

but no mucus present, and walls feel hard from old thickening around, but no deposits; some dark red lobules are seen in the section of lower lobe. *Left pleura* healthy. *Lung*  $1\frac{3}{8}$  ozs., healthy.

*Pericardium* pearly, moistened with serum. *Heart*  $1\frac{1}{4}$  ozs., flabby, no fat on surface, a little fluid blood on both sides.

*Abdomen*.—Peritoneum healthy.

*Small intestine* contains fine lumbrici and some whitish fluid, coats very thin, arborescent injection in ileum showing through, lining rosy, Peyer's patches darker and cribriform; no mucus detachable.

*Large intestine* empty, thin and grey; no mucus.

*Stomach* small, empty; lining pale rosy, in rugæ. *Liver*,  $7\frac{5}{8}$  ozs.; liver coloured with purple tinge on right, and yellow tinge on left lobe,  $3\frac{1}{2} \times 2 \times 4 \times 1\frac{1}{2}$  inch, not fatty. *Gall bladder* full of thin dark bile.

*Spleen*,  $\frac{5}{8}$  ozs.,  $2\frac{3}{4} \times \frac{1}{2} \times 1\frac{1}{2}$  inch; section pale red brown, not friable, and no pulp on pressure.

*Right kidney*,  $\frac{3}{4}$  ozs.; capsule strips easily, anæmic, healthy.

*Left kidney*,  $\frac{1}{2}$  oz., like right, but some injection of medulla.

*Pancreas*.—Three drachms, healthy.

*Mesenteric glands* normal; no fat in mesentery.

ART. XVII.—*Pulmonary Phthisis and Bacilli*.<sup>a</sup> By HENRY S. GABBETT, M.D. Dub., M.R.C.P. Lond.

RATHER more than three years have elapsed since Dr. Koch announced that he had discovered a micro-organism which was constantly present in cases of tuberculosis in man, monkeys, cattle, and other animals; that he had succeeded in cultivating it outside the body for a number of successive generations; that when the minutest particle of such pure cultivations was introduced into the body of a suitable animal, tuberculosis was set up; and, finally, that in such inoculated animals the micro-organism was found to have grown and multiplied. As the result of these investigations, he confidently stated that the true cause of tuberculosis had been at length discovered.

This announcement naturally caused a profound sensation in the medical world. Inasmuch as pathologists had been for years discussing this very question of the causation of tubercle, and as almost everyone had his own pet theory on the subject, there was much opposition to Dr. Koch's views. Some said that the same micro-organisms might be found in normal saliva and in many

<sup>a</sup> The substance of this paper was read before the Eastbourne Medical Society last May.

decomposing substances; others demonstrated to their own satisfaction that the bacilli were consequences not causes of disease; and one writer gravely asserted that they were neither more nor less than *fat-crystals*! But, now that three years have elapsed, this opposition may be said to have completely died away. The question was one to be decided by experiment. If there was no error in Dr. Koch's experiments, there was really no escape from his conclusions. And investigators in many parts of the world have been engaged in testing the accuracy of his work, with the general result that his statements have been confirmed, and the tubercle bacillus acknowledged to be a true pathogenic organism. For its claim to be so regarded rests upon precisely the same grounds as those upon which we rely in considering the anthrax bacillus to be the cause of malignant anthrax in herbivorous animals and rodents, and of "wool-sorter's disease" in man. In both cases the proofs are cogent: and the most competent and careful observers (such, for instance, as Dr. Burdon Sanderson and Dr. Klein) acknowledge that the demonstration has been completely made.

What influence has this discovery upon our views of the pathology of pulmonary phthisis? It would be hard to say what is the latest orthodox opinion upon this long-disputed subject. Doctors differ, and have differed since the time of Laennec, about the nature of phthisis. If we accept the recently-issued *Nomenclature of Diseases* of the Royal College of Physicians (1885) as an authoritative exposition of orthodox doctrine, it would seem that we must acknowledge the existence of three distinct diseases—viz., "acute pneumonic phthisis," "chronic pneumonic phthisis," and "tubercle of the lung." It is evident, however, that the *Nomenclature* cannot be regarded (and indeed is not meant to be regarded) as a strictly scientific classification of diseases according to their essential nature; that the compilers paid "deference to the needs of the various registration authorities;" and that (to quote from the preface to the first edition) "names have not been excluded merely because they may seem to express only vague and imperfect knowledge." Nevertheless, the above division represents the view of phthisis taken by one school of pathologists, who may be said to follow in the steps of Niemeyer, and who hold that in the clinical term, "pulmonary phthisis," several distinct morbid conditions are included. Others maintain that these divisions have no scientific value; that, notwithstanding the great variation in symptoms and

acuteness of course, we have to deal with one disease assuming different forms; and that, notwithstanding the great variation in the *post mortem* appearances, in all true phthisis the tubercular<sup>a</sup> process may be recognised.

Has any light been thrown upon this vexed question by Koch's discovery? It is obvious that if the bacilli of tubercle are observed to be confined to those cases of phthisis which are universally admitted to be tubercular, it would be a strong argument in favour of the first view. If, on the other hand, they are found also in the so-called pneumonic cases, the supporters of the second opinion may fairly claim that an additional proof has been given of the unity of the disease. Two methods of investigation are open to us—the examination of the sputa during life, and the examination of the lung after death, in order to ascertain the presence of the bacilli. The second method is difficult, and requires a good deal of technical skill; so that the statement that bacilli have not been found in a phthisical lung has really no value unless we are sure that the observer is well versed in modern histological methods. The examination of the sputa, on the other hand, is comparatively easy, and trustworthy results may be obtained by any one who has patience to make repeated experiments. By this time a great number of observations have been accumulated, bearing upon this subject. Dr. Klein thus states the result (*Micro-organisms and Disease*)—"Wherever they (the bacilli) are present in the sputum we have to deal with real tuberculosis; wherever, after repeated examinations, they are found to be absent there is no tuberculosis." This statement, as I understand it, I believe to be absolutely correct; but, if the phrase "real tuberculosis" is meant to exclude the "pneumonic phthisis" of the College of Physicians' nomenclature, I must take exception to the first clause. Tubercle bacilli are found in abundance in the sputa and lungs of persons who would be considered typical cases of "pneumonic phthisis." They are never present in bronchitis, emphysema, bronchiectasis, the

<sup>a</sup> The primary conception of tubercle is that of a small nodule, with a certain microscopic structure, and a certain life-history. But it has been shown, on the one hand, that the microscopic structure is not peculiar to tuberculosis, and, on the other, that tuberculosis (identified by its history, infectiveness, &c.) may show itself in some cases without distinct "tubercles;" this is especially common in the lungs. Such was the state of knowledge on the subject before Koch's discovery; and, naturally, there was much disputation and confusion, and a wide-spread desire for the detection of some specific element—some element of unity in the processes known as tubercular. It is believed that we have at length found that element of unity in the bacillus.

various forms of pneumonia, or malignant disease of the lung: they may be found in all the forms of true pulmonary phthisis.\* Here of course arises the inevitable question—What is meant by “true pulmonary phthisis?” It seems to be useless to attempt a definition when the very terms of it would be disputed; but it may be said that by the name we mean to indicate a destructive disease of the lung, which, with remarkable variations in its mode of onset and in its course, usually commences with local consolidations at the apex; a process which tends to spread in an “infective” manner to other parts; which tends to attack both lungs; which tends to the formation of cavities; and which is associated with the train of symptoms commonly called “consumption,” in greater or less degree. What is specially to be insisted upon is this—that the pathogenic organisms are present in all the forms of the disease, and not merely in those in which miliary tubercles are found studding the lung after death, in such numbers and so unconcealed by other morbid processes as to be readily recognisable by the naked eye.

These investigations, then, appear distinctly to support the conclusion that pulmonary phthisis is a tubercular disease, intimately dependent upon the presence of specific bacilli. It would be unreasonable to expect that those who have been long accustomed to other views of the nature and ætiology of the disease, should at once admit the new doctrine; and, indeed, we are all warned by experience of the danger of a too hasty acceptance of pathological theories. But it may be useful to inquire what is involved in the “bacillar hypothesis,” and to see whether it necessarily leads to any conclusions at variance with known facts. Supposing then that we take it as proven that tubercle bacilli are essential factors in the causation of phthisis, the following questions suggest themselves:—Whence do the bacilli come? How do they gain an entrance into the body? And, when they have gained an entrance, how do they set up the morbid process?

1. It may of course be considered absolutely certain that in no case do they originate *de novo* within the body—they are certainly introduced from without. A little consideration will show that it is possible to conceive of different kinds of micro-parasites mani-

\* In 1883 I communicated to the British Medical Association the result of repeated examinations of the sputa in over a hundred cases of chest-diseases. The conclusion was that given above, and all my observations since have confirmed it. It will be remembered that Koch himself found the bacillus in “caseous pneumonia” and “caseous bronchitis.”

festing different habits and vital capabilities—some may be able to live and multiply in the outer world, in air, soil or water, while others may be unable to exist except under conditions which are only to be found in a living body, and must perish when thrown out of the body, unless they can meet with another host. In the latter case the disease with which they are associated is directly communicable from man to man,<sup>a</sup> and, indeed, can only be propagated in that way. In the former case the disease need not, perhaps cannot, be so communicated; infection (in the limited sense of the word) may have nothing to do with its prevalence. Now, it seems to be proved by experiment that tubercle bacilli cannot grow at a temperature much below that of the human body; it follows that there is no probability of their flourishing in the outer world in this climate. From this we might infer that they always come directly from some infected living body, that, in other words, tuberculosis must be directly communicated. But, as a matter of fact, that conclusion is not justified, for the simple reason that tubercle bacilli belong to a class of organisms which are capable of forming *spores*; and the spores of bacilli have marvellous powers of retaining their vitality under the most unfavourable circumstances. Thus it is easily conceivable that spores, thrown out of an infected body in the sputum, may continue to exist for an indefinite period in the outer world, though incapable of germinating till they enter another living body; and it is not improbable that such spores actually surround us in enormous numbers. But whether this is the usual origin of the bacilli which enter a susceptible person, or whether they generally come fresh from a phthisical patient, the fact remains that if we believe in the specific nature of the bacilli<sup>b</sup> we must believe that phthisis, in so far as it is tubercular, is an infectious disease, in the sense that it is due to a “contagium vivum,” which comes directly or indirectly from an infected individual. This is one of the necessary consequences of the bacillar hypothesis: whether it is at variance with ascertained facts in the natural history of the disease, is an important and difficult question which admits of much discussion. With regard to hereditary phthisis, of course the explanation must be, not that

<sup>a</sup> Or possibly to man from a lower animal.

<sup>b</sup> I have not thought it necessary to consider the theory of the transformation of septic into pathogenic bacilli, because in the only instances in which that theory has been supported by experiment—the case of anthrax (Buchner) and of jequirity (Sattler)—the experiments have been proved to be faulty. See *Researches of Koch and Klein*.

the bacilli are transmitted to the ovum by either parent, but that what is inherited is a constitutional liability to infection. In what this liability consists we do not know, but we may assume that it is some condition of the tissues which renders them unable to resist the intrusion of the micro-organisms, or which makes them particularly good soil for the growth and multiplication of the same.

2. By what channel do tubercle bacilli enter the body? There can be little doubt that they usually enter by the air-passages. So long as they merely lie free in the healthy bronchi or alveoli, it is probable that they do no more harm than the other bacterial forms which are constantly present on the surface of mucous membranes. But if once they can secure a favourable nidus for their growth, the conditions are changed. What then constitutes a favourable nidus? If we were attempting to make an artificial cultivation of bacilli, we would secure them the proper amount of warmth and moisture, and a nourishing material containing proteids and salts, and then we would leave them undisturbed. All these requirements would seem to be fulfilled in a partially-collapsed pulmonary lobule, filled with stagnant secretion and epithelial debris; and if the bacilli once get planted in such a position, it is probable that they will flourish and multiply after their kind, until an opportunity is given them of intruding still further, and actually passing into the tissue of the lung.<sup>a</sup> When they have entered lung tissue, any one of three consequences may follow—they may encounter unfavourable conditions and perish; they may get into blood-vessels or lymphatics, and in their diffusion throughout the body set up general tuberculosis; or they may settle in the lung and cause local changes.

3. In what way do these micro-organisms set up the morbid process? Some time ago a paper appeared in one of the medical journals, in which it was stated that the bacilli acted simply as *mechanical irritants*, like other foreign bodies in the lungs. The writer seems to have imagined them to be hard, sharp particles of considerable size, like particles of coal-dust or iron-filings. But the bacilli of tubercle are very small things indeed—very small, soft and fragile, so much so that there is something almost ludicrous

<sup>a</sup> Since minute particulate substances when inhaled are constantly taken up by the lymphatic capillaries of the lung, and carried into the bronchial glands, it is hard to deny that various bacteria in the inspired air—and among them the tubercle bacilli—may thus often penetrate into the body even in health. If so, we must suppose that under ordinary circumstances they quickly perish.

in the idea of associating them with mechanical irritation. A large number of them would fit comfortably into a white blood-corpuscle. The fact is that the only instance in which we can conceive of such micro-organisms affecting the tissues mechanically, is when enormous masses plug the capillary vessels. But this is not what tubercle bacilli do. It would appear probable that the injurious effects of their presence are due to some kind of chemical virus, which is elaborated in the process of their growth, and which has a deleterious influence upon the tissue-cells in their neighbourhood. This is purely hypothetical—no one has isolated the virus, no one knows anything about it—but it is difficult to account for the facts by any other hypothesis.<sup>a</sup>

It is sometimes said that the clinical history of pulmonary phthisis is very unlike that of a morbid process caused by the intrusion of micro-organisms. This would certainly be true if all such processes must of necessity follow the type of fermentation, and if all micro-organisms in their action on the body must behave like the *saccharomyces* in solutions of sugar. In such cases all bacterial disorders should present “zymotic” characters; each disease should run a similar course in every individual attacked; there should be a “period of incubation” from the entrance of the ferment to its multiplication and diffusion through the circulation; then a “period of invasion,” during which the ferment is actively performing its peculiar functions; then a time of cessation from action because the material is exhausted; and lastly a period of protection from subsequent attacks. Certainly this is exceedingly unlike the clinical picture of pulmonary phthisis. But in reality the assumption that all micro-parasites must act in this manner is entirely unwarranted. In the typical “zymotic” disease the organisms are supposed to multiply in the blood; it is not difficult to understand that a very different train of symptoms might be produced by their growth in lymphatic structures or in the fixed elements of the tissues. And in fact it is quite certain that there are organisms which give rise to affections purely local, and presenting none of the so-called “zymotic” features. The diverse phenomena manifested in pulmonary phthisis may be readily explained, by supposing the bacilli to be variously situated; the occurrence of general tuberculosis by supposing them to enter the circulation.<sup>b</sup>

<sup>a</sup> For a discussion of this question see Klein's “Micro-Organisms and Disease,” Chap. XIX.

<sup>b</sup> Tubercle bacilli have been found in the blood in general tuberculosis.

It remains to consider the influence which this view of the causation of phthisis should have upon our prophylaxis and treatment. Soon after the announcement of Koch's discovery enthusiastic writers declared their conviction that in future people would be inoculated for tubercle, and thus the scourge of this country would be abolished. Unfortunately, nothing is more improbable. Even if we could "attenuate" the virus, what reason is there to suppose that it would give immunity? The theory of immunity after inoculation is based upon the observed fact that in certain diseases one attack "protects" the patient for a longer or shorter period, which is explained by supposing that the introduction of the virus produces such an effect upon the body (either by exhaustion of the material necessary for the life of the virus, or by elaboration of material inimical to its development), that in subsequent introductions the virus is inert. But this is by no means the case in every infective disease caused by micro-organisms. An attack of erysipelas does not "protect" the patient, for example. And there is no ground for believing that tuberculosis is different in this respect; on the contrary, clinical experience would seem to show that the invasion of its germs render the tissues less resistant than before. It appears, therefore, that we need indulge no hopes of obtaining immunity by inoculation. Again, we cannot expect to be able to extirpate hereditary tendencies, since we do not know in what these tendencies consist. But we may attempt to strengthen the resisting powers of a person whom we suspect to be susceptible, by improving his physical condition generally, knowing that it is in the highest degree probable that tubercle bacilli have but a poor chance of development in healthy tissues. We may try to ward off those morbid states which, as we have seen, render the lung liable to the inroads of micro-organisms, such as catarrh and pulmonary collapse; we may try to avoid the damage produced by pneumonia and pleurisy; we may forbid sedentary habits, which hinder the expansion of, and circulation in, the lung; we must, if possible, remove the susceptible person from the air of cities, in which it has been proved that all forms of bacteria are more abundant than in the country; we must insist upon thorough ventilation of the rooms in which he lives, and especially of his sleeping room; and, considering that a patient with developed phthisis is to be regarded as a laboratory in which infective bacilli are being constantly cultivated, and from which they are being constantly thrown out,



we must, as far as possible, prevent intercourse between the susceptible individual and such patients. Lastly, as a precaution for the benefit of the community, we should insist upon the destruction of phthical sputum.

With regard to the influence of the bacillar hypothesis upon our views of treatment, the first question which suggests itself is—If bacilli cause phthisis, how are we to kill the bacilli? Accordingly, Koch's discovery gave a considerable impetus to the recommendations of various "antiseptic" and "germicide" modes of treatment, and there has been a large sale of "oro-nasal respirator-inhalers," by means of which the patient is supposed to introduce into his lungs certain vapours fatal to the bacilli. There is certainly something peculiarly attractive in the idea of the specific treatment of phthisis by antiseptic<sup>a</sup> inhalations. But before we indulge in expectations of important results from such a treatment, it is desirable that we should have some definite notion of what our antiseptics are supposed to do, and in what way they can be useful in a bacterial disease. Now, in the case of phthisis, do we expect the antiseptic substances to kill the bacilli and their spores, not only in the air passages and cavities but also in the tissues? Nothing is more certain than the fact that no known antiseptic can be introduced into the body of sufficient strength to do that without running a serious risk of killing the man also. Allusion has been already made to the resisting powers of the spores of bacilli; as an example it may be mentioned that in the case of the bacillus anthracis (which has been probably more studied than any other), the spores are not killed by soaking them in 10 per cent. carbolic acid, in 1 per cent. corrosive sublimate, or in pure terebene, for twenty-four hours; and that they may retain their vitality after being boiled for ten minutes or frozen for an hour (Klein). But perhaps our more modest hope may be that, without destroying the spores, we may hinder their germination; or possibly we may even limit ourselves to the expectation that the bacilli growing in cavities with free access of air may find it hard to flourish in the presence of antiseptic vapour. It need scarcely be pointed out that if this is all that the antiseptics can do, they have no great value as a "radical" cure. But unfortunately it seems quite certain that they cannot even do this. After weeks and months of conscientious inhalations, patients' sputa have been examined

<sup>a</sup> The term "antiseptic," though obviously a bad one, is retained because it is so commonly used by those who deal with this subject.

and found to contain swarms of bacilli which appeared to have been thriving in the medicated atmosphere. It is evident that there is still less prospect of benefit from the introduction of antiseptics into the stomach.

But although at present it seems quite useless to attempt to attack the micro-parasites directly, it does not follow that at some future time, when we have learned more about their life-history, we may not be able to do so. Dr. H. Weber, in his recently published Croonian Lectures on pulmonary consumption, seems to think it within the bounds of possibility that we may learn how to *starve the bacilli* by denying the patient certain articles of diet. It is difficult, however, to understand how it could be possible to deprive the tissues of the elements necessary for bacterial life, without serious injury to the body. Perhaps, again, some medicinal substance, harmless to man, may be discovered which will produce such an effect upon the tissues as to render them unfit soil for the growth of bacilli. Lastly, it is just conceivable that, without waging war with the parasites themselves, we may learn how to neutralise the effect of the chemical virus which they produce, and thus to render them inert.<sup>a</sup>

On the whole, we may as well face the fact that there is no immediate prospect of our being able to attack the bacillus directly, and consequently we must not be sanguine about proposed revolutions in our modes of treatment of phthisis. The most helpful consideration appears to be that this particular parasite is generally unable to effect a lodgment in the human body in conditions of health. Although the great distinction between septic and pathogenic organisms is that the latter have the power of thriving and multiplying in the living tissues, it must not be supposed that the tissues are absolutely unable to resist their encroachments. On the contrary, there is no doubt that a fierce battle is waged between the healthy tissues and the organisms; these attempting to spread, and nature trying to check their progress, sometimes by forming a line of demarcation and by the process of suppuration dividing the diseased from the healthy parts—sometimes by encapsuling the intruders, shutting them up in a dense-walled compartment, the contents of which are left to calcify. It would

<sup>a</sup> See a paper by Mr. Kingzett in the Brit Med. Journal, May 16, 1885. But unfortunately this would not be going to the root of the matter; so long as the bacilli continue to exist, new virus will be produced, and would it be practicable to supply the antidote constantly?

seem therefore that our best chance lies in assisting nature to carry on the war, by increasing the health and strength of the tissues. And although in the case of other parasites there could be very little prospect of a successful issue of the contest, it is quite certain that in the case of the tubercle bacillus the tissues are, under favourable conditions, able to gain the victory. Bearing this in mind, our great efforts should be to promote nutrition, to encourage circulation, to aid expansion of the lung, to check catarrh, and—most important of all—to supply the real food of the lung, and therefore indirectly the best antiseptic, pure air, and plenty of it. And if the general acceptance by the profession of the view that pulmonary phthisis is a disease intimately dependent upon the presence of micro-organisms, together with a recognition of all that is involved in that belief, should promote a wider adoption of these therapeutic measures, then the discovery of the tubercle bacillus will lead to great results.

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ART. XVIII.—*Address at the Opening of the Session 1885-6.*

Delivered in the Theatre of the Meath Hospital, November 2, 1885. By ARTHUR WYNNE FOOT, M.D., Univ. Dubl.; Senior Physician to the Meath Hospital; Fellow of the King and Queen's College of Physicians in Ireland; Professor of the Practice of Medicine, Royal College of Surgeons in Ireland, &c.

GENTLEMEN,—The duty has been entrusted to me by the Medical Board of inaugurating this Session, in the manner sanctioned by long-established custom, by the delivery of an Inaugural Address.

The obligation about to be undertaken is one which has more than once fallen to my lot, but my ideas as to the intention and aims of such an address have undergone no change in the time which has elapsed since I first essayed the task.

The course which I have marked out as suitable for the occasion is one which has reference to the interests of those who are making, or who are about to make, their first acquaintance with the practical realities of sickness as met with in a hospital. It is proposed to occupy your time, and possibly to engage your attention, with a few considerations relative to the object and method of your studies here, which may at least be assumed to concern, even if they fail to interest, the pupils.

This course has been adopted from a conviction that it is for the benefit of beginners undertakings such as the present are