. 1889.
⁵ Lannelongue: "De la tuberculose externe congénitale et précoce." Paris. 1887.

that pathology affords so little evidence of it; but for the rest, notwithstanding the lack of satisfactory evidence, I cannot resist the conviction that the consumption of unboiled milk during the years which follow weaning must have its share in bringing about the fatal prevalence of tuberculous disease at that period of life. This being the case, I feel that, whatever course may be taken as regards meat, I can join heartily with those who think that the sale of contaminated milk ought to be put a stop to by all possible means, and I trust that on this subject there will be no difference of opinion, and that this Congress will take such action as may promote the progress of legislation.

DISINFECTION IN THE LIVING BODY.

Read in the Section of Bacteriology at the International Congress of Hygiene and Demography.

By STAB SARZT DR. BEHRING,
Berlin.

THE number of agents which have been employed in the treatment of infectious diseases during the last century has been almost endless. Corresponding to the views held as to the nature of these diseases, attempts have been made to influence the heart, skin, and digestive organs.

Since the micro-organismal nature of the infectious diseases has been recognised a new class of remedies—the antiseptics—has been brought into use. The results obtained with these substances have, up to the present time, been little satisfactory. Experience has shown that their action outside the body is no criterion of their action when introduced into the body. In most cases they seem to be almost powerless when introduced into the body. Hence so recently as 1883 the view was propounded that it was useless to aim at a disinfection within the body.

Since then the situation has changed. Pasteur's work on hydrophobia and Koch's on tuberculosis have held out the hope that for the various specific diseases, specific remedies may be found; and recent researches on tetanus, diphtheria, anthrax, etc., have shown that it is possible even within the body to combat successfully the various specific poisons produced in these diseases. In short, we have now got so far as to be able to speak of a "disinfection within the body." The term "disinfection" need no longer be limited to the bacteria-killing action of antiseptic agents outside the body, as has hitherto been the case, but may now be extended to the anti-toxic action of certain agents within the body.

There are four possible ways in which it is conceivable that this internal disinfection may be effected:

1. By killing the disease-producing germs.
2. By hindering their growth.
3. By counteracting their disease-producing properties—pathogenic organisms losing their power to produce poisonous products.
4. By antagonising the action of or destroying altogether the various toxic products produced by the bacteria.

It is possible that the disinfecting action may not be exercised directly on the products, but indirectly on the cells of the body, and that the beneficial result may be due not so much to a destruction of the toxic products as to an increased resisting power conferred on the cells of the body, in virtue of which they are able to withstand the action of these products.

This latter, however, is not proved, while concrete examples can be brought forward to prove the occurrence of the four other methods sketched out above.

To begin with the results gained with anthrax. If a small piece of spleen from a mouse dead of anthrax be rubbed up in 5 cubic centimetres of meat broth and $\frac{1}{10}$ cubic centimetre of this be injected under the skin of another mouse, the latter dies of anthrax in the course of twenty-four hours. The fatal result may be postponed or prevented altogether by subsequent injection of a mixture of corrosive sublimate and chloroborate of soda.

Thus if one part of 0.04 per cent. solution of corrosive sublimate be mixed with three parts of a 10 per cent. solution of chloroborate of soda, and 0.4 cc. of this be injected in the same place as the anthrax, death is delayed for several days, so long even as eight days. At the same time there occurs an

intense local oedema at the point of inoculation, which is entirely absent in the animal not so treated. The blood and organs are found after death to contain anthrax bacilli in great numbers, and the spleen is found twice the size of the spleen of a mouse dead of anthrax alone.

If the injection of the disinfecting mixture be repeated on the following eight days, the local oedema gradually disappears, and a local necrosis results, which finally heals by cicatrization in from twenty-five to thirty days. In single cases death may occur fifteen to twenty days later from anthrax; about 50 per cent., however, of the mice permanently recover. This is only the case, however, if the injection of the mixture is made shortly after the original inoculation. If it is delayed longer than two hours the animal dies.

If it now be asked how the healing result is brought about, the answer is not an easy one. The anthrax bacilli are not killed by the injection, since they can be cultivated from the blood of the animal many days later. Nor are they in any way weakened, for other mice inoculated with them die of typical anthrax in the usual time. No doubt some of them are killed as the consequence of the local oedema, but we must assume that changes of a general character have been brought about by which the growth of the bacilli has been hindered; otherwise it is difficult to understand why the bacilli at the seat of injection are not taken up by the lymph and blood streams, as is ordinarily the case.

Curiously enough, the same successful result is not obtained if the disinfectant mixture be injected a short distance from the seat of original inoculation of the anthrax.

The therapeutic significance of these results must be regarded as considerable. During the last four years 100 substances have been tried, and 1,000 observations and experiments have been made by myself, and no such result has been gained as that above noted. With neither the corrosive sublimate nor the chloroborate alone were the same results obtainable, although the latter has healing power in a certain small percentage of cases.

I have referred to this matter in detail, as I believe we are on the way to discover not a little with regard to the action and composition of several new therapeutic agents.

Observations have also been made by myself and others in the Berlin Hygienic Institute, on other diseases as well as anthrax. In all cases the substances were injected hypodermically, the quantity and virulence being such that the control animals always died in from twenty-four to forty-eight hours. The results obtained in animals infected with tetanus have already been reported by Dr. Kitasato. I have already, in a former communication, reported the results which I obtained in diphtheria with chemical agents; I will only add here that in both these diseases a 1 to 2 per cent. solution of trichloride of iodine was found to have remarkable therapeutic properties, double salt of chloride of sodium and gold and zinc preparations being also efficacious in the case of diphtheria. The chemical agents which have been found most active in the experiments just recorded are such as have not yet been systematically tried in the treatment of local infections such as erysipelas, suppurative inflammations, anthrax, puerperal infections. It will remain for the future to show whether the results obtained in these diseases by the use of these remedies will not be better than those hitherto. Since Lister has shown how to avoid all ill results in the healing of wounds, the opportunity of treating these diseases is not so frequently met with as formerly. Nevertheless, it still remains desirable to be able to disinfect living tissues with as little disturbance as possible.

These observations, however, have an interest apart from the immediate therapeutic value of the results obtained, because, both in the case of diphtheria and in that of tetanus, it became evident that the animals, after having been cured, had acquired a certain amount of immunity against the same infection. Furthermore, with the blood of the animal so cured it was possible to obtain therapeutic results such as had never yet been got in diseases running so acute a course.

There is an essential difference between the healing action of the above-mentioned chemical agents and that of the blood of the immune animals, the former, even the best of them, only giving a certain result when they are injected near the seat of the original inoculation. The blood of immune animals, on the other hand, can act locally, even when