

THURSDAY, AUGUST 27, 1891.

## THE CONGRESS OF HYGIENE.

WE continue this week our account of the work done at this Congress. It will be clear that with the space at our disposal it is only possible to refer to few among the many subjects discussed. Among these we have selected those which have the closest connection with those researches now attracting special attention.

In regard to the subject of tuberculosis it was certainly a happy inspiration of the officials of the Bacteriological (II.) and Comparative Pathological (III.) Sections of the International Congress of Hygiene and Demography, to call a joint meeting in order that a full discussion of the scientific and practical bearings of the questions relating to "the transmission of tuberculosis from animals to man by means of flesh and milk derived from tuberculous animals" might be possible; and it was also fortunate, as far as its success was concerned, that the discussion was opened by Profs. Burdon Sanderson and Bang, each of whom in his own sphere is singularly well fitted to lay before the members of the Sections what is at present known in the medical and veterinary scientific worlds concerning this important subject. Prof. Sanderson's early researches on tuberculosis have opened up the way for much of our present knowledge on the subject, in addition to which he has watched the question most carefully through its various stages of evolution; whilst Prof. Bang, by his numerous practical observations and scientific experiments, has given a completeness to our knowledge which has not been attained as the outcome of the work of any other observer.

The discussion on this question afforded another instance of the intimate connection between the purest research and the most practical affairs of every-day life.

Thus from the tenor of the discussion it may be gathered that the danger arising from the ingestion of tuberculous milk and meat has probably been exaggerated.

Some of those who took part in the discussion, for example, seemed to doubt whether primary tuberculosis of the alimentary canal—*i.e.* tuberculosis confined to this region and evidently the result of infection through the mucous membrane—was ever met with in adults, and even whether it was of very frequent occurrence in the child; whilst other speakers were able to instance out of their own experience certain cases of the former and many of the latter, strongly accentuating the fact that such primary disease of the intestinal canal does exist. Then, again, one speaker was convinced that Koch's bacillus had little or nothing to do with the production of tubercular disease; but the contention had been met by so many accurate observations and experiments that he may be said to have been ruled out of court, though it was on all hands agreed that the bacillus might be helped in its work by various predisposing causes, many of which were brought into full prominence during the discussion. It was also accepted that the tuberculosis of cattle is similar, as re-

gards its causal agent, to the tuberculosis of the human subject, and that the disease is merely apparently modified owing to the different conditions, and perhaps delicate tissue modifications, offered by the different hosts of the parasitic bacillus; and from the most careful and detailed experiments, of which a large number were described, there seems to be no question that tuberculosis is communicable from animals to man, and certainly there appears to be none that it is communicable in the opposite direction.

There was a general expression of opinion as the outcome of the discussion that legislation of some kind or other is necessary, but, as pointed out by Burdon Sanderson, if laws were made to-morrow there is absolutely no staff of inspectors capable of giving effect to any that might be drafted. It is probable that this will draw attention, first, to the necessity for conferring powers of inspection of dairy and store cattle on some central authority; and second, to the necessity there is that our veterinary surgeons should undergo a thorough scientific and practical training, such as would fit them to fill the posts from which unfortunately they are necessarily now in many instances excluded.

When all is said and done, it appears that the danger arising from the consumption of tuberculous meat is far less serious than that involved in the consumption of milk from tuberculous animals, as meat, if *thoroughly* cooked, appears to be perfectly innocuous, the tubercle bacilli being readily destroyed by heat, whilst the nutrient properties of the meat itself are little, if at all, interfered with by judicious cooking. In the case of milk, however, in which the presence of tubercle bacilli has been so often demonstrated, it has to be borne in mind that boiling so alters the constituents of the milk, especially the proteids, that it is rendered very much less digestible; and its nutritive value is greatly interfered with.

We now pass to the discussion.

## TUBERCULOSIS IN ALL ITS RELATIONS.

Prof. Burdon Sanderson said the subject which he had undertaken to bring before the notice of the conjoint Sections for discussion was one of the gravest importance, for there was no disease, acute or chronic, which was so productive of human suffering or so destructive of human life. In a Congress of Hygiene the subject of tuberculosis could only be considered in relation to its causes, the aim of hygiene being to prevent disease, not to cure it. He wished specially to direct attention to those questions 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? For the purpose of avoiding useless discussion on subjects on which there ought to be perfect agreement of opinion, he asked that certain fundamental propositions should be accepted 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; and also that it 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 were in a position to enter on the questions which require answers, some of which are pathological or etiological, the others practical or administrative. The etiological questions might be said to 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 were—

(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?

Of the two practical questions 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 again been 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.

In 1888, M. Arloing, following out the principles enunciated by another gifted pathologist, the late M. Toussaint, that tubercle is a disease *totius substantiæ corporis*, maintained that the time had come to act "conformant 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 one thousand 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 this reasoning were true, if we could measure the danger to the human consumer by the presence of tuberculosis among animals used for food irrespectively of other considerations, then M. Arloing was right in his practical deduction from it that whatever interests conflict with public health they must give way. It was our duty to insist on the right of science to dictate; but in doing so it was necessary to be careful not to do so until the question had been looked at from all sides and the whole evidence had been heard.

In some of these discussions it had not been sufficiently considered that the question was not whether the consumption of tuberculous meat was in itself attended with risk, but whether the presence of tuberculous diseases among ourselves was in any way due to the fact that we occasionally eat meat which contained bacilli. It was not sufficient to show that on the one hand there was a fearful mortality from tuberculous diseases, and that on the other there existed a cause to which this calamity might be attributed. It must also be shown that the effect was actually produced by the cause, in such sense that if the cause were removed we might hope that the effect would disappear.

Twenty-three years ago Chauveau fed three heifers with tuberculous material from the body of a cow and obtained positive results. At that time the idea that tuberculosis was a virulent disease was new. M. Villemin had made his great discovery, but it had not yet been accepted, and consequently Chauveau's results were severely criticized, and were the subject of much discussion, which extended over several years (1868-74), 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. Gerlach about the same time 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 many others. In 1884, Baumgarten showed that a couple of ounces of milk to which a pure culture of tubercle bacillus had been added were sufficient to produce characteristic tuberculosis in the intestines 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 stages of the process could be thoroughly investigated, the most important result being that after a period of latency of a fortnight, during which no traces of infection were visible, the lymphatic follicles of the mucous membrane and the mesenteric glands began to enlarge simultaneously without any change whatever in the intestinal epithelium.

It was thus shown with a precision which was not before obtainable that the initial phenomenon of tuberculosis was primarily a proliferation of the adenoid tissue of the lymphatic system, and that the bacillus was 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 had gained admission. Since 1884 our knowledge of the subject had been still further advanced by Cornil, under whose direction two very important researches, confirming and extending Baumgarten's results, have been recently published, from which it was evident 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.

Much, however, has still to be learned by the experimental method—information which could 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, however localized the disease may be, bacilli circulate in the blood, and are so universally distributed.

Prof. Sanderson believed that this was not true, and that we are not entitled to assume that the flesh of every tuberculous animal is infectious unless it be proved to be so. As against the probability of its being so, it must be noted that the tuberculosis of cattle, although the product of the same bacillus as the tuberculosis of man, is a disease of comparatively slow progress. It localizes itself in structures which are not essential to life, and nutrition might be so little interfered with that the animal could be readily fattened for the market. There was no doubt that the flesh of such animals might be to all appearances in good condition, and might be offered for sale as meat of prime quality, and as yet we have no evidence that it is infective.

Turning from the source of infection to its effects, from the bacillus to its field of disease and death-producing action, Prof. Sanderson said that tuberculous diseases contribute something like 14 per cent. to the total of deaths from all causes, and that during childhood, as distinguished from adult life on the one hand and from infancy on the other, 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.

There was evidence that under certain conditions the virus of tubercle was absorbed by the lymphatic system from the small intestine in man, and that when this happens it may give rise to lesions of the same nature as those produced in animals by the injection of liquids in which bacilli are suspended—that is, to lesions which originate in the lymphatic system. Tuberculous disease of the intestinal mucous membrane, although very common, never occurred in the adult and very rarely in infancy as a primary disease. In the adult it might occur as an ulterior consequence of pulmonary consumption, the way in which it occurred being very evident. In the advanced stages of that disease muco-purulent liquid was discharged in quantity from the softened parts. This material charged with virulent bacilli might infect the mucous membrane along which it passed so that it is easy to distinguish bronchi which lead from vomiceæ 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. No effect is produced in the œsophagus 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 incapable of devitalizing the bacillus of tubercle, arrests its development. In the alkaline contents of the small intestine a condition more favourable to its development was found, and from there it was absorbed, just as any other particle of similar size might be, by the lymphatic follicles. Tuberculous disease of the small intestine in the adult thus occurred. It was 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 extra uterine life, but after this there was good reason for supposing that the bacillus plays an important part as a cause of mortality.

To the pathologist the question of how latent tuberculosis of the lymphatic system or of bone originates, *i.e.* how the bacilli which produce them are introduced into the blood stream was one of great interest. Prof. Sanderson confessed it to be his belief that in a certain proportion of cases the cryptogenetic tuberculosis were due to causes which operate before birth. From Dr. Muller's Munich statistics it might be gathered 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 was no doubt affected subse-

quently on tuberculous disease of the lungs, but in the remainder the disease seemed to be primary. If it could be proved that such cases were primary, 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 had very little indeed to say in favour of the belief that human tuberculosis could owe 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.

The author held, therefore, that we are not as yet in a position to demand the interference of the State 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 he maintained that the consumption of tuberculous meat was attended with some danger, and that on that ground its consumption ought to be prevented by the State and avoided by the individual.

As regards the administrative question, he held that if we had, to-morrow, a law forbidding 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 was this. Everything must turn 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 might 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 was 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, and the former of these 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 might indicate danger to the consumer. This knowledge could only be acquired by experiments specially made for the purpose, and having been attained it could only be applied by technically trained persons. He illustrated the sort of skill required by comparing it to that possessed by the professional tea taster as regards the commercial value of tea. Why was the judgment of the expert reliable? Because he was responsible for it and was 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 same moment that this skill was required it would come into existence. What would be wanted in the inspector was not that he should be a pathologist or even a bacteriologist, but a trained expert; for although the rules unconsciously used by him might be based on scientific principles, it is not by these principles he is guided in each case, but by practical skill.

Dr. Sanderson then submitted the following propositions to the meeting of the combined Sections:—

(1) That tuberculosis must be added to the list of diseases regarded by the law as contagious. 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.

(2) 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 insuffi-

ciently 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 as regards the particular case that it would be infecting if administered to test animals.

(3) As regards the duty of the State in relation to the prevention of tuberculosis, what is immediately required is that an efficient system of skilled inspection should be created. This is desirable, not merely as a first step towards a 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," said Dr. Sanderson, "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 are probably infected by inhalation of the tubercle bacillus from the atmosphere, notwithstanding 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."

Dr. Bang, Lecturer in the Royal Veterinary College, Copenhagen, in a paper on "The Alleged Danger of consuming the apparently Healthy Meat and Milk of Tuberculous Animals," stated that the great majority of investigators are agreed that the essential source of tuberculosis in man is found in man himself; but almost all admit that he may contract the disease through the ingestion of milk derived from animals affected with tuberculosis.

It is always agreed that such a danger exists, but as to the extent of the danger there is little unanimity.

Of course, it might be said that there would be no danger if the use of meat and milk from the tuberculous animals were entirely interdicted; but it must not be ignored that the application of such a stringent measure would entail enormous loss from an economical point of view, especially in those countries where the disease has a very wide distribution amongst bovine animals. He looked upon the general application of the French regulations as out of the question, at least for the present, whilst such a course appeared on the whole to be unnecessary. As regards milk, the question of prophylaxis was comparatively easily settled if it was resolved that it should never be employed without first being boiled. But then the question comes to be, How can we protect ourselves against the products of milk?

The experiments made by Galtier, the author, Hum, and others have proved that the various products derived from milk, butter, cream cheese, cheese, and butter-milk may all contain tubercle bacilli, and that these retain their vitality in such products for a period of from fourteen to thirty days. It was true the majority of these bacilli may be separated from milk if the cream be removed by means of a centrifugal machine, as is generally done in Denmark, but if the milk is very rich in bacilli a few usually remain in the milk, and even in the cream. In order to do away with this danger it is necessary to expose the milk or the cream before churning to a temperature high enough to kill the tubercle bacilli (85° C. for about five minutes); a temperature of from 60° to 75° C., however, being quite sufficient to attenuate the organic virus, so far as to render it incapable of setting up infection of the alimentary canal. This method is coming more and more into use in Denmark, as by it several other sources of infection in the butter are also neutralized. As, however, many people object to the taste of boiled milk, it became an important question to determine whether the milk of phthisical cows is really a source of danger in the majority of cases. He had determined

that when the udder is affected with tuberculosis there are usually numerous bacilli in the milk, which is consequently extremely dangerous. But he also finds that mammary tuberculosis is not so common as was at one time supposed. At the *abattoir* of Copenhagen, for example, it has been found that only in 1 per cent. of tuberculous cattle was there disease of the udder. From twenty-eight tuberculous cows, in which, however, there was no disease of the udder, the milk was injected into forty-eight rabbits, and in only two was there any positive result. He then inoculated forty guinea-pigs with milk from twenty-one tuberculous cows, in this case with four positive results. Recently he had carried on a new series of experiments with the milk from fourteen extremely phthisical cows. In this series the milk was virulent in three cases, so that from sixty-three tuberculous cows the milk contained virulent tubercle bacilli in nine cases only. All these cows were affected in a very high degree, and it is probable that in some at any rate the udder was affected; though this could not be demonstrated in the living animal, as it was in three out of the four cases of the second series. Others were affected with milinary tuberculosis in the different organs, a condition which one rarely finds in an animal that is still giving milk, and in one case the supra-mammary lymphatic glands were affected with tuberculosis, although no lesions in the udder itself could be demonstrated.

In several of the positive cases the number of bacilli in the milk must have been very small, as one only of the two guinea-pigs experimented upon succumbed to the disease, this happening in three instances.

It should be added that the quantity of milk injected in the later series was larger than in the earlier series. In the two first series 1 to 3 c.c. was injected, in the third 5 to 10 c.c. He maintained that, although in many cases the milk from phthisical cows is not virulent when the mammary gland is unaffected, it is in a certain proportion of cases, and should always be looked upon with suspicion, and that it is absolutely necessary to take prophylactic measures against the use of such milk, although the danger should no doubt not be exaggerated.

*Meat.*—Flesh itself very seldom contains any tubercle. Nevertheless it had been proved by a number of experiments that the muscle juice may contain tubercle bacilli, but such cases, according to the observations of Chauveau, of Arloing, Peuch, Galtier, Nocard, Kastner, and others, are absolutely in a minority. Amongst seventy-three phthisical cows these observers have found only ten in which the muscle juice gave evidence of virulence on injection into rabbits or guinea-pigs, and sometimes the juice inoculated only produced the disease in one of several animals inoculated.

M. Nocard's experiments in this connection are very interesting. He found that when a culture very rich in bacilli was injected into the vein of the ear of a rabbit, the muscle juice of the animal was virulent only when it was killed within five days after the inoculation, from which he argued that the bacilli carried by the vessels to the muscles only preserve their vitality for five days. If to this experimental result be added the observation that tubercle is very seldom developed in the muscles, even during the development of a condition of general tuberculosis, it must be concluded that muscular tissue is a soil so unfavourable for the growth of tubercle bacilli that they are not able to multiply. The number of bacilli, then, that can be found in the flesh of tuberculous animals is always extremely limited. It is of course true, as M. Arloing has objected to M. Nocard's conclusions, that the circulatory system of a tuberculous animal can continually receive into it fresh bacilli, and therefore until within only a few minutes before the animal is slaughtered. But, on the other hand, it must not be forgotten that it is only in the case of the development of an acute milinary tuberculosis that one can suppose that the number of bacilli introduced into the vessels can be considerable. In ordinary cases in which the tubercular process is developed slowly the bacilli would without doubt escape into the blood in very small quantities, and the number of bacilli that could be found at any given moment in the meat would be very small. Moreover, the experiments carried out by Galtier, Gebhardt, and others, render it very probable that the number of bacilli introduced into the alimentary canal, by which infection does not readily occur, plays a not unimportant part in the result obtained.

Prof. Bang stated that he had recently completed a series of experiments on the virulence of the blood of cows in an advanced stage of tuberculosis. From twenty tuberculous cows he inoculated thirty-eight rabbits and two guinea-pigs with defibrinated blood,

injecting from 10 to 18 c.c. (in four cases only 5 to 9 c.c.). In eighteen cases the results were negative, in two positive, and one of these in which the lesion was small was one of two rabbits injected with blood from the same cow. The cow that supplied the blood with which the other positive result was obtained had developed acute milinary tuberculosis after an injection of tuberculin. Three weeks previously blood from the same cow had given negative results. Even amongst those cases in which the results were negative there were several cases of acute milinary tuberculosis.

He concluded from the foregoing that the seizure of all tuberculous animals is too stringent a measure. So long as the tuberculosis is strictly localized, the meat is not a source of danger; where the malady is generalized, the consumption of the meat may be dangerous, although it is not always so. The eating of uncooked meat should be discouraged, but the best means of avoiding danger to the health of man is to take all possible measures for preventing the propagation of tuberculosis amongst our domestic animals.

Prof. Arloing, of Lyons, contended that the question of transmissibility of tuberculosis from animals to man was one of very great importance, but he admitted that the *diagnose précoce* was very difficult. The danger to children of drinking milk from tuberculous cows was great, and he thought could scarcely be exaggerated. Moreover, he held very strongly that, except under certain special circumstances, the total condemnation of tuberculous meat was necessary, and on grounds of public health he dissented entirely from Dr. Bang's position.

The flesh of all tuberculous animals should be suspected as dangerous to health, the more so as meat was very often insufficiently cooked, the bacilli present under these conditions remaining pathogenic. From statistics he had gathered, he felt no doubt on this subject, and although it might be possible, by first carefully cooking under public supervision, to allow the flesh from animals in which the tuberculosis was localized to be sold, he still maintained his position that total confiscation of tuberculous meat was the safest method to be adopted. It was necessary, however, that in the first instance we should have a system of strict inspection, not only in our large towns, but also in all the smaller centres of population.

A paper was then given by Prof. M'Fadyean (Edinburgh) and Dr. Woodhead (London), on the transmission of tuberculosis from animals to man, by means of flesh and milk derived from tuberculous animals. They maintained that the evidence as to the transmission through the flesh or milk of tuberculous animals was very conflicting, apparently in great part because the methods used were different, and the conditions were not uniform. They had attempted to follow the line of infection of tuberculosis in a number of children, and had found that in 127 cases analyzed tubercle of the intestine was present in 43; 24 of these cases occurring between one and five and a half years; tubercle of the mesenteric glands was found in 100 cases, or in nearly 79 per cent. of the whole; here, again, 62 of these occurring between one and five and a half years; and of 14 cases in which the mesenteric glands were primarily affected—*i.e.* no trace of tubercle could be found in any other part of the body—9 were referred to the same period. It was noticeable that of these 100 cases only 20 were diagnosed during life as suffering from abdominal tubercle. From all that could be learned from these cases (and reference could be made to a large number of other sets of statistics practically proving the same point), it was evident that intestinal and mesenteric tubercle are most frequently met with in children during the period after they are weaned, at which time cow's milk has been substituted for mother's milk. The point of entrance appeared in these cases to be by the intestine. They had come to the conclusion that in some cases at least the tubercle bacilli had passed from the intestine into the mesenteric glands without leaving any trace of lesion to indicate their point of entrance. There could now be no doubt that tubercle bacilli were sometimes present in the milk from tuberculous cattle, especially where the udder was affected, and they had been able to obtain such bacilli embedded in the epithelium of the milk ducts, or lying free in the ducts after the death of the animal. They concluded that wherever the presence of a tuberculous condition of the udder could be demonstrated clinically it would be little less than criminal to give the milk to delicate children, or even to children suffering from any catarrhal derangement of the intestine, a condition that is specially frequent amongst the

poor classes, where the standard of health is exceedingly low and the liability to catarrhal conditions very great. From a series of inoculations with tuberculous udder, and with milk from tuberculous udders, 14 out of 19, or over 70 per cent., had given positive results; with non-tuberculous udders, and with milk from otherwise tuberculous cows, only 2 cases out of 13, or a little under 16 per cent., gave positive results. Where the failure to produce tuberculosis occurred in the first series, the number of bacilli was invariably small, and inoculations were usually into the subcutaneous tissue, though negative results were also obtained when other methods of infection were employed. They thought that in relation to the danger of taking tuberculous milk by the human subject, the site of the infection, and the relation of the number of bacilli introduced, played an important part in determining the severity and rapidity of the course of the disease, and they stated that their experience accorded with that of other observers, that inoculation into the peritoneal cavity is much more certain than inoculation into the subcutaneous tissue, especially where the number of bacilli introduced is comparatively small. They are also led to believe, from a number of feeding experiments, that the production of tuberculosis through the introduction of bacilli into the alimentary canal is of still less frequent occurrence than when inoculation is made into the connective tissue. As regards the possibility of the flesh of tuberculous animals setting up tuberculosis, (a) when introduced *en masse*, (b) when expressed juice only was exhibited, their experiments went to prove that the juice only did not in most cases contain a sufficient number of bacilli to set up tubercle, even when inoculated into small rodents, but from the fact that they have observed tubercular masses in the muscles of the buttock of tuberculous cattle, it must be accepted that tubercle bacilli may sometimes, though perhaps rarely, be present in considerable numbers in this position. Of three cows slaughtered in one day at one slaughter-house, well-defined tubercle was found in the muscles of the buttock of two animals; in one of these there was tuberculosis in every organ and part of the body; in the other there were only a few nodules and in some of the glands; there was certainly no pleural or peritoneal tubercle, and all the other organs were unaffected. They concluded that there was great necessity for a thorough inspection of both dairy cattle and of animals that were slaughtered for food purposes, but it might be accepted that the danger of contracting tubercle from milk was greater than that of contracting it from meat, and that only in a certain proportion of cattle affected with tuberculosis did there seem to be any danger to be anticipated from the ingestion of the flesh. In the main they agreed with Prof. Burdon Sanderson and Dr. Bang that there was not yet sufficient evidence on which to decide that the total seizure of meat from tuberculous animals should be resorted to.

Prof. Hamilton, of Aberdeen, said that there were two principal channels of infection, (1) the gastro-intestinal tract, (2) the lungs; but in addition to these we had what might be spoken of as localized tubercle, which seemed to be shut off entirely from all communication with the external world. (1) In the body the affection might take place by the air channels, as in the case of tubercular pneumonia, where the virus was probably inhaled and the air vesicles were the primary seat of infection. (2) By the blood vessels, as in cases of eruption of miliary tuberculosis. (3) By the lymphatic vessels, as in the more chronic forms of tuberculosis. In the gastro-intestinal canal a tubercular lesion might accompany an ordinary phthisis; it was often seen in children as a primary condition, and he should not be inclined to agree with Dr. Burdon Sanderson that it was not also primary in adults, as he himself had seen several cases, one quite recently. Previous catarrh was not always met with in the lung, but it was certainly a predisposing cause of tubercle, as it interfered with the protective epithelial covering. When tubercle followed whooping-cough, measles, and so on, it was probably the result of the spread of infection from pre-existing caseous spots, or it might be that the glands, weakened by the disease, fell an easy prey to the tubercle bacillus. He could not understand the comparative immunity from tubercle enjoyed by the pericardium and the stomach.

Prof. Nocard, of Paris, did not think that sufficient proof had as yet been accumulated that ingestion of tuberculous meat could give rise to tuberculosis in any large proportion of cases; the greater number of experimental cases had given negative results, and he should, to convince himself, require to see more

positive results obtained in which all possible sources of failure could be eliminated. Whilst saying this, he must admit that in the case of children tuberculous material, whether in meat or milk, would always prove a very important source of danger. He would draw attention to the disease as it occurred in cats, on which animals he had made many experiments.

Dr. Hime, of Bradford, was glad to find that our foreign friends, who are not hampered as we are in making experiments, agree with us in the main. He thought that we were likely to run wild on the subject of the total seizure of tubercular meat, and he would point out that in no country does a total seizure law exist such as it is proposed to adopt here in England. In England he would point out that the inspection is worse than in any other country. He referred to Prof. Lingard's experiments given in an official report, which, he pointed out, spoke only of tubercle being transmitted by caseous material, and not by meat from a tuberculous cow, as was usually assumed. We had the authority of Koch himself, said Dr. Hime, that there is danger only when tubercular material itself is ingested. Infection by milk he looked upon as proved, but he would also insist very strongly that the majority of infection in cases of phthisis was directly between man and man, and it was far more important that we should eliminate possible sources of contagion between human subjects than that we should pay so much attention to the minor possibilities of infection from animals to man.

Dr. Barlow (London), speaking from a clinical point of view, was scarcely able to indorse the results of experimental researches, and he maintained that as regards tuberculosis in children we must for the present keep our minds open. There was no doubt that the *post-mortem*s in children's hospitals gave evidence of the enormous frequency of tuberculosis, but the evidence that such disease was the result of the ingestion of milk and meat was comparatively slight. Other sanitary precautions, which he looked upon as of primary importance, must not be lost sight of in our discussion of the subject. He would, however, enter a protest against the use of the raw meat juice in the case of delicate children, as from what we had heard it was evident that such aliment might prove a source of considerable danger.

Prof. Perroncito, of Turin, referred to a number of experiments that he had carried out with meat, milk, and the products of the latter, and then pointed out that spontaneous tubercle very rarely occurred in the pig, though it might frequently be met with as the result of infection. The same might be said of sheep. Here, also, it might occur, though rarely, as the result of direct infection.

Prof. Burdon Sanderson, in reply, said he was pleased to find that the difference of opinion amongst so many authorities was so slight. It was evident that all were agreed that inspection was necessary, and there was also a general consensus of opinion as regards the difficulty of diagnosis. He was glad to find that although M. Arloing still retained his opinion as to the necessity for total seizure, except under very well-defined conditions, he had so far given way as to acknowledge that such meat might after careful cooking be retailed under special restrictions. In order that something definite might come out of this discussion, he proposed that it be minuted that "the etiology of tubercular disease of early infancy (between three months and five years)" be referred for discussion at the next Congress.

This was seconded by Dr. Septimus Gibbon, and was carried unanimously.

The President said that he had been greatly interested in the discussion, and he hoped that much good should arise therefrom. He was glad to find that there were some animals, such as the sheep and pig, in which spontaneous tubercle was never met with, and he hoped that we might eat these in safety. Sheep especially appeared to have a great immunity as regards tubercle, but pigs were not so safe, as they were apparently frequently the subject of tuberculosis.

Dr. Metschnikoff and Dr. Roux gave a joint paper on the changes that took place in the tissues around tubercle bacilli. It was read by the former, who illustrated his remarks by means of drawings on the black-board, and by microscopic specimens. They indicated the difference in the reaction of our tissues to the tubercle bacilli when the disease is going to run a favourable course, and when the animal is about to succumb rapidly to the disease. The process of recovery was indicated by the presence of concentric rings of hard and inflammatory tissue around the bacilli, which eventually lead to their absorption, the inflammatory tissue itself finally undergoing a process of calcification.

Prof. Ehrlich proceeded to give Koch's present views regarding tuberculin. He said that the results that had been obtained were exceedingly favourable, and most of those who had failed to obtain equally good results had failed because they had used too large doses of the remedy. The principle of cure rested in the local effects which tuberculin exercises on the specifically affected tissues; the inflammatory reaction passing to necrosis was neither desirable nor necessary, but, on the other hand, slight and even repeated stimuli would so act as to give rise to cicatrization of the tuberculous centres, so that the essence of this method of treatment was to retain as long as possible the specific excitation of the tissues, and not to do away with this, as was the case where large doses were used. Wherever successful results had been obtained they had all been by the use of repeated minute doses of tuberculin, which were only very gradually increased in strength, and it should be specially noted that the pathological signs found as the result of the action of tuberculin were always produced by large doses.

Prof. Cornil, Dr. Bardach, Dr. Ponfinck, and Prof. Hueppe were agreed that tuberculin was an heroic and dangerous remedy about which we as yet knew little, and which was therefore to be looked upon as still being experimented with. It also seemed to be the general opinion that where it was in use there existed a danger of setting up generalization of a tuberculosis that had hitherto been localized.

Dr. Hunter gave the results of his own experiments (described in the *British Medical Journal*), from which he had been able to show the nature of the active principle of tuberculin. He had succeeded in isolating principles quite different from those mentioned by Koch, or even reported by Dr. Ehrlich that morning as having been obtained by Koch. They were three—(1) those which produced fever, but set up no local reaction; (2) those which gave a local reaction, but no fever; and (3) those which set up neither fever nor local reaction, which had a distinctly remedial effect.

The President, summing up, hoped that in time we should all be able to obtain the wonderfully satisfactory results that had been so fully described by Prof. Ehrlich on Dr. Koch's behalf.

#### LETTERS TO THE EDITOR.

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##### Rain-gauges.

I DO not think that valuable space in your columns should be occupied by rediscussing old questions. I do not wish to say a word in any respect discourteous to Mr. Fletcher, whose ability in other subjects has, I understand, been already recognized, but it really would have been better had he read up the subject before writing the remarkable letter which appears in NATURE of the 20th inst. (p. 371).

For experimental work, spherical, conical, inclined, horizontal, vertical, and tipping funnels have been used; but until the soil of the British Isles can be made to tilt in altitude and rotate in azimuth, so as to meet the path of falling rain, I think that we must adhere to gauges with horizontal mouths as the best representatives of the surface of the earth.

G. J. SYMONS.

British Association Reception Room, Cardiff, August 21.

##### Cloud Heights—Kinematic Method.

IN NATURE of April 16 (p. 563), and possibly elsewhere, I am made to speak of the method of determining the heights of clouds at sea used by Finemann and myself as the "aberration method." This was a misnomer that I supposed had been corrected. The more proper term is the "kinematic method," since in it we discuss the apparent motions of the clouds considered as the resultant of the true motions of the cloud and the observer. This is the term that I have used since May 1890, and would commend to others.

CLEVELAND ABBE.

Weather Bureau, Department of Agriculture,  
Washington, August 8.

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#### THE BRITISH ASSOCIATION.

THE Cardiff meeting, if it was not made remarkable by any incident of very special importance, was, upon the whole, successful. Several of the addresses delivered by the Presidents of Sections were of exceptional interest, but some were very long, and we shall not be able to print all of them.

At the first meeting of the General Committee, held on Wednesday, August 19, the report of the Council for 1890-91 was read by Sir Douglas Galton. Dr. Gladstone moved a vote of thanks to Prof. Williamson for his long and valuable services as general treasurer, paying a tribute to the manner in which that gentleman had fulfilled his duties. Sir Douglas Galton seconded, and the resolution was cordially agreed to. Mr. Vernon Harcourt moved, and Sir J. Douglass seconded, the appointment of Prof. Arthur Rücker as general treasurer. This motion was also agreed to. At the meeting of the General Committee on Monday, a deputation from Nottingham was introduced. The Association was invited by the Mayor and town authorities to visit Nottingham in 1893. It was stated that it was twenty-five years since the Association had visited Nottingham. The invitation was accepted on the motion of Mr. Preece. It was also unanimously agreed, on the motion of Canon Tristram, to elect Sir A. Geikie as President of the Association, which meets at Edinburgh next year. The Lord Provost of Edinburgh, the Marquis of Lothian, the Earl of Rosebery, Lord Kingsburgh, Principal Sir William Muir, Prof. Sir Douglas MacLagan, Sir William Turner, Prof. Taft, and Prof. Crum Brown were elected Vice-Presidents for the Edinburgh meeting. Prof. G. F. Armstrong, Principal F. Grant O'gilvie, and Mr. John Harrison were elected Local Secretaries for the meeting at Edinburgh, and Mr. A. Gillies Smith Local Treasurer. A deputation from Edinburgh also attended with reference to the fixing of a date for the Edinburgh meeting. It was stated on behalf of the Town Council that September 28 was favoured as the opening date of the meeting, though August 3 and September 21 were also mentioned as alternative dates. A motion was made to fix August 3, while an amendment was moved for September 12; but as only thirteen voted for the amendment, the original motion was agreed to—that is, the Association will meet at Edinburgh next year on August 3. The general officers were re-elected, and the following gentlemen were elected Members of Council for the ensuing year: Dr. W. Anderson, Prof. Ayrton, Sir B. Baker, Mr. H. W. Bates, Prof. Darwin, Sir J. N. Douglass, Prof. Edgeworth, Dr. J. Evans, Prof. Fitzgerald, Sir Archibald Geikie, Mr. R. T. Glazebrook, Profs. J. W. Judd, Liveing, Lodge, Mr. W. H. Preece, Profs. W. Ramsay, Reinold, Roberts-Austen, Schäfer, Schuster, Sidgwick, Mr. G. J. Symons, Profs. T. E. Thorpe, Marshall Ward, Mr. W. Whitaker, Dr. H. Woodward. The following impressions have been recorded by a correspondent:—

CARDIFF, Tuesday Evening.

One of the most prominent features of the Cardiff meeting has undoubtedly been the prevailing bad weather. Rain and cold have had their usual depressing results, and may to some extent account for the disappointment which exists among many of those in attendance. The Local Committee have done their best to render the meeting a social success, but the entertainments by the Municipality and the citizens of Cardiff have been of a somewhat restricted character. Notwithstanding the unpromising state of the weather, the excursions on Saturday and Sunday were largely taken advantage of, and the reception given by Lord Windsor on the latter day was specially appreciated. The total attendance has been about 1500, within 200 of the Leeds meeting, while the amount of money available for grants is within a few pounds of last year. Naturally there has