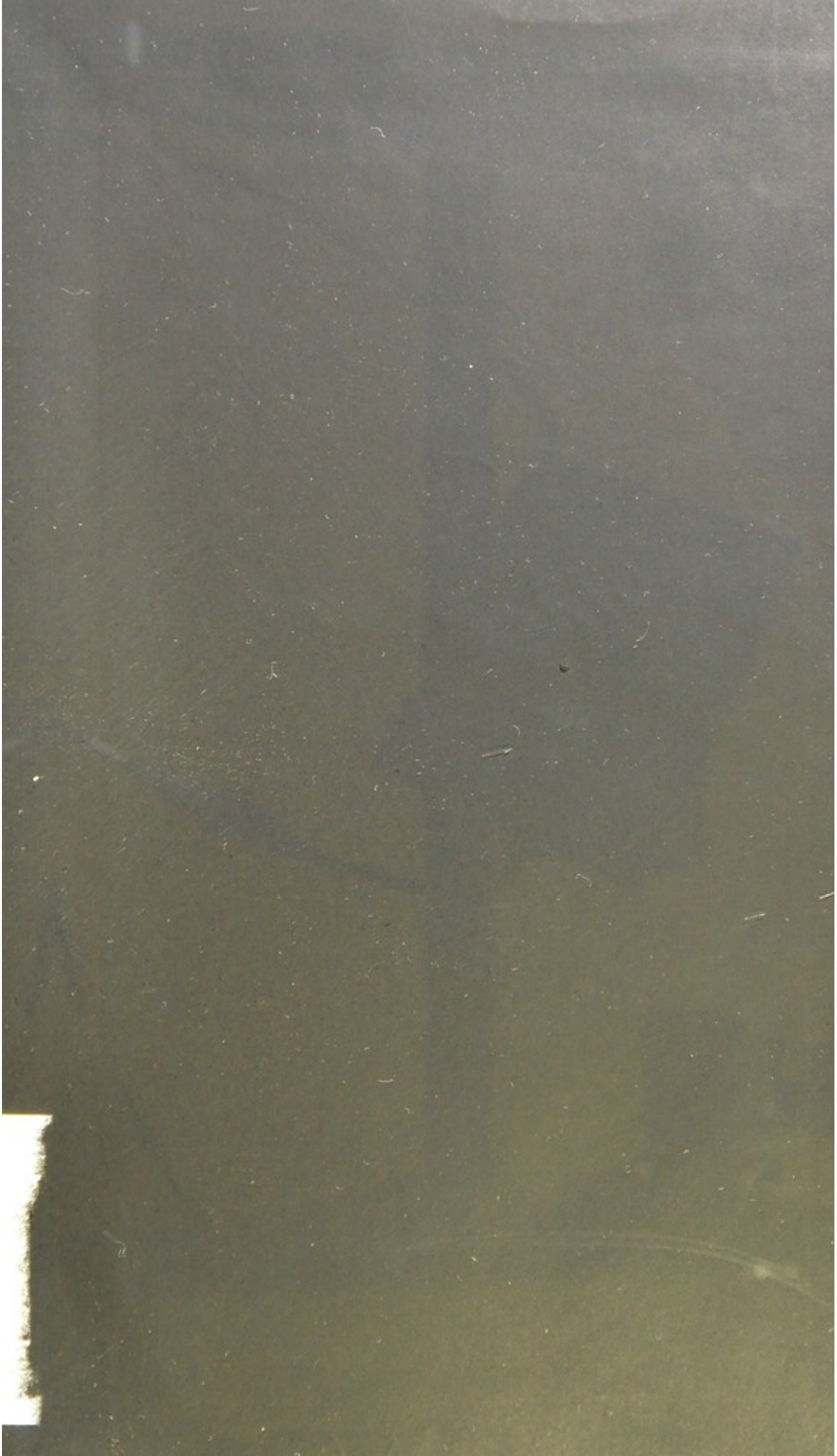
Evidences of the communicability of consumption / by G.A. Heron.



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BY

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TO

PROFESSOR ROBERT KOCH, M.D.,

TO WHOSE GENIUS AND BRILLIANT WORK

MAN ALREADY OWES A DEBT

HE CAN NEVER PAY,

This Book is Dedicated,

WITH GREAT RESPECT AND ADMIRATION,

BY HIS FORMER PUPIL,

THE AUTHOR.

PREFACE.

Last winter, at the City of London Hospital for Diseases of the Chest, I gave two lectures entitled "The Question of the Communicability of Consumption." It was not then my intention to publish the lectures, because what there may have been of interest in them was, of necessity, a *résumé* of the evidence relating to that question, and had already been laid before the medical profession.

Some of those who were among my audience on the occasions referred to, suggested to me that what I then said should be put into book form, for convenience of reference. After much hesitation and delay, I decided to follow this suggestion, and to embody the substance of the lectures in short chapters. It has, therefore, been necessary to alter much of the wording of the original manuscript, and to add to it, here and there.

About a month before the lectures were delivered, I wrote to Prof. Koch, and asked him if he could let me have some references to recent contributions to medical literature, for use in my preparation for

these lectures. I had hoped to receive from him a few words in reply, indicating where what I wanted was to be found. To my surprise, he sent me what now forms the Appendix to this book. Unfortunately, his very kind and valuable assistance was not available for my lectures, for his manuscript reached me after they had been delivered. It seemed to me a pity, that such a useful synopsis of current literature upon so important a subject, should not be used; and, therefore, it is now placed at the service of those who may desire or need its help.

The record of cases given in the Appendix was made, at Prof. Koch's request, by Dr. Frosch, of Berlin, who most kindly gave me permission to publish it in its present form. I cannot sufficiently thank Dr. Frosch for his courtesy and kindness in placing this remarkably accurate piece of work at my disposal.

I heartily thank all those who have so kindly helped me in my attempt to deal, in a few pages, with a very important subject.

HARLEY STREET, W.
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EVIDENCES

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CHAPTER I.

INTRODUCTORY.

THE belief that consumption is a communicable disease, has long been popularly accepted in many parts of southern Europe, and that popular belief has received the support of the majority of medical men in those countries. Amongst all civilised peoples, this view concerning consumption has, at all events in the last half-century, had its advocates in the medical profession. It was not, however, until 1882 that the belief in the communicability of this disease was established upon a firm foundation. In that year, Dr. Robert Koch demonstrated by observed facts, and by the results of his own experiments, that consumption, as well as every other form of tubercular disease, is caused by a living organism, now known by the name of Koch's bacillus of tubercle. As is usual when new and important truths are first brought into notice, this new teaching received a large amount of adverse criticism, and was met with strong opposition. Scepticism is a valuable help to

the progress of truth. That is partly why all reasonable disbelief should receive respectful consideration from those who wish to see scientific truth spreading, not only quickly, but also upon soil properly prepared for its reception, and for its nourishment. To that good end, reasonable doubting of new beliefs works well. A thoughtful and honest critic with a bias towards scepticism, is one of the best helpers of him who first shows the world a scientific discovery. The time inevitably comes when, slowly most likely, but not the less surely, students of the subject are almost as much struck by the breakdown of the attack upon it, as by the steadily increasing weight of evidence which, from various quarters, is brought up in support of the new discovery. Through all these phases Koch's work on tuberculosis has passed. To-day it is no exaggeration to say that this new teaching is regarded, by the great majority of those who are entitled to speak with authority on such matters, as a fact of the first importance in medical science. It surely is right and just, that when a considerable majority of such men express clearly their belief in any new teaching which falls within their ken, then something more than a bare denial of its truth is required of those who decline to believe its doctrines. When, moreover, the teaching in question is based upon evidence founded on experiment, those who doubt or deny its truth are, after a time, if they would maintain their position as just critics, bound either to show error in the experiments themselves, or in the reasoning based upon them. Koch's work concerning tuberculosis hinges upon experiment. No important step in that work is taken which is not

based upon experiment. On the other hand, the objections hitherto advanced against it have no foundation in evidence based upon experiments, which have received recognition from competent authorities. Probably no research of its kind ever had, in a comparatively short time, so much corroboration from work, more or less reliable, done in all quarters of the world. That corroborative work has, to a great extent, been accepted as correct by a very large majority of men whose opinions, on such subjects, are entitled to our best consideration. No doubt, the bulk of the medical profession to-day believe that tubercular disease is caused by a living organism, and that that organism is Koch's bacillus of tubercle. There is not, however, wanting proof of the fact, that there are still those who do not believe either of those propositions. Also, there is prevalent, in certain quarters, a feeling that it can still be truly said of Koch's work on tuberculosis, that it is not yet proved to be correct. Again, there are others who believe it, but who, in their acts and words, do not seem to attach to it any considerable importance. These men appear to regard the work rather as a scientific curiosity, than as a matter full of much practical importance in relation to the question of why from one-fifth to one-seventh of the world's known death-rate is due to tubercular disease.

It may be well to give here an example of those expressions of opinion which, to say the least of them, though not plainly avowing disbelief in Koch's teaching concerning tuberculosis, certainly do not tend to encourage its acceptance. In the Harveian Oration of 1889, Dr. James E. Pollock

says: "Among the latest and most important additions to modern science . . . . must be enumerated the discovery of minute organisms in almost all diseases of the zymotic class, and in tuberculous and other pathological products. The importance of the investigations which have led to our knowledge of this subject cannot be overrated, and the facts so accumulated must be accepted as invaluable additions to our conceptions of the origin and spread of such affections."

"It will be well, however, not to build up too hasty theories of disease on even such facts. There is a palpable danger of results being mistaken for causes. The invariability of certain morbid products being found is no doubt a proof of the unchangeableness of the diseased process, but it would be surpassing the limits of the Harveian method of exploration by experiment, if we were to assume that in all cases these, and these alone, were the causes. . . . . The decay of almost every form of organic life ends in a parasite, or lower grade, and it may yet be found that our assumed causes were only results."

It is not now that bacteriologists are for the first time warned, in solemn words, of the danger of mistaking for its cause what may be a mere result of disease. Again and again has this warning been urged upon them, until one unacquainted with bacteriology might well believe that the warning was based upon observed facts, and that the mistaking of the result of a disease for its cause had become a pitfall into which bacteriologists almost habitually stumbled. It is not surely unreasonable to ask, that

when next this familiar danger signal is unfurled it shall be accompanied by a statement of the facts which have prompted its use. Dr. Pollock's reference to tubercular disease is plainly stated in his words of warning ; the application of them to Koch's work on tuberculosis is clearly intended. It is not, then, going too far to ask, on what grounds that work is challenged ? What error is there in it to justify the casting of grave doubts upon its trustworthiness ? If any man knows of such an error, it is his duty to lose no time in placing that knowledge at the service of the medical profession in every country. This matter is of the utmost consequence, because very grave issues hinge upon it, and amongst them is the fact that one of the strongest arguments in favour of the view which regards consumption as a communicable disease, rests wholly upon the truth of the belief that all tubercular disease is caused by a living organism. That being so, it follows that any attempt to show just cause for classing consumption amongst communicable diseases, should be preceded by a clear statement of what was Koch's work concerning tuberculosis, and of the facts and arguments upon which it rests.

CHAPTER II.

DR. KOCH'S RESEARCHES CONCERNING TUBERCULOSIS.*

On March 24, 1882, in a paper read before the Physiological Society of Berlin, Dr. Robert Koch claimed to have established, by experiment and by observation, the existence of a micro-organism which is associated with tubercle, and not only associated with tubercle, but also the cause of all tubercle. This organism is a bacterium, of the kind known as a bacillus, and it is, of course, rod-shaped. In length it varies from about $\frac{1}{3000}$ to $\frac{1}{12000}$ in., and its breadth is about one-fifth of its length. In looking at a specimen of this bacillus it will be seen that it sometimes contains spores, two to four in number, ranged along the length of the organism.

Since the above date, no observations have been published which disprove Koch's work. On the other hand, the bacillus described by him has been found, by several observers, in the tissues, and in the sputa of persons whose conditions of disease would have suggested to any clinician, of ordinary experience, the probability of the presence of tubercle in the patient. It must, then, be admitted, that we have now to deal

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* The substance of this chapter first appeared in a paper by the author, which was read before the Glasgow Medico-Chirurgical Society on December 1, 1882, and published in the *Glasgow Medical Journal* for February 1883.

with a new fact which characterises, by the presence of this organism, certain cases of disease of well-known type. For those who find themselves justified in accepting Koch's results as true, all difficulties about the nature of these cases must cease, as soon as it is found that the patients concerned harbour in their tissues, or in their secretions, or excretions, this bacillus of tubercle.

The bacillus is demonstrated in tissues by employing a staining process first described by Professor Ehrlich. Koch adopted this process in preference to the one devised by himself, and with the aid of which he worked out all his early experiments. Ehrlich's process will be found fully described in the *British Medical Journal* of October 14, 1882, and Professor Vignal makes some useful remarks upon the process in the same *Journal* on October 28 of that year. It is, for these reasons, unnecessary here to touch upon the method of investigation required for the detection of the bacillus. There is one error in the remarks that appear in the *Journal* of October 14. It ought to have been there stated that the bacillus of leprosy gives precisely similar results with those shown by the bacillus of tubercle, when these two organisms are submitted to the process of staining devised by Ehrlich. There are, however, some differences in form, as Koch points out, between the two bacilli. The bacillus of leprosy is "more slender and more pointed at the ends" than that of tubercle. They are also distinguished from one another by the colour test of Weigert, to which the bacillus of leprosy responds; that of tubercle, on the contrary, is by it unaffected.

Koch thus describes the appearance of the bacillus in tuberculous tissues : " In all cases where the tuberculous process is in its early stage and progressing rapidly, the bacilli are to be seen in great numbers. They then lie thickly, and often in groups or small bundles inside the cells, and in some places give the same appearances as the bacilli of leprosy when they are found in cells. Near these (groups or bundles) are found numerous free bacilli. Especially on the borders of large cheesy deposits crowds of bacilli appear, which are not shut up in cells."

" As soon as the highest point of the tubercular eruption is overstepped the bacilli become rarer, or are only to be found in little groups or singly at the edges of the tuberculous deposits, and lying near them are bacilli so faintly coloured as scarcely to be recognisable ; these are, presumably, already dead or in the act of dying. Finally, they may quite disappear, although they are rarely altogether absent, and then only in such places as those in which the tuberculous process has come to a standstill."

In his lecture, Dr. Koch lays emphasis upon the connexion which appears to exist between the presence of the bacillus and of the giant cell. " If," he says, " in the tuberculous texture giant cells appear, then the bacilli lie by preference in these structures. In cases of very slowly progressing tuberculous processes, the inside of those giant cells is generally the only place where the bacilli are to be found."

Koch has a theory about the connexion between the giant cell and the bacillus, and it is this : " It is to be concluded from the size and position of the giant cells containing bacilli, that these cells are the

youngest, while, on the other hand, those cells which are free from bacilli are the oldest, and it is to be assumed that these last originally contained bacilli, and that the organisms have either died, or have gone over to that condition which will presently be described. From the observations of Weiss, Friedländer, and Laulamié, according to whom giant cells were formed around foreign bodies, such as vegetable fibres and the eggs of strongylus, we may be able by analogy to realise the relation of the giant cells to the bacilli. We may infer that here also the bacilli, as foreign bodies, are enclosed by the giant cells, and on this account, if the giant cells are found empty, all further relations of the tuberculous process go to show that the presumption is correct, that the giant cells had formerly harboured one or more bacilli, the organisms having occasioned the origin of the cells." So much for the appearances described by Koch as illustrating the presence of the bacillus of tubercle in tissue, and its peculiarities there. It makes no difference whether the bacillus is seen in a human being, or in a monkey, a guinea-pig, a mouse, or a hen, the organism is always the same.

And now as to the facts upon which Koch, on March 24, 1882, founded his claim for the recognition of this organism as associated with tubercle. He found the bacillus present in the following cases :

1st. In the human subject—

11 cases of miliary tubercle.

12 cases of "cheesy bronchitis" and pneumonia. (In six of these cavities had formed.)

1 case of tumour of brain, of the size of a hazel-nut.
2 cases of freshly extirpated scrofulous glands.
2 cases of synovial degeneration of joints.
Twenty-eight cases in all.

2nd. Amongst the lower animals—

10 cases of *perlsucht* of the ordinary type.
1 case of caseous cervical gland in a pig.
1 case of a hen which died of tubercle.
3 cases of spontaneous tubercle in apes.
9 cases of spontaneous tubercle in guinea-pigs.
7 cases of spontaneous tubercle in rabbits.
Thirty-one cases in all.

"Besides these cases of spontaneous tubercle, I examined," says Koch, "172 guinea-pigs, 32 rabbits, and 5 cats, all of them infected with tubercle by the inoculation of the most varied tubercular substances, such as grey and calcified tubercle of human lung, phthisical sputum, tuberculous masses from spontaneously diseased monkeys, rabbits, and guinea-pigs, pieces of lung from cattle suffering from *perlsucht*, cheesy as well as calcified, and, lastly, by inoculation from tubercular affections produced in animals by inoculation." In each of these cases, 268 in all, bacilli were not once wanting, and in many instances they were extraordinarily numerous. So much, then, in proof of the statement that this particular bacillus is found associated with tubercle.

And now comes the third point. It remains still to indicate the line of evidence advanced by Koch

in proof of the belief that this bacillus, and nothing but this bacillus, is the cause of tubercle. To prove this, he carried out a series of experiments in which he took tuberculous particles from animals which had either died of tubercle, or, having tubercle, had been killed for experimental purposes. These particles were about the size of millet-seeds, and were removed from the dead body and placed upon the blood serum, prepared in a certain way, of the ox and of the sheep, with scrupulous attention to all those precautions which are familiar, at least in theory, to every one who is acquainted with what are known as "cultivation experiments." The object of these elaborate experiments was to obtain the bacillus of tubercle free from all taint. Koch believes that he succeeded in attaining this end. After describing how he sowed the tubercular morsels upon the prepared blood serum and watched their slow growth, and noted certain of its peculiarities, he makes a statement which deserves special attention. He says: "The extremely slow growth, which alone is to be obtained at breeding temperature, and the peculiar shovel-shaped, dry, and firm condition of these colonies of bacilli, are not to be found in connexion with any other known bacterium, so that the confounding of the culture of the tubercle bacillus with that of any other bacterium is impossible; and already, with only short experience, nothing is easier than to recognise at once accidental contamination of the culture." This is a very important statement, and it is all the more important when it is made by Koch, one of our best experimenters and observers, and one whose words

carry with them that authority which can be given only to a profound and extensive knowledge, such as his, of the life history of bacteria.

After describing the appearances of the growth of the bacillus under cultivation, he says: "By the help of a low power (30 to 40 diam.) the colonies of bacilli" (undergoing cultivation) "are already visible towards the end of the first week. They appear as very elegant spindle-shaped and S-shaped structures, and also in other similar crooked figures, which, if they are spread out on a cover glass, coloured" (*i.e.*, submitted to Ehrlich's colour test), "and examined with a high power, consist solely of the familiar extremely delicate bacilli." Had any other known organism been present, it is hardly within the bounds of possibility that Koch could have failed to observe it, for upon the accuracy of this observation hinges much of the worth of his researches into the nature of tubercle.

These cultivation experiments were carried on for some time. After from ten to fourteen days' cultivation in one test tube containing the prepared blood serum, some of the crop of the bacilli, which had grown there, was transplanted to another test tube, and, after another ten days or so, some of this second crop was sown in a third test tube, and so on, until, in one mentioned instance, the cultivation extended to 178 days.

On such observations and experiments as these rests the proof, that the bacillus of tubercle was obtained free from taint—"pure," as it is technically called.

Dr. Koch next proceeded to inoculate certain

animals with the pure bacillus, obtained by cultivation. The inoculation was always performed with every care against the possibility of contamination. In each series of experiments several animals were used, including rats, mice, guinea-pigs, rabbits, a marmot, pigeons, and frogs. Some of these animals are, it is well known, difficult to infect with tubercle —á fact which is not without some significance in this connexion.

Koch thus sums up the results of these inoculations: If one looks back upon these experiments, one sees that a not inconsiderable number of animals were experimented upon, on which bacillus culture was brought to bear in very different ways—viz., through simple inoculation into the subcutaneous cellular tissue, through injection into the abdomen or into the anterior chamber of the eye, or direct into the blood stream, without failing, even in one single instance, to develop tubercle; and there had formed in them not solitary nodules, but an extraordinary mass of tubercle corresponding with the large number of infecting germs introduced." In each of these series of experiments—there were thirteen in all—a certain number of animals were not submitted to the inoculation of the cultivated bacilli. These animals had been bought at the same time, and fed and lodged in the same way, and in the same places, though not in contact with those animals which were inoculated with the bacilli, but not one of the former showed any evidence of tubercle, either during life, or after they had been killed and examined, post-mortem. It must be remembered that these cultivation experiments were

made with tubercle taken from the lungs, calcified mesenteric glands, and freshly extirpated scrofulous glands of human subjects, as well as from the lower animals, and that there was no difference whatever in the effects produced by inoculating from these two distinct sources; and the bacilli from these two sources were also identical in appearance.

Dr. Koch makes some very interesting observations about certain distinctions which he draws between tubercle occurring spontaneously in an animal, and that type of tubercle which results from inoculation. He bought and examined one hundred guinea-pigs, all of which were healthy. Several of them were shut up in a room with other guinea-pigs, which had been inoculated with the virus of tubercle. In three or four months, but never before the lapse of that time, spontaneous tubercle began to show itself, and always sporadically, amongst the uninoculated guinea-pigs. In them the bronchial glands were "always found unusually large and purulent, particularly, also, in the lung was to be found a large cheesy mass, with very far advanced breaking down in the centre, so that, sometimes, as in human beings, it had reached to actual cavity. The development of tubercle in the organs of the lower part of the body, was very far behind that in the lung. The swelling of the bronchial glands, and the commencement of the development of tubercle in the organs of breathing, leave it beyond a doubt, that the tubercle of these animals was an inhalation tubercle, springing from a few, or possibly only one infectious germ, and, on that account, very slow in its progress."

Contrast that description with what Koch says about inoculated tubercle: the contrast will be found to be very suggestive. "The place of inoculation was in the belly of the animal, near the inguinal glands." The first sign of the success of the inoculation was the appearance, at the end of a week, of a nodule over the site of the puncture. About the end of the second week, the inguinal glands, beside the wound, began to swell, and sometimes also the axillary glands. From that time the animals grew quickly thinner, and died in from four to six weeks, with marked tubercular affection of the liver and spleen, those organs having been but slightly affected, as compared with the lungs, in the cases of spontaneous tubercle.

Several animals were inoculated with certain substances which did not contain the bacillus of tubercle; for example, morsels of a swollen gland, of degenerated synovial membrane from a joint, of a portion of monkey's lung, kept dry for two months, of another portion of the same lung, which had been kept in alcohol for one month, and in not one instance did the animals, experimented upon with these substances, show any sign of tubercle, either during life, or post-mortem.

Several experiments with sputum from tuberculous individuals are mentioned in Koch's lecture. The sputum was allowed to dry, as it may sometimes be seen drying on the floor of a room, not always in an out-of-the-way corner. Tubercular sputum, dried in this way, was found to be as surely fatal in its results, when an animal was inoculated with it, as had been the case when the cultivated bacillus was

used. The specimens of sputa with which these experiments were made, were from two to eight weeks old.

A highly suggestive series of experiments were performed, with the view of ascertaining the effects of varying quantities of bacilli upon animals, into which the organisms were introduced by injection. The anterior chamber of the eye was selected as the site of the experiments. In one case, the pure prepared blood serum, used in the cultivation of the bacilli, was injected. It was, however, in this instance, unmixed with the bacillus, or any other organism. The animal was killed and examined thirty days after the operation. All its organs were found healthy. No bacilli of tubercle were seen, although they were carefully sought. In another case, the injection was made with blood serum mixed with bacilli, which had been cultivated during 132 days. The needle of the syringe was pushed into the anterior chamber of the eye, but the piston of the instrument was not moved. In this way only an extremely small number of the bacilli could have entered the eye. In a fortnight from the day of the puncture, solitary nodules, of a light golden tint, appeared upon the iris near the site of the puncture. From that time tubercular iritis was developed, and the cornea became cloudy. In thirty days the animal was killed, and, besides the changes in the eye, the glands near the jaw and at the root of the ear were swollen, and contained yellowish-white deposits. In two other cases the injection was made with blood serum charged with cultivated bacilli; but many drops were introduced into the interior chamber of the

eye. These two animals also developed the local symptoms indicated in the last case, and they rapidly became thin. In thirty days they were killed, and, in addition to the local changes, their lungs contained "innumerable tubercles." The lungs of the animal subjected to the inoculation of a minute portion of the blood serum unmixed with bacilli, were free from all sign of tubercle, and so were its other organs.

Experiments exactly similar to the foregoing were repeated again and again, and invariably with like results.

Koch thus begins to sum up and give what he regards as the outcome of his work. He says: "All these facts taken together justify the conclusion that the bacilli present in tubercular substances are not merely the associates of the tubercular process, but the cause of it, and that we have before us, in bacilli, the actual tubercle virus. It is also possible, by this means, to draw the boundary of those diseases regarded as tubercular, which, hitherto, could not be done with certainty. A decided test for tubercle is wanting, and one man considers miliary tubercle, phthisis, scrofula, perlsucht, &c., to be tubercle; another man holds, perhaps with equal right, that all these processes of disease are different. In the future, it will not be difficult to decide what is tuberculous and what is not tuberculous. Not the peculiar structure of tubercle, not its non-vascularity, not the presence of giant cells will decide the question, but the presence of tubercle bacilli—be it in the tissues by the colour test, or be it through culture on prepared blood serum. This criterion,

taken as a guide, must, according to my researches, stamp miliary tubercle, cheesy pneumonia, 'cheesy bronchitis,' tubercle of glands, and of the intestine, 'perlsucht' in cattle, inoculated and spontaneous tubercle, as identical."

Many points of great interest have not been touched upon in this attempt to summarise Dr. Koch's work on tubercle, which received from him, in his lecture, considerable attention. It is hoped, however, that enough has been said to indicate the skill and thoroughness with which this most laborious investigation was carried to a successful conclusion.

CHAPTER III.

EVIDENCE IN BACTERIOLOGY.

From the point of view of the bacteriologist, the complete proof that a certain bacterium is the cause of a given disease is threefold :

I. The identity of the bacterium must be established.

II. The disease and the bacterium must be shown always to co-exist in the same individual.

III. The bacterium must be taken from the diseased tissues, and pure cultivations of it having been obtained, it must, in that form, be shown to cause, on being introduced into suitable healthy animals, that disease alone with which it was associated.

By "suitable healthy animals," is here meant those animals capable of contracting the disease in question. As is well known, no animal has been shown to be susceptible to every kind of disease. Certain diseases to which man is subject, have not yet been observed amongst brutes. It is, therefore, obvious that some conditions of disease to which man is prone, and which are probably caused by bacteria, cannot, with our present knowledge, be reproduced in the lower animals. The third part of the complete proof stated above is, therefore, not infrequently wanting.

Koch's researches on tuberculosis meet, to the full, every requirement of the bacteriologist. No theory,

of any kind, is necessary to help the student to recognise the ability of the worker, and the convincing completeness of his work.

It is worthy of note that, to this day, not one of the numerous adverse criticisms which this remarkable work naturally evoked, has had the slightest material effect in stopping the spread, and the general acceptance of its teaching, amongst the scientific thinkers of our time. So large a number of them have accepted Koch's doctrines, practically in the very words in which he first taught them, that, I venture to repeat, it is incumbent on those who still disbelieve or doubt what he has taught concerning the cause of tuberculosis, to bring forward experimental evidence in justification of their position. They must now accept the *onus probandi*, for they are the people who are attacking an established belief.

In what I have still to say here, I shall take it as proved that consumption, and all other tubercular diseases, are caused by the effects of a parasite living in the body of the diseased person ; that that parasite is the tubercle bacillus which Koch discovered ; that without that parasite the existence of tubercular disease is impossible.

CHAPTER IV.

HAUNTS OF THE TUBERCLE BACILLUS.

In an inquiry of this kind, one of the first questions to which an answer must be given is, Where, and in what conditions, may we come into actual personal contact with this parasite, which is the cause of all forms of tubercular disease? To answer that question is, of course, very easy; for wherever tubercular disease is, there is the parasite. We know that this organism is found in all tubercular tissues in which the disease is active. The expectoration and other secretions of the air-passages, in all animals whose lungs, throats, mouths, or nostrils are the seats of tubercle, frequently contain tubercle bacilli, sometimes in very large numbers. When the kidney suffers from tubercular disease, the urine may contain the bacillus. The bowel discharges often carry that organism with them, when intestinal tubercular ulcers are present. A large number of those persons who suffer from disease of the spinal column, owe that condition to the presence of the bacillus of tubercle in the affected parts of the spine. Many diseases of joints and of bones are tubercular. The skin may be the seat of tubercular disease. We pass in the streets numbers of persons, mostly young, who have swelled glands in their necks, and these too, more frequently than not, are the indications of

a tubercular affection of those glands. Not one of all those conditions of disease, be it remembered, could exist without the tubercle bacillus.

When tubercular disease reaches a certain point in its natural history, its tendency is to break down those tissues of the body which have harboured it. In cases of joint disease, or of spinal disease, or of an affection of a long bone, abscesses form as the disease progresses and destroys the tissues around its site. If the discharges from these abscesses are examined, tubercle bacilli may be found in them. The pus which escapes from scrofulous glands in the neck, or elsewhere, may contain tubercle bacilli. The organism is practically always present in the expectoration of persons whose mouths, air-passages, or lungs are the seats of tubercular disease, provided there is breaking down of tissue. The reason for qualifying the statement contained in the last sentence by the use of the phrase "practically always," is twofold. In the first place, it sometimes happens that tubercle bacilli may not be found, even after careful search has been made for them, in the expectoration of a consumptive with well-marked symptoms of his disease. Again, there is a well-known class of consumptives whose expectoration may often be tested for that organism, and yet it may only be found there at long intervals. These last mentioned are cases of "fibroid" phthisis, and they have been very fully and accurately described by Sir Andrew Clark. Their chief clinical feature is their markedly chronic course. The very fact that patients afflicted with this form of consumption may live for ten, fifteen, or twenty years after the first

appearance of the disease, is sufficient, of itself, to explain why the expectoration in such cases, as a rule, contains very few tubercle bacilli. Practically, however, it is true that the expectoration of a consumptive always contains that specific bacterium. For reasons to be stated further on, it is of the utmost importance that this fact, put in that bald way, should be impressed upon every intelligent man, whatever may be his position in life.

Various sources have now been stated whence we can, almost at will, obtain this organism which causes all tubercular disease. Is there, then, any evidence that consumption has been shown to spread to persons previously healthy from any of those sources? The answer to that question must be determined by evidence. Having studied and weighed that evidence for himself, every medical man should, I venture to say, form a clear opinion about the answer he would give to the question—Is consumption a communicable disease or is it not?

CHAPTER V.

EVIDENCE SHOWING THE COMMUNICABILITY OF CONSUMPTION.

The evidence on which this grave issue hangs is chiefly twofold—first, experimental evidence ; second, a record of cases taken from the practice, both public and private, of trustworthy observers.

With regard to experimental evidence, it is completely given by Koch himself in the paper to which reference has already so frequently been made. The *résumé* of it in Chapter II. is, I hope, sufficient to give a clear idea of this part of the evidence. With the exception of Dr. Cornet, not one of the many workers who have followed the teaching of Koch on tuberculosis has, so far as I know, added any very important fact to his discoveries. Their work, it is hardly necessary to say, is most valuable, because it has all helped materially to strengthen Koch's results by confirming them.

And now, as to the records of published cases, which bear with considerable weight upon the subject. The following case is recorded in the *Annales de Dermatologie et de Syphiligraphie*, vol. v., 1884, pp. 362, 363, 364. A man seventy years old, with neither personal nor hereditary tendency to tubercle, had a whitlow on his left thumb. The abscess was opened with a bistoury. Later on, ulceration set in

a little above the left wrist, on its radial side. The ulceration measured 11 centimètres in length, and 1½ to 4 centimètres in breadth. M. Hanot detected the tubercle bacillus in pus taken from the ulceration. One year later this man showed signs of pulmonary tubercle. He died, and post-mortem examination showed the presence of tubercle in his lungs. The axillary glands were sound. It is surely not unreasonable to suppose that this man's whitlow was either itself the result of tuberculous inoculation, or was opened by a knife which carried that infection. It seems also reasonable to believe, that his lung tubercle was caused by infection from the site of the whitlow.

In vol. vi. of the same *Annales*, p. 668, Dr. Tscherning, of Copenhagen, reports the case of a woman, twenty-four years old, in good health, robust, without hereditary predisposition to tubercle, and showing no evidence of herself having tubercular disease, who was cook in the house of Professor H. He died in 1884 of pulmonary consumption, which had lasted about six months. During the last days of his illness, his expectoration was a "pure cultivation of tubercle bacilli." A few days before his death, the glass vessel into which he used to spit was broken, and this woman pricked her finger with one of the fragments. Fourteen days afterwards, she consulted Dr. Tscherning, for the first time. She then showed symptoms of whitlow of the injured finger. Carbolic acid applications relieved her symptoms. Eight days afterwards there was no trace of suppuration, but there was felt, in the subcutaneous cellular tissue, a little hard lump

about the size of a pea. It was painful, and surrounded with a zone of œdema. About one month afterwards, Dr. Tscherning cut out this nodule, and found it composed of granulation tissue. It lay between the skin and the tendon. The wound rapidly healed, under a dressing of iodoform and perchloride of mercury. A little more than a month later, the patient again presented herself with a considerable swelling affecting the same finger, but now encroaching upon the palm of her hand, and interfering with the movements of flexion. The disease got worse. About ten weeks after the first operation, through the œdematous skin, a thickening in the sheath of the tendon could be easily felt. At this time two swollen glands in the forearm, and two others in the axilla, were noticed. In other respects the woman was in perfect health, and the lungs were sound. About eleven weeks after the incision of the nodule, Prof. Studsgaard cut out the axillary and forearm glands, and removed the finger at the metacarpo-phalangeal articulation. At the same time, through an incision in the palm of the hand, Prof. Studsgaard removed, up to that joint, the tendon and its sheath. He also scraped away all subcutaneous granulations. In eleven days the wounds healed completely, beneath an antiseptic dressing. Under the microscope, the diseased tissues were found studded with typical tubercles, that is to say, tubercles with caseous centres, and giant cells. In these giant cells, and around the caseous material, and more frequently in isolated positions, tubercle bacilli were found, and they were also present in the swollen glands. The

patient was in good health when seen about two months after the operation.

Dr. Karg, in the *Centralblatt für Chirurgie*, August 8, 1885, records the following case :

A hospital dead-room porter, aged thirty-eight, had followed that employment during six years, and was often occupied in opening dead bodies. He was married, the father of two healthy children, and had no symptom of tubercular disease. For several years he had had upon his left thumb, close to the meta-carpo-phalangeal articulation, a nodule which, treated in various ways, sometimes was enlarged, sometimes diminished in size, but never disappeared altogether. One day this nodule began to swell. It became red and painful, and a little later some small nodules were noticed in the forearm. When Dr. Karg saw the patient, there were five abscesses upon the fore-arm, in the course of the lymphatics running from the thumb. The largest of these abscesses was about as big as a cherry. In front of the elbow were two hard nodules, about the size of peas, moving freely under the skin. In the axilla, was a single, swollen, but painless gland. Dr. Karg, suspecting that the case was one of tubercular disease, laid open the abscesses, and removed all the diseased tissues. Under the microscope, sections of the nodules, of the sides of the abscesses, and of the swollen lymphatic glands, were seen to contain tubercle bacilli.

Dr. Axel Holst, of the Christiania Hospital, re-lates a case, in the *Semaine Médicale*, of a hospital nurse who, while attending consumptive patients, had pain and swelling of the right thumb, which opened of itself, and resulted in a sore which refused

to heal. Similar symptoms showed themselves in the right index, and left ring fingers. Later, a glandular swelling was noticed in the right axilla. The open sores were scraped before Dr. Holst saw the case, and, therefore, he did not there search for tubercle bacilli; but in the axillary glands, which were excised, he found that organism in large numbers.

Dr. Paul Raymond, in the *France Mēdicale*, 1886, Nos. 99, 100, and 101, reports certain cases, of which the following is one :—A man, aged sixty-two years, without any symptoms of tubercular disease, but whose two sisters and wife died of tubercle, pricked himself with a thorn. At that time this man slept with his consumptive wife, who died three weeks afterwards. He cleaned out the vessels she used as spittoons, and rubbed with his hands the handkerchiefs into which she used to spit, in order not to send them in quite such a soiled state to the laundry. After fifteen days the little sore made by the prick of the thorn, began to get larger, and, four weeks later, little abscesses formed around the ulceration and opened into it. When he was admitted to the hospital, the sore was of the size of a five-franc piece. There were two enlarged and slightly painful glands over the inner condyle of the humerus. The lungs were sound. The sore healed after having been scraped, and under an antiseptic dressing. In three preparations made from the diseased tissues, tubercle bacilli were found.

In the *France Médicale*, of July 1887, Dr. Cartaz relates that he has collected seventeen cases from various authors, besides a case of his own, in which

tubercle affected the nose. The tubercle showed itself in one of two forms, ulceration or small tumour. These two forms sometimes co-existed in the same individual. The seat of the disease was either close to, or just within, the entrance to the nostrils. Sometimes it spread down the lip. These ulcerations co-existed, almost always, with grave lung lesions, undoubtedly tubercular in character. It is reasonable to conclude that these were cases of auto-infection by tubercle.

Drs. Reverdin and A. Mayor, in the *Revue Médicale de la Suisse Romande*, of July 20, 1888, record the case of a student of medicine, twenty-two years of age, who pricked his finger while performing the post-mortem examination of a person dead of consumption. The wound was upon the back of the index-finger, and it speedly assumed the appearance of a tubercular growth. Reverdin excised the fungoid mass, which involved the structure of the finger down to the deep fibrous tissue. Dr. Mayor examined the diseased tissue, and found in it the usual evidences of tubercular growth, and, amongst them, several little groups of tubercle bacilli.

CHAPTER VI.

FURTHER EVIDENCE OF THE COMMUNICABILITY OF CONSUMPTION.

It may be said, that the instances recorded in the last chapter are cases illustrating the well-known truth, that tubercle, in all its forms, is an inoculable disease. That, of course, is a fact, everywhere recognised as true. The point to be kept well in view is, that without the presence of the tubercle bacillus, or of its spores, inoculation of tubercle would be impossible. Since that organism became known to us, no one has succeeded in showing any instance where tubercular disease has been caused without the agency of this bacterium. Cases like those just detailed, bring forcibly before one's mind the fact, that consumption may, and does, result, not infrequently, from inoculation in the every-day sense of that word. But the disease is due to a germ, which, in order that it may accomplish the only purpose we know it to serve, must find a nest for itself in an animal whose body is congenial to its growth. In that way only can consumption arise, and, therefore, that condition of disease must always be due, strictly speaking, to an inoculation. It will be plainly obvious, that the evidence of the inoculation of the disease cannot always be so clear as it is in cases where the source of infection is, so to speak,

under our eyes. If, for example, there are tubercle bacilli in a room, and a man, while in that room, by some act of his, sets these organisms afloat in the air of the room, and then inhales one or more of them, will it seem forcing what we know are facts if we regard that man as therefore in great danger of becoming a consumptive? He has drawn into his air-passages, or into his lungs, the living germ whose growth in his body means, beyond a doubt, the development there of consumption. Cases like those mentioned in the last chapter, illustrate familiar truths in the natural history of consumption. No one, I suppose, doubts their truth. Yet, in the face of that it seems strange that there are men, whose lives have been spent in the study of disease, who do not admit that the inhalation of the tubercle bacillus, by healthy human beings, is likely to be a fruitful source of consumption! As has just been pointed out, the evidence of the source whence came the tubercular infection, cannot always be demonstrated with equal clearness. Where a disease follows from the results of a wound, the evidence appeals much more strongly to our physical senses, than where something happens which cannot be seen or touched. From that point of view, then, it must at once be admitted, that in seeking evidence of consumption being caused by the inhalation of tubercle bacilli, we have to use the mental, almost as much as the physical eye. We cannot see the spot where, on being taken into the air-passages, the bacillus finds its nest, and begins its work of destruction, any more than we can trace the course of the organism when it is drawn, during the act of inspiration, from the

outer air into the lungs, or elsewhere. If, however, we can show that there are, in certain circumstances, tubercle bacilli present in places where men are wont to go, then, it seems to me, it would be but a wilful shutting of our eyes were we to close them to, at least, the very high probability of the inhalation of those organisms being a cause of consumption. The evidence concerning that part of our subject is clearly of very great importance, and deserving of our best attention and consideration.

We will begin this division of the evidence, by going over some of the admirable observations resulting from Dr. Cornet's two years' work in the Berlin Hygienic Institute. They are published, in pamphlet form, by Messrs. Richter of Hamburg.

Dr. Cornet's experiments, to which reference will be made now, were conducted with a view to ascertaining whether, in places occupied by consumptives —such as hospital wards, and private residences— tubercle bacilli were present in such numbers as to be a cause of material danger to animal life. He sterilized sponges, and with them washed the walls and floors, or whatever parts of a room, or its furniture, he wished to examine. Then broth was inoculated by those sponges. If the sponges, in the use to which they had been put, took up tubercle bacilli, those organisms would, of course, grow in the broth, and it being injected into healthy guinea-pigs, these animals, if they showed symptoms of tuberculosis after receiving the injection of the broth-culture, gave clear evidence that tubercle bacilli had gained access to their bodies. When these experiments had been sufficiently multiplied and controlled, the con-

clusions warranted by the facts shown were, that tubercle bacilli were often present where consumptives lived, and that the organisms were frequently sufficiently numerous in those places, to be a source of grave danger to animal life. The guinea-pigs, used for these observations, were killed forty days after their inoculation with the broth, and the condition of their bodies was carefully ascertained by post-mortem examination, as was also done if death happened from any intercurrent cause, before the lapse of forty days. When, in the following record of his work, it is stated that Cornet found tubercle bacilli in this or that set of circumstances, it is meant, that the test of the presence of the bacilli was that which has just been given above.

Of twenty-one hospital wards, where the majority of the patients were consumptives, fifteen of the wards yielded dust which, in the way mentioned, produced tuberculosis. In the same way, it was shown that dust from walls in lunatic asylums was often found infected with tubercle, so also were the walls and floors of rooms in private houses where consumptives had lived. It may be mentioned here, that special attention is due to what Cornet has observed concerning the danger to the healthy community resulting from the habit, which some consumptives have, of spitting upon the floor. The subject will be dealt with further on, and so a mere mention of it here will suffice.

Amongst other places that did not yield tuberculous dust, Cornet ascertained the out-patients' departments, and the surgical wards of hospitals, to be particularly free from evidences of its presence.

The following are some of Cornet's experiments:

In a hotel room, where there was living a woman who was tuberculous, tubercle bacilli were found on the bedstead and picture frames.

In the case of a young man, who had been ill for nine months from consumption of lungs and larynx, and whose habit it was to spit upon the floor, tubercle bacilli were found upon the walls beside the sofa. This man's room and his person were kept, Cornet says, scrupulously clean. Taking that for granted, the case shows, as Cornet points out, how, even where cleanliness is prevalent, the cause of tubercular disease may remain in the room which has been occupied by a consumptive, especially if he be given to the filthy habit of spitting about his room, as this man was.

The examination of this room turned out to be full of special interest, because, three and a half months after it had been completed, the brother of its occupant consulted Cornet, and was found to be suffering from commencing consumption. He had previously made no complaint of illness, and Cornet says that he regarded him as quite well when the examination of the room was being carried out. Cornet regards this as a case which may not unreasonably be classed amongst those resulting from infection.

In the workshops of a tailor, and of a corset-maker, where, in the former case, the master, and in the latter a workman, were ill of consumption, tubercle bacilli were found upon the walls of the workrooms. In the case of the corset-maker, the examination of the room was undertaken because of the illness of a

young man, who had developed consumption while employed in the workroom where the other consumptive was.

In the house of a woman who was consumptive, and on the walls of whose room, and on her watch-case, tubercle bacilli had been found during her lifetime, these organisms were found in the same room when a second examination of it was made, six weeks after the woman's funeral had taken place. Animals were inoculated with some of the bacilli then found, with the result, that all the animals became tubercular with remarkable rapidity. The dead woman's children, who still slept in the bed and in the room she had occupied, might very well have inhaled some of these tubercle bacilli.

Three hundred and ninety-two animals were inoculated with dust taken from the private dwellings of consumptives, from hospitals, streets and other places, with the result, that 59 of these animals became tuberculous; 196 of them were killed by the germs of other quickly fatal diseases; only in 137 cases were the inoculations not followed by any evidences of disease having been communicated to the animals operated upon.

Cornet records the fact, that he did not find tubercle bacilli in dust taken from all the rooms in which lived patients who were suffering from consumption. He did not once find it in dust taken from the rooms of those consumptives who expectorated only into spittoons, never spitting upon the floor, nor into handkerchiefs. In these cases, specially careful search was made for the bacilli, but in no instance were they found. The rooms which held tubercle

bacilli in their dust were those which had been occupied by consumptives who were in the habit of spitting upon the floor, or into handkerchiefs. This fact was clearly brought out in connexion with the results of Cornet's observations made upon the dust taken from hospitals, where were many consumptives. In those institutions, where the patients always used spittoons only, never handkerchiefs, when they desired to spit, the bacilli were not found in the dust of the wards.

CHAPTER VII.

COMMENTS ON THE EVIDENCE JUST STATED.

With Cornet's experiments before us, it must be admitted, that where a consumptive is, there it is possible that tubercle bacilli may be found. So far back as 1882, Koch pointed out the danger that might arise from tuberculous sputum left to dry upon a floor. Animals experimented upon with sputa of that kind, that is, allowed to dry on a floor for from six to eight weeks, were killed by it, dying as rapidly of tuberculosis as animals submitted to the inoculation of tubercle bacilli, growing in pure cultivation.

Cornet's experiments also show, that tubercle bacilli are not found, or, at all events, are but rarely found, in the surroundings of a consumptive, who, when he spits, always uses a properly arranged spittoon, and never expectorates elsewhere. Now this is an observation of the first importance. Even one who doubts the truth of the doctrine which teaches that tubercle bacilli cause consumption, would hesitate to affirm that the man runs no risk who lives in a room known to contain those organisms in its dust. By this observation, Cornet has plainly indicated one means by which the diffusion of tubercle bacilli in the air and in dust can be very greatly limited. One chief source of the organism which is

the cause of tubercular disease, is the expectoration of consumptives. Koch's teaching in that connexion, did not take that firm hold upon the minds of medical men, which, had they clearly grasped the teacher's meaning, must have obliged them to take prompt measures for treating the expectoration of consumptives as something in a high degree dangerous to the well-being, and even to the lives, of the healthy community. We know very well, that to-day it is not only unusual, it is even remarkably uncommon, to find the expectoration of the consumptive, who is not an inmate of a hospital, regarded as a thing so dangerous that it should receive particular attention, with a view to securing its destruction before harm can come of it. In private life, it is rarely that one hears any reference made to the danger which we know lies in tuberculous expectoration. Practically, it is either unknown, or regarded as a delusion of men carried away by foolish beliefs in the wild teachings of a misguided German professor! For eight years, that erroneous view of this most important truth has received the support of well-known members of the medical profession in England and elsewhere. To-day, if acts are to be taken as indicating the value of the convictions of not a few medical men on this head, their belief concerning the dangers which spring from the expectoration of consumptives, is of the feeblest and most colourless kind —not, indeed, worthy of being called a belief. Yet it is, I think, a fact, that the outcome of Koch's teachings receives to-day more tacit acceptance than was the case a few years ago. Then the mere mention of the name of the distinguished Berlin professor

sufficed to evoke, not infrequently, expressions of profound disbelief in his work, so far as it related to tubercle. It was openly held up to ridicule in certain medical journals, and any attempt to apply it to details in the management of consumptives, was then regarded, by not a few of the medical profession, as distinctly and needlessly disquieting to the patient and his friends. It may not be out of place to indicate what is here meant by giving an instance in point. In the autumn of 1882, I read a paper, entitled "The Bacillus of Tubercle," before the Society of Medical Officers of Health. It is published in the Transactions of that Society for 1882–83. In that paper is the following statement: "Now, if Koch's experiments with tubercular sputum are correct, there open out to us probabilities, which have facts for their foundation, concerning the way in which phthisis is spread amongst men. Taking his views as true, we must admit, it seems to me, that the expectoration of a consumptive person probably always contains, in greater or less amount, a poison of the most virulent kind. Apply this knowledge to occurrences which must have been frequent in the experience of every medical man. I cannot better illustrate what I mean, than by relating to you an experience of my own. Not long ago, I saw a patient, for the first time, who was far advanced in consumption. While I was examining her chest, she was seized with a violent fit of coughing. When it had passed off, she asked the nurse to give her a handkerchief. After spitting into a vessel what had been coughed up, she wiped her lips with the handkerchief, and the nurse laid it upon the

mantelshelf. During my visit there was a second, but slighter, attack of coughing, and after it the patient took another handkerchief from beneath her pillow, and passed it over her lips. Now, here were sources from which, with Koch's work before us, we cannot say that it was impossible for infection to spread. I think that if we believe that Koch has shown us the truth about tubercular sputum, we are bound to regard it as, at least, very possible that, without proper precautions, those two handkerchiefs might have conveyed tubercular disease to other people; for I found, on examination, that this patient's sputum contained bacilli in large numbers. These handkerchiefs might have been thrown into a soiled linen-basket containing other articles, and, sooner or later, they must all have been washed, and so several persons must have handled materials some of which carried on them a virulent contagium. Again, consumptives often live for years after their disease has declared itself, and how many of these sufferers habitually keep handkerchiefs under their pillows?" That statement of mine was described only two or three years ago, as a "sensational" one; yet it surely contained nothing which, even in 1882, when it was made, was aught else than the expression of an inevitable consequence of Koch's demonstrations of the cause of tubercular disease. I much doubt whether any scientific physician who has had clinical experience, would now characterise that description as "sensational"; and I am sure that the great majority of such men would hold that what I then said is an accurate statement of what we know is a fact. This change of attitude is a great

gain to those who feel sure, that with a general belief in the bacterial origin of tubercle, there will come, on all sides, a determination to act upon the practical lessons which that belief teaches, and which have for their outcome the adoption of every means tending to prevent, or, at least, very greatly to lessen, the spread of consumption. It cannot be too deeply impressed upon all intelligent people, that the spread of consumption means the spread of the tubercle bacillus. Stop or diminish the spread of the disease, and it is certain you must have previously stopped or diminished the supply of the organism without which there can be no consumption.

CHAPTER VIII.

TUBERCLE BACILLI AND THE BREATH OF CONSUMPTIVES.

THERE can be no doubt that the sputum of consumptive men and beasts is a chief source of the supply of the tubercle bacillus. Other sources of infection have been already pointed out, but, compared with this one, they are, with perhaps one, possibly two exceptions, of but trivial moment. These exceptions are the flesh and the milk of tuberculous animals, when used as food. It is, however, practically certain that tuberculosis in beasts is oftenest caused by infection carried from one animal to another, through the medium of tubercular sputum. It may, therefore, be rightly said, that the expectoration of consumptives yields the chief supply of the germ which causes all tubercular disease. It used to be thought, and some still believe, that the breath of consumptives carries with it tubercle bacilli. Several observers have shown by experiment, that guinea-pigs and rabbits can breathe with impunity air that has been expired by consumptives. The close association, without actual contact, of consumptive with healthy animals, so that the latter must constantly breathe the expired air of the former, does not, according to these observers, result in the healthy animals becoming consumptive. If, however, the animals are

made to live together in actual contact, the healthy ones invariably become consumptive.

In 1883 I performed some simple experiments, with the view of ascertaining whether the breath of persons whose lungs were deeply tubercular, contained this bacterium. Six hospital patients, far gone in consumption, were directed to breathe with usual expiration, with forced expiration, and to cough into test tubes. Each patient used one tube for all three acts. By means of Ehrlich's test and the microscope, I found a few tubercle bacilli in two of the tubes. I do not know during which of these three acts of expiration the bacterium got into the tubes. It seems to me probable, from what we now know, that it was during coughing that the patients' breath carried with it a speck or two of saliva, and so tubercle bacilli were found in those two tubes.

During last summer, my colleague Dr. Wethered kindly supplied me with a dozen sterilized test tubes, plugged with cotton-wool in the usual way. The object I had in view was to use these tubes for the same purpose for which I had used the others in 1883.

Before carrying out the experiments, I ascertained, by placing a solution of lime in test tubes similar to those I was going to use, that the breath, in the conditions laid down for the experiments, would go to the bottom of the test tube. The conditions of the experiments were, that the patients selected should send expired air down these tubes in three different ways—viz., by ordinary expiration, by slightly forced expiration, and by coughing. In the observations made with the tubes containing lime-

water, it was found that a white cloud appeared in the water when the tube was breathed into, in each of those three ways—showing, of course, that the breath reached the level of the lime-water, which was about an inch deep. Four hospital patients used the sterilized tubes in the three ways described, one tube for each act of expiration. At my request, Dr. Wethered kindly examined six of these tubes, and I examined the other six. We did not find tubercle bacilli in any of them.

With the help of a patient who was dying of consumption, and whose sputum contained tubercle bacilli in large numbers, I was able to make some further observations. He was a very intelligent man, and much interested in the object of these experiments, which he clearly understood. I supplied him with large watch-glasses, and with shallow glass vessels. Into the watch-glasses he breathed in the ways mentioned above. After breathing into them, he covered them with inverted watch-glasses. The shallow glass vessels he placed, here and there, upon his bed, in positions most likely to be reached by his breath. When he was about to fall asleep, he covered these vessels with plates of glass, and placed them on a side table. In some of the later of these experiments, the vessels and watch-glasses had been in the patient's keeping for several days, during which he followed the directions I had given him. I examined eighteen of the vessels and watch-glasses. In no instance did I find tubercle bacilli in any of them.

Dr. Ransome in 1882, and Dr. Theodore Williams in 1883, published accounts of experiments they had

performed, with a view to ascertaining whether or not the air expired by persons in an advanced stage of consumption contains tubercle bacilli.

Dr. Ransome's experiments are recorded by him in the 24th volume of the *Proceedings of the Royal Society*. He there states that he condensed "the vapour of the breath in a large glass globe, surrounded by ice and salt." He mixed the condensed vapour of the breath, sometimes with fresh white of egg, sometimes with mucus from the mouth of a non-tuberculous person. The object of that was to "afford a basis by which the substances obtained could be made to adhere to the microscopic cover glasses." By a modification of Ehrlich's process, Dr. Ransome examined the vapour of the breath got in this way, with the result that the "aqueous vapour obtained from two persons suffering from phthisis" was found to contain tubercle bacilli. Dr. Ransome adds that, "In several cases of acute phthisis the search for the organism was unsuccessful, and none were found in the aqueous vapour condensed from the waiting-room of the Consumptive Hospital in Manchester."

It would be interesting to know whether Dr. Ransome's patients, with whose breath he experimented, did, or did not, cough into the glass globe, or in its direction; also, whether their lips might have come into contact with the mouth of the glass globe. In either event, it is obvious that there is a possible fallacy in the experiment. Upon these points the record of Dr. Ransome's experiments, in the *Proceedings of the Royal Society*, gives no information.

So far as collecting the tubercle bacilli is concerned, the experiments of Dr. Theodore Williams were performed in the extraction shaft of a hospital ward filled with patients in an advanced stage of consumption. Glass plates, "well cleansed, sterilized and smeared with glycerine," were hung up in the extraction shaft for two or three days at a time." Dr. Williams states that those plates "were then carefully tested," and that they contained "a few well-marked" tubercle bacilli. Cornet's experiments have shown us, that on the surroundings of consumptive patients, tubercle bacilli are often found. That being so, Dr. Williams' experiments are open to the very important objection, that they do not indicate the source whence the bacilli were derived. Judging from what we know, the organisms were more likely to come from the patient's surroundings, than from the patient's breath. At present, therefore, it seems highly probable, that the breath of a consumptive very rarely, if ever, contains tubercle bacilli. On the other hand, it seems likely, that when he coughs he is always apt to be a source of danger to others, because it is seldom that coughing is not accompanied by the scattering of specks of saliva from the mouth. The danger of infection is in the saliva, not in the breath.

Thinking it might be worth while to observe some of the results of coughing amongst consumptives, I took opportunities, as they offered themselves, to make a few experiments in that connexion. The cases selected were those of six men whose expectoration I knew contained tubercle bacilli. When these men coughed involuntarily, a sheet of clean

paper was held before their mouths, and any moist spots then seen on the paper were examined by Ehrlich's colour test. In two out of twelve pieces of paper thus examined I saw a very few tubercle bacilli in four of the moist spots. The paper was held well clear of the patients' lips. This method of investigation was laborious and unsatisfactory, because so many tubercle bacilli might have been overlooked. I therefore asked my colleague, Dr. Ruffer, who was then occupied with some cultivation experiments, to test the moist spots on the paper by means of the culture method. Dr. Ruffer sent me the following note :

I have examined four cases of advanced phthisis, to see whether the droplets of fluid which are propelled by phthisical patients when coughing, contained bacilli or not.

The patients were made to cough on a piece of white paper, and the droplets of fluid, present on the piece of paper, examined by pressing a clean cover glass on them, and by isolation in cultures on glycerine-agar.

The two first patients (*a* and *b*) coughed *unconsciously—i.e.*, without being told to do so—on the paper. In the first (*a*) one droplet out of several examined showed the characteristic staining reactions of tubercle bacilli, but I was unable to isolate the latter by cultures.

In the second case (*b*) I was able once to isolate the tubercle bacillus on glycerine-agar, out of a pearl-like drop coughed on the paper. I was not successful in four other attempts at isolation, but obtained positive results twice with cover-glass preparations, though I was unsuccessful in several other attempts.

The third (*c*) and fourth (*d*) persons were cases of advanced phthisis also, but were instructed to cough on a piece of paper held about four inches from the mouth. In *c* I was unable to find tubercle bacilli after repeated examinations, and in *d* I only once found a few in five cover-glass preparations examined. Attempts to isolate the bacilli in *c* and *d* were quite unsuccessful.

It is, of course, evident, from these observations, that whenever a consumptive coughs he may scatter near him particles of saliva which may carry with them the virus of tubercle. Probably the tubercle bacilli thus set free are few in number, but they constitute a real danger.

CHAPTER IX.

HEALTH STATISTICS OF THE CATHOLIC NURSING ORDERS IN PRUSSIA.

I DESIRE very heartily to thank Dr. Cornet of Berlin, for the great kindness and courtesy with which he, at my request, placed at my disposal his most important work upon the subject-matter of this chapter. I have also to thank Dr. Cornet—and I do so with a deep sense of my indebtedness to him—for the approval he kindly expressed of my intention to lay before my readers the tables of statistics which appear in this chapter, relating to the Prussian Nursing Orders. These statistics were obtained, at Dr. Cornet's request, by the Prussian Minister of Public Worship.

Accepting it as true that tubercle bacilli are practically never found in the air expired by consumptives, we are able to understand, in some measure, why it is that many people, who are often closely associated with consumptives, frequently escape infection by them. Believing that the dried expectoration of consumptives is a great source of tubercular infection, we naturally look for evidence of the spread of that disease amongst those whose duties require them to keep patients and their surroundings clean.

The most valuable observations, with which I am acquainted, bearing upon this part of the subject,

are those which Cornet recently published in the *Zeitschrift für Hygiene*, vol. vi. part i. He selects, for the purpose of his investigation, the health statistics of the Catholic Orders in Prussia, whose members are bound, by a vow, to remain for life in their respective Orders. Neither when ill, nor for any other reason, are they permitted to leave convent life. As a consequence of that rule, the life-histories of the members of those Orders have been obtained by Cornet with almost perfect accuracy, in so far as disease is concerned. He obtained these statistics from the department of Dr. von Gossler, Prussian Minister of State. It was found impossible to obtain the information, in a reliable form, by other than Government agency. The statistics, therefore, are, in every sense of the word, official in their source, and were, of course, collected by persons who were without bias as to the object of the inquiry.

In Table I. (page 52) the statistics relate to the twenty-five years preceding the year 1889. The questions sent to each convent touched the following points:

The number of deaths in the convent during the last twenty-five years; age at death; number of years passed by deceased in the convent; duration of illness; kind of employment. There were also some general questions as to the age and number of those entering the community during each year.

Thirty-eight convents were selected for statistical purposes, because their reports furnished the most reliable and fullest information in reply to the questions. These communities represented a yearly average of 4028 persons; and, Cornet observes, a

sum total of 87,450 years of human life passed under observation, with 2099 deaths.

The duration of the tubercular disease in each case could not be ascertained, with sufficient accuracy, to permit of its advantageous use in a statistical record.

The figures (1–38), in the column to the left of the reader, indicate the convents. For obvious reasons, Cornet does not give any information by which these convents could be identified. Nos. 29 to 33 inclusive, refer to communities of men.

This table contains the yearly average of those belonging to each convent; the total number of deaths in each, and in all of these religious houses during the last twenty-five years, with the exception of Nos. 19 and 26, whose records extend over twenty-two years only; the various causes of death; the percentage of the total number of deaths to the living; the percentage of deaths from tubercle to the living, and the percentage of deaths from that disease in the total death-rate. The table also contains the total death-rate from each disease in the convents during the twenty-five years. It will be seen that the great excess of deaths, shown in the table, is due to tuberculosis. The death-rate of the general public from that cause, is from one-seventh to one-fifth of all deaths. Instead of that mortality, we find amongst those nursing communities that nearly two-thirds of the deaths, or 62.88 per cent., are due to tubercle alone. In nearly one-half of the convents it rises even higher than two-thirds; in some of them it accounts for three-fourths of the mortality. In two small "Mother-houses" tubercle was the sole cause of death. Cornet emphasises the fact,

TABLE I.—*The Mortality and the Causes of Death in eac*

	Yearly Average Number of Inmates.	Total Mortality.	During twenty-five years there died									
			Tuberculosis.	Typhoid Fever.	Small-pox.	Cholera.	Erysipelas.	Cancer.	Dropsy.	Apoplexy.	Inflammation of Lungs and Pleura.	Heart Disease.
1	2	3	4	5	6	7	8	9	10	11	12	13
Nursing Orders.												
1	515.60	272	198	15	6	1	3	7	5	3	7	8
2	298.96	175	114	23	1	7	—	—	1	—	5	6
3	74.52	81	57	—	—	—	1	3	—	1	2	
4	350.92	187	124	26	—	2	—	2	6	4	—	6
5	48.32	39	28	5	—	—	—	—	—	—	—	1
6	479.48	194	142	13	1	2	—	8	3	1	4	
7	98.21	64	41	7	3	—	—	—	2	1	3	1
8	54.48	60	40	1	—	—	—	—	2	—	3	
9	118.08	59	41	2	1	—	—	—	1	2	1	
10	50.72	34	26	5	—	—	—	—	1	—	—	1
11	254.84	119	72	14	1	—	—	—	3	—	8	—
12	8.36	13	4	1	—	—	—	—	—	1	2	
13	64.61	15	7	—	—	—	—	—	4	—	2	—
14	42.76	10	5	—	1	—	—	—	—	—	1	
15	13.72	5	2	—	—	—	—	—	—	1	—	—
16	43.32	28	16	1	—	1	—	—	2	1	2	—
17	27.40	10	7	—	—	—	—	1	—	—	—	—
18	43.56	18	13	3	1	—	—	—	—	1	—	—
19*	37.72	10	10	—	—	—	—	—	—	—	—	—
20	141.36	57	24	6	1	—	—	1	2	—	7	
21	27.00	11	5	2	—	—	—	—	1	—	—	—
22	18.90	13	5	—	—	—	—	—	—	2	—	
23	56.12	27	13	1	—	—	—	4	1	1	1	
24	69.84	37	18	2	—	1	2	3	—	—	—	
25	77.20	49	27	5	—	—	—	—	5	1	1	
26	60.68	14	5	1	—	—	—	—	1	—	1	-
27	147.96	71	29	2	—	2	—	4	4	—	6	
28	49.20	24	16	1	—	—	—	2	—	1	1	
29†	8.76	6	3	—	—	—	1	—	—	1	—	-
30	63.60	25	11	1	1	—	—	4	1	—	2	
31	25.68	10	4	—	2	—	—	—	—	—	2	-
32	77.32	42	12	8	—	—	—	1	2	2	1	
33	64.40	15	6	—	—	1	—	—	—	—	2	
34	442.15	232	155	25	1	—	—	4	5	1	6	1
35	50.00	27	15	4	—	—	—	3	1	4	—	-
36*	16.00	11	2	1	—	—	—	2	1	1	2	-
37	7.05	2	2	—	—	—	—	—	—	—	—	-
38‡		33	21	2	—	—	2	1	—	—	2	
Total .	4028.80	2099	1320	177	20	17	9	50	54	30	74	7
Observed years of life	87,450											
Percentage of deaths from each cause			62.88	8.23	0.95	0.81	0.42	2.38	2.57	1.43	3.53	3

* The statistics relating to Nos. 19 and 36 refer to a period of twenty-years only.

rsing Order during the last Twenty-five Years.

llowing Nursing Orders from :											
Diseases of Kidneys.	Intestinal Diseases.	Diseases of the Liver.	Rheumatism.	Diseases of the Spinal Cord.	Gout.	Abdominal Diseases.	General Weakness and Old Age.	Other Diseases.	The rate per cent. of Deaths from all Causes to the Living.	The rate per cent. of Deaths from Tuberculosis to the Living.	The rate per cent. of Deaths from Tuberculosis to the Dead.
15	16	17	18	19	20	21	22	23	24	25	26
2	4	1	1	1	—	1	1	3	2.11	1.54	72.79
—	1	—	2	1	2	—	2	9	2.34	1.53	65.14
2	2	2	—	1	—	—	—	6	4.35	3.06	70.37
3	1	2	—	1	—	2	—	5	2.13	1.41	66.31
1	3	—	—	—	—	1	—	—	3.23	2.32	71.79
1	—	1	1	1	—	5	—	1	1.62	1.18	73.20
—	—	3	—	—	—	1	—	1	2.72	1.74	64.06
4	—	—	—	1	—	4	—	2	4.41	2.94	66.66
—	2	1	—	—	—	1	—	4	2.00	1.39	69.49
—	—	—	—	—	—	—	—	—	2.68	2.05	76.47
—	2	1	1	—	—	3	4	8	1.87	1.13	60.50
—	2	1	—	—	—	—	—	1	6.22	1.91	30.77
—	1	—	—	—	—	—	1	—	1.29	0.61	46.67
—	1	—	—	1	—	—	—	—	0.94	0.47	50.00
—	1	—	—	—	—	1	—	—	1.46	0.58	40.00
1	1	—	—	1	—	—	2	—	2.59	1.48	57.14
—	—	—	—	1	—	—	1	—	1.46	1.02	70.00
—	—	—	—	—	—	—	—	—	1.65	1.19	72.22
—	—	—	—	—	—	—	—	—	1.20	1.20	100.00
2	1	1	1	—	—	—	—	7	1.61	0.68	42.11
—	—	—	1	—	—	—	—	2	1.85	0.84	45.45
—	1	—	—	—	—	—	4	—	3.44	1.32	38.46
—	1	—	—	—	—	2	—	2	1.92	0.93	48.14
—	1	—	—	—	—	5	—	3	2.12	1.03	48.64
—	—	1	—	2	—	—	2	2	2.54	1.39	55.10
1	—	—	1	1	—	1	—	2	0.92	0.33	35.71
—	1	2	2	—	1	—	5	5	1.92	0.78	40.84
—	—	—	—	—	—	1	—	—	1.95	1.30	66.67
—	—	—	—	—	—	—	1	—	2.74	1.37	50.00
—	—	—	—	—	—	—	—	3	1.57	0.69	44.00
—	—	—	—	—	—	—	—	2	1.56	0.62	40.00
4	—	—	—	—	—	—	3	5	2.17	0.62	28.57
—	—	—	—	—	—	—	1	2	0.93	0.37	40.00
—	1	1	—	5	—	3	—	9	2.01	1.35	66.81
—	—	—	—	—	—	—	—	—	2.16	1.20	55.56
—	—	—	—	—	—	—	1	1	3.13	0.57	18.18
—	—	—	—	—	—	—	—	—	1.42	1.42	100.00
—	—	1	—	—	2	1	—	1	—	—	63.64
21	27	18	10	17	5	32	28	86			
1.00	1.28	0.85	0.47	0.81	0.24	1.52	1.33	4.09	—	—	62.88

Nursing Orders, Nos. 29 to 33, are communities of men.
In No. 38 the average yearly number of inmates was not given.

TABLE II.—*The Mortality from Tuberculos*

	From 15–20 years.		From 20–25 years.		From 25–30 years.		From 30–40 years.	
	Deaths from Tuberculosis.	From other Diseases.	From Tuberculosis.	Other Diseases.	Tuberculosis.	Other Diseases.	Tuberculosis.	Other Diseases.
1	2	3	4	5	6	7	8	9
Nursing Orders.								
1	—	—	24	4	63	12	85	31
2	6	1	21	16	34	13	42	17
3	—	—	4	—	5	4	21	1
4	1	3	15	11	39	10	49	15
5	—	—	—	1	10	3	13	3
6	—	—	9	2	31	11	72	8
7	—	—	7	4	11	4	16	9
8	—	2	6	3	12	3	16	3
9	1	2	10	2	12	4	11	2
10	—	—	2	3	5	2	15	2
11	—	—	5	4	10	6	32	12
12	—	—	—	—	1	1	—	1
13	—	—	—	—	2	—	5	—
14	—	—	1	—	—	—	3	1
15	—	—	1	—	—	—	—	1
16	—	—	1	—	2	1	5	3
17	—	—	—	—	3	1	2	—
18	—	—	2	2	5	2	5	1
19	—	—	1	—	5	—	3	—
20	—	—	1	2	1	11	16	13
21	1	—	—	2	2	1	2	2
22	—	—	2	—	—	—	2	1
23	—	—	2	1	5	—	5	4
24	—	—	3	7	2	2	9	4
25	—	—	4	1	9	2	8	5
26	—	—	1	2	3	1	—	6
27	1	—	2	—	6	1	10	4
28	—	—	4	1	4	2	4	1
29	—	—	—	—	1	—	—	—
30	—	—	2	—	1	1	2	4
31	—	—	—	—	—	—	1	1
32	—	—	2	—	1	4	4	4
33	—	—	1	—	3	—	1	—
34	4	1	31	9	52	20	45	23
35	—	—	—	—	2	—	8	2
36	—	—	—	—	—	—	—	1
37	—	—	—	—	—	—	2	—
38	—	—	—	2	6	2	11	1
39*								
40								
	14	9	164	79	348	124	525	186
	23		243		472		711	

* In Nos. 39 and 40 only the ages of the de

other Diseases in each Convent at different Ages.

om 40–50 years.		From 50–60 years.		From 60–70 years.		Over 70 years.		Total Number.	
[illegible]	Other Diseases.	Tuberculosis.	Other Diseases.	Tuberculosis.	Other Diseases.	Tuberculosis.	Other Diseases.	Total Mortality.	Average Duration of Life.
10	11	12	13	14	15	16	17	18	19
8	13	4	13	4	—	—	1	272	33.91
9	7	2	5	—	2	—	—	175	30.75
1	8	5	4	1	6	—	1	81	41.69
9	13	1	7	—	4	—	—	187	33.57
4	2	—	1	1	—	—	1	39	34.74
6	10	4	16	—	5	—	—	194	36.24
6	4	1	2	—	—	—	—	64	32.72
4	6	2	—	—	3	—	—	60	34.29
5	4	2	3	—	1	—	—	59	32.42
3	1	1	—	—	—	—	—	34	31.94
0	12	4	6	1	6	—	1	119	38.27
—	—	—	2	1	3	2	2	13	57.07
—	1	—	1	—	5	—	1	15	47.08
1	—	—	—	—	3	—	1	10	46.20
1	—	—	1	—	1	—	—	5	45.20
6	5	2	—	—	—	—	3	28	41.60
2	1	—	—	—	1	—	—	10	37.20
1	—	—	—	—	—	—	—	18	28.88
1	—	—	—	—	—	—	—	10	29.60
5	4	1	2	—	1	—	—	57	35.05
—	—	—	1	—	—	—	—	11	30.63
—	—	—	—	—	3	1	4	13	57.46
1	4	—	2	—	1	—	2	27	38.00
4	3	—	2	—	1	—	—	37	33.54
3	3	—	5	3	5	—	1	49	40.77
1	—	—	—	—	—	—	—	14	30.00
1	8	3	6	3	10	3	13	71	51.88
3	3	1	—	—	—	—	1	24	34.66
1	1	1	—	—	1	—	1	6	50.33
5	2	1	4	—	2	—	1	25	43.68
2	3	1	1	—	1	—	—	10	46.30
4	5	—	6	1	6	—	5	42	47.14
—	3	1	1	—	4	—	1	15	48.06
18	14	3	9	2	1	—	—	232	32.03
1	3	3	4	1	1	—	2	27	46.33
1	1	—	—	1	2	—	5	11	62.72
—	—	—	—	—	—	—	—	2	37.00
4	2	—	3	—	2	—	—	33	36.51
								4	47.50
								158	34.38
01	146	43	107	19	81	6	47	2261	36.27
347		150		100		53			

e given ; the other details were too incomplete for use.

that the convent communities differ much from one another in their death-rates from tubercle. These differences are expressed by such figures as, in some cases, 60 to 70 per cent., in others 40 to 50 per cent., of all deaths. The explanation of these different mortalities from tuberculosis is, Cornet says, that some of these nurses are engaged, either altogether, or for the most part, in attending upon surgical cases, where certainly very few, usually no cases of lung tubercle are found amongst the patients.

Table II. (page 54) gives the ages at death from tuberculosis and other diseases amongst the Nursing Orders.

In studying this table, we must bear in mind that the average age at death of the inmates of these convents is only 36.27 years. That fact makes it easy to understand, why it happens that the death-rate is low amongst these people, after the fiftieth year of life has been passed. Few of them live beyond that age.

Again, the low death-rate that is recorded in the convents, amongst the inmates who are between fifteen and twenty years of age, is explained by the fact that no persons enter convent life below the age of eighteen years.

Table II. shows very clearly, that the highest death-rate in the nursing communities occurs between the ages of twenty-five and fifty years.

The convents in this table numbered respectively 39 and 40, sent no other details than those stated there—namely, their total death-rate, and sufficient facts to enable a calculation to be made of the average age at death of their inmates.

Cornet states that these convent communities are composed of persons whose health at first is known to be excellent, because admission to the Orders is, amongst other requirements, dependent upon the production, by the applicant, of a medical certificate to that effect. Their health is, therefore, at first, better than that of their countrymen in general. It is true that in certain cases that guarantee of physical soundness may, now and then, and as an exception, not be required. The rule, however, Cornet says, is enforced with sufficient strictness to make it certain that the members of those Nursing Orders, when they enter upon convent life, are persons of exceptionally good health. This statement throws a very lurid light upon the fact, that in these communities the average age at death of their members is lower by ten years, and more, than that of men who are engaged in trades notoriously the most unhealthy.

The following table illustrates this point :

	Average Duration of Life.	Mortality per cent.
Blacksmith	55.1	1.8
Locksmith	49.1	1.4
File-cutter	54.0	1.6
Coppersmith	48.6	1.89
Tinsmith	47.0	2.78
Potter	53.1	1.85
Mason	55.6	1.59
Cabinet-maker	49.8	1.89
Miller	45.1	1.7
Cloth-cutter	57.59	1.5
Hair-dresser	57.9	2.39
Upholsterer	—	2.39
Hat-maker	51.6	2.9
Cotton spinner (in favourable circumstances)		0.6
Weaver	54.5	1.36

These statistics, taken altogether, show most

clearly the tremendous mortality which obtains amongst the Nursing Orders of Prussia; and that it is due, in by far the greatest proportion, to deaths from tubercle. That disease kills, as we see, five and six times, and in one instance nine times, as many of these people as do all other diseases put together.

It must strike every one as startling, that in these convents we find communities recruited from amongst persons who, with very few exceptions, are certified by physicians to be in excellent health when they enter upon their conventual duties, and that in from sixteen to eighteen years from that time these healthy young people will have reached the average limit of their lives! If they enter the convents at about twenty years of age, before they complete their thirty-seventh year they have probably finished their span of life, for their average age at death is 36.27 years. A glance at Tables I. and II. shows that this enormous mortality, unequalled, I believe, amongst adults, owes its monster proportions to one cause above all others—tuberculosis.

Table III. (page 59) shows the total death-rate in the thirty-eight convents, the various causes of death, the number of deaths due to each cause, and the ages of the dead.

Table IV. (page 60) shows how many in every 10,000 persons die in the course of a year, of the diseases mentioned in the table, and the ages at death. It also gives the total number of deaths from all causes, and compares the death-rates, at various periods of life, of the general population with those of the Nursing Orders at the same periods of life.

In Table IV. the statistics of certain convents only

were used, because the others had not answered the necessary questions.

TABLE III.—*The Mortality in all the Catholic Nursing Orders, stating the Cause of Death, and the Age at Death.*

	Causes of Death.	From the Diseases named below there died, during the course of the last twenty-five years, the following number of Persons at the Age of:								Total.
		From 15–20 Years.	From 20–25 Years.	From 25–30 Years.	From 30–40 Years.	From 40–50 Years.	From 50–60 Years.	From 60–70 Years.	Over 70 Years.	
1.	Tuberculosis	14	164	348	525	201	43	19	6	1320
2.	Typhoid and typhus.	5	41	54	47	19	10	1	—	177
3.	Small-pox	—	2	8	6	3	—	1	—	20
4.	Cholera	—	2	6	7	1	1	—	—	17
5.	Erysipelas	—	1	3	2	2	1	—	—	9
6.	Cancer	—	—	2	12	15	13	7	1	50
7.	Dropsy	—	1	2	11	9	13	12	6	54
8.	Apoplexy	1	2	—	4	3	11	4	5	30
9.	Inflammation of lungs and pleura	1	2	11	14	14	8	16	8	74
10.	Heart disease	1	7	8	18	20	11	10	2	77
11.	Brain disease	—	3	1	11	8	2	1	1	27
12.	Kidney disease	—	1	2	8	5	2	2	1	21
13.	Intestinal disease	—	—	3	6	6	9	3	—	27
14.	Liver disease	—	1	2	5	3	4	2	1	18
15.	Rheumatism	—	—	3	3	2	—	2	—	10
16.	Disease of spinal cord	—	—	5	4	5	1	2	—	17
17.	Gout	—	—	—	1	2	1	—	1	5
18.	Abdominal disease	1	4	4	3	9	9	2	—	32
19.	General weakness and old age	—	—	—	1	—	—	10	17	28
20.	Other diseases	—	12	10	23	20	11	6	4	86
	Total mortality	23	243	472	711	347	150	100	52	2099

The figures in Table IV. show that, comparing the mortality in the Prussian State with the mortality in twenty-seven convents, we find that, between the ages of fifteen and twenty years, the general proportionate death-rate in the convents is four times that of the State; between twenty and thirty years of age, it is about three times greater in the convents than in the State; between thirty and

TABLE IV.—*Comparison of the Mortality in*
The mortality from all causes

Causes of Death.	For every 10,000 Persons of the stated			
	From 15–20 Years.		From 20–25 Years.	
	In the Whole State.	In the Nursing Orders.	In the Whole State.	In the Nursing Orders.
1. Tuberculosis	18.64	116.96	29.99	137.36
2. Typhus and typhoid	5.63	58.48	5.95	40.33
3. Small-pox	0.02	—	0.04	2.52
4. Cholera	—	—		2.52
5. Erysipelas	—	—		—
6. Cancer	0.10	—	0.19	—
7. Dropsy	1.26	—	1.35	1.26
8. Apoplexy	1.45	—	1.94	
9. Inflammation of lungs and pleura	2.13	14.62	3.68	2.52
10. Heart disease	1.04	—	1.03	5.04
11. Brain disease	1.34	—	1.21	5.04
12. Kidney disease	0.42	—	0.59	1.26
13. Intestinal diseases		—		
14. Liver disease		—		1.26
15. Rheumatism		—		
16. Disease of spinal cord		—		
17. Gout		—		
18. Abdominal diseases		14.62		5.04
19. General weakness and old age		—		—
20. Other diseases	*	—		12.60
Total number of deaths	48.36	204.68	68.32	216.75
The total death-rate exclusive of those dead of tuberculosis	29.72	87.72	38.33	79.39
The total death-rate exclusive of those dead of infectious diseases	23.97	29.24	32.16	34.02

* The blanks in these columns result from the fact that the

The average numbers were reckoned from the Prussian 1876 and 1884.

the Prussian State with that of the Nursing Orders.
is reckoned per 10,000 *living people.*

following Ages, living at the beginning of the Year, there Died, from the Causes below, in the Course of the Year, Persons at the Ages of :

From 25–30 Years.		From 30–40 Years.		From 40–50 Years.		From 50–60 Years.		Over 60 Years.	
In the Whole State.	In the Nursing Orders.	In the Whole State.	In the Nursing Orders.	In the Whole State.	In the Nursing Orders.	In the Whole State.	In the Nursing Orders.	In the Whole State.	In the Nursing Orders.
36.09	176.22	41.87	142.11	47.92	88.82	66.12	47.31	73.02	88.88
5.28	29.14	5.18	13.72	5.99	9.80	7.65	15.14	7.03	6.35
0.07	4.26	0.08	1.76	0.09	1.23	0.10	—	0.09	12.70
	4.26		2.11		—		—		—
	1 42		0.70		0.61		1.89		—
0.43	1.42	1.62	3.87	5.25	3.06	11.19	17.03	17.07	25.39
1.84	1.42	3.59	3.17	8.27	4.90	19.49	17.03	44.79	82.54
2.84		5.27	1.06	10.28	1.23	21.85	17.03	41.80	31.75
4.11	7.11	7.17	4.57	12.52	7.96	22.05	7.57	21.60	57.14
1.04	3.56	1.59	4.92	2.45	5.51	4.27	13.25	7.04	44.44
1.24		1.86	2,81	2.34	4.29	3.11	3.79	4.21	—
0.87	0.71	1.19	2.46	1.60	3.06	2.67	5.68	5.75	12.69
	0.71		2.11		3.06		13.25		12.69
	0.71		1.41		0.61		5.68		6.35
	2.13		0.70		0.61		—		12.69
	1.42		0.70		2.45		1 89		12.69
					0.61		1.89		—
	2.13		0.70		4.29		13.25		12.69
	—		0.35		—		—	334.48	126.98
	2 86		6.68		7.96		11.35		38.10
81.37	239.47	106.06	194.81	143.92	150.08	238.79	193.04	556.88	584.13
45.28	63.25	64.19	52.70	96.00	61.26	172.67	145.73	483.86	495.25
39.50	22.75	57.31	30.54	84.66	46.56	153.73	111.67	459.67	480.81

Prussian statistics were incomplete on those points.
statistics for the years 1879-1880 and 1884, and for over 60 years from

forty years of age, the convent death-rate is double that of the State. After forty years of age, the inmates of the convents, and the general population, begin to show something like an equal proportionate death-rate. If from the total death-rate in the State and in the convents that portion of it due to tuberculosis be deducted, then the marked difference between the two death-rates disappears to a great extent. If the mortality due to tubercle, and that resulting from other diseases commonly regarded as infectious, be both deducted from the death-rate in the State and in the convents, then up to the age of forty years the death-rates in State and convent are remarkably equal. From forty to sixty years of age, the death-rate due to non-infectious diseases is lower in the convent than in the State.

It should be borne in mind that the great majority of the inmates do not begin convent life until they are between twenty-two and thirty or thirty-five years of age, and that they die from consumption in the greatest numbers between the ages of twenty-five and forty years. In this connexion, it is to be remarked, as a fact bearing directly upon this subject, that novices have most of the rough work to do in the Nursing Orders. They have to clean the wards, make the beds, and remove and wash pocket-handkerchiefs, and bed- and body-linen used by the sick. Even after the close of their novitiate, work of that kind frequently falls, for a year or two, within the nurses' duties.

From what has already been said it is obvious that amongst persons so occupied we should expect to find tubercular disease unusually frequent. These

are the people most likely to come into intimate and frequent contact with a chief source of infection—the dried expectoration of consumptives.

The principal insanitary condition of convent life is the living together of considerable numbers of persons who have not, from the nature of their calling, sufficient opportunities for open-air exercise. It is impossible to believe, knowing what we do of the cause of tubercle, that such a condition of life could, of itself, produce tubercular disease. On the other hand, it would certainly lead to the rapid spread of that disease after it was introduced amongst such communities.

Table V. (page 64) shows the frequency in the convents and in Prussia of each cause of death in every hundred deaths between the ages of fifteen years and over sixty years.

In this table, the following points are again brought out very clearly :

Amongst the Nursing Orders 63 per cent. of the deaths are due to tuberculosis. Up to the age of fifty years never less than half of the deaths, but, for the most part, three-fourths (75 per cent.) of them, are due to that disease. Also, this table shows, once more, that the deaths from tubercle in the Nursing Orders are by far the most numerous between the ages of twenty-five and forty years — just the period of life which includes the term of the hardest work amongst these nurses ; for again it is necessary to repeat that the members of those Orders do not all enter the convents at the same age, but at some time between their eighteenth and thirty-fifth year, and, as a

TABLE V.—*The Frequency of each Cause of Death at the Ages stated below. Comparison between Nursing Orders and State.*

Causes of Death.	Out of every 100 Deaths, from the causes named below, there died in the Nursing Orders and in the State, at the following Ages (from 15 to over 70):																	
	From 15–20 Years.		From 20–25 Years.		From 25–30 Years.		From 30–40 Years.		From 40–50 Years.		From 50–60 Years.		From 60–70 Years.		Over 70 Years.		Total number of Deaths.	
	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders	State.	Nursing Orders
1. Tubercle	37.86	60.87	43.01	67.49	43.56	73.73	39.38	73.84	32.78	57.93	26.89	28.67	17.88	19.00	3.25	11.32	23.78	62.89
2. Typhus and typhoid	12.00	21.74	9.13	16.87	6.88	11.44	5.07	6.61	4.28	5.48	3.25	6.66	1.68	1.00	0.34	—	3.40	8.43
3. Small-pox	0.05	—	0.10	0.83	0.09	1.69	0.09	0.84	0.09	0.86	0.05	—	0.03	1.00	0.005	—		0.95
4. Cholera		—		0.82		1.27		0.99		0.29		0.66		—		—		0.81
5. Erysipelas		—		0.41		0.63		0.28		0.58		0.66		—		—		0.42
6. Cancer	0.23	—	0.26	—	0.52	0.42	1.58	1.69	3.61	4.32	4.90	8.66	3.60	7.00	1.20	1.89	2.55	2.38
7. Dropsy	2.65	—	2.00	0.41	2.30	0.42	3.43	1.55	6.01	2.59	8.45	8.66	8.67	12.00	3.51	11.32	5.58	2.57
8. Apoplexy	2.97	4.34	2.79	0.82	3.40	—	4.89	0.56	6.88	0.87	9.01	7.33	9.68	4.00	5.55	9.43	6.92	1.43
9. Inflammation of lungs and pleura	4.42	4.35	5.41	0.82	5.23	2.33	6.84	1.97	8.70	4.03	9.30	5.33	7.90	16.00	2.48	15.09	6.55	3.53
10. Heart disease	2.23	4.35	1.53	2.88	1.32	1.69	1.51	2.53	1.77	5.76	1.87	7.33	1.55	10.00	0.62	3.77	1.42	3.67
11. Brain disease	2.85	—	1.78	1.24	1.51	0.21	1.73	1.55	1.54	2.31	1.22	1.33	0.81	1.00	0.30	1.89	1.15	1.29
12. Kidney disease	0.91	—	0.85	0.41	1.14	0.42	1.11	1.13	1.13	1.44	1.13	1.33	1.00	2.00	0.55	1.89	0.96	1.00
13. Intestinal disease		—		—		0.63		0.84		1.73		6.00		3.00		—		1.29
14. Liver disease		—		0.41		0.42		0.703		0.86		2.66		2.00		1.89		0.86
15. Rheumatism		—		—		0.63		0.42		0.58		—		2.00		—		0.48
16. Diseases of spinal cord		—		—		1.06		0.56		1.44		0.66		2.00		—		0.81
17. Gout		—		—		—		0.14		0.58		0.66		—		1.89		0.24
18. Abdominal disease		4.35		1.65		0.85		0.42		2.59		6.00		2.00		—		1.52
19. General weakness and old age	—	—	—	—	—	—	—	0.14	—	—	—	—	22.14	10.00	72.23	32.07		1.33
20. Other unnamed diseases	33.83	—	33.14	4.94	34.05	2.15	34.37	3.24	33.21	5.76	33.93	7.33	25.06	6.00	9.97	7.55		4.10
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

The State mortality was taken from the Prussian statistics for the years 1876, 1880 and 1884. The diseases No. 4 and No. 5, as well

rule, much nearer to the latter age than to the former.

Table VI. (pp. 66, 67) shows, that in the first half-year of convent life the death-rate is very small, but that afterwards it rapidly increases, so that in the first five and a half years, out of 709 deaths 494 are due to tubercle alone. In the first ten years nearly twice as many die from that disease as succumb to it in all the other years of convent life put together.

It is also here shown, that in the nurses' third year of cloister life tuberculosis reaches its deadliest period. It is a fact worthy of notice, that all the other infectious diseases, mentioned in Table VI., reach their highest rate of mortality during the earlier years of convent life.

Table VII. (pp. 68, 69) deals with the expectation of life amongst the Nursing Orders. The chief facts here brought out are, that a healthy person of twenty-five years of age, who then begins cloister life and the work of a nurse, has an expectation of life equal to that of a healthy woman, of the general population, who is fifty-eight years of age! A member of the Nursing Orders, who begins convent life at thirty-three years of age, has an expectation of life equal to that of a healthy woman, of the general population, who is sixty-two years of age! To put these remarkable facts in another way :— Let us suppose that it is wished to effect an assurance upon the life of a young person who, being in perfect health, and without hereditary flaw, desires at the age of twenty-five years to enter one of these Nursing Orders. Instead of a payment of £1 15*s.* 6*d.* as premium for every £100 assured,

TABLE VI.—*Shows the relation of the Mortality to length of Residence in the Convent, and Employment as Sick Nurses.*

Length of Residence in Convent.	At the following Periods of Residence in the Convent and Employment as Sick Nurses there died:						
	Total Mortality.	In each Quinquennial Period.	From Tuberculosis.	From other Infectious Diseases.	From Cancer.	From other Diseases.	Total Death-rate per 1000 from every Cause.
1	2	3	4	5		6	7
½	11		2	9		—	5.25
1	120		69	33		18	57.28
2	176	709	111	38	1	27	84.01
3	140		104	18		18	66.83
4	140		110	19	1	11	66.83
5	122		98	10	2	14	58.23
6	114		93	7		14	54.42
7	104		81	8		15	49.64
8	106	505	72	9	3	25	50.60
9	96		67	10	1	19	45.82
10	85		61	7	1	17	40.57
11	59		43	5	2	11	28.16
12	57		41	3		13	27.21
13	70	300	49	6	3	15	33.40
14	63		38	6	3	19	30.07
15	51		39	3	1	9	24.34
16	51		33	5	2	13	24.34
17	32		24	5	4	3	15.27
18	40	197	29	3	1	8	19.09
19	47		32	5		10	22.43
20	27		15	3	2	9	12.89
21	34		20	2	1	12	16.23
22	23		9	2	2	12	10.98
23	21	134	5	3	2	13	10.02
24	26		10	6	2	10	12.40
25	30		9	5	3	16	14.32
26	19		5	3	2	11	9.07
27	14		4	1		9	6.68
28	14	94	6	2		6	6.68
29	21		7	2	1	12	10.02
30	26		5	3		18	12.41

TABLE VI.—(*continued*).

Length of Residence in Convent.	At the following Periods of Residence in the Convent and Employment as Sick Nurses there died :						
	Total Mortality.	In each Quinquennial Period.	From Tuberculosis.	From other Infectious Diseases.	From Cancer.	From other Diseases.	Total Death rate per 1000 from every Cause.
1	2	3	4	5		6	7
31	14		3	2	1	9	6.68
32	12		2	2	1	8	5.73
33	8	49	2	1		5	3.82
34	7		—	1	1	6	3.34
35	8		—	3	3	5	3.82
36	9		2	—		7	4.30
37	8		1	1		6	3.82
38	6	31	1	—		5	2.87
39	5		1	2	2	2	2.39
40	3		—	—		3	1.43
41	5		—	1	1	4	2.39
42	10		3	—		7	4.77
43	5	35	1	—		4	2.39
44	8		3	—		5	3.82
45	7		1	1		5	3.34
46	4			—		4	1.91
47	2		1	—		1	0.96
48	3	16		—		3	1.43
49	3			—		3	1.43
50	4		1	1	1	2	1.91
51	4					4	1.91
52	4					4	1.91
53	5	14				5	2.39
54	—					—	—
55	1					1	0.48
56	1					1	0.48
57	—					—	—
58	1	6				1	0.48
59	2					2	0.96
60	2		1			1	0.96
over 60	5	5				5	2.39

TABLE VII.—*Expectation of Life in the Nursing Orders and in the State.*

Age.	Nursing Orders.			State.	Expectation of Life of those who Outlive the Ages stated in Column 1.		
	Total Mortality at Ages Mentioned.	Survivals of the Age Mentioned.	Average Age at Death of the Survivors of the Age Mentioned.	Average Age at Death of the Survivors of the Age Mentioned.	In the Nursing Orders.	In the State.	Death Occurs in the Nursing Orders ... Years Earlier.
1	2	3	4	5	6	7	8
17	2	2033	36.67	58.17	19.67	41.17	21.50
18	7	2031	36.68	58.40	18.68	40.40	21.72
19	10	2024	36.74	58.64	17.74	39.64	21.90
20	16	2014	36.83	58.90	16.83	38.90	22.07
21	27	1998	36.97	59.16	15.97	38.17	22.20
22	43	1971	37.19	59.45	15.19	37.45	22.26
23	64	1928	37.52	59.76	14.52	36.76	22.24
24	63	1864	38.00	60.06	14.00	36.06	22.06
25	88	1801	38.49	60.37	13.49	35.37	21.88
26	75	1713	39.24	60.66	13.24	34.66	21.42
27	87	1638	39.79	60.97	12.79	33.97	21.18
28	99	1551	40.52	61.26	12.52	33.27	20.75
29	88	1452	41.37	61.57	12.37	32.58	20.21
30	93	1364	42.17	61.88	12.17	31.88	19.71
31	96	1271	43.06	62.19	12.06	31.19	19.13
32	74	1175	44.05	63.50	12.05	31.50	19.45
33	86	1101	44.86	62.81	11.86	29.81	17.95
34	77	1015	45.87	63.13	11.87	29.13	17.26
35	79	938	46.84	63.45	11.84	28.45	16.61
36	61	859	47.93	63.78	11.93	27.78	15.85
37	59	798	48.84	64.09	11.84	27.09	15.25
38	42	739	50.06	64.43	12.06	26.43	14.37
39	52	697	50.79	64.76	11.79	25.76	13.97
40	48	645	51.74	65.09	11.74	25.09	13.35
41	52	597	52.68	65.42	11.68	24.42	12.74
42	41	545	53.80	65.76	11.80	23.76	11.96
43	40	504	54.75	66.09	11.75	23.09	11.34
44	36	464	55.77	66.44	11.77	22.44	10.67
45	31	428	56.76	66.79	11.76	21.79	10.03
46	35	397	57.68	67.13	11.68	21.13	9.45
47	26	362	58.81	67.49	11.81	20.49	8.68
48	17	336	59.72	67.84	11.72	19.84	8.12
49	21	319	60.35	68.20	11.35	19.20	7.85
50	15	298	61.15	68.56	11.15	18.56	7.41

TABLE VII.—(*continued*).

Age.	Nursing Orders.			State.	Expectation of Life of those who Outlive the Ages stated in Column 1.		
	Total Mortality at Ages Mentioned.	Survivals of the Age Mentioned.	Average Age at Death of the Survivors of the Age Mentioned.	Average Age at Death of the Survivors of the Age Mentioned.	In the Nursing Orders.	In the State.	Death Occurs in the Nursing Orders ... Years Earlier.
1	2	3	4	5	6	7	8
51	15	283	61.74	68.93	10.74	17.93	7.19
52	28	268	62.34	69.30	10.34	17.29	6.95
53	14	240	63.55	69.68	10.55	16.68	6.13
54	12	226	64.20	70.06	10.20	16.06	5.86
55	18	214	64.77	70.44	9.77	15.44	5.67
56	9	196	65.67	70.84	9.67	14.84	5.17
57	14	187	66.13	71.25	9.13	14.25	5.12
58	11	173	66.87	71.67	8.87	13.67	4.80
59	12	162	67.48	72.11	8.48	13.11	4.63
60	19	150	68.16	72.55	8.16	12.55	4.39
61	7	131	69.34	73.01	8.34	12.01	3.67
62	9	124	69.81	73.48	7.81	11.48	3.67
63	10	115	70.42	73.95	7.42	10.95	3.53
64	11	105	71.13	74.45	7.13	10.45	3.32
65	7	94	71.96	74.95	6.96	9.95	2.99
66	12	87	72.52	75.48	6.52	9.48	2.96
67	8	75	73.57	76.02	6.57	9.02	2.45
68	6	67	74.35	76.58	6.35	8.58	2.23
69	8	61	74.98	77.15	5.98	8.15	2.17
70	7	53	75.88	77.74	5.88	7.74	1.86
71	4	46	76.78	78.55	5.78	7.55	1.77
72	5	42	77.33	78.97	5.33	6.98	1.65
73	4	37	78.05	79.15	5.05	6.62	1.57
74	3	33	78.66	80.28	4.66	6.28	1.62
75	4	30	79.13	80.95	4.13	5.95	1.82
76	8	26	79.76	81.64	3.76	5.64	1.88
77	3	18	81.44	82.34	4.44	5.34	0.90
78	1	15	82.33	83.06	4.33	5.06	0.73
79	4	14	82.64	83.80	3.64	4.79	1.15
80	2	10	84.10	84.55	4.10	4.55	0.45
81			84.61	85.37	3.61	4.37	0.76
82	1	8	85.12	86.12	3.12	4.12	1.00
83			85.34	86.94	2.34	3.94	1.64
over 84	7	7	85.57	87.78	2.21	3.78	1.57

which would be charged in the case of a person of that age living under the ordinary conditions of life, the premium charged upon the nurse's life would be £5 12*s.* 6*d.* for every £100 insured. Applying the same rule of practice to a member of these nursing communities, who enters cloister life at the age of thirty-three years, the premium charged in this case would be £6 16*s.* 4*d.* per cent., instead of £2 3*s.* 5*d.*, which would be the charge per cent. for a healthy life of that age in ordinary circumstances. These figures have been kindly worked out for me by Mr. Stanley Day, from the Non-Profit Tables of the Life Assurance Office with which we are officially connected.

CHAPTER X.

MORE STATISTICAL EVIDENCE.

In July 1883, there was published a report of the Collective Investigation Committee, of the British Medical Association. In that report, the committee stated the results of their inquiries concerning the "Communicability of Phthisis." They sent to a considerable number of medical men, certain printed questions meant to elicit some definite expression of opinion upon that important subject.

In reply to their questions, the committee received 1078 returns. Of these, 673 were simple negatives. They merely intimated that the men who sent them had not observed cases of consumption originating in infection. The writers of these returns expressed no opinion, one way or the other, concerning the communicability of consumption. The remaining 405 answers are divided by the committee into three classes:

Class I.	Affirmative Observers	.	261
Class II.	Doubtful ,,	.	39
Class III.	Negative ,,	.	105

Amongst the affirmative observers, 192 mention cases of supposed communication of consumption, occurring between husband and wife. It is clearly stated, that in 130 of these cases there was no hereditary predisposition to consumption in the

person believed to have been infected. In nine cases only is it thought there may have been some hereditary taint. It is needless to refer in detail to the cases mentioned in the report of the Investigation Committee, for they bear, in many respects, a very close resemblance to several of those which are given in the Appendix to this book. There are, however, some very suggestive returns, to which the committee call especial attention. They refer to cases of probable infection "occurring among persons unrelated to one another," and on page 34 of their report, the Investigation Committee briefly summarise them. They include such cases as, that of a servant who nursed her master and mistress, who were consumptives. There may have been some hereditary taint in her case. She died of consumption. A young man who slept with his phthisical friend: an apprentice who slept with his phthisical master: a young man who was "constantly" with his consumptive *fiancée:* a young girl who "was attending to" a case of phthisis: a young man, believed to have been infected by "close contact with a fellow-workman, who had phthisis": patient and nurse: healthy servant girl who "slept with" a phthisical fellow-servant: a young lady who slept in the same room with her phthisical governess, and "never left her till her death": a female servant who emptied and cleaned, twice a day, the spittoons used by two consumptives: three young girls, from three adjoining villages, apprentices to a phthisical dressmaker, "who took it in turn to remain in the house, and sleep with her." "In less than two years from her death, they all died of phthisis,

although in the family history of each no trace of phthisis existed." Then we have the record of a "perfectly healthy child, nursed, night and day, by a consumptive nurse": patients in one particular ward of an asylum, the keeper of which was phthisical: sailors in the same ship—these are some of the cases. With the exception of the last two instances, all these persons, who contracted consumption, are expressly described in the report as without hereditary tendency to that disease.

It will be seen that these cases of probable infection, occurred in persons who were not blood relations of, nor connected by marriage with those who infected them. It is also worthy of remark, that the consumptives, and those who became consumptive, lived together, in every instance, in exceptionally close and frequent contact with one another. The whole history of those cases which make up the evidence favouring the view that consumption is a communicable disease, goes to show that the essence of the conditions under which infection, not due to inoculation, may take place, is close and prolonged association of a healthy person with a consumptive. There is also good cause for the belief, that faulty ventilation is one of the most powerful helpers, if, indeed, it be not the chief helper, in spreading consumption amongst those who come into close and prolonged contact with tuberculosis. It is not very often that, in discussing matters connected with the question of the communicability of consumption, we find ourselves dealing with a statement which is accepted by every one, and on all sides acknowledged to be true. It is, however, a fact, that, fortunately,

there is no dissent from the acceptance of the belief, that bad or faulty ventilation greatly helps the spread of consumption. The general acceptance of that belief, has, in no slight degree, impressed upon all responsible people the importance of having the rooms and houses in the occupation of consumptives, thoroughly well aired by night and by day. It is, perhaps, not too much to hope, that from being impressed with the importance of thorough ventilation as a part of the treatment of consumption, people may, in course of time, be led to put that belief into wide practice. At present that belief is, in far too many instances, of the most passive kind. The fear of "catching cold" is a much more potent influence, than the merely passive belief in the value of good ventilation. It is curious to note, that the fear of "catching cold," as it is felt and expressed in both words and acts, by even the educated public, is a fear which is not based upon recognised facts, but is a survival of ancient and vague theorisings as to the origin of certain diseases —consumption amongst the rest.

CHAPTER XI.

TUBERCULAR MILK A SOURCE OF INFECTION.

In the *Deutsches Archiv für Klinische Medicin*, vol. xliv., Hirschberger publishes a paper which deals with the experimental evidence relating to the question of the infectiousness of the milk of tuberculous cows. He says that 25 per cent. of all children dying under one year of age are killed by tuberculosis. He thinks it reasonable to connect this fact with tuberculosis in cows. With the view of throwing light on this point, Hirschberger, under the guidance of Prof. Bollinger, made some experiments with the milk of tubercular cows. He tried to answer, by his experiments, these two questions:

I. Are the cases in which cows with tuberculosis give an infectious milk frequent or rare?

II. In what forms of tuberculosis in the cow is the milk infectious: in cases only where the tuberculosis is generalised, or in localised tuberculosis as well?

To obtain the necessary milk, the whole udder of a tuberculous cow just slaughtered was amputated. In other cases, milk was taken in the ordinary way from tuberculous cows. In the experiments on the udder, with the usual antiseptic precautions, the milk ducts were cut across above the nipple, and from them was drawn, by means of a syringe, as

much milk as could be obtained by very gently squeezing the sides of the udder. Only milk of good appearance, and untinged with blood, was used for experimental purposes. The milk was injected into the abdominal cavities of young guinea-pigs. Every experiment was submitted to Bollinger himself. Not a single guinea-pig died of sepsis. Many of the guinea-pigs were killed, and both Hirschberger and Bollinger satisfied themselves that tuberculosis had commenced, with unmistakable distinctness, in most of these animals. Of the twenty udders used in these experiments, only one was shown microscopically to contain tubercle bacilli. The cows were in five instances highly tuberculous, and inoculations of their milk gave in four instances a positive, and in one a negative result. From six moderate cases of tuberculosis in the cows, four positive and two negative results were obtained by inoculation of the milk. Nine cows were tuberculous in their lungs only. In three inoculations with their milk positive results were obtained, and in six instances a negative result. The milk, says Hirschberger, is, therefore, infectious in slight cases, and where the tuberculosis is localised.

In the "Report of the Departmental Committee, appointed to inquire into Pleuro-pneumonia and Tuberculosis in the United Kingdom," some important evidence is published. It goes to show that there is a connexion between the existence of tubercle in an animal, and the spread of that disease to other animals. Professor McFadyean, of Edinburgh, states, in his evidence before that committee, that he knows there is ground for very strong suspicion,

that tubercular milk produces tuberculosis in healthy animals. He has observed tubercle bacilli in cows' milk. That fact, of itself, it seems to me, even were it unsupported by other evidence, proves that milk, so contaminated, might cause tubercular disease. Given that that organism, in a healthy state, gains entrance to the body of an animal capable of contracting tubercle—whether man or beast—and there can be no reasonable doubt that that animal is consequently in danger of becoming tubercular. Prof. McFadyean laid most stress in his evidence before the committee, upon certain cases which seemed to him and Dr. Woodhead strongly to suggest that tubercular disease may be spread by infected milk. They examined certain cows, about a dozen in all, which were kept to furnish a supply of milk to a public institution. Very decided evidence was found of tuberculosis in the udders of three of those cows. The deaths "from phthisis among the inhabitants of this institution had been in one year 30 per cent. of all the deaths, and in another year 40 per cent." The institution in question was a dairy. There pigs were kept and fed with refuse milk. The pigs had been very unhealthy, and Prof. McFadyean was told that some of them had died from "lung disease." The butcher who bought the surplus stock of this dairy, was reported to have complained that there was "disease in the animals."

In his evidence before the same committee, Dr. Robert Peel Ritchie, President of the Royal College of Physicians of Edinburgh, refers to the case of the institution mentioned by Prof. McFadyean. Dr. Ritchie states that when the supply of the milk, in use in the

institution, was stopped, "the health of the children and pigs improved"—*i.e.*, the disease ceased to attack the healthy children and pigs. He also notes several other cases, which, he thinks, tend to show that milk may carry the infection of tubercular disease. It ought to be mentioned, that Dr. Ritchie said that his evidence before the committee embodied the views of the Medico-Chirurgical Society of Edinburgh, concerning the subjects investigated. He said, that the great mortality in Edinburgh from tuberculosis during the last ten years, amongst children under five years of age, had attracted much attention. It amounted to "6.8 per cent. of the deaths—that is to say, of 44,616 deaths at all ages, 3054 occurred under five years of age from tuberculosis." He also points out that, according to the returns of the Registrar-General for Scotland, during the ten years ending with 1885, 7415 children, under five years of age, died from tubercular disease of the abdominal glands, and 13,216 children, within the same age limit, of tubercular meningitis. Dr. Ritchie makes the following statement, with reference to these death-rates, in his evidence: "Now it occurs to myself that possibly the greater number of inflammations of the brain have been preceded by disease of the glands of the abdomen. One point is this, that in the first three months" of the lives of these children, "tabes is in a larger proportion" as a cause of death, "but at all other periods between the three months and five years of age tubercular meningitis" kills "the largest number." "Tubercular meningitis, according to the return, may thus be regarded as due to infection from tuberculous glands. The glands, therefore, possibly

may have become affected from the milk which the children have been fed on (I am merely speaking as a possibility), and the secondary disease, inflammation of the brain, may have thereafter resulted."

Without entering upon the question of the connexion which may exist between tabes mesenterica and tubercular meningitis, it is certainly a matter of importance to note that the great mortality amongst children, due to those two tubercular diseases, has attracted attention in various directions, and that almost all those who have recently dealt with the subject incline to the belief that these diseases are caused by an infection, using that word in its ordinary sense.

Mr. Hedley, travelling inspector under the Veterinary Department of the Irish Privy Council, also gave evidence before the committee touching this question of the conveyance of tuberculosis from the bovine animal to man. He stated that he had had personal experiences which pointed clearly in that direction. Mr. Hedley mentioned, as a part of his experience, the case of a certain farm in Scotland. There "during the course of the season" he used to see from fourteen to twenty cases of tuberculosis amongst the cattle. Those who worked amongst the cattle on that farm were women, and Mr. Hedley makes the following statement concerning them: "There was a large number of patients among the servants on this farm suffering from consumption, and there were many more cases of consumption in that immediate district than at other places." He refers, for confirmation of his statement, to the statistics of the Rhines District of Wigtownshire;

but no figures seem to have been shown or mentioned during Mr. Hedley's examination before the committee.

It is interesting to note that the landlord of the farm, to which Mr. Hedley refers in this part of his evidence, was urged to pull down certain sheds which stood upon the property and were frequented by the cattle. The result is stated by Mr. Hedley to have been, that "there was a great deal less tuberculosis on the premises after that" amongst the cattle. Mr. Hedley said, in answer to a question, that he did not know whether, after the removal of the sheds, there had or had not been a diminution in the number of cases of consumption amongst the servants engaged upon that farm.

It is a matter of common knowledge, that milch cows are more often the subjects of tubercular disease than any other kind of stock. According to the evidence laid before the committee, the percentage of animals found affected with tuberculosis in Dublin was 4.9 per cent. Ayrshire dairy cattle are markedly apt to contract the disease. It was stated, in the evidence now being quoted, that 25 per cent., 30 per cent., even as many as 50 per cent. of these Ayrshire cattle had been found suffering from tubercle, in one form or another, on various farms and other places. On looking back at what has just been stated concerning the very important question of the carriage of tubercular infection by means of cows' milk, it must be obvious to every one that there is trustworthy experimental evidence, and a considerable weight of medical opinion, in favour of the view that tubercular disease is con-

veyed from beast to man by the milk of consumptive cows.

Judging from the published opinions, and from the public teachings of the leading physicians of Europe and America, who are entitled to express an authoritative opinion concerning this question, there can be no doubt that the great majority of them regard the use of the milk of tuberculous cows as, in a very high degree, likely to make healthy people tuberculous. The evidence in favour of these views receives the strongest support, and is greatly increased in importance, by the practically unanimous opinions expressed at the Paris Congress of 1888, and by the Report of the Departmental Committee, appointed to inquire into Pleuro-Pneumonia and Tuberculosis in the United Kingdom in 1888, and also by the evidence given in the *Proceedings at Trial* before the Glasgow Local Authority, relating to the sale of tuberculous meat in that city in 1889. Hirschberger's experiments have a most important bearing upon the question of the carriage of tubercular infection by cows' milk. Not only does his work show, that in cases where cows are deeply tuberculous there is certainly danger to be feared for those who drink the milk of such animals, but it also shows what is of even graver import. It has been mentioned in this chapter that, in certain of his experiments, he used the milk of cows in which the lungs only were found to be affected by tubercle. The disease was, therefore, what has been almost universally regarded as "localised." But Hirschberger's experiments clearly prove, that it is easy to carry a belief in the localisation of tubercular

disease much too far, for out of nine inoculations performed with the milk of cows suffering from "localised" tubercle, three resulted in the production of tubercular disease in the animals used in the experiments. It is, therefore, not a fact that "localised" tubercle affects alone those parts of an animal where that disease is evident from its naked-eye appearances after death, or from the local signs of it which may be noticed during life. Hirschberger shows us by his experiments, that tubercular disease can never be safely regarded as affecting only that part of the body where its evidences can be either seen or otherwise detected by our trained senses. Unless we deny the truth of the evidence of his researches, we must accept it as proved, that it is never safe to regard an animal affected by "localised" tubercle whose milk or flesh may be used as food by man, as aught else than an animal suffering from a disease which may, at any moment, infect, practically, its whole structure.

CHAPTER XII.

FLESH OF TUBERCULAR ANIMALS A SOURCE OF INFECTION.

Numerous experiments have been performed, by a considerable number of observers, with a view to establish upon a definite basis the value of the belief, which is very generally held, that the flesh of animals suffering from tubercular disease does convey that infection to healthy animals, including man.

It is accepted as proved by these experiments, that any obviously tubercular part of the carcass of an animal is likely, when used for food, to cause that disease in the animal eating it. Perhaps it is hardly desirable to quote, in full, the experiments that bear upon this point. Those who wish to go through the evidence in detail, will find a careful record of much of it in Prof. Fleming's book on Veterinary Medicine. The purpose now to be accomplished, is sufficiently well indicated by a brief summary of a few of those experiments. Rodents, dogs, pigs, calves, fowls, and various other animals, have, by many observers, been fed upon tissue taken from tubercular animals, man included; juice pressed from tubercular flesh has been injected below the skin of healthy animals; saliva, milk, and mucus, taken from consumptives, both amongst men and

beasts, have been swallowed by healthy animals. Some hundreds of animals have been used in these different ways. As a matter of course, the animals submitted to these experiments did not all thereafter show signs of tubercular disease. Not a few of them remained apparently healthy. The majority, however, either died of tubercular disease, or were killed and shown, post-mortem, to have been tubercular. In certain of these experiments the tuberculous food was cooked before being given to the animals, and where the food was thoroughly roasted or boiled, tubercular disease did not supervene upon its use. If, on the other hand, tubercular meat was cooked so as to remain underdone in parts, it was noticed that tubercular disease occasionally followed upon the use of the underdone part of the meat. It must, however, be admitted, that while experiments of the kind indicated above, have settled the question of the danger of using as food meat obviously tainted with tubercle, the same kind of experimental inquiry has often failed to show that there is danger in using for food flesh which, though in itself apparently healthy, was obtained from the carcasses of beasts that had suffered from tubercular disease of seemingly very limited extent. Now, this is one of the most important, and one of the gravest, points requiring to be considered in connexion with the question of the communicability of tubercular disease. Experiments, as has just been said, have, in the greater number of cases, failed to give evidence of any infection resulting from the use as food of the flesh of animals suffering from tubercle localised, seemingly, in, for example, a part of one lung. This

failure of experimental investigation has been so frequent, that people have, until recently, been led to believe, by recognised authorities on this subject, that there is, practically, no danger in using as food the flesh of beasts which appear to be tubercular to a definite and limited extent only. It is a fact, that the bacillus of tubercle is seldom found in the muscles of animals which usually form part of the food of men, even when the internal organs of those animals are deeply involved in tubercular disease. Why this is so we do not know; consequently, it is not uncommon for theories to be started with the intention of throwing light into this dark corner of bacteriology. When theories abound in the literature of any subject, one or two of them are apt, as men become familiar with them, to be ranked amongst facts. So it comes to pass, that daily the carcasses of beasts whose lungs only have appeared to be affected with tubercular disease, are sold in thousands, and eaten by the public. But the evidence laid before the Paris Congress in 1888, and before the Departmental Committee in London in the same year, showed clearly that—in the words of the Report of the latter—" . . . . although the bacilli" (*i.e.*, bacillus of tubercle) "may be found but rarely in the flesh, still the chance of their being present either there or in the blood is too probable to ever allow of the flesh of a tubercular animal being used for food under any circumstances, either for man or the lower animals.

All that we know about the history of tubercular disease points clearly in the direction that, in the vast majority of instances, the animal—man or beast—

attacked is subject to very sudden exacerbations of his disease. It is, I suppose, a matter of common observation in the wards of a hospital, that after one of these exacerbations in a consumptive, the disease is often found, by its symptoms and physical signs, to have extended itself within the patient's body. In other words, consumption and most other tubercular conditions progress chiefly, and, as a general rule, by leaps and bounds, separated from one another by periods of abatement often of all the symptoms of disease. These periods of intermission of symptoms, are of very various duration. Sometimes a case is characterised by intervals of only a few days between the attacks. At other times, the same case may seem for weeks, or even for months, to be on the high road to recovery—so long may the interval continue which divides one exacerbation from the next. All these features of tubercular disease are very well marked in cases where it attacks chiefly the lungs, and where the disease follows its usual chronic course. Since Koch's discovery of the bacillus of tubercle, it has been generally supposed, and accepted as probably true, that the periods of exacerbation in cases of tuberculosis, are due to the escape into the blood-stream of numbers of the bacillus. This theory is brought practically within the domain of fact, because, as has been already mentioned, fresh tracts of newly infected tissue are often easily detected after these outbursts of the symptoms of consumption, and we know that no tubercular infection is possible excepting as a consequence of the presence of the tubercle bacillus, or of its spores, in the affected parts. This branch of the subject has, it seems to me, a very im-

portant practical bearing upon the question of whether it can ever be safe to use, for the food of men, the flesh of any animal which suffers, no matter how slightly in degree and in extent, from tubercular disease. For that reason I venture to dwell at some length upon the tendency of tubercular disease to spread, in various directions, in the bodies of its victims. It is plainly obvious from the results of numerous post-mortem examinations, that the bacillus of tubercle is carried by the blood-stream to parts of the patient's body remote from the site of the original outbreak of the disease. On the same authority we have it established, that the bacilli thus carried by the blood in cases of chronic tuberculosis, very often cause, here and there in the tissues, lesions of remarkably limited extent. This fact shows, that probably a very few of the bacilli—possibly only one or two of them—may suffice to originate a new point of tubercular infection. Also, experiments have proved that the bacilli, or their spores, may lie for a considerable time in the tissues without giving any evidence of their presence. For example, in several instances, the juice pressed out of the seemingly healthy muscles of an animal suffering from apparently localised tubercle in one lung, has been injected into the body of a healthy animal, with the result that tubercular disease has been developed at the site of the injection. It is, therefore, clear, that an animal which is tubercular, in even the slightest degree, is not certainly free from that condition of disease at any given time, in any part of its body which might be used for food. These facts, together with what we are entitled to regard as reasonable

deductions from them, point in but one direction. Accepting them as true, we are no longer at liberty to speak of "localised" tubercular disease. We must regard that condition as dependent upon a parasite which, once it has gained a footing in a living body, is carried about by the blood-stream, and causes, therefore, not a "localised" disease, but one which is general to the whole body, and which may at any moment light up, practically anywhere in the body, new local evidences of its presence. This view, whether commonly recognised or not, is certainly not enforced in the literature of the subject with sufficient emphasis to arrest the attention of the ordinary student. That, at all events, seems to me to be the state of the case. I therefore asked my colleague Dr. Sydney Martin to give me, in brief tabular form, some of the results of his very valuable experience, in this connexion, during his term of office as Pathologist to the City of London Hospital for Diseases of the Chest. Dr. Martin very kindly sent me the following statement which, it seems to me, illustrates, very clearly, how often the evidence of the dead-room shows the frequency with which "localised" tubercular disease is associated with facts proving, that the infection of that disease travels far afield, even in very chronic cases.

Dr. Sydney Martin's Report.

"From the examination of the records of fifty-four cases of chronic phthisis examined, post-mortem, by me at the City of London Hospital for Diseases of the Chest, the following results may be tabulated. Only those cases are included in which there was a chronic cavity at one or both apices of the lungs, the chronicity of the cavity being judged by the absence of progressive

caseation of its walls, and by the presence of a ring of connective tissue round the cavity. Cases are not included which showed lesions throughout the lungs of about the same date as the primary lesion at the apex.

The cases tabulated showed, in many instances, the primary apical lesion as a very chronic cavity of variable size. In a few cases there was a scarred apex, with fibroid tissue in the lung surrounding a caseous or calcareous nodule.

(A.) *Cases of Chronic Phthisis without a Secondary Outbreak of Acute Tubercle in the Lungs.*

(1) Cases without tubercle elsewhere	7
(2) ,, with intestinal ulceration	6
(3) Case with intestinal and laryngeal ulceration	1
(4) ,, ,, meningitis	1
Total	15

These cases died from hæmoptysis, albuminoid disease, exhausting diarrhœa, or meningitis.

(B.) *Chronic Phthisis with Acute Tubercle of Lungs.*

(1) Cases without tubercle elsewhere	9
(2) ,, with intestinal ulceration	11
(3) ,, ,, laryngeal ,,	7
(4) ,, ,, ,, and intestinal ulceration	7
(5) Case with tubercle of intestine, larynx, brain, and liver	1
(6) Case with tubercle of liver, spleen, and peritoneum	1
(7) ,, ,, ,, larynx and kidney	1
(8) ,, tubercular peritonitis	1
(9) ,, strumous cervical glands, and caseous mesenteric glands	1
Total	39

The second class of cases showed the chronic lesion at the apex or apices, and the acute lesion spreading from the apex more or less throughout the lung tissue. This acute lesion was, in a few instances, discrete miliary tubercle; in the majority of instances miliary tubercle in aggregated and firm racemose patches, varying in size from a bean to a horse-chestnut; while in some cases the acute lesion consisted of rapidly softening (so called) yellow

tubercle. In a few instances pneumonic consolidation surrounded the racemose patches.

From these cases it is evident that a not uncommon mode of death in chronic phthisis is a sudden outbreak of acute tubercular consolidation in the rest of the lung."

(Signed) "SYDNEY MARTIN,

"*Pathologist, Middlesex Hospital; late Asst. Physician and Pathologist, City of London Hospital for Diseases of the Chest.*"

Another record of observations makes, if possible, still stronger the evidence relating to this important point in the natural history of tuberculosis. It has been frequently remarked by several authorities (*e.g.*, McCall, McFadyean, Cope, Sir Charles Cameron, Hedley, and others), that tubercular bacilli have often been found in the marrow of the bones of animals which, judging of them by all known standards, would have been passed as "prime beasts" by men best able to give an opinion upon that subject. This fact proves to demonstration, that the tubercular virus may circulate with the blood-stream throughout the body of an animal, before any "localised" symptom of that disease can be detected. Also, it is a matter of common knowledge amongst veterinary surgeons, that tubercular disease in cattle, used by man for his food, very early in its onset shows, by unmistakable signs, that it has become a generalised, not merely a localised disease.

It was pointed out in the preceding chapter, that there is a considerable amount of evidence in favour of the view, that infection has been carried by milk taken from tubercular cows. Both Hirschberger, and Ernst, of Boston, U.S.A., have observed that

infection has come from the milk of such cows, even when the animals' teats and udders, after careful examination, were not seen to have any kind of lesion. These observations also tend to show how widespread the bacillus of tubercle may be, even when the disease resulting from it is "localised." These observers expressly point out that certain of these cows, with seemingly healthy udders and teats, had signs of tubercular disease only in the lungs. Now, if we call to mind what is accepted as true concerning the secretion of milk, and if we accept the statements of these two observers as probably correct, we surely must cease to derive material satisfaction from an assurance that the milk we drink, or the meat we eat was taken from a partially tubercular animal. The blood is the original source within the body of all the ingredients out of which milk is made. They, however, undergo a process of special manufacture in the epithelium cells which line the alveoli of the mammary gland, whence they issue possibly to mingle with other substances, and then appear as milk. If, then, in cases of "localised" tubercular disease, under the conditions pointed out by Hirschberger and Ernst, cows' milk is found to contain the virus of that disease, what stronger evidence than this could we have of the free and wide circulation throughout the blood-stream of the tubercular bacillus, even in very slight cases of tuberculosis ?

A very suggestive contribution to the study of this question of the carriage of infection by means of the flesh of tubercular cattle, was made, some years ago, by the authorities at Baden-Baden. They

published a sort of map which showed, that where cattle suffered much from tuberculosis, the human population also suffered much from that disease. A remarkable observation is recorded in the map, and it is to the effect that where butchers who deal in cheap meat are numerous, there tuberculosis is exceptionally prevalent amongst the people. Now it is well known, that about ten years ago, when the Baden-Baden authorities issued the map referred to, a very considerable trade was carried on in the sale of the carcasses of tubercular cattle for human food. That trade was largely in the hands of those butchers who sold cheap meat; and so we have a remarkable series of facts which point, it seems to me, unmistakably to the conclusion, that the tubercular cheap meat, and the unusual prevalence of tuberculosis amongst those who fed upon it, bore to each other the relationship of cause and effect. This map referred to fifty-two towns, and was, therefore, the outcome of pretty extensive observation.

Barndoor fowls are very susceptible to the infection of tuberculosis. A remarkable instance of the spread of that infection to a healthy woman from the half-cooked flesh of hens, of which she had eaten, is noted in the Appendix to this book. In that case the hens became tubercular by eating the expectoration of a consumptive man. Instances like this, so strongly suggestive of infection from the flesh of tubercular animals, are extremely rare in the literature of the subject. It should be clearly understood, that those who advocate the view, that no tubercular animal should be allowed to contribute in any way to the food of man, rest their arguments chiefly on what is

known of the habits of the tubercular bacillus, within the bodies of the animals it attacks. The law in England, in practice at all events, permits an inspector of meat exposed for sale in the public markets, to allow the carcasses of animals obviously tainted with "localised" tuberculosis, to be sold for food under certain conditions. The restrictions are, that the obviously diseased parts, and a certain, or rather an uncertain, extent of apparently sound tissue around them, shall be cut away from the carcass, and not sold for food. It is, therefore, certain, that a large amount of flesh of tubercular animals is daily eaten by the people of this country.

Ever since the decision of Sheriff Berry in June 1889, concerning the sale of tubercular meat in Glasgow, the law touching that matter has, it is said, been very strictly enforced in Scotland, and the carcasses of animals showing even "localised" tuberculosis, are there rigidly excluded from the public markets. I believe the Irish markets are being regulated, in this particular, by an application of the law similar to that which obtains in Scottish communities.

Statistics published by the Departmental Committee show, that in Dublin 4.9 per cent. of slaughtered animals were found tubercular. In Edinburgh the percentage is 0.2 ; in Glasgow, 1 in 180 ; in Paris, 0.6 per cent. ; for all France, 0.5 per cent. In Germany the percentage varies from 1.5 to 20. There inspection of meat is carried out with great strictness, and especially is that the case in the large towns. In Berlin, out of 130,733 animals slaughtered, no fewer than 4300 were found tubercular. In Great Britain

and Ireland it is, I think, probable, that about 4 per cent. of the animals slaughtered would, judging from published statistics, turn out to be, more or less, affected with tubercle. People who understand such questions could, no doubt, easily, and with sufficient accuracy, fix the value of the money loss which would fall upon England, were the destruction of all tubercular animals strictly enforced throughout the country. The first loss from such a proceeding would certainly be the greatest, unless all the evidence concerning the cause and the spread of tubercular disease, which modern investigation has placed before us, is worthless.

CHAPTER XIII.

ON THE ALLEGED IMMUNITY OF JEWS FROM TUBERCULAR DISEASE.

It has often been asserted, that the Jewish people enjoy a marked immunity from tubercular diseases. A cause of this alleged immunity has been found, it is said, in the fact that Jews who conform to the laws of the Hebrew faith are very careful in the selection, the killing, and the cooking of their food, and especially of that part of it which is taken from the carcasses of animals. The killing and inspection of beasts whose flesh may be used for food by conforming Jews, are carried out under the supervision of officers, appointed for the purpose of seeing that the very exacting Hebrew law, touching that matter, is strictly enforced. All the internal organs of the animal are most carefully examined, and the lungs are objects of specially minute scrutiny. One pleural adhesion, or adhesion between the lobes of the lungs, would ensure the rejection of the whole carcass, no matter how healthy it might be in appearance. The lungs of the animal are inflated to the full under water. The slightest leakage of air through the substance of the lung, under those conditions, would necessitate the condemnation of the whole carcass, even were the beast in seemingly the best of prime conditions. If tubercles are seen

in or on the lung, the whole carcass is rejected. Dr. Gaster very kindly allows me to quote from a letter of his, which he courteously placed at my disposal. I need hardly say, that it is with pleasure I find myself permitted to quote from so distinguished a scholar. He says, concerning the laws of the Jews relating to the slaughter of cattle:

"The rules are the same throughout the world, wherever observant Jews live."

"In a most comprehensive and tabulated form they make a portion of the Jewish religious code, known under the name of the *Shulhan Aruch*, compiled by Rabbi J. Aaro in 1563. Their sources, however, may date as far back as the second Temple, and the rules observed nowadays in slaughtering and examining the animals, belong to the so-called Oral Law embodied in the *Chisna* and *Talmud*."

The sources of these laws date back to the time of the second Temple—*i.e.*, about 520 B.C. Here, then, we find in records of great antiquity, a law, which, were it enforced all over the world to-day, would, in the opinion of the medical profession, confer upon mankind an incalculable boon, and meet, to the full, even the ideal requirements of the most devoted adherents of the teachings of recent scientific researches. How true it is, that truth must prevail!

In a very interesting and instructive article in *The Nineteenth Century* for September 1889, Dr. Henry Behrend gives many important details concerning the healthiness of Jewish communities, compared with their Christian neighbours. It is an article which should be read by every one who is interested in such subjects. Dr. Behrend gives

numerous references which deal with the demography of the Jews in various parts of Germany, Austria, Saxony, Hungary, and other countries of Europe. Almost without an exception, the figures speak strongly in proof of the remarkable sturdiness of the Jewish race at all ages of life. They live longer, suffer less from disease, and a very much larger number of their children live through the first five or ten years of life, than is the case in the Christian communities around them. The Jews themselves regard these privileges as greatly owing to the strict observance paid, by many of their race, to those sanitary laws which form an important part of their religious belief. It seems, too, that the same explanation is accepted by many persons not of the Hebrew faith, who have given this subject careful consideration. My friend Dr. MacLaurin, when he was President of the Board of Health of New South Wales, sent me a paper he had read at the International Medical Congress in Melbourne. In it he drew attention to the ravages of tubercular disease amongst cattle in Australia. He stated his belief, that the use of the flesh of such animals for food was a danger to the public health, and gave statistics in support of that view of the case. He also mentioned, in the same paper, that only one case of death from consumption had occurred during three years amongst the Jews of New South Wales, who number over 4000, and live mostly in the towns. He said, that amongst the same number of Christians in the colony, thirteen or fourteen died from consumption in that period of time.

Dr. Cohen, of Sutherland Avenue, told me that he

had often noticed the rarity of tubercular diseases amongst Jews. He is a member of the Jewish Board of Guardians, and Medical Officer to the Jewish Schools, where about 3000 Jewish children are educated. His opportunities for observation are, therefore, exceptionally extensive, and, although he has not, I understand, kept statistical records of his experiences amongst his own people, he is sure that he has very rarely indeed seen evidences of tubercular disease amongst them, and that the children are peculiarly exempt from such conditions as swollen glands in the neck, crooked spines, and hydrocephalus.

Dr. West, whose very large experience of children's diseases is known to every medical man, allows me to say that, although he has not figures of his own to quote from, his recollection is perfectly clear as to the fact that tubercular disease amongst Jewish children is rarely seen. In the paper to which reference has already been made, Dr. Behrend says, ". . . . in a practice of thirty years, largely among Hebrew patients, I have not yet met with a single case of phthisis in the members of that faith."

In the London Hospital, certain wards are reserved for patients who are Jews. It occurred to me that, in the records of the practice in those wards, there might be found some facts concerning the prevalence, or otherwise, of tuberculosis amongst their inmates. I therefore communicated with Drs. Stephen Mackenzie, Turner, Gilbart-Smith, and Anderson, and with Mr. Fred. Treves, and they, in the kindest way, placed their notes of cases treated in those wards at my disposal. Records of the years 1888 and 1889

were tabulated. The patients were divided into two classes :

I. Those who, both before and after their admission to hospital, conformed to the Hebrew faith.

II. Those who did not so conform.

With Dr. Hadley's help, and with the permission of the Committee of the Hospital, I am able to state the following results of the inquiry :

The diseases taken for comparison are—

1. General Tuberculosis.
2. Tubercular Meningitis (acute and chronic, including Hydrocephalus).
3. Tubercular Peritonitis.
4. Tubercular Skin Diseases.
5. Pulmonary Phthisis.
6. Tubercular Glands.
7. Tubercular Joints.

The presence or absence of hereditary taint is not always mentioned ; sometimes a definite answer was unobtainable. In those cases where it is mentioned, it points in the direction of heredity being more frequent (it might therefore be argued that the acquired disease is rarer) among conformers.

It will be seen that the percentages of conformers and of non-conformers, suffering from tubercular diseases, are very similar, and were larger numbers taken, the results would probably be brought still closer to each other.

1888.

Admitted—

649 conforming to Jewish laws } 1 to 11.74 nearly.
7619 not so conforming . . }

14 out of 649 conformers suffered from tubercular diseases (or 2.16 (nearly) per cent.).

237 out of 7619 non-conformers suffered from tubercular diseases (or 3.12 (nearly) per cent.).

1889.

Admitted—

664 conforming to Jewish laws. } 1 to 11.8.
7839 not so conforming . . }

36 out of 664 conformers suffered from tubercular diseases (or 5.43 (nearly) per cent.).

312 out of 7839 non-conformers suffered from tubercular diseases (or 3.98 per cent.).

1888 and 1889 combined.

Admitted—

1,313 conforming to Jewish laws. } 1 to 11.78 (nearly).
15,458 not so conforming . . }

50 conformers out of 1313 suffered from tuberculous diseases (or 3.8 per cent.).

549 non-conformers out of 15,458 suffered from tuberculous diseases (or 3.56 (nearly) per cent.).

It may be of interest to give some details of the statistics of which the above statement is an outcome. The small number of cases of meningitis mentioned below, is due to the fact that nearly all cases of tubercular meningitis are accompanied by tubercle affecting other organs, and, therefore, come under the head of general tuberculosis. The following are some of the chief points brought out by an examination of these statistics :

JEWS ADMITTED SUFFERING FROM TUBERCULAR DISEASE.

Conforming.		*Non-conforming.*	
General Tuberculosis.			
2 males.	5 females.	50 males.	18 females.
Tubercular Meningitis.			
2 ,,	0 ,,	3 ,,	2 ,,
Tubercular Peritonitis.			
3 ,,	3 ,,	8 ,,	7 ,,
Tubercular Pyelitis.			
0 ,,	0 ,,	2 ,,	0 ,,
Lung Tubercle.			
11 ,,	11 ,,	127 ,,	79 ,,
Tubercular Glands.			
1 ,,	3 ,,	34 ,,	18 ,,
Tubercular Joints.			
3 ,,	5 ,,	76 ,,	57 ,,
Lupus.			
0 ,,	1 ,,	29 ,,	39 ,,
Total .	50	Total .	549

Fifty-two Jews have been admitted to the wards of the City of London Hospital for Diseases of the Chest, during the last twenty months. Of these, fourteen men and ten women, twenty-four in all, were suffering from tubercular disease of the lungs. Ten of the men and seven of the women are believed to have been observant Jews; the others did not conform to the Hebrew faith. Of the observant Jews four only showed hereditary tendency to tubercular disease; the rest had no knowledge of anything of the kind. Amongst the seven non-conforming Jews, two only had a history of family predisposition to consumption, three had no such history, and the other two could give no information on the subject.

With the kind help of the Rev. S. J. Roco, who for many years has ministered to the Hebrew patients in the wards of the City of London Hospital for Diseases of the Chest, and of Dr. Chaplin, the Resident Medical Officer of that hospital, I am able to add thirteen other cases of Jews to those already mentioned, who have been admitted to the wards of the hospital suffering from consumption. These cases were found recorded in the hospital registers of 1875 and the four following years, and the registers of 1881, '82, and '87. I do not wish to make undue mention of what will at once suggest itself to any one who reads these statements, taken from the hospital statistics. I refer to the comparatively large number of Jews who were admitted to the hospital during the past twenty months. The list, which extends over the eight years mentioned above, contains the names of only thirty Jewish patients in all. As has already been said, a total of fifty-two Jews passed through the hospital during the last twenty months. It is difficult to explain that fact, and it is probable that several causes have been at work in connexion with it. It may, however, have some value when taken in association with what has yet to be said, in these pages, about the causes which may have led to a possibly recent increase of consumption amongst Jews.

Rabbi Roco allows me to say, that the majority of the Jews who come into the wards of the City of London Hospital for Diseases of the Chest, observe the doctrines of the Hebrew faith.

The numbers now given are far too small to enable one to form a decided opinion, concerning the amount of immunity from tubercular disease enjoyed by the

Jews. They certainly are a healthier race than the Christians amongst whom they live ; but the figures quoted show that tuberculosis is not so uncommon amongst them as has been supposed. There seems, however, judging from the evidence, good reason to believe that the Jews do enjoy some immunity from tubercular diseases. Admitting that view to be correct, it becomes of great importance to ascertain why the immunity exists. The facts material to the decision of that question seem to be, chiefly, the wise laws which, to a considerable extent, regulate the quality of the food of Jews ; the hereditary sturdiness of the race ; and the care with which house cleaning is carried out amongst a considerable number of Jewish families. At least once a year, besides the ordinary house cleanings common to all people who object to dirt, the Jew, whether he be rich or poor, cleans his house and all that is in it, in a way which might, with much advantage, be copied by persons who are not Jews. The thoroughness of the cleaning will be appreciated when it is known that, in some Jewish families, every book in the house is dusted, opened, and its leaves well shaken. This thorough house cleaning takes place at the time of the Feast of the Passover, and is done in obedience to the Hebrew law of cleanliness. Of course, the Jew who is true to the Hebrew faith carries out these rules with strict attention to every detail : it is, however, the case that many Jews who do not conform to that faith, enforce its tenets concerning the manner of the periodical cleaning of the houses they inhabit, and the furniture they use in their homes. From a sanitary point of view, the importance of such house cleanings as those just de-

scribed could not be overrated. The common sense that underlies them will appeal, with special force, to those who are acquainted with what is known of the habits outside of the animal body, of certain parasites which prey upon mankind, and the most deadly of them is the parasite which causes all tubercular disease. These remarks regarding cleanliness, are meant to apply to houses among whose inmates there is no tubercular disease, and not at all to cases where that condition already exists. In these circumstances, as will be explained later on, special precautions have to be taken in house-cleaning. Viewed in the light of modern research into the pathology of disease, it seems highly probable that the rules which control the Jews, more or less, in the matter of their food, are calculated to have a most beneficial effect upon the health of that people, especially where diseases due to bacteria are concerned. It seems, therefore, in a high degree probable that the amount of immunity from tubercular disease which is enjoyed by the Jewish race is, as has already been stated, in no slight degree due to the observance of those dietary laws ; and, though probably in a less degree, to the hereditary sturdiness of the people. Last of all, but certainly much less important than either of the foregoing causes, the Jew's habits of cleanliness may be regarded as a probable factor in this question touching the incidence of tuberculosis upon his race. The problem is, however, complicated by the fact that, like their neighbours who are not their co-religionists, the Jews count amongst their numbers many persons who ignore the requirements of religion altogether, besides very many others who suffer occasional lapses

from the strict observance of the laws of their faith.

The recent savage persecutions of the Jews in certain parts of Europe have, during the past eight years or so, sent into England many thousands of Jews who are, for the most part, very poor. These poverty-stricken people have flocked to our largest towns and cities, and crowded many of the most miserable of the wretched dwellings which, to England's shame, still exist among us and disgrace even the vilest slums of many of our cities. It will at once occur to one who has studied the bacteriology of tubercular disease, that here arises a set of conditions which might well account for an outbreak of tuberculosis, and especially of consumption, among those poor Jews. They, in England, crowd, in a considerable number of instances, the parts of towns, and the houses, whence come many of the poor creatures who supply instances of consumption to our hospitals. Unless recent research concerning the origin of consumption, and the means by which it is spread throughout communities, is one long series of blunders, it is certain that those Jews have thus been exposed to the infection of tubercular disease in, what was for them, an unusual degree. Partly from choice, no doubt, but also, in great measure, because of the cruel hatred with which their Christian neighbours regarded them, the Jews had lived in the towns and cities of Eastern Europe, in streets and quarters which were chiefly, and oftentimes exclusively, inhabited by Hebrews. The statistics of these communities of Jews in various parts of Europe, and the experience of the physicians who have been, to a great extent, their

medical advisers, agree in showing that tuberculosis, in any form, is of very rare occurrence among the Jews. Therefore, they were not exposed to the infection of that disease in any other than an extremely trivial degree, and, living with their own healthy surroundings, they preserved, in a remarkable way, their own healthiness. Suddenly, all that is changed for many of these people; and they find themselves driven out, destitute and wretched, amongst the dirt and the disease of the lowest communities of the towns of Western Europe. The conditions thus arising were certainly very likely to originate consumption, and to help greatly its spread amongst those poor Jews. In this way, it may be urged that the Jews are becoming tubercular, and I am not sure that the argument could not, with extended and careful inquiry, be supported by new and cogent facts. When a man with the experience of Sir Andrew Clark, unequalled, perhaps, in its extent, says—and he kindly allows me to quote him—that he has not seen, in private practice, half a dozen cases of tubercular disease of the lungs amongst his numerous Jewish patients, and when one looks at the experience of others—some of them have already been quoted in these pages—one cannot but admit that the case is a strong one which supports the belief, that Jews are in the enjoyment of a considerable immunity from tubercular diseases. On the other hand, it is certain that, at all events in London, the amount of immunity has either been made too much of, or is confined to the well-to-do Jews, or is being lost chiefly by those Jews who have the misfortune to supply our hospitals with some statistics concerning tuberculosis amongst their own people.

CHAPTER XIV.

POINTS FOR CONSIDERATION SUGGESTED BY THE EVIDENCE.

In common with most subjects worth discussing, the question of the communicability of tubercular disease raises problems difficult of solution. If we consider how widespread the virus of that disease is, we shall not be surprised to learn that, according to the Registrar-General's returns, nearly one-half of those who die between fifteen and thirty-five years of age are killed by tubercular disease of the lungs alone. In each of our largest cities and towns, many hundreds of persons who are tubercular walk daily in the streets. Most of those amongst them who are consumptive, often spit as they go along. Any one of these expectorations may become a source of infection. Again, a very large amount of milk is sold which is taken from tubercular cows. The bulk of the people do not know that there is any danger in using such milk, without proper precautions for its disinfection having been previously taken. Therefore, large quantities of milk which carries with it the virus of tubercle, are consumed daily. Precisely the same statements may with truth be made concerning the use of butter, cheese, and cream, as well as of the tubercular flesh of animals. In this country alone, many thousands of persons must be brought into

daily contact with tubercular people and beasts. Under this head would come those who live in the same houses with consumptives, and nurses, doctors, farm-servants, cooks, butchers. Add to that crowd of people, the far larger crowd of those who may, at any moment, come into direct contact, for a longer or a shorter time, with a possible haunt of the bacillus of tubercle. Amongst them would be found the thousands who daily throng the out-patients' departments of our hospitals—and, in short, every one who goes where a consumptive person has spent even a few minutes. When one tries to realise what a multitude of people are, in those different ways, exposed, more or less, to possible infection, he is not surprised to hear that tuberculosis, in the form of lung disease alone, kills one-half of those who die in this country between fifteen and thirty-five years of age. At first glance one might, in the circumstances not perhaps unreasonably, express surprise that many victims should be forthcoming for diseases which are not tubercular. Considerations prompted by observations and reflections such as those, have led men to look around in search of explanations of the fact, that so many persons who certainly are often exposed to the infection of tuberculosis, never suffer from that disease. The old theory which teaches that there is, in certain persons, a marked proneness to contract tubercular disease, naturally suggested itself as a probable explanation, and as likely to lessen some of the difficulties surrounding the question. Now, this very old theory of what has been popularised under the phrase, "hereditary predisposition to consumption," may be sufficiently clearly ex-

plained, for our present purpose, in this way : When one or both parents of a family die of consumption, and that disease thereafter affects any of the children in that family, it is said that the family has a predisposition—an hereditary tendency to consumption. At one time this theory was pushed so far as to lead to a widespread belief, that there could be no such thing as consumption without hereditary tendency to that disease, in the person in whom it showed itself. Perhaps it is true that, even to-day, this curious belief is not without its advocates ; but, as a matter of course, the theory of heredity in disease covers no such eccentric creed as that. It is a fact, universally admitted, that a considerable number of those who fall victims to tubercular disease of any kind, have a family history which shows that one or more of their nearest blood relations have died of tuberculosis. It is in cases of tubercle affecting the lung that this type of family history has been defined with the greatest clearness. Many observations have been made with a view to determine, what part hereditary predisposition to the disease fills in the story of consumption. So far as I have been able to make out the results of those observations, they seem to prove that there is a considerable minority of consumptive people whose fathers, mothers, brothers, or sisters have, in very varying numbers, also suffered from lung tubercle. About 30 per cent., more or less, may be taken as a figure which would fairly represent the number of persons who, amongst hospital patients, give histories of consumption having occurred in their families, within the limits of relationship named above. About 70 per

cent. of consumptives give no history of family predisposition to tubercular infection. It is therefore obvious, that in a large majority of cases of consumption we have no evidence of hereditary tendency to it, within the limits of relationship already specified. Every hospital physician must often have seen men of good physique suffering from tuberculosis in its earliest stages, who could give an accurate account of their family histories, and very often it turned out to be the case, that not one of their near blood relations had shown any symptom of lung disease. There is, of course, nothing very remarkable about that; but it is curious to note that these men's children, born even before consumption seized the fathers, would be certainly counted amongst those who have inherited a predisposition to that disease. It is, of course, open to any one to argue, that the fact of the existence of tubercular disease in a man shows that he is predisposed to its infection. If by that argument it is meant to convey, that no man becomes tubercular who has not inherited or acquired a peculiar aptitude for favouring, in his body, the growth of the bacillus, then the grounds on which the argument is founded have in them no facts to justify such an assumption. There is ample evidence to prove, that when several animals belonging to a species have been shown to be subject to the infection of a disease, then practically every member of that species is susceptible to that infection. It is certain that man is very apt to suffer from tuberculosis, and, therefore, we are justified in holding the belief that all men are prone to its infection. It would not, I imagine, occur to any one to dispute

the assertion, that all men are not equally well suited for the reception and growth, within their bodies, of the tubercular bacillus. All that is to-day meant or implied by this doctrine of the hereditary tendency to tubercular disease is, that certain families are unusually likely to contract tubercular disease, because some of their nearest blood relations have previously suffered from that condition. We have seen in the evidence that has passed under consideration in these pages, that no inconsiderable number of people, without hereditary taint in that direction, have acquired tubercular disease in one form or another. Before those persons became consumptive, their children would not have been regarded as having inherited any such taint; but as soon as consumption showed itself in the parent, all the children, whether born before or after that event, would have been classed, in the statistics upon which the doctrine of heredity in consumption is founded, as having a special proneness to that disease. I do not remember having ever seen any attempt made, in statistical records, to distinguish between the class of cases just mentioned, and those other cases in which consumption appeared to have arisen in the usual way—that is to say, without any history of a distinctly accidental infection. The statistics on this subject fail, therefore, to take into account a material number of cases which, I submit, ought not to be classed with those who are said to have a history of hereditary tendency to consumption. When tuberculosis, in this connexion, is looked at in the light which has been thrown upon its pathology by Koch and Cornet, not to mention other

observers, it becomes clear that the error just pointed out is far from being a trivial one. For one case in the list of those which can be reasonably shown to have resulted from tubercular infection, and to have had no history of hereditary predisposition to it, it is plainly obvious, from the evidence, that there are no inconsiderable number of like cases omitted from that list, which would have appeared in it had all the facts that concern them been fully known and appreciated. These considerations, it seems to me, tend to lessen, very considerably, the importance of the part enacted by hereditary predisposition as a factor in the spread of consumption amongst human beings. To advocate the adoption of this view of the subject is, in the circumstances of our knowledge concerning it, surely not unreasonable. To argue, as some have done, that hereditary predisposition to tubercular disease is an exploded theory, and has nothing to do with the spread of tuberculosis, is, if I apprehend the facts aright, going much further than our present knowledge of them entitles us to go. No doubt there are instances within the experience of most people, illustrating events which seem to point distinctly to hereditary predisposition as an agent in the incidence of consumption amongst families. For example: the children of a certain family were, very early in their lives, scattered about the world. They were eight in number. Their father, a healthy man, sprung from a vigorous and sturdy family, was accidentally killed. Their mother died, near her fortieth year, of consumption, which had killed her father and sister. As the children came of age, they, with only two exceptions, left England.

One went to Canada ; another devoted himself to the work of a ranch, in one of the Western States of America ; a third went to North-Eastern India ; a fourth to Australia ; two went to China. With the exception of the rancher, who is now a healthy man of about thirty-five years of age, all the children of this family have died of consumption. That kind of family history is not uncommon amongst those who are well-to-do or rich. Parents seeing their children, as they grew up, droop and die, one by one, of consumption, have done everything that money and the most skilled medical opinions could suggest or do. Every medical man who has had much experience of the practice of his profession knows, and has heard, of such cases, and can tell of how, almost year by year, in such families, another son or daughter was added to the number of the dead, while yet another, perhaps far from home, began to show the first symptoms of the disease which would, almost surely, kill him. It is impossible not to be struck by such family records as these, when we study the subject of hereditary predisposition in its connexion with consumption. Nevertheless, it is a fact that the value of hereditary predisposition in its association with consumption, has been diminished by the revelations of the bacteriology of tuberculosis, for it is now known that tuberculosis, in any one of its forms, can arise from infection only, no matter whether hereditary tendency to that disease is or is not present in the infected person.

It is only of late years, that men with opportunities for the study of leprosy at their command, have, to a considerable extent, recognised that the importance of hereditary predisposition has been

very greatly exaggerated in connexion with that disease. The apparently healthy children of lepers have, in several instances, been removed from their leprous surroundings, and transferred to parts of the country remote from districts where leprosy prevails amongst the people. This experiment, most humanely kind in its object, has been carried out to a considerable extent. Year by year, it becomes more and more evident, that these children of lepers, when thus dissociated from lepers, are as unlikely as any class of the healthy community to become leprous. It is a matter of common knowledge, that in America there is a well-known set of people who are the descendants of lepers. By parentage these people are Scandinavians, and they are between 130 and 135 in number. Their condition of health is well known, and in no instance has any one of them shown the slightest symptom of leprosy.

In many important pathological points, leprosy and tuberculosis seem to touch one another closely. In both of them much weight has been given to the influence of hereditary predisposition as a chief factor in their diffusion amongst men. It is only within the last ten or twenty years, that those who are entitled to speak with authority on such subjects, have begun to attach far more importance to the question of infection, than to the theory of hereditary predisposition where leprosy is concerned. It is only within the last eight years that there has arisen a serious demand to know, on what sure grounds is founded the high place that is given to the theory of hereditary predisposition, in connexion with the spread of tuberculosis.

But the question arises,—Considering how widespread is the virus of tubercle, why have we not even more deaths from consumption? What we know of hereditary predisposition, does not supply us with a sufficient answer to that question. One theory advanced as a possible answer to it is, that as this disease has so widely, and for so long a time, affected mankind, certain persons may have inherited, or acquired for themselves, a special power of resistance to the virus of tubercle. Again, it has been argued as not impossible, that many people become protected from tubercular disease by having suffered a previous attack of it; just as one attack of scarlet fever protects an individual from a second. The evidence on which this theory is based is found in the familiar fact, that a considerable number of bodies, examined post-mortem, show unmistakable signs of tubercular disease, of which, however, there had been, in many of the cases, no record during life, and which had had no apparent connexion with the patients' death. Several other theories have been advanced with a view of answering this question, but, hitherto, no satisfactory solution of the difficulty has been discovered. It may, however, throw light on this point if we keep clearly in view, what seems certainly true, that the infection of tubercular disease is in no way to be compared in the celerity with which it strikes down its victims, with the infections of such diseases as whooping-cough, scarlet fever, and measles. We must remember that a chief reason why scarlet fever, whooping-cough, measles, and such-like ailments, are universally recognised as infectious diseases is, that their manifestations follow

shortly after infection, and thus enable us to trace the source of the virus. In tubercle we know not how long a time may pass between infection and the first symptoms of the disease. We know it must be at least many weeks. Again, the symptoms of the fevers which every one associates with the idea of an infection, are striking, and, as a rule, at once attract attention. On the other hand, the first symptoms of consumption are, in the vast majority of instances, so slight that they escape notice altogether. The patient has "slight colds," or complains of being a little feverish at night, or fears that he is getting thin, and so months may pass before some startling symptom, such as a hæmorrhage, opens the eyes of all concerned to the fact, that the case is one of consumption. And yet, during all these months, nothing has been further from the minds of the patient and his friends than the idea of an infection. Still, though infection is the only route by which tubercular diseases reach mankind, and beasts also, there does remain something of mystery—so it seems to me—around the fact that so many people, who are often exposed to the infection of tuberculosis, through many years of their lives, never show a symptom of tubercular infection. The oft-quoted statistics of the Brompton Hospital, and my experience amongst my colleagues at the City of London Hospital for Diseases of the Chest, and my observation of the resident staff there—medical officers and nurses—have greatly impressed me with the fact, that it is not a trivial number of people who are often and closely associated with consumptives, and who escape infection by them. I cannot adequately explain this very

interesting and important point. When, however, I turn to the bacteriology of tuberculosis, and to the statistics, for example, of the Catholic Nursing Orders of Prussia, the evidence strikes me as overwhelming in its force, and as leaving no escape from the solemn conclusion, that tuberculosis, in all its forms, results from infection alone, and that the only source of that infection, of which we have any knowledge, is found in the tubercular bodies of animals—both men and beasts.

CHAPTER XV.

LIFE ASSURANCE PRACTICE VIEWED THROUGH THE EVIDENCE.

In all Life Assurance Societies it is customary to demand, in some cases proposed for assurance, certain money payments in excess of the charges usually made. These surcharges are enforced in instances where it is thought that the proposer's life is, for some reason, unlikely to last long enough to give the Assurance Society a very good chance of not only covering its risk, but also of making a considerable profit by the transaction. The surcharge is usually indicated by a certain number of years being added to the actual age of the applicant for assurance. For example, a man of twenty proposes to assure his life; but it is found that, from one cause or another, he is not likely to reach the usual limit of the expectation of life at his age. A surcharge is therefore suggested, by the assurance office, as a fair way out of the difficulty, and so five, seven, ten, fifteen, or twenty years may be added to the young man's real age. In such circumstances, a man of twenty might, for the purposes of life assurance, come to be regarded as thirty years of age; and the yearly cost of keeping up his policy of assurance would be the same as if the young man had really reached his thirtieth year.

One of the heaviest of these surcharges is placed upon persons who, being themselves in excellent health when they propose to assure their lives, are the children of parents of whom one or both have died of consumption. Again, if a proposal for life assurance is made by a man whose brothers or sisters have suffered from or been killed by consumption, a surcharge will, in certain circumstances, be placed upon him, even were his own condition of health found to be excellent. A tabular statement, showing on what terms the large class of people now referred to may be admitted to the benefits of life assurance, will best convey an idea of how that part of the business is worked.

Where the family history shows cases of consumption, regard must be had both to the age of the life proposed, and the proportion in which the relatives have suffered. The following table embodies these views, it being assumed that the life proposed is himself in sound health:

Deaths from phthisis, or pronounced cases of the disease.	Age of life proposed.	Surcharges or other decisions.
One parent	under 30	10 years.
"	" 35	7 years.
"	above 35	ordinary rates.
Both parents	under 40	decline.
"	" 55	7 years.
"	above 55	ordinary rates.
Fewer than one-fourth of all brothers and sisters	greater than that of deceased relatives	ordinary rates.
A number equal to one-fourth of all brothers and sisters	under 35	7 years.
A number equal to one-third of all brothers and sisters	"	..!
A number equal to one-half of all brothers and sisters	"	10 years.
A number equal to two-thirds of all brothers and sisters	"	decline.
One parent and one-fourth brothers and sisters	"	double rates.
One parent and larger proportion than one-fourth brothers and sisters	"	decline.

It may be well to mention, that the statements in the table are taken from the records of a Society now merged in an Assurance Company. The table is, I understand, the outcome of a careful examination of somewhere about four thousand cases, taken from the books of the now extinct Association. Of course, these four thousand cases were not composed exclusively of consumptives or their family connexions. They had reference to all sorts and conditions of disease. Of how many of the four thousand bore directly upon the problems of tubercular diseases, there is no information given.

The surcharges suggested for adoption in the table are, I am told, moderate in amount, and fair to all those whose interests are concerned. That is, however, I am bound to admit, the state of the matter as it appears when viewed from the standpoint of the Assurance Offices. It may occur to the unprejudiced mind, and possibly also to people who have to pay the surcharges, that this question might have much light thrown upon it, were the results of the imposition of these surcharges made known, in so far as they affect the money profits of the leading Assurance Societies.

It need hardly be said, that by far the largest number of these surcharges are made in cases where there is a record of family history, showing the existence of an hereditary tendency to consumption. With a hope of getting some useful information on this subject, and confining my inquiries to surcharges arising out of supposed family predisposition to consumption, I applied to one or two of the largest and best Assurance Offices in this country, and to one

office in America, which transacts, with marked success, one of the largest life assurance businesses in the world. To my surprise, I was, in effect, informed by all these offices, that they did not know what had been the results to their business from the surcharges, made upon those amongst their policy-holders who had a story of "consumption in their families." The American office told me that, in the matter of these surcharges, their practice is founded on that of the English offices. The English offices, on the other hand, "follow the usual practice" when they deal with the imposition of surcharges. It should be remembered that these imposts came into vogue when no weight of authority, in this country, was given to the view that consumption might arise from infection, and when hereditary predisposition to that disease was regarded as, practically, the one thing needful to the origin and full development of it in any person. Now all that is changed; and an overwhelming majority of the highest medical authorities in every country, unreservedly accept the belief that consumption is a disease which can arise only from infection. The same authorities also recognise that the results of modern research concerning tuberculosis, have very materially lessened the importance of the theory of hereditary predisposition, in its bearing upon the question of how that disease spreads. Still in America the Assurance Offices "follow the practice of the English offices," and the English offices "follow the usual practice" of many years—I do not know how many years—ago.

Some of the ablest business men of the day are engaged—and very many of them have for years past

been engaged—in the conduct of the affairs of life assurance, both here and in America. It would be impossible to persuade such men to countenance persistency in a course of action, in business matters, which did not yield direct or indirect money profits. It is therefore certain, that whatever may have been the result of these surcharges to the Assurance Offices, it has not taken the form of a money loss. Had that been the state of the case, the amounts of these surcharges would have been increased years ago. But there seem to be some signs, here and there, of a tendency to diminish these surcharges, in so far as they touch lives believed to be tainted with an hereditary predisposition to consumption. The case stated below will illustrate, to some extent, what has just been said.

"A man, aged thirty-three, applies for life assurance. He states he suffered from pleurisy five years ago, but, as he was only ill a week, the probability is, either that he had not pleurisy, or that the attack was a very slight one. He had scarlet fever followed by dropsy twenty years ago; and appears to have had scarlet fever a second time four years afterwards. His mother died of consumption at thirty-six; his sister died of that disease at seventeen. He has two brothers, aged thirty-four and thirty-one, and two sisters aged twenty-four and twenty-six, all four in good health. He is 5 feet 9½ inches in height, weighs 154 lbs., and his chest capacity is 32 inches to 34 inches. On examination there is nothing further to note. Organs found healthy."

This proposal was submitted, in the ordinary course of business, to the medical adviser of an Assurance

Office, which has its headquarters in London. He was guided, in stating his opinion about the proposal, by the "usual practice," and, accordingly, he advised that five years should be added to proposer's age, so as to cover the extra risk which the "usual practice" implies that the office would run, in dealing with a person predisposed to consumption. The proposer did not accept that view of his case, and betook himself to another office. There his proposal was accepted at ordinary rates. Both the Offices were of equally high standing, and, not unnaturally, the man preferred to assure his life in the Office which charged him the lowest price for that privilege. Cases of this kind are apt to disturb the official mind in Life Assurance circles.

The instance given above was submitted, by way of experiment, to the medical referees of three assurance offices of good standing. In the opinion of one of these men, a surcharge represented by an addition of five years to proposer's age, would have met the requirements of the case; another suggested an addition of ten years; and a third said that he would himself have advised the acceptance of the proposal at ordinary rates, but he knew that the Directors of the Office with which he is connected, would not entertain the case unless it carried a surcharge of, at least, five years added to proposer's age. Here, then, is evidence of an amount of difference of opinion amongst the medical advisers of good Assurance Offices, which must, sooner or later, lead to confusion; and possibly, also, to the hurried or rash settlement of a matter which is of consequence both to Assurance Societies and to their

policy-holders. It is, obviously, the interest of all concerned, that some definite rule of practice should be established, to govern the imposition of these surcharges. The facts on which to found the rule lie amongst the papers of the oldest Assurance Offices in this country, and I cannot suppose that there would be any difficulty in getting at these facts, were the task of working them out entrusted to proper hands. From a medical point of view, such an inquiry as this is very desirable. Were it thoroughly carried out it would go far to settle—I think it would settle, once for all—the real value of hereditary predisposition to consumption (and to other diseases also), as a factor in the calculations of Life Assurance work.

CHAPTER XVI.

ON THE PROPHYLAXIS OF TUBERCULOSIS.

It has been said, that if the evidence stated in the preceding pages is true, at least two very grave conclusions are forced upon us, because they are its logical consequences. One of these very grave conclusions is, that every man, woman, and child who is tubercular, should at once be removed from all possibility of contact, direct and indirect, with the healthy community. The other very grave conclusion is, that all tubercular beasts should be slaughtered, and their carcasses destroyed. I believe these are both logical consequences of the evidence. But when we consider the human element that is here involved, we at once find comfort in the happy fact that logical consequences, unaided by other considerations, have never yet, in the world's history, exercised a paramount influence upon men's acts. Even the clearest of sound logic, if it did not carry with it some touch of human kindness, has never been able to set in action what is highest and best in men. Therefore, there is no fear that wholesale segregation will be enforced when, for the first time, men find themselves obliged to deal seriously with the subject of tuberculosis in its relations to their fellow-men, who are its living

victims. If these numbered only a few thousands or even a few hundreds of thousands of people scattered throughout the civilised nations of the world, then, it seems to me, there would be much to say in favour of the adoption of some system which should ensure the segregation of all tubercular persons. But it is certain that there are millions of tubercular people in the world. Such numbers could not be dealt with by any mode of segregation that has ever yet been mooted—not to refer to any more humane argument against such a proposal. What, then, is to be done to diminish the amount of tubercular disease that is broadcast over the earth? In the first place, I venture to urge upon the notice of all concerned, that it is essential that a thorough education in the main points which teach how tuberculosis spreads, should be publicly given. No person, of even a little less than average intelligence, should be allowed to remain in ignorance upon a subject of such vital importance as this. There is no mystery about it, for any child of the age of twelve, who has done fairly well at a Board school, could be made to understand the matter sufficiently well for all practical purposes. If people were educated up to the level of what is now common knowledge in our medical schools touching this subject, the prevention of tuberculosis, at least to a very great extent, could be, with reason, counted among those things which must soon happen. If people but knew this common knowledge, they would entertain no absurd dread of the consumptive, even when they found him in their midst. They would take care that he and his surroundings were kept

clean; that he never when he was obliged to spit, did so elsewhere than into a spittoon, the contents of which were always kept moist; that these spittoons were carefully and thoroughly cleaned, and that before being cleaned, and afterwards, they were well soaked in some fluid of a potency sufficient to ensure the destruction of the bacillus of tubercle. All these measures of precaution, would have for their object the prevention of the scattering of bacilli of tubercle about the immediate surroundings of the patient, where these organisms would become dried, and so be apt to be wafted about in the air of a room.

The consumptive himself should have a special education, as to the duties entailed upon him. He should know why the things just mentioned are done. He should also know, that it is not possible for great progress to be made in the prevention of tuberculosis, unless all consumptives help towards the accomplishment of that good end. The one fact for him to keep clearly before his mind, and which should regulate his every act, is that his expectoration and his saliva may, at any moment, become the carriers of the tubercular bacillus. He should never forget that it is certainly true, that the very great majority of consumptives have their expectoration, practically always, deeply tainted with the virus which has made him what he is, and that, with this knowledge in his possession, and if he neglect those precautions which it inculcates, he may become the wilful cause of the beginning of consumption in his healthy fellow-man. In his intercourse with his fellows, such a man should ever be governed in his

acts by the facts of his condition of health. Even his affections must be put under control, for it is not straining the truth to say of him, that his kiss upon another's lips may carry with it the infection of consumption.

It may be that, by some, the statement just now made will be dubbed sensational. I would ask him who may adopt that view, to point out, in the statement, anything that is not in absolute accord with what is held as clearly proved, by the very great majority of those who are recognised, by the world of medicine, as the leading authorities upon this question. In the three last International Congresses of medical men, no one came forward to dispute, in any serious manner, the truths that underlie these statements, and which justify, as well as demand, the making of them.

In the eighth chapter of this book, mention is made of certain experiments, which were performed with the view of ascertaining whether or not a consumptive is apt to scatter, when he coughs, "particles of saliva which may carry with them the virus of tubercle." The conclusion reached is stated at the end of that chapter in these words: "Probably the tubercle bacilli thus set free are few in number, but they constitute a real danger." It seems to me that this risk to the healthy might be met, by the consumptive holding a handkerchief before his mouth when he feels he must cough. He should have a handkerchief pocket made very easy of access to himself, and it should be fitted with some sort of movable waterproof lining. This lining should protect the inside and mouth of the pocket, in such a way as to make it likely that moisture would pass

from the handkerchief on to the waterproof cloth only, and not to any other part of the patient's garments. The movable waterproof lining to the pocket could be changed as often as might be thought desirable, and either disinfected or burned. If the former plan were adopted, the lining, after use, should be allowed to soak during twenty-four hours in a solution of perchloride of mercury, of the strength of one part of the salt in five hundred parts of water. The handkerchief should undergo a like process of disinfection; and both the pocket lining and the handkerchief should thereafter be washed and dried. In some such way as this, and with attention to details, a consumptive patient would very greatly reduce any risk that, when he coughs, might arise from the scattering of tubercular bacilli in droplets of saliva. There can be no doubt that this risk is a very slight one; there can also be no doubt about its being a real one. More than that, or less, cannot fairly be said concerning a risk of this kind. Indeed, it is not possible, with our present knowledge, to gauge with accuracy the capacity for evil, of any one of the means by which infection may spread from tubercular substances. Tubercular bacilli floating about in the air, and the milk and flesh of tubercular animals are, so far as we know, the chief sources of tubercular infection. There are, no doubt, other sources; but, as compared with these, they are, almost certainly, of but very secondary importance. However that may be, to try, by every means he can devise, to lessen even the least of these sources of possible infection, is surely the plain duty of every man.

The consumptive patient should also be made to understand very clearly, that his expectoration is a source of danger when it is allowed to dry in any place where healthy people may go. When in that state, as has been already explained, it may be wafted about in the air, and so any passer-by may inhale particles of it containing tubercular bacilli. To lessen, and, if possible, to prevent altogether any chance of this, I know of no better plan than the constant and careful use, by the consumptive, of one of those pocket spittoons lined with prepared paper. As often as may be convenient, the paper that has been in use should be burned, and the spittoon itself soaked in some efficient disinfectant.

Wherever consumptives congregate—for example, in the various health resorts frequented by them, and in hospitals—there should be spittoons placed not far from one another, and so that they may be easily got at and seen. They should be large and filled with water. Sawdust is very apt to be scattered near any spittoon which has been filled with it, and therefore it is not suitable nor safe for use in that way.

It would be well were properly arranged spittoons to be seen in the railway carriages, which convey consumptives to and from the winter resorts where they go in such large numbers.

There ought also to be obtainable some trustworthy guarantee that rooms, bedding, linen, and furniture, known to have been recently used by consumptives, have undergone thorough disinfection, before these same rooms and their contents are placed at the service of—let us say—the next visitor

to the hotel or lodging. Such a guarantee ought always to be produced, for the inspection of the person who may be about to occupy the rooms. I am not aware that an assurance of the kind is to be had in any hotel in England or elsewhere.

In cleaning rooms that have been in the recent occupation of consumptive people, it is important to bear in mind that nothing should be done to raise more dust than can, in any possible way, be avoided. The methods of house cleaning usually followed in ordinary circumstances are, therefore, to be avoided on these occasions. For instance, the method of house cleaning used by many Jews, alluded to in a former chapter of this book, is to be highly commended from the point of view of the sanitary requirements of every-day life. But when consumptives have to be taken into account, the matter is very different. In the dust of their rooms may lie the tubercular bacillus, and no means should be left untried to prevent that organism being carried about by moving dust. The only means by which that object can be conveniently secured, is by moistening everything that has to be cleaned, in such a way as to leave as little movable dust as possible within the room. In order that soap and water may play a prominent part in the cleaning of these rooms, their walls and floors should be covered, not with carpets and with paper, but with preparations—there are many of them—which are meant to be cleaned with soap and water. In that way dust would be avoided, and a sufficient cleansing of the rooms accomplished.

To try to meet every known or possible means by which tubercular infection may be spread from man

to man, with a set of special instructions for its prevention, would be to attempt the impossible. General principles only can be laid down; and this has probably been sufficiently plainly done in the preceding pages.

Now we come to the second of the two grave conclusions, mentioned at the beginning of this chapter, —"that all tubercular beasts should be slaughtered, and their carcasses destroyed." It has been said that such a proceeding would cost the nation a very large sum of money. So far as I have been able to ascertain, from inquiries made in various quarters, that is the only strong reason that is urged against this suggested wholesale slaughter of diseased beasts. There can be no doubt as to how this objection to the measure will fare at the hands of the people of this country, when they clearly grasp what the eating of tubercular flesh, and the drinking of tubercular milk mean for themselves and their children. Surely it would be a waste of time to discuss the commercial aspect of the case, for, important and serious though it certainly is, it is only a point of very secondary importance and gravity, when it is compared with that other aspect which has to deal with the immense human mortality that results from tubercular diseases of the organs of the abdomen. In England the cost of the slaughter of all tubercular beasts will soon cease to be counted, for the carrying out of the measure is an inevitable consequence of the spread of knowledge amongst the people.

There is a large trade in dead meat carried on between this country, and some of our colonies and America. Over that supply of our food, as well as

over the market which supplies us with our home-grown butcher's meat, a very strict supervision should be enforced. The whole carcass of any animal showing signs, no matter how slight, of tuberculosis should be destroyed by public officials. The cargoes of dead meat should be carefully inspected, and dealt with in the same way; the whole consequent loss falling, as a matter of course, upon the people who sent the diseased beasts over sea.

Meanwhile, and pending the very protracted deliberations, which seem likely to precede the passing through Parliament of the laws for the regulation of the matters just referred to, we must content ourselves by seeing that the milk we use is cooked, very thoroughly, before we drink it ourselves or give it to our children. Also, we should take care not to eat the flesh of any animal which shows any sign of not having been thoroughly well roasted or boiled. These, then, are, in outline, the conclusions to which we are brought by the consideration of the evidence we have had before us. Unless that evidence is utterly false, and Koch's greatest work one long series of blunders, there is no doubt that for the future it should be known of all men that all tubercular diseases result from infection, and that without infection their existence is impossible. It should be impressed on every one, that suggestions have been made indicating means by which the frequency of consumption, and of every other tubercular disease, can be very greatly lessened. It should be known everywhere, that the evidence of experiments, and of observations founded on them, entitles us to speak thus confidently; for these

experiments have been tested by very many skilled observers, and no semblance of error has yet been found in them. Surely it is the duty of medical men, no matter whether they believe in Koch's teaching or not, to urge, by all means in their power, that the precautions which are based on a study of his work, and which have for their object the prevention of tubercular disease, should have a fair trial. The measure of the success of our efforts to combat these diseases is to-day a thing so trivial, when compared with their tremendous mortality, that for any man wilfully to hinder, even by his indifference to the subject, any reasonable attempt to lessen this scourge of our race, is to take upon himself a very grave responsibility.

I can remember very well the time, three-and-twenty years ago, when septicæmia was rampant in the hospitals of Europe. The great fear that then haunted surgeons was not the danger of any operative procedure they had to undertake; it was what might follow the operation that they dreaded. Even the most trivial operations were then followed by fatal sepsis, with what we should now regard as appalling frequency. I can remember very well, that that was the condition of things when I was Prof. Lister's dresser in the wards of the Royal Infirmary in Glasgow. It was the case there in 1865. In 1868, in those same wards, absolutely unaltered as regards their structure, drainage, and ventilation, a totally different picture was seen. Sepsis was then literally unknown in them. Most of the gravest operations, then known to surgeons, were undertaken and carried out with a success un-

equalled in the annals of the surgery of that day ;—all this was done by the genius of the illustrious surgeon, whose name is now a household word, Sir Joseph Lister. Not the least of the good that Lister has done for surgery, consists in his proof of the fact, that sepsis does not come by the will of God, but through the fault of the surgeon.

I have the strongest belief that what Lister did for surgery, when he rid it of sepsis, Koch's work will yet do for medicine, and rid it of tuberculosis,—a disease which kills more men than cholera, yellow fever, and all other fevers put together. If an effort in that direction—a strong effort—is not soon made, the medical profession will have to bear the greater part of the reproach that the existence of tubercular disease is to mankind.

APPENDIX.

Cases of the Year 1889.

Case I.—*P. Gerber.**—*Contribution on Inoculation Tubercle in Man.*

Report of a case of auto-infection of the author, during post-mortem examination of a tuberculous woman. Symptoms began with an ulcer on the spot of inoculation: next swelling of corresponding axillary and infra-clavicular glands. The affected glands were excised. Tubercle bacilli found in the ulcer. Healing under iodoform dressing without after symptoms. Author had always been a healthy man, without hereditary tendency to tubercle.

Case II.—*E. Düring.*†—*Case of Inoculation of Tubercle.*

Transmission of tubercle by means of the earrings of a person who died of consumption, to a healthy girl of fourteen years of age, without hereditary predisposition to tubercle. The tuberculous swelling began in the lobe of the ear; later, consumption and tubercular infiltration of the glands showed themselves.

Case III.—*Pietz.*‡—*On Tuberculous Skin Diseases.*

(1) A student received a slight wound in the dissection-room. From the wound resulted a nodule, soon followed by painful swelling of the glands of the forearm. Glands affected were excised, and showed central caseous masses. Tubercle bacilli and

* *Deutsch. Med. Wochen.*, 1889, No. 16.

† *Monatsschrift für Praktische Dermatologie*, vii. 22, p. 1128. Reported in *Schmidt's Year-Book*, 1889, vol. ccxxii.

‡ *Prag. Med. Woch.*, xiv. 19, 1889. Reported in *Schmidt's Year-Book*, vol. ccxxiii., and in *Wien. Med. Woch.*, No. xi. 1889.

the question of heredity are not mentioned, though the condition is described as tuberculous.

(2) The auto-infection of a consumptive baker is recorded.

CASE IV.—*Lilienthal.**—*On Local Traumatic Tubercle.*

There is contained in the preface to this article, a reference to four cases of traumatic tubercle recorded by König.

CASE V.—*Steigenberger.*†—*Infection of a Child through the Milk of a Tuberculous Wet Nurse.*

A healthy child, without hereditary taint, was nursed for four weeks by a phthisical wet nurse. In two months the child developed a hard swelling, of the size of a hen's egg, in the right neck glands. Tubercle bacilli were found in the swollen glands. The lungs were healthy.

CASE VI.—*B. Fraenkel.*‡

Mentions discussion of Cornet's work which relates to prophylaxis of tubercle.

CASE VII.—*Drysdale.*§—*Phthisis Pulmonalis in Husband and Wife. Possible Case of Contagion.*

A healthy robust man, without hereditary tendency, became consumptive one year after his marriage with a woman who was suffering, at the time of the marriage, from tubercular disease of the lung. This man was the only member of a family of nine who showed symptoms of consumption.

CASE VIII.—*Runeberg.*‖

A peasant, thirty-nine years of age, of "unstained family history," in excellent health, slept in the same bed with his phthisical wife, and nursed her constantly. Shortly after her death, he, for the first time, showed symptoms of pulmonary consumption.

* *Deutsch. Med. Zeit.*, 1889, No. 73.

† *Pester. Med. Ch. Pr.*, 7, 1888. Reported in *Deutsch. Med. Zeit.*, 1889, No. 33, p. 392.

‡ *Berl. Med. Gesell.* Meeting of March 13, 1889.

§ *British Medical Journal*, 1889, No. 1498, p. 604.

‖ Reported in the *Journal of the American Medical Association*, No. 12, 1889.

Case IX.—*Grawitz.**

Three cases of tubercular disease are mentioned, almost certainly resulting from infection through wounds—one of which was due to the extraction of a carious tooth. Reference is incidentally made to Prühle's article on different modes of infection in his *Handbook of Pathology and Therapeutics.*

Unfortunately, the sources of the contagion are not mentioned in Grawitz's cases.

Case X.—*Steinthal.*†—*A case of Tubercle of Skin, through Inoculation and Auto-infection.*

A woman washed the linen of her husband, who was in the last stage of consumption. While so occupied, her left middle finger and the back of that hand showed evidence of tubercular skin disease. Tubercle bacilli were found in the diseased tissues. The lungs remained healthy.

Cases of the Year 1888.

Case XI.—*Demme.*‡—*Some Cases of Tuberculosis.*

Report in *Schmidt's Year-Book* for 1888, vol. ccxviii. Case 2 of these is worthy of remark. In a healthy little girl of three years of age, vulvitis and vaginitis, tubercular in character, were, according to the author, the result of the child's sleeping with her consumptive mother.

Case 4 in the same series, is also a noticeable one. In brief it is as follows :—

A young infant, healthy and without hereditary taint, was fed upon the unboiled milk of a certain cow. The child became thin, showed symptoms of inflammation of the bowels, and died in four months. Post-mortem there was disclosed marked tubercle of the mesenteric glands.

The cow was at once slaughtered, and at the post-mortem there was found advanced tubercle of the lung. In the milk in its udder, tubercle bacilli were found.

* *Deutsch. Militarärztliche Zeitschrift*, 1889, Part x.

† *Deutsch. Med. Wochenschrift*, No. 10, 1888.

‡ *Wien. Med. Blatt.*, vol. x. 49, 1887 ; and in the same Journal, vol. xi. 6, 1888.

CASE XII.—*Eve, F. S.*—Communication of Tuberculosis by Ritual Circumcision.*

Two cases recorded. (1) A tubercular ulcer situated on the frænum, and two abscesses in the groins appeared on a child after he had been circumcised.

Guinea-pigs inoculated with the caseous contents of these abscesses all died in ten weeks of tubercle. (No mention is made of search having been made for tubercle bacilli.)

Three months after this child was circumcised, the official who performed the operation died of phthisis pulmonalis.

It is mentioned by Mr. Eve, that although the operator did not bring his lips into actual contact with the wound, he squirted wine from his mouth on to it to stop the bleeding. The child's parents were healthy.

(2) Mr. Eve heard from a woman living in the same house, that seven years previously, when her son was circumcised by the same official, her boy developed abscesses in the region of the groin. Mention is not here made of any sore upon the penis.

CASE XIII.—*L. Pfeiffer.†—A Case of the Transmission of Tubercle from Cattle to Man.*

A veterinary surgeon wounded himself while performing the post-mortem examination of a tuberculous cow. As a consequence he developed local, and later on, lung tubercule. Tubercle bacilli were found both in the post-mortem wound, and in the lung lesions.

CASE XIV.—*W. Porter.‡—Contagiousness of Consumption.*

A lady, without hereditary taint, and in robust health, went, accompanied by her eldest daughter, to nurse her godmother, who was dying of consumption.

Both mother and daughter died of that disease, and are regarded by Porter as cases of infection.

CASE XV.—*Salzer.§—Case of Tuberculosis Verrucosa Cutis.*

Describes the case of a person who contracted this disease through a wound of the fore-finger. The case was read before the German Medical Society.

* *The Lancet*, p. 28, vol. i. 1888.
† *Zeitschrift für Hygiene*, vol. iii. p. 189.
‡ *Journal of the American Medical Association*, vol. iii. 1888, p. 320.
§ *Deutsch. Med. Wochenschrift*, 1888, No. 2.

CASE XVI.—*Früger.*—On the so-called "Post-mortem Warts," and their relation to Lupus and Tubercle.*

Raymond.†—Contribution to the Study of Tubercle of the Skin caused by Inoculation.

Cases bearing on this point (post-mortem warts and their relation to lupus and tubercle) are given in the *Deutsch. Med. Wochenschrift*, 1888, No. 5, by Verneuil, Verchère, Holst, and Merklen.

One case of auto-infection by a consumptive; and a second case of infection due to the binding up of a trivial wound with the pocket-handkerchief of a phthisical woman.

CASE XVII.—*Congress on Tuberculosis held in Paris*, 1888.

In the summary contained in this report, there are communications by Chauveau and Verneuil, concerning tubercle of the skin, and tubercular abscesses happening after wounds incurred during post-mortem examination of the bodies of dead consumptives.

There is also a case, reported by Leloir, of a girl of ten years of age, to whose scalp a poultice of earthworms was applied. Lupus attacked the poulticed part. The earthworms had been taken, it was said, from a spot where a tuberculous animal was buried.

Jeanseln also records the fact, that he has often seen lupus affecting the skin around abscesses connected with tubercular glands, bones, or joints.

CASES OF THE YEAR 1887.

CASE XVIII.—*Loewenthal.‡—Case of Tubercular Inoculation of the Conjunctiva in Man. Tubercle Bacilli Found.*

A healthy woman, who slept with her tubercular husband, turned, when in bed, her left side towards him. Her left conjunctiva became tubercular. Part of the diseased conjunctiva was excised, and tubercle bacilli were there found. On this habit of the woman, Loewenthal grounds his supposition as to the nfection in this case.

The specimen is in the Library of the Institute of Hygiene.

* *Deutsch. Med. Wochenschrift*, 1888, No. 5.
† *France Médicale*, 1886.
‡ *Inaugural Dissertation*, Halle, 1887.

CASE XIX.—*Leser.**—*Clinical Contribution as to the Doctrine of Tubercular Infection.*

Contains references to certain cases, which Leser regards as trustworthy. Cases by Verchère, Merklen, Kraske, Tscherning, Lindemann, Lehmann, and Elsenberg are mentioned. Leser gives also cases he himself observed. In brief, they are as follows:—

From a trivial cut in the skin of the ungual phalanx of the thumb of a healthy woman, aged fifty-four years, without hereditary taint, there resulted a tubercular ulcer. In eighteen months, the forefinger of the same hand became affected with tubercular disease, on that part of it which was nearest to the diseased thumb. The lymph glands became swollen and suppurated, and retro-mammary abscesses formed. Tubercle bacilli were found in the diseased parts. The lungs remained intact. Source of contagion not stated.

Leser's contribution also contains three observations by Volkmann, taken from the *Verhandlungen der Deutch. Gesellschaft für Chirurgie*, 1885.

Observations are made referring to the appearance of lupus in man, after inoculation with tuberculous material. But no details of cases are given. There is also the record of the case of a boy, suffering from tubercular hip-joint disease, upon whose skin lupus appeared under the bandage which kept in place the dressing covering the fistulous openings, through which flowed discharges from the diseased joint.

Tubercle bacilli were present, and so the tuberculous nature of the skin disease was demonstrated.

CASE XX.—*Eiselsberg.*†—*Contributions Concerning the Inoculation of Tubercular Disease in Man.*

Four cases are recorded of tubercle resulting from infection through wounds. The third of these is that of a woman who washed the linen of a patient who suffered from caries of the spine. The woman developed an acne-like pustule, upon which lupus appeared. The linen was much soiled with discharges from the spinal disease.

* *Fortschrit. der Medicine*, No. 16, p. 501.

† *Wien. Med. Wochenschrift*, 1887, No. 53. Report by Baumgarten: *Jahresbericht*, 1887, p. 183; and also in *Virchow's Jahresbericht*, 1887.

In the other three cases, the source of the tubercular infection is not stated. These three cases are—

(1) The wearing of earrings by a girl, sixteen years old, was followed by lupus.

(2) A wound in the right arm of a healthy youth of seventeen was followed by tubercle.

(3) A girl, twenty years of age, had a tuberculous, fistulous opening in the skin on the spot where a hypodermic injection of morphia had been administered to her. All these persons had been healthy previous to the accidents mentioned, and showed no trace of tubercle.

Tubercle bacilli were found in all these cases.

Case XXI.—*O. Thesen.—On Inoculation of Tubercle.*

Virchow and Hirsch* report the following :

After the extraction of a foreign body from under the finger-nail of a healthy young woman, aged twenty-eight, without hereditary taint, there appeared an abscess below the nail. Later on there appeared, on the exposed matrix of the nail, little yellow granulations, which were also observed in the glands of the fore-arm. The affected glands were excised, and tubercle bacilli were found in them.

Case XXII.—*Derville.†—De l'Infection Tuberculeuse par la voie Genitale par la Femme.*

A record of cases, and amongst them two observations by Fernet, meant to show that tubercle can be conveyed by sexual intercourse to healthy women. The evidence of the tuberculous nature of the disease in these women, was the finding of tubercle bacilli in the vaginal discharge.

Case XXIII.—*Knight.‡—The Contagiousness of Tubercular Disease of the Lungs, with a Report of one Case.*

A young girl, twenty-three years old, shared the same bed with her younger sister, who was dying of consumption. She nursed her to the end, and slept with her until five weeks before her death. Four days after the death, this girl showed the first symptoms of consumption, of which she died two months later.

* *Jahresbericht*, 1887.

† Paris: Steinheil. In the Library of the Institute of Hygiene.

‡ *Journal of the American Medical Association*, 1887, vol. ix. p. 505; *Boston Med. and Surg. Journal.*

Of her family only one person, an uncle, had had tubercular disease.

CASE XXIV.—*Schmidt.**—*A Case of Inoculation of the Skin by Tubercle.*

A healthy woman, forty-four years old, without hereditary taint, was accidentally bitten in her upper lip by her consumptive husband shortly before his death. The wound soon showed that it was tubercular in character. On the little finger, hand, and wrist, this woman developed three tuberculous nodules. The demonstration of the presence of tubercle bacilli made the diagnosis of the woman's condition a matter of certainty.

CASES OF THE YEAR 1886.

CASE XXV.—*Hofmokl.*†

Tubercular ulcer on the prepuce of a boy, son of healthy parents, followed by swelling of inguinal glands. Tubercle bacilli detected in the ulcer. This was a case following upon circumcision, and, unfortunately, no mention is made of the state of health of the operator.

CASE XXVI.—*Elsenberg.*‡—*Inoculation of Tubercle in a Child.*

Describes a case of tubercle resulting from contagion, in a healthy boy, without hereditary taint. Another case resulting from circumcision. Preputial ulcer of the boy, and sputa of the operator both contained tubercle bacilli. The boy died of general tuberculosis. Several similar cases have come under Elsenberg's notice.

CASE XXVII.—*Wahl.*§—*Case of Inoculation, Tubercle following Amputation of Forearm.*

Case of a boy, one year old. Left forearm amputated for traumatic gangrene. The boy was nursed by a girl suffering from lupus of nose. Wahl noticed, after a little time, a fungoid ulcer

* *Inaugural Dissertation*, Leipzig, 1887. Report in *Schmidt's Year-Book*, 1887, vol. ccxv. p. 150.

† *Wiener Med. Presse*, 1886, Nos. 22, 23, 749. Report in *Baumgarten's Year-Book*, 1886, p. 235. Winkel, *Inaugural Dissertation*, Grieswald, 1889.

‡ *Berl. klin. Wochenschrift*, 1886, p. 581.

§ Communication made to the Fifteenth Congress of Berlin Chirurgical Society, 1886. *Deutsche Medizinal Zeitung*, 1886, No. 32, p. 358.

on the wound. Fever, bronchitis, and swelling of axillary glands set in at the same time. Tubercle bacilli were found in the tissue of the ulcer, and in its discharge.

There is also mentioned a case by König, where tuberculous abscess of the abdominal wall and tuberculous peritonitis followed the use of a hypodermic syringe, which had been used for a long time by a patient in advanced consumption.

CASE XXVIII.—*Riehl and Paltauf.**—*Tuberculosis Verrucosa Cutis. A Form of Tubercle of the Skin, not previously described.*

Describes new growths, in which tubercle bacilli are found in strong and healthy persons, whose work brings them into constant contact with domestic animals. Butchers, coachmen, cooks, and farm labourers are instanced. In most of these persons the internal organs were healthy, and there was no swelling of the glands.

CASE XXIX.—*Holst.*†—*Tubercular Inoculation in a Nurse.*

A nurse in charge of consumptives had ulceration of finger, followed by swelling of the axillary glands. Tubercle bacilli were found in the swollen glands, but not in the ulcer.

CASE XXX.—*Hanot.*‡—*Contribution a l'étude de la Tuberculose Cutanée.*

Certain cases of tuberculosis resulting from inoculation, amongst them the following:

A rag picker, aged seventy years, who had much to do with bones and blood, had tubercular ulcer of the left forearm. It was found to contain tubercle bacilli. Swelling of the axillary glands followed, and, later, death from consumption.

CASE XXXI.—*Demme.*§—*Bacillary Tubercular Infection of a Chronic Suppuration of the Abdominal Wall.*

A child, very vigorous at his birth, began to suffer at three years old from eczema of the skin of the abdomen. Tubercle

* *Vierteljahrsschrift für Dermatologie und Syphilis*, 1886, p. 241.

† *Lancet*, vol. ii., 1886, Oct. 10.

‡ *Archiv. de Physiol. norm. et patholog.*, 1886, No. 5, p. 25.

§ *Twenty-third Report of the Jenner Childrens' Hospital in Bern during* 1885, Bern, 1886.

bacilli were searched for, but not found. After four years of age, he slept with his consumptive mother, and from that time tubercle bacilli were found in the eczematous vesicles.

At the same time the disease in its clinical aspect changed to lupus.

CASE XXXII.—*Middeldorpf.**—*A Case of Infection of a Wound of the Knee-joint with Tubercular Virus.*

A carpenter's apprentice, aged sixteen, healthy, and without hereditary taint, opened his right knee-joint by a misdirected blow of an axe. He bound up the wound with a clean pocket-handkerchief. A fortnight after the accident there was swelling of the joint, and an operation became necessary. Tubercle bacilli were found in the excised capsule of the joint. The capsule was greatly thickened.

Reference is also made to an observation of Volkmann's ("Chirurgische Erfahrungen über Tuberculose," *Langenbeck's Archiv*, Bd. xxxiii. H. 1, p. 130), touching a case of eczema of the hand, with resulting tubercular disease of the corresponding glands of the forearm.

CASE XXXIII.—*Gottstein.*†—*Cases of Inoculation of Tubercle in Man.*

Refers to a number of cases by Lehmann, Hofmoke, Czerny, Wahl, Hanot, Merklen, Holst and Elsenberg.

CASE XXXIV.—*Gannet.*‡—*Should Nurses who are Tuberculous be allowed the care of Children?*

Three cases of children, aged eighteen months and four years, healthy, and without hereditary taint. They were looked after by women (not wet-nurses) who were known to be consumptive. All three children suffered from tubercle, affecting their internal organs.

CASE XXXV.—*Martin.*§—*La Transmissibilité de la Phthisie.*

Refers to the work of Vallin concerning the contagiousness of pulmonary phthisis. Eighty-three medical men report 493 cases,

* *Fortschritt der Medicin*, 1886, No. 8.
† *Ibid.*, H. 17, p. 578.
‡ *Boston Med. and Surg. Journal*, 1886, vol. iv.
§ *Revue d'Hygiène et de Police Sanitaire*, No. 8, p. 282, 1886.

of which 213 are attributed to infection. About one-half of these relate to the transmission of tubercle between husband and wife.

Case XXXVI.—*De Lamallerée.**—*De la Contagion de la Tuberculose par les Poules.*

A soldier returned to his home consumptive, after undergoing confinement in a Prussian military prison. No one in the village, previous to his return, had, for very many years, suffered from consumption. His wife nursed him, and soon developed the disease. His fowls were seen to eat this soldier's expectoration. Sixteen of these fowls, in the course of four months, were eaten, half-cooked, by a remarkably robust woman, who lived in the same village as the soldier, but at some distance from his house. She, without direct communication with him, also became consumptive.

In one of these fowls there was found tubercle of the liver, uterus, and spleen.

The village is 1500 feet above sea level.

Case XXXVII.—*Lehmann.*†—*On a way by which Tubercle was Inoculated amongst Men; the Etiology of Tubercle and its Relation to Scrofula.*

A series of observations, made in 1879, relating to ulcerous conditions of the prepuce, and consequent affections of the glands of the groin, in ten Jewish boys who were all circumcised by the same man, only a short time before his death from consumption. It was notorious in his district that he was suffering from that disease. There is given distinct evidence that, as is usual in this ceremony, the saliva of the consumptive man came into contact with the preputial wounds of the boys. The details of the respective illnesses are tabulated, and bring out the following points:

The tuberculous nature of the disease of the groin glands was first ascertained. The possibility of syphilis having to do with the conditions of disease was negatived by the failure of mercury to improve those conditions. All the children showed the first symptoms ten days after circumcision, and three weeks after it there set in swelling of the glands of the groin. Three of the

* *Gaz. Méd. de Paris*, No. 32, 1886. Also mentioned in Dr. Lingard's evidence before the Departmental Committee in Questions 8048, 8049, and in *British Medical Journal*, 1886, vol. ii. p. 600.

† *Deutsch. Med. Wochenschrift*, 1886.

children died of tubercular meningitis; three of weakness and marasmus; one of intercurrent diphtheria. Three children survived, but were "scrofulous."

Cases of the Year 1885.

Case XXXVIII.—*Tscherning.**—*Inoculation of Tubercle in Man.*

Records case of a healthy woman, aged twenty-four years, who became tuberculous in consequence of a wound of the hand, due to a splinter of a broken glass spittoon, the sputum in which contained numerous tubercle bacilli. Swelling of the glands of arm and axilla followed, and they contained tubercle bacilli.

Case XXXIX.—*Megheroff.*†—*On the Contagiousness of Tubercle.*

Gives tables of forty cases, with explanatory notes. These cases were tubercular, and illustrate the question of hereditary tendency, and other important points. Twenty-three cases bear on marriage relationships; eleven are cases of nurses employed in the care of consumptives; three are those of persons who lived together; two shared the same bed and used the same articles of clothing; one drank the milk of a tuberculous cow. These are all given as cases of infection.

Case XL.—*Mendelssohn.*‡—*Traumatic Phthisis.*

Records the case of a rag-picker, mentioned by Windelschmidt, who shortly after an injury to his fore-finger died of consumption.

The work deals chiefly with those forms of phthisis which follow injuries to the thorax.

Case XLI.—*Kraske.*§—*On Tubercle of Wounds.*

Two cases of tubercular infection of wounds, caused by operation. The cases, when operated upon, were not tuberculous. One of them became tuberculous after having shared the same sick room with his phthisical sister. It is to be noted, that in both these cases there was distinct hereditary tendency to consumption.

* *Fortschritt der Med.*, 1885, p. 65.
† *Zeitschrift für Klin. Med.*, vol. viii.
‡ *Inaug. Dissertat.*, Berlin, 1885.
§ *Centralblatt für Chirurgie*, 1885, No. 4.

CASE XLII.—*Karg and Riehl.**

Demonstration of tubercle bacilli in so called post-mortem warts.

CASE XLIII.—*Treitel.*†—*A Case of Cured Tubercle of the Iris.*

Case of wound of the iris by a straw. Tubercle resulted in a previously healthy boy, without hereditary tendency. He was twelve years old. Three weeks after the accident, nodules appeared on the iris, and were found to contain tubercle bacilli.

CASE XLIV.—*Demme.*‡—*The Diagnostic Value of Tubercle Bacilli in Childhood.*

Records a case of tubercular ozæna in a previously healthy boy eight months old. He was without hereditary taint. The father of the family, with whom this infant was boarded, was suffering from acute lung phthisis. The child, having suffered from ozæna, died, later on, of tubercular meningitis.

CASE XLV.—*Alison.*§—*On the Chief Causes of Pulmonary Phthisis.*

Relates an experience of fifteen years in the district of Barraret, in the Vosge. Fifty-eight cases were observed in a community previously free from consumption. Of these only seven were evidently results of infection, but it is probably true that thirty-seven of them originated in that way.

CASE XLVI.‖—*The Transmission of Phthisis between Man and Wife.*

Record of cases resembling one another by French authors—*e.g.*, Potain, Musgrave-Clay, Bernard, Guérin, Buder, Lamarc, and Bergeret. The last named relates the case of a soldier, healthy, and without hereditary taint, who, having a trivial illness, was sent into hospital. His bed was placed between those of two consumptives, and he also became consumptive. On his return home, his mother, two brothers, his father, a neighbour and his wife, one after another became consumptive.

* *Centralblatt für Chirurgie*, 1885, Nos. 32 and 36.
† *Berlin Klin. Wochenschrift*, 1885, No. 28, p. 445.
‡ *Ibid.*, No. 15.
§ *Arch. Gén. de Médicine*, September, 1885.
‖ *Journal of the American Medical Association*, 1885, vol. v.

CASE XLVII.—*Merklen.**—*Inoculation of a Finger with Tubercle, with Secondary Infection of the Glands of the Arm, and of One Lung.*

A healthy woman, without hereditary taint, nursed her consumptive husband for the last six months of his life. After two months of this work, there appeared two nodules on the woman's right fore and middle fingers. A lupoid condition showed itself on the back of her hand and forearm, after the lapse of a month. Then followed swelling of the axilliary glands, and catarrh of the apex of the lung. Tubercle bacilli were not detected.

CASE XLVIII.—*Wahl.*†—*On the Present Position of the Question of Heredity in Consumption.*

Records cases of transmission of tubercle from husband to wife, and *vice versâ*. In that connexion, H. Weber, Lendel, and Borkendehl are quoted. Gives in *résumé* some of his own observations amongst sixty-four families, with one hundred and ninety-seven phthisical members. Amongst these were twenty consumptive married couples. Thirteen of these cases were instances of infection of the wife by the husband (one of the men infected his second wife as well as his first one.) In two cases the infection passed from wife to husband.

Reference is also made to a case by Herterich (*Aerztl. Intelligenzblatt*), in which a man infected his wife, and the wife infected their child during lactation.

CASE XLIX.—*Fernet.*‡—*Tuberculous Infection through the Genital Organs.*

Four cases tending to show that tubercle can be transmitted through sexual intercourse.

Details in these cases are wanting.

CASES OF THE YEAR 1884.

CASE L.—*Von Lesser.*§

Records case of a washerwoman, aged forty-eight years, who, after the death of her consumptive husband, had a tumour,

* *Bullet. de la Société Méd. des Hôpitaux*, 1885.
† *Deutsch. Med. Wochenschrift*, 1885, No. 1, p. 3.
‡ *Gaz. Hebdom.*, 1885, Nos. 3 and 4.
§ Reported in *Schmidt's Year-Book*, 1884, vol. cci.

about the size of a cherry, on the volar aspect of her right arm. In the tumour was a central caseous mass. No search made for tubercle bacilli.

CASE LI.—*Bennett.**—*The Contagion of Phthisis.*

A healthy young military officer, without hereditary taint, whose wife was in the last stage of consumption, took, with her, a sea voyage, lasting four months. On account of bad weather they were confined very much to their cabin, which was small and badly ventilated. On their arrival in London the wife died, and the husband showed the first signs of consumption.

CASE LII.—*Ogston.*†—*A Clinical Observation in Support of the Theory of the Contagiousness of Pulmonary Consumption.*

Records the case of a healthy family of ten persons, without hereditary taint. A son contracted consumption abroad, and returned home to be nursed. His two sisters nursed him, while a brother shared his room and bed. These three and the patient all died of consumption. The parents and the four surviving sons remained healthy.

CASE LIII.—*Verchère.*‡—*Des portes d'entrée de la Tuberculose.*

A student, with hereditary taint, pricked himself during the post-mortem examination of a consumptive. A tuberculous ulcer appeared upon the site of the wound. Consumption followed.

CASES OF THE YEAR 1883.

CASE LIV.—*Mosler.*§—*On Infection of the Mucous Membrane, through Swallowing Tuberculous Sputa.*

Relates the case of a consumptive whose habit it was to swallow his abundant expectoration. He died suddenly with abdominal symptoms. Post-mortem were found tubercle of the lung, swelling of the mesenteric glands, and marked hyperæmia of the mucous membrane of the jejunum and ileum. In the jejunum there were tuberculous nodules of the size of a millet-seed.

Judging from the known habits of the patient, and the results

* *Brit. Med. Journ.* 1884, Oct. 11. † *Ibid.*, pp. 2, 11.
‡ *Thèse de Paris*, 1884.
§ *Deutsch. Med. Wochenschrift*, 1883, p. 442.

of the post-mortem examination, Mosler expresses the opinion that the intestinal condition was due to the swallowing of tuberculous sputa.

CASE LV.—*Lindmann.**—*Report on the Question of the Contagiousness of Consumption.*

Records two cases of tubercle of the prepuce, following ritual circumcision, and the usual contact of the wounds with the operator's saliva. He was highly consumptive, and these were the last operations he performed. In both cases the children were healthy, but in one of them there was hereditary taint. The latter died in its fifth year, with symptoms of consumption; the other child recovered, and remained healthy.

CASE LVI.—*Tokolewski.*†—*On the Infectiousness of Consumption.*

Three cases (details wanting) are mentioned, in which infection is regarded as having been the cause of consumption.

CASE LVII.—*Bohm.*‡—*Is Consumption an Infectious Disease?*

Relates a case in which, in a very healthy family, a brother suffering from consumption was nursed by his three healthy sisters. They became consumptive. A brother who did not live with them remained healthy.

CASE LVIII.—*Debore.*§—*Etiology of Tubercle.*

Records a case, by Viulette, of transmission of consumption by a man to his healthy wife, she having no hereditary taint. This woman's second husband became consumptive. Her niece, who nursed her, also developed that disease, and so did her husband. All these persons are stated to have been free from hereditary taint.

A second observation by the same author relates the case of a healthy young girl, without hereditary taint, who had charge of a consumptive. She is stated to have been infected by the patient and to have herself been the cause of the infection of her six sisters, with whom she lived "en commun." A seventh sister, residing at a distance, remained healthy.

* *Deutsch. Med. Wochenschrift*, 1883, p. 442.

† *Gaz. Cekarska*, No. 30. Reported in Virchow-Hirsch *Jahresbericht*, 1883, vol. ii.

‡ *Aerztl. Intelligenzblatt*, 1883, No. 14.

§ *La Semaine Méd.*, 1883, p. 125.

Finally, there is a brief mention of twenty patients in Debore's practice who, while in hospital either as patients or as nurses, contracted this disease.

Cases of the Year 1882.

Case LIX.—*Demme.**—*Twentieth Yearly Report of the Jenner Children's Hospital in Bern*, 1882.

A collection of four cases of children who suffered from abdominal phthisis, after having drunk the uncooked milk of a tuberculous cow. Part of the evidence is the finding of tubercle bacilli. Similar evidence (*i.e.*, finding of tubercle bacilli) is given to prove the tubercular nature of a case of eczema.

Case LX.—*Wolfe.*†—*A Case of Tubercle of the Iris.*

A case of tubercle of the iris following a blow on the eye, in a boy eight years old, not without hereditary taint.

Case LXI.—*Knoevennagel.*‡

Records a case of consumption following the filling of a tooth in a healthy young man, without hereditary taint.

Case LXII.—*Kruche.*§—*An Illustrative Case.*

A young, robust lawyer spent some time at a health resort. Some weeks after his return home he showed the first symptoms of what proved to be a rapidly fatal attack of acute consumption. Upon inquiry it was ascertained that in the health resort this lawyer had occupied a room and bed which had just previously been vacated by a consumptive, who suffered from suppurating sores. The inquiry as to the cause of this young man's illness and death was very carefully conducted.

Case LXIII.—*P. Drochen.*‖—*Modes of Tubercular Infection in Marriage.*

Goes to show that consumption may be conveyed by husband to wife.

* Noticed by Wahl in the *Deutsch. Med. Wochenschrift*, 1885, No. 1, p. 4.
† *Glasgow Med. Journ.*, vol. xvii. No. 4, p. 293.
‡ *Schmidt's Year-Book*, 1882, vol. cxcv. p. 101.
§ *Deutsch. Med. Zeitung*, 1882, p. 445. ‖ *Thèse de Paris*, 1882.

Dr. Herman Weber's cases (nine in number) are quoted, and four similar examples are given by the author taken from his own experience.

A very remarkable fact about these cases is, that where the man became a widower and married again he infected his second healthy wife.

Cases of the Year 1880.

Case LXIV.—*Uffelmann.**

Mentions a case of probable infection of a child by the use of the uncooked milk of a tuberculous cow.

Case LXV.—*Bryhn.*†—*Experiences of the Infectiousness of Consumption.*

The author refers to his thirty years' experience of the treatment of consumption, and is convinced that that disease is a communicable one.

Amongst many cases the following is mentioned:—

A consumptive man conveyed the disease to his wife, and to her sister who helped to nurse him. The sister transmitted the disease to her husband, and probably to a niece (previously healthy), who was on a visit to her. Of the children of this marriage one died of meningitis, two had consumption, the fourth remained healthy.

The author also expresses the opinion that consumption is most apt to infect during its last stage.

Case LXVI.—*R. Thompson.*‡—*The Infection of Phthisis.*

A reference, without details, to the experience of the author, who has observed fifteen thousand cases. He does not regard infection as of great importance as an agent in the spread of tubercular disease, and combats that view. Fifteen of his cases were, he nevertheless believes, undoubtedly due to contagion.

* *Archiv f. Kinderheilkunde*, 1880, vol. i. p. 414.
† *Norsk Magazin for Lægevidens*, Bd. ix. p. 295.
‡ *Lancet*, Nov. 6, 1880.

Cases between the years 1879 and 1867.

Case LXVII.—*Demme.**—*Transmission of Consumption from a Cow to a Boy.*

An infant, the child of healthy parents, was suckled by his mother during the first five months of his life. From that time until he died, this boy was fed on milk taken from one cow, whose only food during fourteen months was hay. Before the child took it, the milk was warmed in hot water. The child died of tubercle of the intestine and mesenteric glands. Lungs, meninges, and other organs, healthy. The cow died during the same summer as the child, and post-mortem there was found wide-spread tubercle of the cow's lungs and pleura.

Case LXVIII.—*Wernich.*†—*When does Consumption Infect?*

Relates the cases of two persons, suffering from pleurisy, who were infected by a consumptive.

Case LXIX.—*Reich.*‡—*Tubercle, an Infectious Disease.*

Details the facts concerning the transmission of tubercle to ten infants by a midwife in the last stage of consumption.

This woman had the remarkable habit of blowing air and putting her own saliva into the mouths of new-born children.

Case LXX.—*Holden.*§—*Is Consumption Contagious?*

Records several cases, most likely due to infection passing between husband and wife.

Mentions, amongst others, the well-known cases of Dr. H. Weber, and one by Windorff. In Windorff's case, the infection was believed to be conveyed by the clothes of a consumptive which were worn by a healthy person.

Case LXXI.—*Webb.*‖—*Is Phthisis Pulmonalis Contagious, and does it belong to the Zymotic Group?*

A number of cases, without details, which tend to show that consumption can be acquired by contagion.

These cases are mostly concerned with private sick nurses.

* *Seventeenth Yearly Report of the Jenner Childrens' Hospital*, Bern, 1879.
† *Deutsch. Med. Wochenschrift*, 1879, p. 83.
‡ *Berl. Klin. Wochenschrift*, 1878, No. 37, p. 550.
§ *Amer. Journ. of Med. Science*, 1878.
‖ *Ibid.*, April, 1878.

CASE LXXII.*—*The Hygienic Significance of Tubercle in Cattle.*

Relates an observation of Buhl concerning a boy, five years old, who died of tubercle of the abdomen. It was clearly shown that for two generations there had been no case of tubercular disease upon either side of this boy's family. For two or three years he had drunk milk, warm, but uncooked, from a cow, which was proved, post-mortem, to be tuberculous.

CASE LXXIII.—*Baas.*†—*Remarks on the Contagiousness of Consumption, and the Treatment of the latter.*

Relates two cases of infection in married couples, where all question of hereditary taint was practically excluded.

CASE LXXIV.—*Eastaw.*‡—*Concerning the Contagiousness of Pulmonary Consumption.*

A history of the question of the contagiousness of consumption in recent times, with the addition of three examples.

(1) A consumptive man was much in the company of his mother-in-law, a healthy, strong woman of sixty. After his death she became phthisical while the wife remained healthy.

(2 and 3) Refer to men who became consumptive while nursing their consumptive wives.

CASE LXXV.—*Villemin.*§—*The Prevention of Pulmonary Consumption.*

Relates cases of infection.

(1) Three sisters without hereditary taint. One of them returned to her home, from school, a consumptive. She is regarded as having infected her next sister, and she, in her turn, infected the youngest. They fell ill in such order, that one of them occupied the bed, bedroom, and bedclothes of her who had just died.

(2) A healthy servant-girl, without hereditary taint, fell ill of consumption after nursing a phthisical person.

(3) Three observations by Leger concerning transmission of consumption in the cases of married couples. One of these cases is that of the infection of several women by one man.

* *Deutsch. Med. Wochenschrift*, 1876, p. 83.
† *Deutsch. Klin.*, Nos. 20 and 21, 1874.
‡ *Mont. Méd.*, Feb. 1869.
§ *Union Méd.*, 1868, No. 12.

CASE LXXVI.—*Drysdale.*—Cases Bearing on the Question of the Contagion of Phthisis.*

Two cases are mentioned of infection passing between husband and wife. Also a case of a woman who became consumptive after having nursed her adopted daughter.

CASE LXXVII.—*Windrif.†—Contagiousness of Consumption.*

Many instructive cases, but without detailed statements.

OTHER REFERENCES.

1. NOSOTTI: *Atti XII. Cong. d. Ass. Med. Ital.*, 1889. Pavia, 1888, i. 322–29. Further details as to the possible transmission of tubercle from animals to man through the organs of digestion, &c.

2. CHAUVEAU: *Congress pour l'étude de la Tuberculose*, 1886.

3. DEMUTH: "On the Contagiousness of Tubercle, with contributions from the Practice of Physicians in the Palatinate."—*Aerztl. Intelligenzblatt*, 1883, Nos. 44–46.

4. WINDELSCHMIDT: *Allgemein. Med. Central-Zeitung*, 1883, No. 18.

5. GEHLE: *On Primary Tubercle of the Female Genitals.* Heidelberg, 1881.

6. HEGAR: *The Origin, Diagnosis, and Surgical Treatment of Tubercle of the Genital Organs in Women.* Stuttgart, 1886.

7. VERNEUIL: *Études Expérimentales et Cliniques sur la Tuberculose.* Paris, 1887.

8. FLICK: "The Contagiousness of Phthisis." Reprinted from the *Trans. of the Med. Soc. Pennsylvania*, 1889.

9. MEYER: "A Case of Inoculation of Tubercle by Ritual Circumcision." *New York Med. Press*, 1887.

10. LANGUINETTI: "A Case of Tubercular Metritis." *Giorn. Ital. della Mal. Ven. edella pelle*, 1887, vol. xxii.

11. KLEBS: *Virchow's Archiv*, vol. xlix. p. 291.

* *Brit. Med. Journ.*, Feb. 1868.

† *Presse Méd.*, No. 4, 1867.

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