CLINICAL LECTURE

ON THE

CONTAGIOUSNESS OF PULMONARY CONSUMPTION,

Delivered in King's College Hospital,

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GENTLEMEN,—Within the last few weeks, you have had an opportunity of seeing, in the Physiological Laboratory of King's College, specimens of certain micro-organisms, prepared by Koch of Berlin, and described by him as the bacillus of tubercle.* This organism is believed by him to be the active agent in the origin and spread of tuberculous diseases. You have also had an opportunity of seeing that this micro-organism can be artificially cultivated and successive generations produced, each retaining with undiminished virulence the power of producing tubercle when introduced into the bodies of certain animals.

Now, this demonstration, which you have seen with your own eyes, introduces you to problems in pathology and in practical medicine, the importance of which it is impossible to exaggerate. Never, in the whole of the past history of medical science and of medical discovery, have propositions been advanced of greater import than those which have been advanced and maintained in connection with this discovery.

Let me state to you, in language as clear and simple as I can, what these propositions are.

1. Tubercle is an infective malady, originating in a specific virus, and propagated by the conveyance of that virus from body to body, and originating in no other way.

2. The specific virus of tubercle consists of a particular micro-organism, found only in tubercle; this organism can be seen in the cells of tubercle, can be obtained in a separate form, and cultivated in successive generations, without losing its original properties.

3. Certain forms of disease, termed "scrofulous", are essentially tuberculous; and their characteristic anatomical morbid products contain the infective organism peculiar to tubercle.

4. The disease known as pulmonary consumption is, in the main, a tuberculous disease, and is dependent on the presence and propagation in the body of the infective organism characteristic of tubercle.

5. Pulmonary consumption is a contagious malady.

Of these five propositions, it is claimed for the three first that they rest on demonstration, as I propose to show you; the last two are, more or less, of the nature of inferences from the three preceding; and, in connection with these, we may expect to find there will exist some differences of opinion.

The idea, that consumption is a contagious disease, is not a new one. It is a doctrine which has always been maintained in the south of Europe—in Italy, Spain, and Portugal. Galen believed it, Morgagni believed it, and great names in the history of medicine, from their time to ours, may be found both for and against it.

Pidoux, in France, who had unusual opportunities of becoming acquainted with the histories of a large number of consumptives, declared that his own experience was directly opposed to this doctrine; and that he had never seen a single case of consumption that he could refer to contagion.

One of the most distinguished physicians of our own times, formerly Professor of Medicine in this College, Sir Thomas Watson, in a course of lectures delivered in that very College where you have recently seen demonstrated the existence of a tubercle-bacillus, thus expresses himself on this subject.

"Is phthisis contagious? No; I verily believe not. A diathesis is not communicable from person to person. Neither can the disease be easily (if at all) generated in a sound constitution. Nor is it ever imparted, in my opinion, even by one scrofulous individual to another."

From my own experience of consumption—and, as I shall show you presently, it has been a very large one—I cannot doubt that this was the judgment of sound common sense at the time it was uttered, and with such evidence as was then, and has been until quite recently, attainable. But it would be unscientific now to tie oneself to this opinion, in the face of such facts as recent researches in experimental pathology have established.

On the other hand, another very eminent physician, a brother of another former Professor of Medicine in this College, Dr. William Budd of Bristol, long ago promulgated the view that pulmonary consumption was a disease "strictly analogous to the ordinary eruptive fevers in everything but the slowness of its progress; that, among European populations, tuberculous disease had undergone mitigation of its original severity by long prevalence; but he entertained no doubt of its eminently contagious character."

We must not be surprised that Dr. Budd's views met with little acceptance at the time. Insight, however penetrating, is not demonstration, and scientific belief rests wholly on demonstration. Then (and even now), the evidence, derived from practical experience, against the contagiousness of consumption, in at all the same sense as small-pox and scarlet fever are contagious, seemed overwhelming; and, if we yield now to the teaching that phthisis is a contagious disease, we shall yield solely to demonstration and experiment. For such evidence as we obtain from the experience of physicians in their practice amongst consumptive patients affords, at most, but a weak presumption; and the facts I shall bring before you certainly show that consumption is by no means contagious in the sense which is ordinarily and popularly attached to that word. But the modern methods of experimental research are, doubtless, destined to widen our conception of "contagion", as they have widened and corrected our conceptions in respect of many other pathological doctrines; and it is quite possible that, under certain given conditions, consumption may be a contagious disease.

During ten years of service in an institution devoted to the treatment of consumption, I saw over 27,000 persons who came to that institution for treatment, and a large proportion of that number were actually suffering from phthisis. Throughout this period, many problems naturally came into my mind as to the nature, the causes, and the treatment of this terrible malady; and, a few years ago, I endeavoured to obtain some data, from this extensive field of observation, as to the contagiousness or non-contagiousness of consumption. I followed the following train of reasoning: if consumption be a contagious or infectious malady, in the same sense and at all in the same degree as other maladies which are known to be contagious, the conveyance of the disease from husband to wife and from wife to husband especially among the poorer classes in this country, ought to be a common and not a rare occurrence; for, amongst these classes, the husband and wife almost invariably occupy the same bed, and live a life of close personal intimacy. The rooms they occupy are, more frequently than not, overcrowded, close, and badly ventilated. In short, the external conditions amongst which consumption commonly appears amongst the working classes are precisely those which would favour the dissemination of a contagious malady. If consumption in this country were, under ordinary conditions, a contagious malady, it would follow, so fatal as its course usually is, that, in dealing with large numbers of consumptive patients taken from the poorer classes, we should often find, amongst the males, the survivors of wives who had died of phthisis; and, amongst the females, the widows of men who had succumbed to this malady. That fact must, I think, be clear to everyone. So also we should expect to find husband and wife frequently the victims, together, of this disease. But this is comparatively rare.

For the purpose, then, of throwing some light on this question, I collected, a few years ago, the particulars of 1,055 cases of consumption that had come under my care, consecutively, in the institution to which I have referred. Of this number, 621 were males and 434 females. Of the 621 males, 306 were married, 297 were single, and only 18 were widowers; about 3 per cent. of the whole, and about 6 per cent. of those who had been married. Of the 18 widowers, two only could state positively that they had lost their wives by consumption, and one of these wives had been dead thirteen years; six of them had lost near relatives by consumption (father, mother, brother, or sister), giving a presumption in favour of hereditary predisposition, and in ten no precise information could be obtained. Of the 434 females, 199 were married, 206 were single, and 29 were widows; the widows being about 7 per cent. of the whole, and about 15 per cent. of those who had been married. Of the 29 widows, 5 only were able to state positively that their husbands had died of consumption, one lost her husband "in a fit," 6 had lost near relatives (father, mother, brother, or sister) by phthisis, pointing to hereditary predisposition, and 17 could give no precise information.

At the same time that I was collecting these particulars from my out-patients, Mr. J. P. Bartlett, at that time acting resident medical officer, was good enough to obtain the following particulars from those who were then in-patients. Of the 94 males in the hospital with phthisis, 53 were married, 37 were single, and 4 were widowers; of these 4, 2 had lost their wives by consumption. Of the 53 whose

* Exhibited by Mr. Watson Cheyne and Mr. E. M. Nelson.

wives were alive, all the wives except two were quite healthy. Of the 83 females who were then in the hospital with consumption, 62 were single, 15 married, and 6 widows; of the 6 widows, 3 had lost their husbands by consumption; in 2 of the 3 there was marked hereditary predisposition; and in 1 there was none; in the remaining cases the husbands were healthy.

Taking these figures for what they are worth, it seems certain that the communication of consumption from wife to husband, even among the class in which the conditions of life favour to the utmost the communication of contagious disease, is very rare; while it would seem that communication (assuming, for the sake of argument, the disease really was communicated) from husband to wife is more frequent.

About the same time that I was making these observations, Dr. Hermann Weber brought the subject of the communicability of consumption from husband to wife before the Clinical Society, and in his paper he states that he possesses the history of "68 persons, male and female, who, with a more or less pronounced consumptive taint, have married healthy partners. One or several of the partners of 10 out of these 68 cases became consumptive. The question, however," he says, "takes a different aspect if the originally tainted husbands and wives are considered separately. Of the 68 persons, 39 were husbands, 29 wives. Only one of the husbands of the 29 wives became diseased, while the wives of 9 out of the 39 husbands became affected. These 9 husbands lost 18 wives, viz., 1 lost 4 wives, 1 lost 3, 4 others lost 2 each, and 3 only 1 each."

One of Dr. H. Weber's cases is certainly very remarkable. A young man, who had lost his mother, two brothers, and a sister of phthisis, and who himself had twice had hæmorrhage from the lungs, had quite recovered, and married at twenty-seven years of age, being then perfectly well. His first wife was in good health, and came of a healthy family. She died of consumption after her third confinement. The man shortly married again, an "apparently healthy woman," and this second wife, after a year of married life, died of "galloping consumption." He again married a third wife, a healthy young woman of 25, belonging to "an exceptionally healthy family". During her second pregnancy, she developed symptoms of phthisis, which ran a rapid course, and ended fatally in about eight months. Undaunted by his previous experience, this man, who seems to have had a mania for matrimony, married a fourth wife, a perfectly healthy young woman, twenty-three years of age, of healthy family antecedents. Three months after her first confinement, she too began to show symptoms of phthisis, and, notwithstanding two sea-voyages, died after an illness of nine months, with tubercle in liver, spleen, and intestines, as well as in the lungs. Though the husband of these four wives, who was a sailor, remained in apparently good health, physical examination revealed the existence of morbid changes about the apex of the left lung. It is possible that the life at sea kept his disease in abeyance; for, when he had to lie by on account of a severe fracture, the disease became active, and he died of consumption within two years.

I have called your attention to this case, because it is perhaps one of the most remarkable on record bearing on the communicability of consumption from husband to wife.

In Dr. Weber's second case, three wives in succession of a consumptive husband died of phthisis, the husband ultimately dying of that disease himself. The disease in the wives appeared during pregnancy, or soon after delivery. The same story is repeated, with but little variation, except as to the number of wives, in Dr. Weber's seven other cases quoted in his paper. Altogether, he had observed thirty-nine diseased husbands, and the wives of nine of them became consumptive after marriage; but, as several of the diseased husbands married repeatedly, it would appear that, out of fifty-one such marriages, eighteen wives became consumptive after marriage. As a set-off against this, out of twenty-nine marriages between consumptive wives and healthy husbands, only one husband became consumptive.

Another noteworthy observation of Dr. Weber's was, that in the infected wives the disease manifested itself in an unusually active florid form, and ran an unusually rapid course; while in the husbands it was chronic, stationary, and apyretic. The fact of the onset of the disease following or occurring in connection with impregnation and utero-gestation, as well as the fact of the immensely greater proportion of wives infected by husbands compared with that of husbands infected by wives, naturally provoked the suggestion that the latter became infected through impregnation and from the *fœtus in utero*, just as constitutional syphilis is conveyed from husband to wife. But there is another hypothesis equally tenable, and perhaps more in accordance with modern research; which is, that, during the puerperal state, the female constitution is peculiarly prone to the reception and cultivation of the germs of infective disease; and, assuming for the sake of

argument that tubercle is propagated through the agency of an infective organism, the puerperal state may supply one of the conditions (such, for example, as we could conceive an increased body-temperature to supply) necessary for its cultivation and spread.

These valuable and striking observations of Dr. Hermann Weber, while they give weighty support to the belief that consumption is, under certain circumstances, communicable from husband to wife, corroborate also the suggestions I have already made that, if phthisis be a contagious malady, it is so under very peculiar conditions and laws; that it is not contagious in precisely the same sense as is ordinarily and popularly attached to that word.

I have said enough to show you that it would be extremely difficult to prove from clinical observations alone, or from experience, however extensive, of cases of consumption encountered in this country, that phthisis is an infective and contagious malady. Many, who have had the largest opportunities of judging, have formed an opinion altogether opposed to this view, and would regard Dr. H. Weber's experience as quite exceptional. And yet it seems very probable that consumption is in a sense contagious—contagious under certain conditions; and the practical question, at this moment especially urgent, is, "Under what conditions is consumption contagious?" But, before attempting to answer this question, it will be necessary to go back to the consideration of the remaining propositions which I formulated at the commencement of my lecture, and see on what kind of evidence they rest, and what is the exact relation of that evidence to the final proposition which forms the special subject of my lecture.

The first of these propositions was, that "tubercle is an infective malady, originating in a specific virus, and propagated by the conveyance of that virus from body to body, and originating in no other way." It has taken many years to obtain for this proposition anything like general acceptance amongst pathologists and physicians, and even now there are not a few who hesitate to accept this doctrine. It is some years ago (1865) since Villemin published the results of a series of methodical experiments, which he had undertaken for the purpose of showing that tubercle was an infective malady. His method was to take a small portion of tuberculous matter, as big as a pin's head, from the body of a man, a dog, cow, or a rabbit, and introduce it under the skin of the ear, the groin, or the axilla, in rabbits and dogs. He found that the wound at first healed over; but, after four or five days, the seat of the inoculation began to be red and swollen, and a tuberculous mass became developed there, causing an ulcerated wound. If these animals were killed after the fifteenth day from the inoculation, tubercles were always found in the viscera; in the lungs, they were usually abundant; grey granulations, as well as extensive infiltrated masses of tubercle, more advanced according to the length of time that had elapsed since the inoculation and cavities, were sometimes found; while at the seat of inoculation a caseous mass was usually found, surrounded by small yellowish granulations. The corresponding lymphatic glands were enlarged, and often contained scattered nodules of tubercle, some having undergone caseous degeneration. Cats and guinea-pigs were readily inoculated; but sheep, goats, and birds escaped infection. He obtained the same results from injecting hypodermically the sputa of phthisical patients in very small quantities, mixed with water. Blood taken during the life of animals with phthisis gave negative results; but, taken after death from phthisical men, it readily produced general tuberculosis in rabbits.

Chauveau of Lyons corroborated Villemin's results, by means of experiments on oxen, animals disposed to tuberculosis. He gave to oxen, by the stomach, tuberculous matter obtained from the human subject, or from other oxen, and they all became tuberculous, the lesions varying from trivial ones to the gravest possible. Typical tubercle-granulations were found in the lungs, as well as caseous masses in all stages. The same results followed inoculation into the connective tissue, and injection into the veins of water holding in suspension tuberculous matter after filtration.

Other experimenters (including Drs. Burdon Sanderson and Wilson Fox, in this country) soon opposed other views to those of Villemin and Chauveau. They stated that, in order to produce tuberculosis in rabbits and guinea-pigs, it was not at all necessary to inoculate these animals with tuberculous matter; that they might be rendered tuberculous by other means. They stated that, in the guinea-pig and some other animals, tuberculosis might be produced by inoculations with pus, or with caseous matter of inflammatory origin, or with sarcoma, just as well as with tubercle; that, in the guinea-pig, tuberculosis had been produced by the application of a simple seton; and that, in the rabbit, deep wounds, without inoculations of any sort, would produce pulmonary tuberculosis. Wilson Fox, in his experiments on guinea-pigs, introduced under the skin various substances—portions of putrefied muscle, fatty liver, and even vaccine virus, with the same result; and it was

maintained by others, that such substances as aniline blue, cinnabar, caoutchouc, cotton, etc., caused similar effects; and that carnivorous animals might be fed long on tuberculous lungs without the production of tuberculosis.

Then, it was said by others that the lesions produced by Villemain were not tubercle at all, but simply inflammatory lesions, or embolic infarcts; and some went so far as to say, it was impossible to produce tuberculosis experimentally. At the same time, Chauveau, Klebs, and Böllinger, maintained the correctness of the experiments and views of Villemain.

Two physicians, mentioned in the *Nouveau Dictionnaire de Médecine et de Chirurgie* (Art. "Phthisis"), went so far as to inoculate themselves with the serum of a blister applied to a phthisical patient, and, we are not surprised to hear, without effect: for, if the peculiar micro-organism which we have recently seen be the active agent in the production of tubercle, we should scarcely expect to find it in the serum extracted from the blood by the action of a blister. Another remarkable case of human inoculation is mentioned in the work I have just cited. Three medical men of Syra (in Greece), in 1874, inoculated a man, fifty-five years of age, with tubercle. He was suffering from gangrene of the left great toe, due to obliteration of the femoral artery, and was in a moribund state. They inoculated some of the sputa of a phthisical patient into the upper part of the right leg. The lungs were previously examined with great care, and found to be perfectly sound. Three weeks later, there were signs of commencing induration at the right apex. On the thirty-eighth day after the inoculation, the patient died of gangrene. At the necropsy, there were found, at the apex of the right lung, seventeen small tubercles, varying in size from that of a mustard-seed to that of a lentil. Two similar tubercles were found at the left apex—two others on the convex surface of the liver. The authors of the experiment considered the embryonic state of the tubercles, and their limited number, to correspond with the short space of time that had elapsed from the inoculation.

It is not likely that an experiment of this kind will be often repeated; but though it stands alone, it is, none the less, an important observation.

Tappeiner and others have shown that animals could be rendered tuberculous, if tuberculous matter (such as the sputa of phthisical patients) were diffused in spray in the air which they breathe.

It has also been stated by Professor Gerlach that, in the variety of tubercular disease which affects oxen, the infection can be introduced by the stomach, if portions of the tubercular organs be mixed with the food, or if the healthy animal be fed with milk from the animal which has tubercle (Simon: *Proceedings of International Congress*). Now, as tubercle is a malady which is very common among cows, this observation is one which may have a vast importance in connection with the feeding of young children.

Cohnheim has also made numerous observations on the infective nature of tubercle. He introduces the tuberculous matters either into the subcutaneous tissue, or into the pleural or peritoneal cavity, or into the anterior chamber of the eye. After introduction in the latter situation, the primary irritation soon passes away, the small piece of tuberculous matter becomes smaller and smaller, and may even wholly disappear; for a time, the eye appears quite clear and intact, when suddenly in the iris a number of delicate grey nodules appear, grow to a certain size, and then caseate. In rabbits and guinea-pigs, fourteen days after the introduction of the virus, disseminated tuberculosis will appear in the various organs; in other animals, twenty-one days is the usual period of incubation. He has succeeded with pieces of lung affected with caseating pneumonia, or with pieces of caseating testicle, or with freshly excised scrofulous gland from the neck; but he has never found any result from introducing caseated sarcoma or myoma, or simple lymphoma.

But some of the most instructive and conclusive observations and experiments on this head are those of Dr. Hippolyte Martin of Paris. They are related in an article on the "Relations between Tuberculosis and Scrofula", in the *Revue de Médecine* for April of this year; and also in the *Archives de Physiologie* for 1881, on the "Infective Properties of Tubercle". The object of his original experiments was to show that inoculation with true tuberculous matter was alone capable of producing true, general tuberculosis, and that all the lesions produced by the introduction of foreign bodies of non-tuberculous nature were not true tubercle, but what he terms false or "pseudo-tubercle". But he insists that it is of prime importance that all these inoculations should be performed with strict antiseptic precautions; and that if, perchance, the inoculation of non-tuberculous foreign substances have been followed by an eruption of true tubercle, it is because these precautions have been disregarded. He also points out that the anatomical structure of the true and false tubercle, as revealed by microscopical examination, is identical, and that the only means of distinguishing between them is by

inoculation *in series*—by a series of successive inoculations. True, infective tubercle is reproduced in an indefinite series, producing always a general tuberculosis as a consequence of local infection; the infectious properties becoming, if anything, more energetic as the series is prolonged. The same method proves the absolute innocuousness of false (pseudo) tubercle.

Some of his experiments are so important, that I make no apology for citing them to you. First, Dr. Martin tested the effects of injecting irritating animal and vegetable powders, such as cantharides, lycopodium, and pepper, into the peritoneal cavity of guinea-pigs. In one instance, he injected sixty centigrammes of lycopodium diffused in water into the peritoneal cavity of a guinea-pig; the animal died four months afterwards of general adhesive peritonitis, but all the viscera were healthy. Into the peritoneum of another guinea-pig he injected a large quantity of powdered cantharides mixed with water; nine months after the injection, the animal was quite well.

His next experiments were with fragments of morbid growths, non-tuberculous. Four pieces, of a cubic centimetre each, were cut from an epithelial tumour freshly removed from the neck of the uterus; two pieces were placed in alcohol, and two pieces in bichromate of ammonia. After a week, the two preserved in alcohol were introduced into the peritoneum of an adult rabbit, and rather more than three months afterwards the animal was killed; both fragments were found encysted in different parts of the peritoneal cavity; all the viscera were healthy. The two other fragments were introduced into the peritoneum of another rabbit, and about a month later the animal was killed, and the fragments were found enveloped in a fold of omentum, their angles rounded, and absorption evidently commenced. All the viscera were healthy.

In another experiment, two pieces of a sarcoma of the testicle, freshly removed, were immediately introduced into the peritoneal cavity of a guinea-pig; about a month later, the animal was killed, and no trace of the foreign bodies was to be found, and all the viscera were perfectly healthy. The same experiment was repeated with portions of mammary carcinoma, on a large and strong female guinea-pig in a state of advanced utero-gestation. She was confined with two healthy little ones a few days after, and, when killed two months afterwards, two free masses were found in a cyst in the abdomen, wholly caseous, and dry like crude tubercle. All the viscera were healthy.

The same kind of results followed the introduction in the same manner of a piece of the femur of a rabbit, with periosteum and some fragments of muscle adherent; half the tibia of a new-born infant that died of erysipelas; three squares of a hard pear; two squares cut out of a ripe apple. In one of these cases, about six weeks after the operation, the two pieces were found surrounded by yellow pus in a large vascular cyst. There was no peritonitis; the viscera were healthy.

The next experiment is very significant. In the centre of a large sarcoma removed from the thigh of an infant, there was a large completely caseous nodule; a portion of this caseous matter, weighing 50 centigrammes, was introduced into the peritoneal cavity of a rabbit, with careful antiseptic precautions. A year afterwards, the animal was in perfect health.

These experiments prove conclusively that those observers were certainly in error who asserted that almost any kind of foreign body—animal or vegetable—would produce tuberculosis in guinea-pigs.

In other experiments, Dr. Martin has shown that foreign bodies having irritant properties, non-specific, may set up inflammation, the pathological products of which may have a complete anatomical resemblance to true tubercle, no distinction being possible by microscopical examination; and he has obtained by means of cayenne pepper, lycopodium, and cantharides, the finest specimens of pseudo-tubercle; but these lesions, in spite of their special anatomical structure, have no specific virulence. He had repeatedly injected, with antiseptic precautions, the caseated inflammatory products of such experiments, and always failed to produce an eruption of tubercle. He insists strongly on the necessity, especially in a pathological laboratory, of these antiseptic precautions. All the instruments should be washed in alcohol and heated in a flame; and before each operation all parts of the syringe should be taken to pieces and treated in the same way.

On the other hand, pus from a scrofulous gland in the neck, as well as scrofulous products not yet degenerated, not caseous, inoculated immediately after surgical removal, produced a series of cases of generalised tuberculosis.

Dr. Martin's experiments completely establish the following conclusions: 1. Tubercle, inoculated locally, determines, after incubation, the formation of a local tubercle, and, after a variable time, general tuberculosis; and the virus seems to acquire increased activity by inoculation in series of animals of the same or allied species. 2. But, if we

inoculate matter obtained from those tubercles secondary to the injection of non-tubercular foreign bodies, they never give rise to general tuberculosis; and, after two, or, at most, three terms of the series, they even lose the power of producing a local inflammation, and become absolutely inefficacious.

Here, then, he remarks, we have two inflammations: one specific, infective, and truly tuberculous; the other non-specific, non-infective, and not true tubercle; but both having the same anatomical structure, and the former differing from the latter by the presence of the property of a morbid agent at the present time unknown. It is this "unknown morbid agent" which Koch believes he has made known to us and shown us—an agent which the microscope had failed to discover until those special methods of preparation were employed which Koch has had the honour of discovering.

So, then, the proof of our first proposition seems complete: that "tubercle is an infective malady, originating in a specific virus, and propagated by the conveyance of that virus from body to body, and originating in no other way." And Koch's experiments appear to have proved the truth of the second proposition: that this "virus" is the property of a micro-organism peculiar to tubercle, and which may be called the tubercle-bacillus.

I need not repeat what has already been published as to Koch's methods of investigation. I may, however, say that the tubercle-bacilli appear as "delicate rods from a quarter to half the diameter of a blood-corpuscle in length"; that they have been found "in large numbers in all places where the tubercles are of recent formation and spreading rapidly, more especially at the border of the cheesy masses." They possess a special relation to the giant-cells, being found in their interior sometimes to the number of twenty in each cell. They do not appear to possess any power of movement. In some of the rods, oval spores have been seen. They have been seen in the human subject in cases of miliary tuberculosis, in cases of caseous broncho-pneumonia, in tubercle of the brain, in intestinal tuberculosis, in freshly extirpated scrofulous glands, and in certain cases of synovial degeneration of joints. Nor need I repeat the account (already published in this JOURNAL) of the beautiful series of experiments by which Koch has shown that it is to the presence of this organism, and to this alone, that tubercle owes its infective property. One fact, however, let me mark, *en passant*, for future comment. "It was found that these bacilli required a temperature approaching that of the human body for their growth." The minimum temperature of 86° Fahr., and the maximum of 104°, are the limits between which they can develop and multiply. This disposes of the first and second propositions, and brings us to the third; viz., "that certain forms of disease termed scrofulous are essentially tuberculous."

Both the experiments of Koch, as well as those of Dr. Hippolyte Martin, go to establish this proposition. I have just said that Koch has found the infective bacillus of tubercle in freshly extirpated scrofulous glands, and in certain cases of (scrofulous) degeneration of the synovial membrane of joints. And Dr. Martin has obtained a series of cases of generalised tuberculosis, by successive inoculations in guinea-pigs; the original inoculations being in one instance from a small collection of pus found, after death, in a firmly encased submaxillary gland of a child, who had died of measles and broncho-pneumonia without any trace of tubercular disease, but with well marked clinical characters of scrofula; and in another, from non-degenerated (non-caseous) scrofulous products, a few instants after surgical removal.

Dr. Martin suggests, however—and the suggestion seems to me a sound and practical one—that scrofula is, perhaps, not a distinct morbid type, and that some of its manifestations must be included under the class of tuberculous diseases, and that others belong simply to the "lymphatic constitution;" that the possession or non-possession of the property of infection, capable of being transmitted through a series of inoculations, affords the only elements of a certain diagnosis, or, as Koch would probably say, the presence, in their characteristic anatomical elements of the tubercle bacillus.

The fourth proposition, that pulmonary consumption is, in the main, a tuberculous disease, will no doubt be stoutly opposed by many in this country, who have adopted those views of the origin of pulmonary consumption in ordinary inflammatory processes which have been so ably advocated by Niemeyer; and much additional experimental research will be necessary in order to set this question at rest.

At present, this proposition rests on the observation that fresh caseous matter, as well as the grey granulations found in the lungs of phthisical patients, are infective, and contain in their anatomical elements the tubercle-bacillus, and that the sputa of phthisical patients are infective; whereas the caseous degenerated products of ordinary inflammation are not infective (in series), and do not contain the characteristic micro-organism.

But it is not denied that chronic inflammatory changes may be produced in the lungs by the entrance of various irritating foreign particles, and that these changes may in time produce fatal injury to the organs of respiration; it is, however, suggested that these cases should not be spoken of as phthisis, but as forms of chronic pneumonia.

In conclusion, we again come to the fifth and last proposition, the proposition with which we started, that pulmonary consumption is a contagious malady. I must again say that it is impossible to over-estimate the importance of establishing the truth or error of this proposition.

It is precisely one of those questions upon which the Collective Investigation Committee of the British Medical Association may be expected to gather up valuable information. And it is one also which can scarcely be cleared up without prolonged and repeated investigations by means of experiments on animals; not painful experiments, happily; there is no need to give pain in carrying out the kind of investigations which this subject demands, and which are calculated to promote the welfare both of man and animals. There are, moreover, many matters of daily concern connected with this investigation; the way, for instance, in which consumptive patients should be tended and nursed; the propriety of massing together a great number of consumptive patients in the same building; the propriety of allowing healthy persons to breathe air contaminated by the breath of such patients; the mode of dealing with their expectorations; the kind of medical, climatic, or other treatment best suited to the arrest and cure of the disease, regarded as an infective malady; the marriage of consumptive patients. Supposing consumption to be, under certain conditions, a contagious malady, there seems to be, *primâ facie*, some ground for believing that one of those conditions may be that of temperature—the temperature of the body, or the temperature of the external air.

I have already mentioned that in the South of Europe consumption has always been looked upon as a contagious disease. May this not be owing to the relatively higher temperature of these regions? And we naturally associate with this reflection Koch's statement that the tubercle-bacillus requires a temperature above 86° Fahr. for its propagation.

I must content myself at present with simply pointing to this question of the influence of temperature upon the origin and propagation of consumption, as one which requires careful investigation. I shall have something to say in a future lecture on the antiseptic treatment of consumption. Finally, there is the pressing question of the possibility of conveying tuberculous disease to children by feeding them with the milk of consumptive cows; but I have said enough I hope to convince you of the truth of the statement I made at the commencement of this lecture, that it is impossible to exaggerate the importance of the subject to which I have now called your attention.

ABSTRACT OF AN ADDRESS ON THE MATERIALS OF BLOOD-POISONING: IS MALIGNANT DISEASE PARASITIC?*

*Delivered at a Meeting of the Lancashire and Cheshire Branch
at Blackpool,*

By RUSHTON PARKER, B.S., F.R.C.S.,
Professor of Surgery in Liverpool.

I HAVE to show you micrococci from acute abscess, gonorrhœa, and pyæmia, and bacilli from a wound in a case of septicæmia. They are prepared by Koch's method of aniline-staining, and rendered distinct under microscopes bearing high powers, illuminated, in two instances, by Abbé's condenser; and are additionally represented in the diagrams which hang before you.

The germ-theory of disease is so far a reality, that spirillum is the demonstrated organic cause of relapsing fever, bacillus anthracis that of splenic fever; while the local and constitutional changes in septicæmia, pyæmia, and acute suppuration, are equally proved to be due to the presence, propagation, and influence of bacilli and micrococci of various sizes and differing degrees of irritative or toxic virulence.

In reviewing the germ-theory of infective disease in general, and of traumatic infection in particular, it may be convenient to allude to two distinctive types severally represented by septicæmia and pyæmia. Many of the infective diseases having been proved, most of them are provisionally supposed, to be due to organisms imported in some way

* This Report was kindly prepared by Dr. Barr, from the extempore address; and has been revised, with slight verbal alterations and additions, by the author.