potent for good the Acts might be made; but the one I have adduced speaks, in my opinion, trumpet-tongued in their favour.

But encouraging as the results of the Acts have been, it is not from such partial legislation as that contained in them that we can look for any great or permanent improvement. This need not be expected until statesmen and philanthropists of all nationalities shall combine in endeavouring to crush the enemy in our midst, that every day brings in its train disease, destitution, and death, not alone to the guilty, but also to the guiltless, and transmits a bitter inheritance of sorrow and suffering to the innocent yet unborn. And yet to the efforts made to mitigate or stamp out the disease the strongest opposition is made by those "friends of humanity" whose perverted notions of right and religion make them give an insensate opposition to a movement which, if carried out effectually, would put such a check on immorality and diminish so largely diseases among all mankind. When we consider the suffering, blighted hopes, the loss of life that the disease unchecked carries in its wake, we cannot but realise the fact that although sentiment is a mercy, it may be one that for a nation is the most costly—and for humanity, the most cruel.

The task of dissipating many of these prejudices and errors of persons of doubtless good intention as a rule, but of weak intellectual fibre, and which, in more than one instance, have culminated into what has become a real calamity for mankind, is one that all can undertake, no matter what their abilities or mental powers may be. If it be not possible to have a position in the scientific vanguard of our profession, much may be done in supplementing the work of those whose strength and whose work have enabled them to get there. Men of much creative genius are, as they ever have been, rare in their generation. But those without this may not the less be "true sons of their century," for it is the men of order, the men who work with method, earnestness, and truth, that do the great mass of the world's work. If they have not strength to carry a votive tablet to the Temple of Truth, they can at all events assist in fixing and cementing it; and fortunate it is that such is the arrangement made by the One Perfect Workman, for it shows us the importance—nay, necessity—of mutual help which must exist so long as men's qualities, mental powers, and tastes are so diverse.

In future, the relations between surgery and medicine being now so happily altered, the physician and surgeon will work in unison, the labours of the one supplementing those of the other, their mutual jealousies and differences forgotten, or relegated to the hazy traditions of a past that has but little interest to anyone, save, perhaps, the historian or the antiquary. This union for the good purposes of mutual help will bring us increase of strength, of confidence, and hope, and assuredly prove that we are all, so to say, of the same guild, all animated by the same worthy ambition, by the same desire to "allow," as Lord Bacon said, "the spials and intelligencers of Nature to bring in their bills," and all animated by the same fair aspiration to discover, collect, and replace the scattered fragments of that precious crystal of truth, which, it has been said, fell from, and was given to us, from heaven.

THREE LECTURES

ON

TUBERCULAR JOINT-DISEASE AND ITS TREATMENT BY OPERATION.

Delivered at the Royal College of Surgeons of England, June, 1888.

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LECTURE I.

MR. PRESIDENT AND GENTLEMEN.—I shall doubtless best show my deep sense of the great honour you have done me in placing me in the position I occupy to-day by addressing myself at once to the task confided to me, with no more preface than a frank admission of my consciousness that the treatment of the subject chosen is worthy of far higher powers than I can hope to bring to bear upon it.

In selecting for the subject of these lectures some of the

questions involved in the operative treatment of tubercular disease of joints, I ventured to think that the time had come for a reconsideration of our position in this field of surgery. Within the last few years two great events have occurred, which may be said without exaggeration to have affected this subject to its very foundation. I allude to the general acceptance of the theory of antiseptic, or, as it may now be better styled aseptic, wound treatment, and the discovery of the true nature of what is known as tubercular disease. But, though the theories of a sepsis and of the parasitic nature of tubercle have already taken deep root in the surgical mind, reading and observation have convinced me that as yet they have not had that profound effect upon the daily operative treatment of scrofulous joint affections which they are destined to have when more thoroughly familiar to the profession at large. I have thought therefore, that to review this subject in the light of these two theories would not be a useless task, especially as the observations and researches bearing upon many of the questions involved are widely scattered, and more or less inaccessible to the ordinary reader; and, although it has been a labour of love to me to collect, study, and weigh these, and to test them in practice, I can easily believe that to many practitioners this might be a task demanding larger privileges than I have been fortunate enough to enjoy.

Step by step real and solid progress has been made in the operative treatment of joint affections in past years; but to those who look closely into the subject now in the light of these two events, it seems probable that these improvements will soon be left far in the distance by the achievements of the near future. The territory before us is large, and as yet its borders only have been cultivated. The object of these lectures will be to inquire whether, with our improved resources, we are not now better able to meet and overcome its hostile forces; and whether, with the increased light thrown upon some of its darkest spots, we have not already augmented its yield of fruit, and are not justified in looking for a still more abundant harvest.

In this survey, which must of necessity be brief, I cannot traverse all the ground already broken, but I do cherish the hope that I may be able, at all events, to make an outline sketch of our present position and of the ground before us, and thus perhaps assist in preparing the way for further steady advance.

If one were asked to furnish a good single illustration of the evolution of surgery from the condition of a mere handicraft to the dignity of a science, one could hardly do better than point to the change which has lately come over the surgeon's mode of regarding and dealing with what has hitherto been generally spoken of as scrofulous joint-disease.

In order to give this illustration its full force, it would be necessary, in the first place, to point out the various steps in the process of reasoning which had led to the substitution of the more exact term "tubercular" for the vague expression "scrofulous," and to trace the gradual crystallisation of the former term into its present more precise meaning. It would be necessary, further, to show how this gradual growth of knowledge had influenced not only the selection of cases, but also the actual mechanism of operation, and converted procedures which formerly seemed to demand little more than an acquaintance with the anatomy of a joint and the exercise of manipulative dexterity into a test of all those processes which go to make the success of a delicate experimenter in physics or chemistry. In this inquiry it would soon become abundantly evident that the old days of the showy *tour de maître*, as applied to excision, had passed away, and had given place to a better era, in which the principles of physiology, chemistry, physics, and biology are applied to overcome difficulties and to repel forces either quite unknown or wholly misinterpreted in former times.

This, Sir, I am aware, is but hinting in homely phrase at what you have so eloquently and philosophically expressed on this spot in your Hunterian oration, the influence of which upon surgical thought cannot be overrated.

Remembering your words I am emboldened to pass on without apology to a review of the question on the lines indicated, to the consideration of those first principles which ought and actually do guide us now in excising diseased tissue from scrofulous joints; and though this review can only be brief, I fear, nevertheless, I shall have to claim the indulgence of many here to whom much that I have to say must be already familiar.

First in order among the numerous questions bearing upon the operative treatment of tubercular mischief in joints comes the

inquiry as to the nature of the disease so characterised; and before all things, we have to decide whether it is not the same as that hitherto spoken of as "scrofulous." To an audience such as I have the honour of addressing, I need hardly give all the reasons in detail for regarding them as identical; but I may be permitted, perhaps, *in order that my position may be defined*, to recall to your minds the leading facts which have been gradually accumulating in support of this view.

To some this may appear unnecessary, but I cannot forget that, up to a comparatively recent period, it was generally taught that scrofula and tuberculosis were two distinct diseases; also that many surgeons at home and abroad, who do not perhaps enjoy the privileges of closely following the rapid advances of pathological investigation, are still under the dominion of the same view. Further, the importance of settling this question is not only amply attested by the number of earnest workers who have devoted themselves to its study, but, as I hope to show, by the bearing it has upon the treatment of joint-disease, whether by or without operation.

The first great step towards a settlement of this matter was the gradual recognition of the fact that tuberculosis, as it presented itself in internal organs, was a well defined disease, producing definite tissue changes. That the result of the latter in their earlier stages was the formation of peculiar bodies having a well-defined structure recognisable in any tissue of the body, and liable, as they grew older, to certain secondary changes of a degenerative kind. These bodies, which received the closest attention in the lungs, soon came to be recognised in many other organs, both in the miliary form as well as in larger aggregations. Differences, to be sure, were noticed among them, but these were soon seen to be due to the stage of growth in which they were examined. The small miliary tubercle differed in its outward appearance from the larger caseating nodule; but, soon, intermediate forms were found, and it was observed that the larger body sprang originally from a focus identical with the smaller, and had only changed in so far as its more central portions had undergone fatty or caseous degeneration. It was observed further that when such a nodule broke down upon a surface exposed to the air it rapidly liquefied, the walls of the resulting space became more or less inflamed, and threw off not only its own proper necrotic fatty debris, but actual living leucocytes in the form of pus. We had, then, the tubercular cavity, say in the lung, secreting pus, and throwing off caseous detritus, and in the walls of which vessels of greater or less calibre were eroded, and often bled freely. Moreover, it was noticed that patients in whom these deposits could be demonstrated in the lungs frequently became affected similarly, and often fatally, in other parts, such as the joints, the brain, or intestines, and that the deposits in these parts underwent identical degenerative changes in the course of time.

Then came the recognition of the fact that the offspring of such patients appeared to be peculiarly prone to chronic joint-affectations, besides enlargements of the lymphatic glands.

Further, it was noted that in these chronic affectations of the joints and glands, characterised from time immemorial as "scrofulous," the ultimate result of the tissue changes was the production of caseous foci identical with those known as "tubercular" in the lungs.

Again, in innumerable cases of apparently primary scrofulous joint-disease, it was observed that, sooner or later, the lungs, brain, intestines, or kidneys became affected with typical tubercular disease. Ultimately, a careful microscopical study of the tissues of such joints revealed the fact that the initial lesion of joint scrofula was histologically the same as that of lung tuberculosis, and that typical tubercles could be demonstrated in them with the same ease as in the lung, and undergoing the same degenerative changes.

This would almost appear enough to establish the identity of the two diseases, but, in addition, there was a mass of clinical evidence accumulated, which pointed in the same direction. The age of the patients most commonly affected was in both cases usually the same; the conditions of life favourable to the development of scrofula and tubercle were shown to be closely allied. The general appearance of the patient was as nearly as possible alike in the two conditions; the variations of temperature, pulse, appetite, and body-weight, according as the disease was advancing or retrograding, were nearly parallel in the two affections.

But, though all these facts seemed to point very clearly to the identity of scrofula and tuberculosis, it was not until the disco-

very of the bacillus tuberculosis and its demonstration in the initial lesions of the two affections that positive proof was actually forthcoming. Almost at the same time Koch and Baumgarten pointed out that in typical tubercular and scrofulous nodules this organism could invariably be demonstrated by different methods of preparation, to which it is not necessary further to refer. Their researches were soon supported by a whole army of bacteriologists, both abroad and at home, and among our countrymen none has done more in this direction than Mr. Watson Cheyne. And it is a noteworthy fact that many of those who at first, on the strength of their own observations, had stood out most firmly against the theory of the specific or parasitic nature of tubercle have since become its most ardent supporters, and, moreover, have given in their adhesion to the view that this bacillus is the specific organism of tuberculosis. Among these may be mentioned Cohnheim, Klebs, and Schüller in Germany, and, I believe, the late Dr. Wilson Fox and Professor Burdon Sanderson in England.

But it was not alone on the constant discovery of the bacillus in tubercle, be it remembered, that the theory of its causal relation to tuberculosis was based. Experimental research soon showed that no substance not containing these organisms was capable of producing in healthy animals the disease in question; and, on the other hand, that substances in which they were present, if inoculated with due precautions, invariably produced the disease in certain animals, not only locally, but as a rule also generally throughout the system. It is true that experiments at first appeared to point in the opposite direction; but a repetition of them with proper precautions against error left no doubt on the subject. And not only was the inoculation of fresh tubercle shown to produce in all cases a definite tuberculosis, but it was also demonstrated that the organisms in question, cultivated for many generations in various media until all trace of contamination with matters from the original living tissue had been got rid of, were capable of producing this disease when introduced into the animal body, with as great certainty as deep sleep is produced by the hypodermic injection of morphine. Again, the bacillus could be obtained in any quantity from tubercles produced in internal organs by inoculation of these cultivations in distant parts, and could be multiplied *ad infinitum* by cultivation and propagated among some of the domestic animals with unerring certainty.

Now, it mattered little whether the tissue from which the inoculations were made was taken from a scrofulous joint or a typically tuberculous lung; the result was practically the same. And here we have, I think, the identity of the two diseases, tuberculosis and scrofula, proved to demonstration as clearly as anything is capable of proof by experiment.

The researches bearing upon these facts are far too numerous for detailed description. A mere enumeration of them would occupy more time than is placed at the disposal of a Hunterian lecturer. But to any candid mind they bear but one construction, namely, that tuberculosis and scrofula are diseases produced by the introduction into the animal body of a specific poison, and that this poison is always associated with the presence of the bacillus in question, if it be not actually the organism itself; and further, that without the presence of this organism typical tubercle does not exist.

But though we cannot follow here one tithe of the researches in support of this position, it will greatly promote the objects I have in view in discussing the nature and treatment of tubercle in joints if I am permitted briefly to sketch one typical inoculation experiment and its effects upon the tissues and organs. I will take, then, for illustration a well-known one as performed by Baumgarten, who is peculiarly qualified for such work by his profound histological research in other fields as well as this, an experiment which has been repeated by many other observers with the same results. The tissue changes here seen in the rabbit's eye have a close parallel in those demonstrable in tubercular disease in human organs, as is shown by Arnold's careful studies of the formation of tubercles in the lung. But as they can be followed in their various stages, and uncomplicated by ordinary inflammatory processes only in experimental inoculations on animals, the latter are taken for illustration.

In the experiment in question, a small fragment of caseating tissue is removed from a scrofulous joint or gland, with due precautions against contamination from without, and is inserted into the anterior chamber of a healthy rabbit's eye through an incision in the cornea (Fig. I, N.). The same operation is also performed at the same time on a large number of other rabbits' eyes. One or

more of these eyes is excised daily and placed in preserving fluid for histological examination.

Now, what is found?

In the first few days absolutely no change is observed, except the cicatrization of the corneal wound (Fig. I, N.) and the formation of a capsule of granulation tissue (Fig. I, Gr. K.) around the foreign body introduced. But from the second day on, a very evident increase of the bacilli is demonstrable within the inoculated fragment, until they are present in profusion. From this spot at which they first multiply they are now seen to spread rapidly. In the first place they permeate the granulation capsule (Fig. I, Gr. K.) around the caseous particle in enormous numbers, to which they communicate the blue colour seen in this enlarged drawing of Baumgarten's section. Subsequently they penetrate into the adjacent parts of the iris and cornea. In the latter they spread chiefly along the fresh scar tissue (Fig. I, N.), a fact of much significance to the operator, explaining as it does the occasional appearance of caseating foci in perfectly healed scars in the skin, perhaps weeks after an operation for deep-seated scrofulous disease.

On the fifth day scattered bacilli are seen in those portions of the cornea nearest to the point of inoculation, but without so far producing the slightest deviation from their normal histological texture. No traces of other species of organisms are to be seen with or near these immigrants, or throughout the whole iris or cornea.

Fig. I.—Sk., sclerotic; C.M., ciliary muscle; L., iris; C., cornea; T.F., tubercular foreign body (the black dots represent bacilli); Gr.K., granulation capsule around latter packed with bacilli; N., new scar tissue in corneal wound with bacilli; Bcg. T., beginning of tubercular hyperplasia around bacilli.

On the sixth day the bacilli are present in great numbers throughout the tissues of the cornea, which are still however practically unchanged. But at certain points, especially where the bacilli lie in dense groups, certain newly formed cells are to be seen, having the general appearance of endothelial or epithelioid elements, rather than of white blood or lymph corpuscles. Each day now adds to the hosts of invading parasites, which occupy an ever increasing tract of the tissues of the iris. The nearer to the point of inoculation, the more closely packed are they; the further off, the more scattered. Where the organisms are very sparse no histological changes are to be detected, but close to the point of inoculation young tubercles in the form of aggregations of epithelioid cells are now noticed, and a little later every intermediate form up to the perfect type of miliary tubercle with their lymphoid and epithelioid cells are to be seen, as in Fig. II, L.T. and E.T., which I have enlarged from Baumgarten's drawing of a microscopic section. These formations are constantly found associated with foci of bacillus proliferation, no organisms of any other kind being present. Moreover, in this experiment no tubercle, not even the smallest, is ever found at a spot free from the presence of bacilli, or having only a few of them. The amount of cell proliferation always corresponds to the richness in bacilli of the

nests of parasites. Thus developing and extending, the tubercular process advances further until on about the tenth or eleventh day a visible macroscopic iritis and keratitis is produced.

In the distant internal organs of the animals inoculated as above, an entirely analogous process of tuberculisation was observed by Baumgarten. This was best seen in the kidneys at about the fifth week after inoculation. Here the vessels of the

Fig. II.—C., the cornea; I., the iris; L.T., lymphoid tubercle of iris; E.T., earlier tubercles.

glomeruli were frequently found packed with bacilli, and, where the latter were spreading into the parenchyma around, typical tubercles were produced. Large numbers of bacilli were also excreted by the kidneys. Similar experiments have been repeated by many other observers with cultivated bacilli, and with exactly

the same results. The dosage of microbes was, however, shown by Mr. W. Cheyne materially to influence the rapidity of the development of the disease, a point of the utmost importance as bearing upon clinical experience.

The question now arises, Can we produce any clear evidence that anything similar to this direct inoculation of tubercle on the surface of the body ever takes place in the human subject? This question can, I venture to say, be answered distinctly in the affirmative, both as regards children and adults. Numerous cases have been put on record within the last few years which place the matter beyond doubt, and I cannot help thinking that other convincing cases must have come under the notice of some of those present here to-day. From the long list at our disposal allow me to select a few observations which are very striking, and which deserve to be familiar to all.

In a Continental town containing a Jewish community of some 9,000 souls, there were, during the months from February to May inclusive, nineteen children, all healthy, subjected to the rite of circumcision. Sixteen of the children were operated on by one man, the remaining three by others. In every case the bleeding was stopped, as was customary, by the application of the mouth to the prepuce and by sucking the latter. This part of the ritual is often carried out by different individuals, sometimes members of the family, sometimes by the operator. In the present instance the sucking was performed in ten cases by the functionary mentioned above as having circumcised sixteen of the children. In the remaining nine cases the application of the mouth to the prepuce was made by other members of the community. All these last nine cases recovered perfectly from the operation in the usual way; but the ten children in whom the bleeding was stopped by the application of the first operator's mouth all became affected with very serious disease between the eighth and twelfth day, and in precisely the same way. The wounds or scars in the prepuce first became the seat of nodules, then of unhealthy spreading ulcers, secreting but little. In about three weeks the inguinal glands became much enlarged in spite of vigorous anti-syphilitic treatment (the disease having at first been diagnosed as syphilis by Dr. Lehmann, under whose treatment the children were placed, and who records the outbreak with great care). In three cases these glands did not suppurate, but the patients died with all the symptoms of tubercular meningitis within a few months. In the remaining seven the glands suppurated, and four of these died, one of intercurrent diphtheria, three of "marasmus." Three of the ten children recovered, but only after years of suppuration in the inguinal glands and burrowing of sinuses under the skin. On looking into the matter Dr. Lehmann found that the operator on these ten children had been a patient of his own during the period of the outbreak, suffering from advanced phthisis of the lungs with cavities, characteristic sputa, night-sweating, etc., and who succumbed to this disease shortly after the last of these circumcisions in the month of May. He found that this patient had only applied his mouth to the prepuce in these ten infected cases, though he had circumcised sixteen, and that everyone of the ten were affected as above, while in the remaining six which he had circumcised, but in which the blood was sucked off by others, no evil result followed, nor in three other cases circumcised at the same period, though not by the same hand.

The careful way in which the details of this outbreak are given and the tables drawn up by Dr. Lehmann leave no room for doubt that the disease produced was local, and in several cases general, tuberculosis; and that it was inoculated into the prepuce from the mouth of the operator, who was dying of destructive tubercular lung disease at the time, and who became so weak at last that he had to be brought in a carriage from house to house for the performance of the rite in question.

I will not weary you by reciting all the cases of a similar kind which have recently been put on record, but will only mention that in many—notably those of Merkle, Holst, Eisenberg, and Pfeiffer—not only was the disease produced by the inoculation typically like tuberculosis, but the bacilli was fully demonstrated in the affected tissues. Pfeiffer's case, however, deserves a passing notice on account of its completeness.

The patient was a healthy veterinary surgeon, with a good family history, who, while dissecting a tubercular cow, punctured the joint of his left thumb. The wound soon healed, but was followed by induration of the scar, and later by swelling of the whole joint, which underwent the typical changes of a scrofulous synovitis, but without the formation of sinuses. Some

months later the patient began to show signs of pulmonary phthisis, which rapidly increased, and he died of this disease a year and a half after the wound of the thumb. The latter, which showed much swelling but an unbroken skin at death, was removed for special examination. The joint, on being laid open, showed all the destructive changes of scrofula both in the bones and synovial membrane; and in the latter, as well as in the broken-down material which filled the intervals between the bones, an unusually large number of bacilli tuberculosis were found. The microscopic appearance of the diseased tissues was also typically tubercular.

Such cases as those just described leave no room for doubt that tubercle can be inoculated in any part of the surface of the body, and may spread from the original point of entry throughout the whole system, until a fatal amount of general disease is produced.

Now, if the numerous facts of this kind already accumulated—of which those to which brief allusion has been made are only a sample—are capable of the interpretation put upon them, it is evident, in the first place, that a disease identical with human tuberculosis can be produced at will in animals by the inoculation from man of the products of strumous degeneration, and of the organisms obtained from them by repeated cultivation; also that the disease so induced may manifest itself locally before ultimately becoming general, and may remain localised for some time. It is also clear, from many experiments, that its tendency to become a general disease varies *ceteris paribus* directly with the number of the specific organisms present at the original point of inoculation, and that without these organisms no tuberculosis can be produced. Further, it is evident that the same disease can be produced in the human body in exactly the same way and subject to the same conditions.

But a number of other interesting and important facts have also been brought to the front in the extensive researches which have been made in this field—facts which have long been foreshadowed by clinical experience, and have only awaited proof by experiment. Among these, one of the most important is the influence of the condition of the soil upon the growth of the organism.

As of the pyogenic microbes so also of the bacilli tuberculosis, it may be said that they have to do battle in the animal economy with the vital forces of the tissue in which they are first deposited, and that these are in a large number of cases sufficient for their overthrow, or at all events sufficient to arrest their multiplication and dispersion throughout the body. In the case of the human being it has been shown, by accidental inoculation, that though they may be introduced in a thoroughly active form they may, if the body is healthy, be arrested in their development and kept at bay until finally eliminated or destroyed; but if the vitality of the individual or part be low, that they have a great tendency to multiply and spread. Schüller's long and admirable series of experiments, which must be familiar to many here, place this beyond all doubt as regards animals, and our clinical experience of scrofulous inflammations in man confirms the view. We know, for instance, that those who are weakly from inheritance or bad hygienic surroundings are most liable to these diseases, and also that those tissues and organs whose vitality has been lowered by injury or disease are specially prone to become the seat of tuberculous affections. Children again are more frequently a prey to scrofula than adults whose tissues are in their full vigour. Again, it has also been proved beyond cavil, that tubercular disease is auto-inoculable, that the introduction of the poison at one spot does not give immunity from inoculation at another, but further than this, that it is particularly liable to be grafted from one part of the body on to another. The importance of a full recognition of this last fact cannot be overrated in considering the operative treatment of tubercular joint-disease, and it will be necessary to refer to it over and over again.

We must now glance briefly at the ordinary modes of introduction of the tubercular poison into the human body before considering its behaviour towards the structures of the joints in particular.

Ever since the disease in question was first defined, the respiratory passages have been recognised as the point of attack at which the human body most frequently suffers. And clinical and pathological experience has shown that it is from this tract of mucous membrane that the infection most commonly spreads to the other parts of the system. The mode of this infection has been so often demonstrated by experiments on animals as to require only a passing notice here. Not only has it been shown that the injection of phthisical sputa or crude tubercular matter, or the bacillus tuberculosis derived pure by cultivation from it

into the air passages will produce typical tuberculosis of the lungs, but it has been observed that even healthy animals of certain species simply living with others thus affected speedily develop the same disease; and again, that healthy animals placed in an atmosphere contaminated by tuberculous dust are soon similarly affected. Not only has all this been proved by many independent observers, but the various stages of the disease from the first initial lesion of the catarrhal mucous membrane to the fully developed general tuberculosis have been traced step by step in animals thus dealt with.

And when we come to consider these experiments, and to compare their results with our clinical experience of phthisis in the human body and its minuter pathology we cannot doubt for a moment that its etiology is the same in both cases.

Next in the order of frequency comes the infection of the system through the alimentary tract. That disease was frequently propagated in the latter by direct inoculation due to the swallowing of phthisical sputa had long been suspected by clinical observers; but by others the presence of tubercular ulcers in the intestinal mucous membrane of patients suffering from pulmonary phthisis was regarded simply as evidence of the general infection of the blood with this poison, and that, once introduced, it could break out secondarily in almost any organ whose vitality was lowered by local diseases. Experimental researches have, however, proved that primary inoculation may take place in the intestinal mucous membrane without any lung disease through the medium of food contaminated with tubercular elements. Animals fed upon such food have developed the disease in the intestine readily, while other animals of the same species fed upon similar articles of diet but uncontaminated have remained healthy, though placed in exactly similar surroundings.

But perhaps the most striking illustration of this mode of infection through the medium of the alimentary tract is furnished by a series of the most interesting observations made by Bang on tubercular disease of the udders of cows. After describing this disease in detail, he goes on to show that it is associated with the presence in the diseased udders of countless bacilli tuberculosi, and ultimately with the characteristics of general bovine tuberculosis. And, further, he shows that the organisms can be demonstrated in the milk of such an udder, and that such milk will produce typical general tuberculosis when supplied as food to sucking-pigs or rabbits, or when injected into their peritoneal cavity.

The special knowledge of this observer, and the care with which his investigations were conducted, leave no room to doubt the correctness of his conclusions, which are also confirmed by Bollinger's demonstrations of bacilli in the milk of tubercular cows and its infective properties. That this infection also frequently takes place by means of milk in the case of children there is every reason to suppose, and, moreover, there are cases on record in which even healthy adult individuals, living an isolated life amid the healthiest surroundings, away from other causes of infection, have become tubercular from a diet consisting largely of the milk of *perlsüchtige* cows. The most convincing instance of this is to be found in the case of certain shepherds in the Swiss hills mentioned by Klebs. Amongst these hardy men, living in the purest air and apart from other unhealthy individuals, acute tuberculosis has been shown to have been produced by a diet consisting almost exclusively of bread and the milk of cows suffering from the same disease. Klebs has also described the case of a healthy St. Bernard dog fed upon bread and the milk of a *perlsüchtiger* cow, with the result of producing general tuberculosis.

There is one other supposed mode of introduction of the tubercle virus into the human system to which I should like to direct your attention for a few moments, namely, that by inheritance. I am aware that here I am on disputed ground. But after a careful study of the evidence on this point *pro* and *con.*, I feel bound to express the opinion left in my mind, inasmuch as this opinion will influence considerably what I have to say later on in regard to the operative treatment of tubercular disease. Now, I must confess that the theory which I was always taught, and which I have hitherto held, that tubercular disease is directly inherited in the parasite form in a large proportion of cases, appears to me no longer tenable. There is a vast amount of evidence on this point, and the literature of the subject one can hardly even think of without a shudder. That the organism of tubercle may be transmitted from a diseased mother to the fetus *in utero* in animals has no doubt been shown by Johnes in one single case. But it is a significant fact that Johnes himself—with his special knowledge of the subject and his great oppor-

tunities amongst animals for study, and believing in the possibility of such transmission—writes in 1885 that the case he then described was the first certain one of fetal tubercle placed on record. It is also a remarkable fact that numerous other specially competent observers have failed to find evidence of tubercle in fetuses born of tubercular animals, or found *in utero* after death from the disease in question; and, so far as I can discover, typical tubercle has never been demonstrated beyond question in a human fetus at birth, or taken from the uterus after death, in spite of frequent search. But, even if it were occasionally found in the fetus, this would only show that such an infection was possible as an exception, but it would not account for the enormous amount of tubercular disease observed among very young children. We are, therefore, led to look for other possible methods of infection besides that from the mother *in utero*; and there are so many, as I have endeavoured to show above, that we are in no difficulty. Children born of parents debilitated with phthisis may inherit a low vital energy, but be without a trace of parasitic disease at birth. But, with inherited debility, they are peculiarly fitted to become a fruitful soil for the propagation of the tubercle bacilli if implanted on them; and in a household in which phthisical people live together there are countless ways in which an infant may acquire the disease from them. In the first place, the mother's milk may introduce the organism into the child; her breath may infect it; the dust of the house, contaminated by sputa, may carry the poison into its lungs or alimentary tract, or deposit it on an abrasion of the skin. Indeed, it seems almost difficult to explain how a child born weakly and brought up among consumptive people can escape more or less infection in one or other of these ways briefly alluded to. At all events, the prevalence of tuberculosis among the children of consumptives is easily accounted for without any resort to the theory of inheritance.

Without going further into this very interesting question of inheritance, I will venture to say that anyone who will carefully study the evidence bearing upon it, and especially Wahl's exhaustive paper, will come to the conclusion that, although tuberculosis can certainly be inherited, such an occurrence is excessively rare, and that, in the vast majority of cases met with, the disease has been acquired, most probably, from the surroundings of the patients or from the food supplied to them.

It is highly probable, however, that there is such a thing as hereditary predisposition to tubercular disease among the offspring of consumptive parents; in other words, that their tissues are a peculiarly fertile soil for the growth of the organism once introduced; but wherein this predisposition consists—whether in anatomical or physiological deviations from the normal, or simply in a general loss of that unknown quantity "vital energy"—is still a mystery.

When once engrafted upon one of the surfaces of the body, the bacillus tuberculosis is disseminated throughout the latter in a variety of ways. In the first place, though it has not been proved to possess the power of locomotion, its mode of spreading from a point of inoculation strongly suggests this. In Baumgarten's experiments on the eye mentioned above, the position of individual bacilli in the outskirts of the primarily infected spot can hardly be explained by their transport by any known tissue current. For instance, they spread by preference into the cornea along the fresh scar tissue of the recently healed incision (Fig. I, N.), in which, of course, there would be no vessels of any kind during the first few days; and, unless they travel by virtue of some power inherent in themselves, it is hard to account for their presence here at all. A few, of course, may be carried in the interior of wandering leucocytes, but this does not explain the movements of the majority, many of which are found apart from the leucocytes. They have also been shown to have the power of penetrating the walls of the venules and arterioles from without, and of so gaining access to the blood-stream.

But leaving this question as to their power of moving themselves from place to place to be settled by future observation, the other modes in which they are spread through the body demand brief notice. There can be little doubt that, in the vast majority of instances, they are primarily taken up by the lymphatics, and pass from these into the blood-current, to be carried by the latter secondarily into distant parts of the body. But, as a rule, the glands nearest to the point of inoculation arrest the progress of the organism more or less completely. It must not be forgotten, however, that the walls of a large lymphatic vessel such as the thoracic duct may be secondarily infected from proximity to an inde-

pendent focus of caseation. From a vessel so infected an abundant supply of bacilli may be furnished direct to the circulation, no glands intervening to offer a barrier. Through the coats of the pulmonary vessels they have also, as already stated, been observed to pass directly into the circulation; but they probably do so to a very small extent as long as the walls of the vessels are unbroken by inflammation. But it is quite otherwise when a vein, whether in the lung or elsewhere, lies in close apposition to a caseating focus of tubercular disease. In such a case the wall of the vessel may be eroded, and the contents of the caseous abscess may be poured directly into the venous, and from this into the general circulation. This has actually been demonstrated by Weigert, in an interesting series of cases, to have taken place, and to have been followed by rapid general tuberculosis. A knowledge of this fact ought to have an important bearing on the operative treatment of tubercular caseating foci. It is very easy to imagine how easily surgical interference may give rise to this mode of general infection when we remember the constant presence of dilated thin-walled veins around the walls of caseous abscesses, and the ease with which they may be torn. Again, the rough handling of a tubercular joint, even without any cutting operation, may complete the rupture of a vein already partly eroded by its proximity to a caseating process, and may regularly inundate the venous blood-stream with the products of the latter. We have all, I suppose, seen rapid general tuberculosis follow upon some disturbance of a scrofulous joint by injury or surgical interference, and such a sudden inroad of the products of the local disease into the venous circulation would best explain such an occurrence. The beneficial effect of absolute rest too in limiting tubercular processes may be no doubt explained in part by absence of this dispersion of bacilli through eroded vessels, rest giving the latter time to erect barriers against the encroachment of the organisms by means of ordinary plastic phlebitis.

But it is to the lymphatics that we must look as the ordinary carriers of the microbes from their first landing-place; and it is fortunate that this is so, for in a large proportion of cases the lymphatic glands appear to have the power of arresting their further progress until they either die or in some way their dangerous powers are curtailed. There is every reason to suppose that in many cases the bacilli are arrested completely in the glands and never get any further. But it is equally probable that in a large proportion of cases they or their spores pass quickly through them in greater or less number, and gain an entrance into the blood. It is also more than likely that they, or their spores, often pass on from the glands into the circulation after a long and comparatively quiet sojourn in the former, perhaps amounting to years, and only become dangerous on being disturbed and widely distributed through the circulation. The importance of this power of the lymph glands to arrest the organisms and prevent their contamination of the whole blood-stream is, of course, enormous; for, once they have entered the blood, they find a most fruitful soil for their propagation, and not only this, but they are carried to every part of the system, and can select among the organs and tissues one or more spots specially suited, either physiologically or pathologically, for their propagation. That certain organs and tissues are peculiarly liable to be attacked by this disease has been well known for a long time past; but the conditions determining the point of attack have not been so well understood. Undoubtedly the view that injury to a part predisposed it to tuberculosis is quite correct, whether this injury consist of disintegration of tissue, with extravasation of blood, or disturbance of its functions, or only amount to impairment of those forces which go to make up what is briefly termed its "vitality."

But besides the influence of external agencies in predisposing to tubercular growth, there appears to be in certain spots in the body some inherent suitability of soil for the cultivation of the bacillus tuberculosis depending upon their physiological conditions. In other words, with the organism in the blood of an individual not unfavourably influenced as regards one part or another by external agencies, the bacillus appears to prefer to make its home, as a rule, in certain tissues, and to leave others unaffected.

The pia mater of the child furnishes, perhaps, the best example of what I mean, the medulla of the bodies of the vertebrae the next best. Both of these tissues in the child are as far removed from the action of injury, or, indeed, of any external influence, as possible, and yet the frequency with which they become the seat of tubercular disease is proverbial.

It would be interesting to examine the various aspects of this

particular question at greater length, but I am obliged to content myself to-day with this very brief allusion to it. Enough has been said, I hope, to indicate the line of reasoning I have been led to adopt as regards the nature of tubercular or scrofulous disease, and which I shall venture to pursue in its direct application to joint-disease in my next lecture.

ON HYDROPHOBIA AND ITS "TREATMENT:"

ESPECIALLY BY THE HOT-AIR BATH, COMMONLY TERMED
THE BOUISSON REMEDY.

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HYDROPHOBIA being a disease of which the true pathology was scarcely known until a few years ago, indeed almost until M. Pasteur began his remarkable investigations, has always been regarded by the quack and the impostor as a fair field of enterprise. The authoritative statements employed by such therapeutical pirates to foist their methods and nostrums upon the much beguiled public commonly include the prominent expression of some popular belief. Amongst such beliefs must be placed the ubiquitous confidence reposed by the laity in the active secretion of sweat as an efficient means in getting rid of the *materies morbi* of acute specific diseases. It is a very widespread notion that if there is such a poison in the body, it can be "sweated out," just as it used to be generally believed (though now only by a particular sect) that the exercise of religious faith would, if energetically resorted to, get rid of a malady. The application of this sweating treatment in the shape of hot baths to the relief of rabies is of very ancient origin: and, under the belief referred to, it has been largely employed and advocated by irresponsible persons of every degree.

The practice of subjecting hydrophobic patients to hot air baths, however, received support from a French physician of professional repute, Dr. Bouisson. This gentleman seems to have suffered from symptoms, most of which resembled those of hydrophobia; but, from the account he gives of his trouble, his diagnosis that he was really suffering from that disease may well be called in question. Acting on the belief that he was so stricken, he entered a hot-air bath with the idea of terminating his existence, but he gradually became calmer, and soon the symptoms totally disappeared. Struck by these circumstances, he strenuously advocated the use of the hot-air bath in hydrophobia, and published cases in which he thought he had successfully combated the disease. He stated that if the patient were placed in the bath on the first day that the symptoms manifested themselves, a cure would be infallibly obtained. If only on the second day, that the cure was possibly uncertain, and that the treatment was hopeless if begun as late as the third day. Since Dr. Bouisson's papers were published, many patients, actually or supposititiously suffering from hydrophobia, or in whom the occurrence of the disease seemed possible, have been treated on this plan. All those patients who have been reported by respectable practitioners to have been suffering from genuine hydrophobia have died in spite of the Bouisson treatment.

Instances of its employment by such practitioners will be referred to presently. In spite of the failure of this procedure an attempt was made in the recent epidemic of 1885, and subsequently, to secure its trial by the profession. As might be supposed, its adoption is principally urged by those who are, for obvious reasons, opposed to the progress of medical science, the paid antivivisectionist agitators. These persons spread broadcast glowing misrepresentations of the system, and raise, as I have myself seen, many false hopes, and so cause much pain in the minds of the patient and his friends. For instance, one of their agents, a Rev. J. P. Wright, made the assertion that "Eighty cases had been already cured by this method, and only one doubtful case was chronicled." (*The Zoophilist*, January, 1888, p. 152.) It is deeply to be regretted that certain medical practitioners—to wit, Dr. Bell Taylor, of Nottingham, and Dr. Clarke, of Clapham, have countenanced the statements of these people, and advocated the trial of such treatment on man. What the "antivivisectionists" clearly desire is that the profession at large should make a series of experiments on man to see whether this Bouisson treatment is worth going on with or not. Most of us,