

An Address

ON THE TRANSFERENCE OF BOVINE TUBERCULOSIS TO MAN.

Given at the International Conference on Tuberculosis in Berlin.

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[We are indebted to Dr. R. Koch for a copy of the text of the address which he delivered in the course of the discussion on this subject opened by Dr. Kohler at the International Conference on Tuberculosis in Berlin on October 25th.

The following translation of this address will, it is believed, be read with interest:]

In the following communication I shall keep strictly to the subject appointed for discussion, "the transference of bovine tuberculosis to man," and not follow the example of most of the preceding speakers who have occupied themselves with the reverse question, the transference of human tuberculosis to cattle. It would lead me too far if I debated this question here also, but I reserve to myself the right of entering more fully into it in a short time, when I publish my further investigations on human and cattle tuberculosis.

On the whole I completely agree with what the Chairman has said. I too have been specially struck by the fact that the statistics of primary intestinal tuberculosis collected up to now are somewhat uncertain, and too much affected by contradictions to be turned to good account as evidence to determine the point at issue.

This form of tuberculosis is said to be specially frequent in England, according to the accounts of Woodhead,¹ Still,² and Shennan.³ But English returns are not wanting according to which primary intestinal tuberculosis in this country is said to occur less frequently (according to Carr⁴ only five times in 53 tuberculous children under 2) or even very seldom.⁵

In America out of 369 children in New York, 5 (1.4 per cent.) were found with primary intestinal tuberculosis according to Bovaird.⁶ In Boston, on the contrary, according to Councilman,⁷ there were 37.1 per cent.

In Germany, as far as I have been able to find statements on the subject in literature, and as far as my personal inquiries have reached, all authors have expressed the opinion that primary intestinal tuberculosis is with us a very rare occurrence. The only exception to this is at Kiel, where Heller has found 37.8 per cent. of primary intestinal tuberculosis at necropsies of tuberculous children.

I can contribute the following facts to the critical examination of these circumstances. A year and a quarter ago the Board of Education issued invitations at my request to the heads of the university clinics in Prussia to render accessible to me such cases of primary intestinal tuberculosis as have incurred the disease ostensibly through the use of the milk of cows suffering from *Perlsucht*. The same invitation was issued eight months ago to the directors of the Institute of Pathological Anatomy of the Prussian Universities with regard to cases of primary tuberculosis of the intestines, the mesenteric glands, and the peritoneum, so far as the onset of the illness might be traced to the use of food affected with *Perlsucht*, from the histories of the disease or special facts ascertained. Herr Heller in Kiel received a special invitation of this kind.

But up to now only a single announcement has reached me either from the hospitals or from the Institute of Pathological Anatomy, so I think I must conclude that within this time at the Prussian Universities no case of primary intestinal tuberculosis has come under observation which can be referred to the use of food affected with *Perlsucht*. Still, before this decree Virchow placed at my disposal a case of primary intestinal tuberculosis, in reference to which he expressly noted that cases of the kind did not often occur—perhaps three or four times a year—at his institute. Perchance this is the same case—as I note, by the way—which Herr M. Wolff has reported on in the course of the discussion. He stated that he had produced *Perlsucht* in a cow with tuberculous

material which he had obtained from it. In my investigation of this case I have arrived at an exactly opposite result, for the pure culture of tubercle bacilli obtained from it showed itself quite non-virulent for cattle. I cannot enter here on the reasons why Herr M. Wolff and I arrived at such contradictory results. I must reserve the discussion of these for another occasion.

The striking contradictions already mentioned in the statistical data of primary intestinal tuberculosis must naturally depend on some such circumstances. Local differences do not appear to lie at the root of the matter; at least, I have been able to make out nothing of the kind with regard to Kiel and the rest of Germany. There remains, then, scarcely anything else in which to seek the explanation but the uncertainty of subjective opinion as to what is understood by primary intestinal tuberculosis, so that many still apply this description to cases which others will not allow to pass as such. But we shall scarcely arrive at facts for consideration acknowledged on all hands as reliable till we have striven after agreement on this point.

Less full of contradictions are the assertions concerning observations of skin infection in veterinary surgeons, butchers and slaughter-house employes related by the Chairman. There already exist a fair number of communications as to occurrences of the kind. I have myself had many opportunities of examining such cases.

They all have this in common, that after a wound on the hands or arms which has occurred while cutting up an animal affected with *Perlsucht*, wart-like formations—the so-called tuberculosis verrucosa cutis—develop. If the wound extends to a tendon it may in rare cases become a tuberculous inflammation of the tendon sheath. In isolated cases the process seems to have attacked the nearest lymphatic glands as well, but to a very slight extent. In the remaining cases the disease remains localized, does not lead to a tuberculosis of internal organs, and runs its course as an insignificant skin malady which often gets well of itself as slaughter-house employes have assured me.

Up till now it has only in one case ever been held to lead to a general infection. This is the case recorded by Pfeiffer of a veterinary surgeon in whom tuberculosis of the lungs developed fifteen months after a wound of the finger, leading to death in the following eighteen months. At the necropsy, however, the axillary glands proved to be free from tuberculosis, and we must conclude from this that no connexion existed between the wound of the finger and the tuberculous infiltration of the lungs. The question was only one of a casual coincidence between the *Perlsucht* infection—if it existed at all, and even this is not proved—which remained local, and an infection of the lungs from another quarter. Bearing in mind the extraordinary frequency of primary tuberculosis of the lungs, a coincidence such as this with tuberculosis verrucosa cutis must occur incidentally now and then.

A new case of the same kind almost insinuated itself into the literature of the subject a short time ago. A veterinary surgeon in Berlin is said to have injured his index finger at the necropsy of a cow infected with *Perlsucht*, to have become phthisical in consequence of this, and to have died of haemoptysis. Inquiries instituted at once elicited that the man in question came of a tuberculous family, and before wounding his finger showed undoubted signs of tuberculosis of the lungs.

Again, a case communicated by Hartzell⁸ cannot even stand the mildest criticism. A labourer had received a wound on the back of his hand while repairing a cattle truck. Warts subsequently developed, and he died a year later of tuberculosis of the lungs. Every proof of connexion between the two affections is wanting here. It is not even stated whether a necropsy was made. Still more insufficient is the statement contained in the same work by Ravenel that the death of Mr. W., of the Royal Veterinary College of Edinburgh, was attributed to an infection which he contracted at the necropsy of a cow infected with *Perlsucht*.

With the best will in the world there is no doing anything with such defective information towards clearing up the question considered here. It is better to leave it on one side and look out for really conclusive observations.

Baumgarten's communication concerning the cancer patients

inoculated at Königsberg with virulent *Perlsucht* bacilli, I consider, on the contrary, very important. It is a question of an experiment under trustworthy observation in all its bearings and throughout its whole course; and since it is recognized as proved that no antagonism exists between cancer and tubercle, the negative result of this investigation only points to the fact that the *Perlsucht* culture in question possessed no virulence for man in subcutaneous injections.

In all investigations which aim at solving the question of the transference of bovine tuberculosis to man through statistics of primary intestinal tuberculosis and observations on skin infection in man, we must be clear that the evidence with which we have to deal is always indirect. For of the cases on which statistics are based we know that in the most favourable event they are genuine cases of primary intestinal tuberculosis, but not whether they really depend on *Perlsucht* infection, and not far more on human tuberculosis, with which, on account of its extraordinary frequency, we have to reckon in every single case.

Even the occurrence of a *Perlsucht* infection, which remains local, as a result of a skin wound, does not in any way prove that *Perlsucht* bacilli are also in a position to infect the uninjured intestinal mucous membrane, or if they are able to pass through it without leaving any traces behind; that they render the mesenteric glands tuberculous, and from thence bring about a general infection of the body with its well known and justly feared consequences.

On the other hand, we cannot but expect that if tuberculous infection through partaking of meat and milk infected with *Perlsucht* really occurs as frequently as is asserted, direct observation must make this obvious.

This side of the question has, in my opinion, been much too little regarded up to the present, and it is very necessary that we should turn our attention once again in this direction. Analogous considerations are not wanting in this connexion. There are several other infectious diseases which are conveyed to man by feeding on meat and milk, and their behaviour may be very instructive to us in relation to tuberculosis.

I recollect in this connexion the so-called cases of meat poisoning which have been largely caused by a typhoid-like bacillus, and also the illnesses resulting from the use of the flesh of animals which had suffered from splenic fever. Milk, too, may contain typhoid bacilli, as has been so frequently observed in recent times, and these give rise to an outbreak of enteric.

It is extraordinarily characteristic of all these outbreaks that they do not occur as isolated illnesses, but in groups and often in epidemics. This could scarcely be otherwise for the milk of a cow, the flesh of a sick animal is practically always partaken of by several, and often by a great many people at the same time, who will be infected and fall ill, certainly not as a whole, but on a larger or smaller percentage.

Not only is attention directed to the infection which has taken place, and to its common cause, by the number of cases of illness of the same kind, but incontestable evidence arises thus that the food in question must have contained the infectious material. Under such conditions no statistics and no experiments on animals are required; the observation itself yields us direct proof of the occurrence of the illness from the use of infected food.

A tuberculous infection must also take shape in the same way if tubercle bacilli which are virulent for man are found in meat or milk. Here, too, a certain percentage of people who have taken the infected food must fall ill, and a group of illnesses must occur.

Of course the circumstances will differ to some extent in the case of tubercle and that of typhoid; for, owing to the much longer incubation period of tuberculosis, the illnesses will not arise so soon after infection or be comprised within so short a space of time. But, on the other hand, tuberculous infection is favoured by the fact that the ingestion of tubercle bacilli is repeated many times, and extended over a long period among those people who are given to the use of food infected with *Perlsucht*, so that the probability of the outbreak of infection must be essentially raised.

Everything, then, combines to show that tubercle also—as a fact it can be produced by the flesh and milk of animals suffering from *Perlsucht*—must occur in groups, and it is only

a question whether this has not for a long time been observed and described.

[B. Fraenkel has since drawn my attention to the fact that he expressed a similar opinion in his work on tuberculosis in the *Gerhardt Manual of Diseases of Children* before the discovery of the tubercle bacillus. He at that time maintained the opinion that tuberculosis could not be conveyed by the milk of cows suffering from *Perlsucht*, and gave as his reason, that he had never observed that several children in one family suffered at the same time from tuberculosis, which would necessarily be the case if the common milk-can furnished the cause.]⁹

Let us next examine the literature of the subject for communications concerning illnesses following the ingestion of meat infected with *Perlsucht*.

But I should like to draw attention beforehand to the fact that probably not only meat free from tubercle and certainly boiled or well roasted, is eaten as is usually supposed. On the contrary, an expert on meat inspection, Ostertag,¹⁰ says of this: "Day by day an uncounted number of tuberculous organs come into the market and are consumed." They are mostly made into sausages. Only a short time ago I had to express an opinion as an expert witness in legal proceedings about a case in which meat, infested with *Perlsucht*, which had been delivered without his knowledge at the business house of a court meat purveyor, was only by chance prevented from being made into sausages. Although, then, no doubt can exist that a short time ago, from deficient meat inspection, much meat infected with *Perlsucht* reached the market and was often enough eaten, yet in the whole literature of the subject not a single observation of groups of illness or epidemics, in consequence of the ingestion of meat infested with *Perlsucht* can be found. But still more, not even once is an isolated case of illness described, and reports on damage to health from meat infected with *Perlsucht* are equally wanting.

On the contrary, facts are recorded by several authors which prove the opposite. According to Bollinger,¹¹ a collective investigation instituted by the order of the Bavarian Government yielded a number of isolated observations which speak for the harmlessness of the flesh of tuberculous animals. Many families, even whole villages, were found which consumed tuberculous meat as a matter of course without tuberculosis occurring more frequently among them than elsewhere. Göring¹² and Schottelius¹³ have had quite similar experiences.

In consequence of this a very lenient opinion prevails with regard to the danger of meat infected by *Perlsucht*. At the Congress on Tuberculosis in Paris in 1885 and 1891 the complete exclusion of the flesh of tuberculous animals as a class was decided on. But at the Congresses of 1893 and 1898 a more rational opinion was arrived at, and the sale of the flesh of animals in which tuberculosis was only local was considered permissible. At the Seventh International Congress on Hygiene in London the complete exclusion of tuberculous meat was unanimously set aside. Ostertag, an energetic champion of the identity of bovine and human tuberculosis, says, in his handbook of meat inspection (1899): "In face of the rare occurrence of primary intestinal tuberculosis in man and the wide dissemination of bovine tuberculosis, only a very slight risk to the health of mankind can be empirically attributed to the flesh of these animals."

The same standpoint is taken by the highest authorities in Prussia. From a circular decree from the Ministers of the Interior, of Agriculture, of Medical Affairs, and of Commerce and Trade, dated March 26th, 1892, I quote the following:

Since attempts on a large scale and carried on for some years at the Berlin Veterinary College and several Prussian universities to produce tuberculosis in animals by feeding them on the flesh of other animals affected with *Perlsucht* have given an essentially negative result (opinions of the scientific deputation for the Faculty of Medicine from December 1st, 1886), the transference of tuberculosis from the use of meat which is even infected with tubercles is not proven, and the flesh of well-nourished beasts cannot be considered as a rule less valuable, even if (tuberculous) illness exists, nor can its sale be placed under special police supervision.

From all this we gather that proof of the danger of meat infected with *Perlsucht* is completely wanting; it is, as the Ministerial decree expresses it, "not proven."

But no one will contest that the *Perlsucht* bacilli in meat are identical with those occurring in milk, and an insoluble contradiction exists in the fact that far stricter views have

prevailed recently against the milk of tuberculous beasts than against tuberculous meat.

Now, how goes it with regard to the direct proof of the danger of the milk of animals suffering from *Perlsucht*? *Perlsucht* bacilli contained in milk also come into the market to a considerable extent, and are taken in a living condition much more frequently than is usually accepted. Next, it should be observed that 1 to 2 per cent. of all milch cows suffer from tuberculosis of the udder, and without exception yield milk containing more or fewer bacilli. But tuberculosis of the udder is not of such a character that it can be recognized as such from its earliest onset. If one watches the disease and allows a tolerably certain diagnosis to become possible, it will have existed for weeks and even months, and all this time the milk with its *Perlsucht* bacilli will have been drunk. Such milk will scarcely ever be used by a single individual. As a rule it will be mixed with the milk of several other animals from the same byre and be ingested by a still larger number of people. If the milk reaches a central dairy it may be divided amongst hundreds of consumers.

In regard to the last event, I cannot share the view of Nocard, that milk may become less infectious from dilution and the *Perlsucht* bacilli finally quite inert. If it were a question of a poison in solution this assumption would be justifiable. But here we have to do with micro-organisms which can only be separated, not diluted, but then come into contact with all the more people, and—if they are virulent, for them—become all the more dangerous.

Now people usually rely on the fact that *Perlsucht* bacilli are killed by boiling the milk, but in this respect they make a great mistake. To be sure, if in a laboratory experiment milk is brought to boiling point, all the *Perlsucht* bacilli are destroyed. But in the household method of boiling milk they remain alive. Professor Beck¹⁴ has, at my instigation, instituted numerous and important investigations on this point at the Institute for Infectious Diseases, and has found that tubercle bacilli are not killed by a single, short boiling up of milk in wide-mouthed vessels—the treatment milk usually receives in a household. To attain this object, uniform boiling for several minutes is necessary, and this the housewife will not condescend to do because the milk easily boils over or gets burnt. If, therefore, any one asserts that he imbibes no living *Perlsucht* bacilli because he only drinks boiled milk he has still to produce evidence that the milk taken by him is always kept boiling for several minutes.

Again, one cannot absolutely rely on the sterilizing apparatus used in the larger dairies. As long as it is used according to regulations and carefully superintended, most apparatus of this kind may certainly fulfil its object, but as soon as the necessary care is once temporarily wanting, the infectious material perchance present slips uninjured through it, as the numerous typhoid epidemics which have originated from such dairies show.

One other point I might draw attention to, one which almost always remains unnoticed in discussions on milk infected with *Perlsucht*. We are not only concerned with the milk, but also with the products which are made from it, especially with butter, which evidently very frequently contains living *Perlsucht* bacilli. It has frequently happened to me that persons who vehemently protest that they have only used boiled milk for years because of the danger of *Perlsucht*, when asked what they did about the butter, confessed that it had never entered their heads, that in the natural order of things this should be sterilized too.

Under such circumstances I believe I am justified in asserting that certainly almost every one in the course of his life has more or less often, and in considerable numbers, ingested living *Perlsucht* bacilli. If *Perlsucht* bacilli are really dangerous to man we might logically expect that instances have been very frequently observed and described of injury to health which have been unquestionably caused by milk infected with *Perlsucht*. I have looked at the literature bearing on the subject, and believe I can assert that nothing essential has escaped me. Instead of the countless cases on which we ought to reckon I have been able to find among them all only two groups of illnesses and 28 isolated cases of illness, and we must, moreover, consider whether as pieces of evidence they are really free from objection.

Thus the next thing to discuss is the celebrated and con-

stantly quoted case of Ollivier which he communicated to the Académie de Médecine on February 24th, 1891. In a girls' school in the course of a few years 13 pupils sickened with tuberculosis, 6 of whom died. In several cases the intestinal canal seemed the starting point. When the cause was sought it appeared that a cow which had been kept for some years in the establishment of the school suffered from tuberculosis of the udder, and that the milk had been drunk by the boarders. This indeed looked just as if a group of illnesses had occurred in consequence of the use of milk infected with *Perlsucht*, and that here a case of *Perlsucht* infection was found which was free from objection. Ollivier was of this opinion, and so have been all those who up to the present time have turned this case to good account as a classical example of infection through milk containing *Perlsucht* bacilli. Yet the case is by no means so free from objection as has been maintained, for, apart from the consideration that apparently only one necropsy was made, and that the diagnosis of alleged intestinal tuberculosis is somewhat uncertain, people have contented themselves with excluding heredity as a cause from another quarter which comes under consideration. A direct infection from one person to another has not been publicly brought under consideration at all, and yet the course of this little epidemic of tuberculosis would have been exactly the same if one of the boarders or a pupil had suffered from tuberculosis of the lungs, and infected a number of her companions through the sputum. Something of the kind has often occurred, and its possibility would have to be considered among all the circumstances. But, even apart from this consideration, the alleged classical case vanishes away, and even proves the reverse, as the result of a second communication by Ollivier, which he found himself obliged to make at the next session of the Academy, in consequence of better information. He actually had to declare that he was mistaken; that the milk from the cow in question was not drunk by the boarders, but by the teaching staff and the domestic servants of the establishment. Among those persons who had regularly partaken of the suspected milk not a single case of tuberculosis had occurred.

If, in spite of this correction, Ollivier's case is still used by defenders of the identity of human and bovine tuberculosis as a proof, they show in what a one-sided and uncritical way they go to work to procure their evidence.

I come now to the second example of a group of illnesses. This was published by Huls in the *Münchener medizinische Wochenschrift* a few months ago. In a miller's family of nine persons who are alleged to have fed for years on the milk, butter, and meat of tuberculous animals, and in other respects are said to have had no opportunity of infection, seven members died of consumption. In this case we need only pay attention to the succession of the fatal cases to see at once that the connexion is quite different from the one accepted by Huls. First the mother sickened but recovered again after some months. In the following year the youngest child sickened and died. In the same year a son, aged 18 years, became ill and died. A year later followed a son, aged 23 years. In the next year the mother got ill again and died; then followed a girl of 16, then the father, and, lastly, a third son. That, among the relations of the illness to the family here indicated, contiguity, the dwelling together of the sick and healthy, and so the transference from one to another should be excluded, is to me incredible. Every expert in infectious diseases will be convinced without any further evidence that there was in this case a continuous chain of contact infections and not a group of illnesses arising from infected food. In order to be able to accept the last as the origin the illnesses must have ensued in the course of six months or a year at least; they could not, as was the case here, be protracted over a series of years. So this case of a group of illnesses also comes to nothing, and there only remain the 28 cases of isolated illnesses.

These do not merit any great confidence in and for themselves. Should we allow a single typhoid case, in which the use of suspected milk could be proved, to pass without further investigation? We certainly should not. Notwithstanding, I neither can nor will contest the possibility that single cases may occur. But in order to be convincing they must fulfil certain conditions. These conditions are as follows:

(1) Certain proof of tubercle in general, and, where possible

the primary focus must be supplied. In adults we must, therefore, require the existence of unassailable clinical symptoms, and a necropsy when these are not present. In children the clinical symptoms are much too uncertain, and so a necropsy is always requisite with them.

(2) Other sources of infection must be excluded with certainty. The assurance that the person in question comes of a healthy family is under no circumstances sufficient. There are numerous other possibilities of infection either inside or outside the family which come up for consideration. In this connexion I can only agree with the Chairman who has drawn attention to the researches of Preisich and Schutz, and of Dieudonné on the occurrence of tubercle bacilli round the nails of children, and thus to a source of infection in children well worthy of heed.

(3) In each case of alleged infection from milk affected with *Perlsucht* the condition of the rest of the people who have taken the same milk should be borne in mind. These fellow-consumers form to a certain extent a control experiment, and if of the numerous people who have drunk the suspected milk only a single one sickens, this weighs decidedly against the belief that this one person was infected by the common food. With enteric, too, if only one of all the people who had drunk the same milk contracted typhoid, we should on this ground alone immediately relinquish the suspicion that it could depend on a milk infection.

(4) The source of the milk should be attended to. Since in recent years it has become more and more evident that milk containing tubercle bacilli is yielded only by such cows as suffer from tuberculosis of the udders, the general statement that some one has drunk milk from a cow suffering from *Perlsucht* no longer suffices to prove to us that *Perlsucht* bacilli have really reached his digestive organs. A man can certainly ingest milk from a cow suffering from *Perlsucht* without coming into contact with *Perlsucht* bacilli through it. It must be milk from a cow with tuberculosis of the udder, and therefore a statement on this subject should not be wanting in a report on milk infection if it is said to be complete.

If I now examine in this way the 28 single cases I have collected from literature and see how far they correspond to the conditions just laid down, I come to the following results:

(1) In only 10 cases is it stated that a necropsy took place, and only 7 of these are said to have had intestinal tuberculosis.

(2) Only in 3 cases is it asserted that the milk came from a cow with tuberculous udders.

(3) In not a single one are other possibilities of infection excluded with certainty. As a rule only absence of heredity is alleged, though we know that just this plays a very subordinate part if any.

(4) In no case is anything stated about the condition of other people concerned.

The insufficiency of these data has not even entirely escaped those who use them. Thus Reverel says:¹⁵ "The number of cases in which infection can be traced back to the use of tuberculous milk is not great (it would be more correct to say, 'is, contrary to the expectation, small'), and almost all are open to the objection that all other sources of infection cannot be completely excluded." And in the report of a Committee of the American Public Health Association,¹⁶ which is distinguished in other respects by the observance of a strikingly biased point of view, it is confessed that we cannot tell from the recorded cases whether the illness was caused by the *Perlsucht* bacillus. But in spite of this confession, the collected cases are treated as if they were incontrovertibly proved.

It therefore appears to me necessary to mention shortly some of these cases, and particularly those among them which are regarded as quite certain and have attained thus to a degree of celebrity.

I begin with the case of Gosse which Nocard¹⁷ has recorded. Dr. Gosse, a Genevan doctor, regularly resorted with his family to a farm on Sundays, where his granddaughter, 17 years old, drank by preference milk straight from the cow. The young girl sickened, and after a long illness died of intestinal tuberculosis as the necropsy showed. On this an investigation was set on foot, which showed that of the five cows on the farm four were tuberculous and two of the latter actually suffered from tuberculosis of the udder. This fact

was considered sufficient to base on it the assertion that the illness and death of the young girl must have been caused by milk infected with *Perlsucht*. The possibility of the infection arising in any other way is nowhere discussed, and yet during her permanent residence in town she must undoubtedly have had sufficient opportunity of being infected from some other quarter. We must further ask, what became of those people who drank the rest of the milk which came from the farm. The inhabitants of the farm had undoubtedly done so. Have any of them become ill? Had this been the case we should have been made acquainted with it at once. As this has not happened we must consider that no one else became ill, and we are further urged to the logical conclusion that the milk in question was not injurious to health, and cannot be blamed for the illness of Dr. Gosse's granddaughter. Nocard, who introduced the case into the literature of *Perlsucht*, was of the opinion that it had almost the value of an experiment. I do not believe that this distinguished expert in tuberculosis, who knows quite well with how many precautions and how carefully experiments on tuberculosis must be carried on, in order to satisfy our present-day scientific demands, would still maintain the opinion. Still less sound than the case just mentioned is the one which Dr. Stang observed in Amorbach. This is described by Bollinger¹⁸ A 5-year old boy suffered from dropsy and died with the symptoms of consumption. At the necropsy, tuberculosis of the lymphatic glands of the abdomen and of the serous membranes and lungs was found. With regard to the etiology of the case, it was elicited that no tubercle had occurred in the family for two generations, and that the boy for a year had drunk the milk of a cow affected with *Perlsucht*. This case too, Bollinger says, may be compared to an experiment, but besides the same critical considerations which had to be raised against the preceding case, there is this in addition, that we cannot ascertain whether the cow suffered from tuberculosis of the udder. Furthermore, the boy had tuberculosis of the lungs, as well as of the mesenteric glands and peritoneum, and it would have to be fairly established that this was not the primary lesion as is so frequently the case.

In the often-quoted case contributed by Johné,¹⁹ we only learn that a child, 2½ years old, whose state of nutrition had been enfeebled by measles and bronchial catarrh, died of milary tuberculosis of the brain. He had been fed with milk from a cow infected with *Perlsucht*. Whether a necropsy was made, whether other possibilities of infection were excluded, whether the cow suffered from tuberculosis of the udder, whether other people who had drunk the same milk had sickened, is not stated.

According to Uffelmann²⁰ a child died after partaking of the unboiled milk of a sick cow, of tubercles which developed in the subcutaneous tissues. Neither in the case of the child nor the cow was a necropsy made. Uffelmann himself assigns no evidential value to this case, yet in spite of this it is regularly brought forward in literature when the point at issue is to prove the danger of the milk of cows suffering from *Perlsucht* from cases occurring in practice.

Some reporters²¹ have even said that children while they took milk from a cow suffering from *Perlsucht* were sickly, suffered from eruptions and coughed, but soon recovered again if the milk from healthy cows was given to them. Such cases naturally prove just the opposite from what they are meant to prove, namely, that milk infected with *Perlsucht* was drunk by children for a long time without their becoming tuberculous.

The rest of the cases are like those just enumerated.

We come then to the conclusion that not one single observation free from objection can be cited of the injurious influence of milk infected with *Perlsucht* any more than for the harmfulness of meat affected in the same way, though numerous people continually expose themselves to the supposed danger.

But for milk infected with *Perlsucht*, as with meat, there exist observations of the fact that people have for a long time drunk it with no ill results. To be sure, the statements on this point are not numerous, evidently because it was much more interesting to look for infection, while none bothered themselves about the absence of infection.

Yet it would be easy in a short time to collect serviceable

material. In the country where relations are clear it would only be necessary to have cases of genuine udder tuberculosis, and to ascertain how long the illness had existed in the animals; what people, especially children, had partaken of the milk and the butter made from it; whether, and how, the milk was boiled; and whether the persons concerned had fallen ill of tuberculosis in the course of one to two years; and, of course, the form which it took.

Very numerous letters have reached me in the course of the last year from people who have told me that they themselves or their belongings had drunk unboiled milk affected with *Perlsucht* for a longer or shorter time, and had remained healthy. As it is not now possible to examine these cases as to their accuracy, I will not enter upon the matter; but I should like to request the International Committee to bring its influence to bear, so that instead of the quite unserviceable material now existing, reliable observations should be collected, including, of course:

1. Cases of alleged infection from ingesting milk infected with *Perlsucht*, having regard to the conditions advanced by me (necropsy, exclusion of other sources of infection, condition of other people who have drunk the same milk, proof of tuberculous udders).

2. Cases of absence of infection after partaking of milk infected with *Perlsucht*, likewise under the control of the required conditions (proof of udder tuberculosis, sufficiently long observation of the people, statement as to whether and how the milk was boiled).

Provisionally we can only say that the injurious effects of milk infected with *Perlsucht* and its products are not proven. What these facts signify in relation to the immensely frequent opportunities of infection, I leave to the individual judgement.

Obviously this opinion only holds good in the case of mankind. It is a matter for agriculture and veterinary science to determine how far milk infected with *Perlsucht* is detrimental to cattle, and what measures should be taken to combat the danger which perhaps exists. Measures concerning meat and milk infected with *Perlsucht* which are meant to combat human tuberculosis cannot be well founded at the present time. Further, such measures would be very costly, because of the compensation which would have to be paid for animals judicially seized, and on account of the immense quantity of milk which would have to be inspected. It is, however, decidedly more fitting not to lay out a sum of this kind for something which is far from being established, but to apply it rather to such measures as must with certainty lead to a decline of human tuberculosis.

In this connexion I can only repeat what I said in my London address: The fight with tuberculosis must not be fought on wrong lines if it is to have a real result. It must aim at shutting off the chief, indeed we may say almost the only, source of infection. This is those consumptives who in consequence of the unfavourable conditions under which they live, or because they obstinately set aside the simplest rules for the prevention of infection, are a danger to their companions. In some way or other we must look after these sick people, either by procuring for them more favourable conditions, for example, as regards dwelling places, or by so sheltering them in suitable institutions that they cease to be a danger to their neighbours.

After the experiences we have had of other infectious diseases, we must come to the conclusion that in no other way can anything be attained, and therefore I should like urgently to advise that for the future this task should be kept to the fore in the battle against tuberculosis until it has been accomplished.

REFERENCES.

- ¹ *Lancet*, July 14th, 1888. ² *BRITISH MEDICAL JOURNAL*, August 10th, 1890. ³ *Scottish Medical and Surgical Journal*, September, October, 1901. ⁴ *BRITISH MEDICAL JOURNAL*, August 10th, 1899. ⁵ *Coutts, BRITISH MEDICAL JOURNAL*, August 10th, 1901. ⁶ *Bovaird, Archives of Pediatrics*, vol. xviii, No. 12, 1901. ⁷ *Counsellman, Mallory, and Pearce, Diphtheria*, Boston, 1901. ⁸ *Ravenel, The Intercommunicability of Human and Bovine Tuberculosis*, 1902, p. 18. ⁹ *Compare B. Fraenkel, Berl. klin. Woch.*, 1901, No. 38. ¹⁰ *Handbuch der Fleischbeschau*, 1899, p. 646. ¹¹ *Ostertag, loc. cit.*, p. 646; *Bollinger, Deutsche Zeitschr. f. Thiermedizin*, Bd. i, p. 242, Bd. ii, pp. 138 and 279. ¹² *Deutsche Zeitschr. f. Thiermedizin*, Bd. VI, p. 142, u. 290. ¹³ *Virchow's Archiv*, Bd. xci, p. 129. ¹⁴ *Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege*, 1900, p. 430. ¹⁵ *Loc. cit.* ¹⁶ *Relation of Bovine Tuberculosis to the Public Health*, Washington, 1901, p. 22; published by the U.S. Department of Agriculture. ¹⁷ *Les Tuberculoses Animales*, p. 124.

- ¹⁸ *Deut. Zeitschr. f. Thiermedizin*, Bd. ii, p. 281. ¹⁹ *Geschichte der Tuberkulose*, Leipzig, 1883, p. 57. ²⁰ *Archiv f. Kinderheilkunde*, 1880, I, p. 414. ²¹ *Göring, Deut. Zeitschr. f. Thiermedizin*, Bd. vi, p. 142; *Schoengen, Aus der Dissert. von Behrens, Ueber primäre Tuberk. Darm-Infection des Menschen*, Berlin, 1894.

A Lecture ON MALARIA.

Delivered to the Students of the Practice of Medicine Class, and of the Clinical Medicine Class, of Professor T. McCall Anderson, of Glasgow University.

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Governor of Lagos.

GENTLEMEN,—It is with great pride and pleasure that I avail myself of the privilege of addressing you here to-day on the subject of malaria. It is now upwards of thirty years since I sat on the seats you now occupy. I then listened to the lectures of the highly accomplished and distinguished professor (now Sir William) Gairdner. That great teacher has had a most fit and proper successor in the illustrious physician that now occupies this famous chair. To Professor McCall Anderson, and to Dr. Thomas Reid, of this city, I owe my early introduction to those scientific studies that more particularly require the use of the microscope in pathology and parasitology. To my very great regret, events have deprived me of the opportunity of cultivating the more purely scientific branches of the medical profession; but at the same time circumstances often require me to apply in practice the principles worked out and established by other men. This is specially the case with regard to malaria. In speaking of that subject to-day I therefore confine myself as far as possible to what I know best, and to what will be most useful to you—the purely practical side of the question.

IMPORTANCE OF THE SUBJECT.

In the first place it should be pointed out that this study is one that has a direct bearing on the development of our Colonial Empire. It is true that malaria is practically extinct in the islands of the United Kingdom; but we possess the lion's share of the malarial areas of the earth; and at the same time no other great Power is so much, or is likely to become so much, dependent on its foreign possessions as we are. But we hold those vast territories subject to the tyranny of the destructive giant Malaria, who bestrides the globe, and exacts his yearly tribute of scores and scores of thousands of human lives from white and black indiscriminately. Few of our great colonial possessions in the tropics or subtropics are exempt from this widely distributed malady. France and Germany, with their great tropical possessions; Italy, with her two million cases of malaria a year on her own soil; and the United States of America, are all deeply interested in this subject, and they are doing their duty towards it with generosity and devotion, in proportion as they become aware of its importance. From the earnest workers of those nations we can, and therefore ought to, learn much. We have to recognize the fact, however, that our responsibilities as a nation are greater than theirs, in this respect, in the proportion represented by hundreds of millions of human beings. This heavy national, imperial responsibility can be illustrated to you by the statistics of malaria in India alone:

MALARIA IN INDIA IN 1900.

Mortality from fever:

Native population	...	4,919,591
Admissions for malaria during the year:		
European troops (60,553)	...	18,679
Native troops (123,463)	...	39,601
Convicts (121,811)	...	43,594

The significance of these figures you can grasp more easily if you reflect that the annual Indian mortality from fever exceeds the total population of Scotland by half a million.