very serious, as Surgeon-Colonel Benson's experience shows. I cannot believe that with a careful and antiseptic operator there is any danger at all of tetanus. I have by me a letter telling of 800 cases of malarial fever cured by a native Indian doctor, nearly all of them by one subcutaneous injection each. No ill consequences followed any of these injections. The native doctor used each time $2\frac{1}{2}$ grs. of quinine sulphate dissolved, with the aid of tartaric acid, in 20 minims of water. I have also another letter, in which an old patient of my own writes of having cured about 50 Indian natives in the same way, many of them after months of fever. One abscess but no tetanus followed in this set of cases. The method followed by me—I must not call it my method—is to inject subcutaneously 3 grs. of quinine bihydrobromate dissolved in 20 minims of pure warm water. I first inject it under the skin of the upper arm, then under that of the thighs, then under the skin of the abdomen, or at the top of the chest or between the scapulae. Six injections on alternate days are usually required in a serious case, and 3 grs. under the skin will prove much less distressing and more curative than 30 by the mouth. I keep a syringe for the purpose, and use it for nothing else. I disinfect the syringe and the patient's skin with strong carbolic lotion, and carefully disinfect my own hands. I always sterilize the needle in the flame of a spirit lamp. The solution of quinine is sterilized when first made, but I have not myself boiled it each time before using, though, following Lieutenant Barrow in this respect, I will beg that it be always done. With such precautions I am convinced there need be no fear of tetanus, and I am further convinced that there are few or no cases of malarial fever that will resist six subcutaneous doses of 3 grs. each of quinine bihydrobromate. This dose may, of course, be exceeded on special occasions, or it may be given several times a day, but it will usually be sufficient. It may be that intramuscular injection into the glutei (as advised by Dr. Manson) is a still better method, but I have no experience of it, and would expect it to be more crippling and more painful.

None of my cases have required more than six injections, and some have got well after only three. Considering that quinine is almost completely excreted within twelve hours, it is not easy to understand why so many convalescents remain malarial proof, unless it be the case that, like other febrile convalescents, they have manufactured a special antitoxin. The excretion of quinine through the kidneys begins a few minutes after a dose has been given, and it is this fact that explains the superior results from its subcutaneous use. Slowly absorbed through disordered stomach and intestinal membranes, it is excreted nearly as fast as it is absorbed, and never reaches in the blood the strength sufficient to destroy the malarial plasmodia. Subcutaneously used its maximum and effective strength is probably reached within half an hour. In a case of malarial fever contracted in Holland treated by me many years ago it required 30 grs. daily of quinine by the mouth for nearly a week to subdue the fever; smaller doses had failed, and, though cured, this patient suffered much in head and stomach during his treatment. It is difficult to explain why quinine subcutaneously used affects the head less, but the fact is so. It has probable reference to the sympathy between the head and the stomach, and the latter is of course not irritated at all by the subcutaneous treatment. I would advise the injections to be given two or three hours before the expected paroxysm, so as to catch and destroy the spores; though in chronic cases, like all I have had to deal with, it does not seem to matter much when you inject, provided that you do it often enough.

In the hope that the simple and effective treatment described may soon become the rule instead of the exception, and at the suggestion of the Editor I have contributed this short paper.

REFERENCES.

- ¹ BRITISH MEDICAL JOURNAL, 1902, i, p. 302. ² Trans. Indian Med. Congress, 1895.

ANTIRABIC INOCULATION IN MEXICO.—The Mexican National Board of Health reports in its last bulletin that since 1888, when the Pasteur treatment of hydrophobia was introduced, 4,000 persons have been treated, with a total mortality of only 3 per 1,000.

SHOULD MILK BE BOILED?*

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SOURCES OF CONTAMINATION OF MILK.

THE slightest acquaintance with the methods of the farmer, the dairyman, and the milkman shows that pure milk is an unknown substance on our tables. Secreted perchance in a healthy mammary gland, the fluid is drawn through unwashed rustic hands into a pail placed under the dung-spattered udder and belly of a cow who spends at least half her time in a dark and noisome byre, carpeted with a slush of decomposing urine and faeces and papered with the splashings of the same, while the air is thick with the bacterial flora of these admirable culture media and of the bovine alimentary canal. What wonder that the bottom of a milk-can nearly always exhibits a rich sludge, and thus serves the purpose of a cesspool or septic tank? It has been calculated that the inhabitants of Berlin consume in their milk 3 cwt. of excrement per diem. Even in the milk of one of the most model dairies of this district, where hand-washing and teat-washing are supposed to be *de rigueur*, have I seen this sludge, which the milkman said he could not understand, because he always strained the milk through a cloth before sending it out! And on arrival in the city do we not daily see a row of milk-carts in the bright and perfumed air of Station Street, where milk is being poured from big cans into smaller ones through dirty cloths which between their services lie about anywhere?

When in addition to the chances of pollution we recall the contaminated water with which in country places the milk cans are often washed, the contaminated atmospheres of shops and cellars in which the milk retailed to the poor is usually stored, we no longer wonder that milk, even from a healthy cow, occasionally makes people ill.

But in the present state of the law we have no guarantee that our milk does come from a healthy cow, and in most English towns milk is sold coming direct from udders which are affected by tuberculous or other inflammatory disease, and from which in milking a considerable quantity of pus is squeezed into the milk can.

PATHOGENIC PROPERTIES OF CONTAMINATED MILK.

Thus, as matters now stand, we are liable to drink milk which may come from a diseased cow and which is almost invariably exposed to contamination by subsequent dirt. The milk on which our children mainly live may be primarily or secondarily a pathogenic fluid. Thus epidemics of scarlet fever and diphtheria have been traced to the milk from diseased cows, while the virus of these diseases and of typhoid fever has been introduced by infection from the *personnel* of the dairy or milk seller. Tuberculosis I will not dwell on, though I think that cases of milk infection in that disease have been made out. But undoubtedly the main disease caused by milk is the summer diarrhoea or gastro-enteritis of hand-fed infants, the mortality from which is appalling. Thus the deaths in Nottingham among children under 1 year of age were in 1900 equal to 196 per 1,000 born, and in 1899 to 210 per 1,000, and the total of deaths from diarrhoea in 1899 being 600.

During the summer of 1899 the epidemic of infantile diarrhoea spread all over England, and the death-rate everywhere rose; for example, in 67 large towns from 156 to 179 (or *plus* 23) per 1,000. To this increase, however, there was one notable exception—St. Helens—where it fell from 176 to 157 (or *minus* 19). In this town Dr. Drew Harris, the energetic M.O.H., in August started the public distribution, in closed bottles, of milk which had been exposed for three-quarters of an hour to a temperature of 102° C. Although the distribution only began in August, the effect was to cause the infantile death-rate of the whole town to fall from 176 to 157, while among the consumers of the sterilized milk it fell to 103. This system was introduced in 1894 at Fécamp, in Normandy, by Dr. Leon Dufour, with the result that in 1898-99 but 1.3 per cent. of the infants drinking the sterilized milk of the *goutte*

* Abstract of a paper read before the Nottingham Medico-Chirurgical Society.

de lait died of enteritis; while the mortality of the other town infants from the same cause was 10 per cent.

It is hardly necessary to bring further evidence that sterilizing the milk checks summer diarrhoea, for this is admitted, I think, by all.

ALLEGED SCURVY OF BOILED MILK.

What, then, is the harm of heating milk to such a temperature as will kill pathogenic germs? It has been alleged that the nutritive value of milk is largely diminished by boiling, and that it causes rickets, infantile scurvy, and tuberculous diseases in infants, and deficient nutrition in the aged and sick. Further, it has been complained that boiling kills the living cells and coagulates the albuminoid constituents, so that they must be digested before being absorbed, whereas it is implied that the living cells of fresh milk enter the circulation direct as living protoplasm and build up the tissues direct. Again, Dr. Frederick Smith speaks of the number of babies seen as out-patients "who are made peevish, fretful, and even seriously ill by the pernicious effects of boiled milk on their nutrition."¹ Dr. Smith's opinion is based on impressions gained in the out-patient room of the London Hospital. What hospital physician has not seen babies peevish, fretful, and seriously ill from the use of unboiled, sour, and adulterated milk; and what guarantee can there be, even if the mother says she has boiled the milk, that the boiling was efficiently carried out; that the many precautions needful to prevent subsequent contamination were taken, or that the milk was originally of good quality and not diluted or adulterated?

Let me quote from Dr. Variot,² of the Hôpital des Enfants Malades, Paris, where for ten years sterilized milk has been distributed (as at Fécamp) to the infants of the poor, the children being afterwards weighed and inspected weekly by the doctor. The milk is either sterilized at Paris in a Soxhlet's apparatus or sterilized beforehand in Normandy at 115° C.:

In these conditions we have given this milk to a number of infants carefully looked after, and have noted neither rickets nor infantile scurvy. In five years I have had about 200,000 litres of sterilized milk distributed to 1,000 infants, and have never observed a single case of Barlow's disease. Rickets is very exceptional..... Infantile scurvy is rare in France. Ten cases have been collected, and 7 of these can be imputed to "humanized milk" made by Gaertner's method. It would seem that the modifying of milk rather than the sterilization does the harm. Farinaceous mixtures and milks artificially made up in laboratories by the method of Rotch seem to us most dangerous food even if well sterilized. We have brought up a large number of healthy and even atrophic children with sterilized milk. The tracings of their growth, without being as perfect as in the case of infants nursed by their mother, are nevertheless very satisfactory in general.

Again, Holt in his textbook says:

I have carefully investigated this question [infantile scurvy] in the records of three institutions in which for five years sterilized milk was the standard food for all artificially-fed infants. The number of children under 18 months who had this diet is nearly 1,000. During this period but 2 cases of scurvy were observed, and in neither case had the child been upon a diet of sterilized milk. However, I have recently seen in private 2 cases of scurvy in which the cause seemed to be prolonged sterilization at a high temperature, that is, 212° F. for over an hour. In some of the cases in which the sterilized milk is supposed to have been the cause of scurvy, it was undoubtedly the milk formula which was at fault and not the process of heating. In two patients under personal observation who developed scurvy while taking sterilized milk and a proprietary food, the food was discontinued and the patient recovered, although heating the milk was continued. In 4 cases observed by Winkes no other treatment was employed than the substitution of sterilized milk for the previous diet, which in three instances had been proprietary foods. All the patients promptly recovered. The milk was heated to 212° F.

In an article on infantile scurvy³ Dr. E. Cautley, of the Belgrave Hospital for Children, says that in seven years' hospital practice he has brought up a very large number of infants on boiled milk; that none of them have developed scurvy, and that the gain in weight has been satisfactory. He notes also that in London shop milks he found from 3 million to 30 million microbes in each teaspoonful.

In my own experience I have never known scurvy, rickets, or atrophy occur as the result of feeding with milk that had been boiled or sterilized by exposure to the temperature of boiling water. At the General Hospital the milk is sterilized in an Aymard's sterilizer, and the rapid improvement in nutrition that occurs in the wasted infants brought to us is most striking. In private practice and in my own family I advise for young infants the sterilization of milk in the bottles in a Hawksley's or Soxhlet's apparatus, and for older

ones in an Aymard, the water being put in tepid and kept at the boiling point for about ten minutes.

All the cases of infantile scurvy that I have seen have been due to the sole use of proprietary dried foods. However perfect the food may appear to be from the point of view of chemical composition, there is no doubt that their prolonged use (for example, for six to eight months) does, in a certain number of cases, cause scurvy, although the child may for a time have gained weight and appeared thriving.

Sir Thomas Barlow, the discoverer of "infantile scurvy," or "scurvy rickets," discussed the question in his Bradshaw Lecture,⁴ and has recently been good enough to communicate his views to me in a private letter. He says: "Undoubtedly the proprietary foods are the worst offenders; condensed milk is responsible for a fair number of cases, and sterilized and humanized milk as supplied by the dairies is, if used long enough, very apt to produce scurvy. By this preparation I mean milk which has been deprived of half its quantity of casein and has been subsequently sterilized, and in several cases stored for some weeks." He also adds: "I have had several cases of scurvy in children taking milk sterilized by Soxhlet's process, which takes forty to forty-five minutes. I have not seen scurvy in children brought up with milk just scalded."

Dr. Kingston Barton⁵ comes to similar conclusions, namely, that completely sterilized milk, that is, milk which will keep fresh in sealed bottles for several days, will produce scurvy, whereas milk raised to the boiling point and kept at that temperature for five to ten minutes will never do so, while it is almost quite safe from pathogenic organisms.

Now, with regard to these views and facts, I would venture to point out first that in the case of "humanized" or "modified" milk, we are not dealing merely with milk that has been heated, but with a fluid the chemical composition of which is markedly different from whole milk, and that in some cases it may well be the milk formula which is to blame. Condensed milk is notoriously often an imperfect nutriment. Secondly, I would remark that when so-called "sterilized" milk has been brought from a dairy laboratory or manufactured at home, there is a tendency to undue confidence in the virtues of sterilization, to keep it too long, and to give a supply of fresh milk at too long intervals. Milk sent down from a London "laboratory" is frequently given when a week old. But it is by no means true that milk which has been boiled, even for three-quarters of an hour, can be absolutely relied on as sterile. Repeated discontinuous heatings are necessary to kill all spores. The outbreak of diarrhoea a few years ago at St. Bartholomew's, which was traced by Dr. Andrews to the bacillus enteritidis sporogenes existing in well-cooked rice puddings, is striking proof of the resisting power of spores.

It happens not very rarely that "sterilized" milk from the best London dairies is found when the bottle is opened to be obviously bad to smell and taste, and it is practically certain that minor fermentative changes may go on in milk which seems good enough to give to the child. Hence we may be for several months administering to the infant small doses of the chemical products of saprophytic or pathogenic germs.

In this connexion let me remind you of the extremely interesting paper by Mr. F. A. Jackson and Dr. Vaughan Harley⁶ on the etiology of scurvy. This disease has been generally held to be due to the absence in the diet of some constituent of fresh food, and especially of fresh vegetable food, by many supposed to be the salts of organic acids, such as citrates, malates, and lactates, and it is generally believed that the administration of fresh vegetables or limejuice in addition to meat and preserved foods will prevent the outbreak of scurvy. That this is not the case is shown by the fact that scurvy was rife among the members of the Nares Polar expedition, although limejuice was regularly taken. On the other hand, a shipwrecked party, of whom Dr. W. H. Neale was a member, lived for nine months on freshly-killed meat without any vegetables, and had no scurvy at all.

Dr. Nansen did the same for the same period, with the same result, and a party of Mr. Jackson's expedition spent three years in Franz Josef land without limejuice, vegetables, or scurvy, while their companions on the ship *Windward*, living on tinned and salted meat with a regular allowance of

limejuice, suffered severely from scurvy. The conclusion drawn from such facts as these by Professor Torup, of Christiania, and Messrs. Jackson and Harley is that scurvy is due, not to the absence of a hypothetical x in preserved food, but to poisoning by the ptomaines of tainted animal food. Jackson and Harley bring experimental support to this view by finding tainted meat produce scorbutic symptoms in monkeys, even when plenty of fresh vegetables were given as well.

The cases reported by Winkes, and mentioned above, of infantile scurvy caused by proprietary foods, and cured merely by the substitution for them of sterilized milk, strongly support this view of the pathology of the disease. I would submit, then, that the evil effects observed not rarely after the prolonged use of powdered substitutes for milk, and occasionally after the use of modified milk supposed to be thoroughly sterilized may be partly due to unsuitable chemical composition as to food elements, but more largely to actual insufficient sterilization, and subsequent keeping the food long enough to allow of decomposition processes to occur.

Flügge⁷ found that in milk that had been kept at 90° C. for some time various anaërobic organisms could be cultivated at a temperature of 30° C., the commonest being the bacillus butyricus, which made the milk toxic to guinea-pigs. He also obtained several kinds of spore-bearing aerobic bacilli. Repeated heatings to 100° C. at intervals are needful to destroy such bacilli, or a prolonged exposure to 120° C., which latter process greatly alters the colour and taste of the milk. Hence it is obvious that in milk supposed to be sterilized various toxic substances may be formed if it is kept long enough to allow of the growth of micro-organisms, and, if the taste and smell are not obviously altered, a fluid containing small doses of poisons may be administered for long periods to infants.

It should also be remembered that if fermentative changes have taken place in the milk before sterilization, the latter process, though it may destroy the living organisms, may not destroy the poisonous chemical substances they have produced. In these days, when the milk for the metropolitan dairies is drawn from as far off as Derbyshire, these are points worth remembering. It travels 120 miles to London to be mixed, modified, and "sterilized," and then the same distance back again to the Midland baby. It is just conceivable that on its journeys changes may occur, for milk is not, like sherry, better for travel. It is a not uncommon experience occasionally to open a bottle of "humanized" milk from the best London dairies, which to vision, taste, and smell is bad; but for one in which microbic growth is thus obvious there may well be a dozen in which slight unperceived chemical changes have occurred.

Condensed milk is, I believe, usually sterile, though often of unsatisfactory composition as a nutriment; but I feel some doubt as to its being an important cause of infantile scurvy, for this disease is admittedly much more common among the children of the richer classes than among those of the poor, who are the chief users of condensed milk. Rickets and malnutrition, on the other hand, are frequently traceable to its use.

ALLEGED LOSS OF NUTRITIVE VALUE.

Let us pass on to the statements as to the loss of nutritive value alleged to occur in milk as the result of boiling or exposure to the temperature of boiling water.

First let us consider the statement that we are thus deprived of "living food." If it is meant that living protoplasm, or animal or vegetable matter, is absorbed into our system and incorporated with our living tissues without being previously killed and converted into a totally different chemical substance, I venture to say that this is an absolute fallacy. Such a process occurs in the fusion of the spermatozoon with the ovum, and in the conjugation of lower organisms, but is unknown in the process of nutrition of the higher animals. Putting aside the fact that the protoplasmic envelope of the fat globules of cow's milk is dead long before it reaches the consumer, even when unboiled, there can be no doubt that the same substance in mothers' milk drawn from the breast must be acted on and dissolved by the gastric juice before absorption, just as the casein is precipitated by the rennin ferment and subsequently peptonized. Neither is raw meat

juice in any sense a "living" food. Potatoes have been described as such, even when boiled and mashed. Although an excellent remedy for scurvy, they do not act by virtue of being living. If scurvy were due to the want of living, or even of raw food, most of us would have scurvy; for there are thousands of persons who for years never consume uncooked food. It should be remembered that the use of raw milk is almost peculiar to Great Britain.

Is there any scientific evidence that boiled is less digestible and less absorbable than raw milk? It is asserted by the advocates of raw milk with the utmost assurance that this is the case; but for facts to prove their assertion we look in vain, while evidence to the contrary is not lacking.

Most people know that the clot of boiled milk (at least, outside the body) is less dense than that of raw milk, and may therefore be expected to be more rapidly acted on by pepsin.

Further facts as to the effect of boiling (that is, heating to 110° C.) on milk are given by Dr. Hutchison in his valuable book on *Food and Dietetics*.⁸ Thus he points out that there is not, as alleged by some, a material loss of nutriment in the scum, which consists mainly of phosphate of lime with a minute quantity of lactalbumen and casein. Very prolonged boiling gives a brownish tint to the milk, probably owing to caramelization of the sugar; but it is not shown how far this renders it less digestible; nor is such prolonged boiling necessary.

Then it is said that boiling destroys the beautifully fine emulsion in which the fat exists in milk, causing the droplets to run together. This to some extent is true, and, if sterilized milk be kept for a week or a fortnight, it is very difficult to again get a fine emulsion by shaking the milk; but this is hardly perceptible in milk consumed within a few hours of boiling. This is another reason, besides that before mentioned, for not keeping milk long.

As regards the rate at which raw and boiled milk are digested in the stomach, the results of experimenters vary somewhat, some finding one and some the other more rapidly digested; but the general conclusion is that there is no great difference.

As regards the absorbability and nutritive capacity of boiled and raw milk, here again experiments show no inferiority in the former. Chamouin of Paris⁹ found that kittens fed on boiled milk were twice as fat and healthy as those fed on raw milk. Bendix found that both infants and calves assimilated both nitrogen and fat quite as well from milk sterilized for over an hour as from milk just boiled; while between raw and boiled milk in animals and man the results of other experiments gave no constant difference. Hutchison¹⁰ concludes that "just as boiling does not appreciably diminish the digestibility of milk in the stomach, so it does not to any important extent interfere with its absorption in the intestine," and he gives as his clinical experience at the Hospital for Sick Children that "amongst several hundreds of infants thus fed" (with boiled milk) "I have but rarely had any difficulty in obtaining the normal increase in weight. This is not a mere general impression, for I make a point of having these children weighed every week, and a careful record kept of the increase in weight and the exact method of feeding." One wishes that the writers on the other side would give something beyond "general impressions." Dr. Hutchison's experience thus falls into line with that already quoted of Holt, Variot, Cautley, and the towns of Fécamp and St. Helens.

CONCLUSIONS.

To sum up: we may say that there is no solid evidence to show that milk raised to its boiling point (110° C. = 233° F.), or to the temperature of boiling water for ten minutes or a quarter of an hour, suffers any diminution of its nutrient qualities. Neither is it probable that, if consumed within twenty-four hours of the heating, it will cause infantile scurvy. The same is true of pasteurised milk heated to 80° or 85° C. None of these methods render the milk absolutely sterile, but they do kill most pathogenic microbes (for example, those of tuberculosis, cholera, diphtheria, and typhoid),¹¹ and if the milk be kept cool and drunk within twelve hours of the heating, few or no spores will have developed into bacilli. Pasteurisation is probably less reliable than heating to 212° F.

for ten minutes, and is also more difficult to carry out, as it is easy with simple domestic apparatus such as Aymard's, or other double saucepan, or Soxhlet's, or Hawksley's bottle-holding tins to keep the milk in a bath of boiling water for ten minutes.

In times of epidemic summer diarrhoea the heating should be prolonged for at least half an hour, and the milk drunk within a few hours, or subjected again to the process, as the spores of the bacillus sporogenes enteritidis are very resistant. Under all circumstances milk, whether raw or "sterilised" should be drunk as fresh as possible, and then the liability to gastro-enteritis and nutritional diseases will be diminished; but it is my emphatic opinion that infants who live wholly or mainly on milk as at present supplied to us should never be exposed to the dangers lurking in the raw fluid.

Lastly, let me say that nothing in this paper is intended to detract first from the paramount importance of children being suckled by their mothers for the first seven or eight months of their life; and, secondly, from the equally vital matter of securing a pure milk supply from healthy cows, hygienic stables and dairies, and clean milk cans. Educational and legislative measures to secure such a pure milk supply should have the heartiest support of every medical man.

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REMARKS ON THE RELATIONS OF HUMAN AND BOVINE TUBERCULOSIS.*

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In addition to the danger of inhaling the infection of tuberculosis it has until lately been believed that human beings may also be infected through the digestive passages by the consumption of meat or milk derived from tuberculous animals; but Professor Koch has startled the Congress recently held in London and the world by declaring that the risk of this occurrence is extremely slight and that in his opinion no measures to prevent it are necessary.

What, then, are our reasons for believing in the identity of human and bovine tuberculosis, and that the disease can be transmitted from one species to the other?

1. The bacilli found in each case are extremely alike both in their form, their staining reactions, and their mode of growth under artificial cultivation.

2. These bacilli, whether of bovine or human origin, produce typical tuberculosis when injected into rabbits and guinea-pigs.

3. Tuberculin prepared from human tubercle bacilli produces a characteristic reaction when injected into tuberculous cattle just as it does when injected into tuberculous man.

Objections can be urged against each of these statements. The similarity of the bacilli, it is said, does amount to identity of form. The bovine bacillus is not beaded like the human one, and is also shorter and thicker. In pure culture there are some differences in the mode of growth, and the bovine bacillus will not grow on glycerine-agar while the human will.

COMMUNICABILITY OF HUMAN TUBERCULOSIS TO BOVINES.

A fact, admitted by all observers, is that while both bacilli are pathogenic for animals, the bovine bacillus is much more virulent than the human. This fact, however, may eventually turn out unfavourable to Koch's views. His argument is based on the results of experiments in which he found calves very susceptible to bovine tuberculous material, whereas these animals were not susceptible to infection by human material, and swine but very slightly. But it is a matter of experience that man is as a rule liable to the diseases which are common to the domestic animals, and if bovine tubercle is virulent for a large number of different animals it

strengthens the probability that it is virulent for man also. With regard to the tuberculin reaction Koch explains that, although the bacilli are different, they belong to the same group, the members of which give a common reaction with toxins. In support of this statement he points out that typhoid serum agglutinates cultures not only of typhoid bacilli, but also of paratyphoid [a form of colon bacilli]. As regards pathological and experimental evidence, the conclusion seems to be justified that the differences between human and bovine bacilli are those of variety rather than of species, such variation being due to the soil on which the organism grows.

Other observers, however, have not met with such uniformly negative results after attempts to communicate human tubercle to cattle. Ravenal of Philadelphia¹ inoculated intraperitoneally four calves with human sputum; three of these became tuberculous, two showing extensive lesions of true *Perlesucht* character. Contrary to Koch's experience, he found swine very susceptible to infection by human sputum. Lately Professor Delépine² has succeeded in giving human tubercle to the calf. Dr. Sidney Martin fed calves on bovine and human material. Those fed with bovine material were easily infected. The experiments with human material, while not being entirely negative, failed to communicate tubercle in two cases out of six, while in the other four there were lesions of limited extent in Peyer's patches and the mesenteric glands. Accidental infection of cattle, pigs, and even fowls, by means of the sputum of phthical attendants, has been thought possible, and cases in support have been cited, but, as we are not told that all other sources of infection were excluded, the evidence is not very convincing.

COMMUNICABILITY OF BOVINE TUBERCULOSIS TO MAN.

We may now turn from the possibility of communicating tuberculosis from man to cattle to the far more important consideration whether transmission of the disease from cattle to man can take place, and whether the danger of contracting tuberculosis from meat and milk is real and substantial. I have nothing to say about the danger from meat, because meat inspection is practised by our authorities; and even if tuberculous meat escapes the inspector, the risk is so much diminished by cooking, that the transmission of tuberculosis by this means is so rare as hardly to constitute a substantial danger. Indeed, Dr. Sidney Martin³ tells us that meat itself very rarely contains tubercle bacilli, and that danger consists only in its being contaminated by knives, cloths, etc., which have been in contact with tuberculous organs. Nocard⁴ was unable to infect animals by feeding with raw flesh from highly tuberculous beasts, and even inoculation with juice from the same generally failed. The case is different as regards milk, because it is much more frequently taken uncooked, and the general opinion is that it is a fertile source of the tuberculosis of childhood. This belief is supported by the findings of the Royal Commission in 1895. We are told that something like 30 per cent. of milch cows—kept as is usual in confinement—are tuberculous, but that only the milk of cows with tuberculosis of the udder is infective. Udder disease is said to exist in 2 per cent. of cows; but this estimate may be too high, for Mr. Lloyd,⁵ veterinary surgeon to the Manchester Corporation, after examining 9,576 animals, found this affection in 0.5 per cent., and appears to consider this a fair average for the whole country. Tuberculous milk is dangerous in proportion to the number of bacilli contained in it, and it is easy to exaggerate the infectiveness of milk, unless we remember that the infection is very much diluted by the mixing of milk. Tuberculous milk has been amply shown to be infective for animals. Knowing this, we find in the bodies of children lesions in the intestine, glands, or peritoneum, and we argue thus: All children drink milk, some milk is infective, therefore some children die of infection by milk. This conclusion may be correct, but in forming it there is something we have not taken into account.

Koch⁶ has said: "It is just as likely these cases of intestinal tuberculosis were caused by the widely-propagated bacilli of human tuberculosis." In breathing a germ-laden atmosphere tubercle bacilli may be deposited in the mouth or nose and afterwards swallowed mixed with mucus, or even after being inhaled they may be expectorated and swallowed.

* Extracts from a paper read before the Nottingham Medico-Chirurgical Society.