A Lecture ON LEPROSY:

A NEW VIEW OF ITS BACTERIOLOGY AND
TREATMENT.

DELIVERED AT THE LONDON SCHOOL OF TROPICAL MEDICINE.

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I AM greatly indebted to Sir Patrick Manson for this opportunity of laying before you the results of investigations which I have been carrying out for some years into the bacteriology and treatment of leprosy.

Before proceeding to a description of my own results I should like to draw attention to the work of Major Rost, I.M.S., who is the pioneer of this work in India. Although doubt was thrown on his original work, published in 1904, I think that careful consideration of those results, especially in the light of Major Rost's more recent researches, and of that of other investigators, will give the impression that his early work was most important, and entitled to serious consideration. Personally, I am greatly indebted to Major Rost for the help which he has given me in connexion with my own research work.

The view which I wish to advance is that the lepra parasite is not an acid-fast bacillus belonging to the fission fungi, but that it is a very pleomorphic streptothrix, which, in addition to changes in form, exhibits marked changes in its staining reactions in regard to the quality known as "acid-fastness." This being the main point of my lecture, it will conduce to a clearer exposition of the subject if I may be allowed to refer very briefly to some of the principal features of the Streptotrichae. I would especially refer those interested in this group of organisms to the Milroy Lectures of 1910 by Mr. Foulerton of the Middlesex Hospital, which give a most interesting and clear account of this group of organisms, based on original researches extending over many years. The following description of the Streptotrichae is taken from those lectures:

The typical life-history of a streptothrix may be said to consist of:

1. Branching mycelium.
2. Isolated rod segments.
3. Spherical spores.

Development may be studied in one of the quickly growing saprophytic species. One starts with the spore; from this two or three threads sprout and elongate, so that at an early stage of development one has a typical ray fungus consisting of three mycelial threads, usually of unequal length, and radiating out from the position occupied by the central spore. From these primary threads lateral branches in turn sprout out, and soon there is developed a densely tangled mass of mycelium representing the fully developed stage of the organism.

The next stage is transverse segmentation. The branching mycelium, which hitherto has been apparently homogeneous in structure throughout its length, now presents transverse segments produced by an obvious process of degeneration extending across the mycelium.

Following this is a stage of fragmentation. The degenerated portions of mycelium disappear, and a conglomeration of separate rod segments represents the original system of branching mycelium. Generally speaking, these rods are morphologically identical with bacilli, except that here and there a rod with the remains of a lateral branch attached to it may be seen.

With, or soon after, the occurrence of segmentation a special kind of spore formation may be observed. In a typical instance special spore-bearing organs are developed; fine aerial hyphae, which, erecting themselves from the growth of mycelium, often cause a powdery appearance on the surface. Spores are produced in these aerial hyphae. It seems probable, also, that under certain conditions these spores may be produced along the length of the mycelium, as well as in the special hyphae. From these spores fresh filaments grow out.

The bacteria or fission fungi are defined as unicellular organisms, which reproduce themselves by a process of transverse fission or spore formation. In the one case the parent cell produces two new cells by clean transverse fission; in the other case a single endogenous spore is produced, so that a single cell succeeds a single cell.

In the hyphomycetes, or mould fungi, we have a more complex kind of organism, in which sporulation is a function of specialized spore-bearing organs of various types, the simplest,

perhaps, of which is represented by the aerial hyphae of the Streptotrichae.

The stage of full development of the streptothrix is represented by a system of branching homogeneous mycelium. . . . As to the nature of what have been described as the spherical spores, there can be no doubt, and it is probable that the rod segments also have to be considered as being in a sense spore bodies; that is to say, it is probable that these rod segments represent a more resistant form which is capable of producing a new mycelium directly, and by means of which, in case of disease, the infection commonly is transported from one part of the body of the host to another. The fully-developed mycelium obviously, because of its bulk, would not pass easily from one part to another, except by steady invasion along continuous tissues; and there are reasons for believing that, when living as a parasite, under many of the conditions applying in case of disease, a streptothrix does not readily undergo complete sporulation, with the development of spherical spores. But, under parasitic conditions segmentation and fragmentation of the mycelium occur freely; isolated rod segments will be carried from part to part readily enough, and by the examination of sections through recently established secondary foci of infection, it has been found possible to obtain evidence microscopically of the early sprouting of branching mycelium directly from rod segments, and not from spherical spores.

The history of the Streptotrichae is further complicated by the fact that there is strong evidence that, under parasitic conditions of existence, the rod segments may be capable of reproducing themselves directly as rod segments, and thus simulating true bacilli.

It will be realized, then, how very complicated is the life-history of this group of organisms, and one may be led into many errors unless one keeps these facts constantly in mind.

I. BACTERIOLOGICAL WORK.

I have been engaged on a study of this question for several years. Prior to 1908 I had accepted the ordinary teaching that leprosy was due to an acid-fast bacillus belonging to the fission fungi. I had been getting results which, although considered useless at the moment, were producing an effect on my mind, and about the end of 1908 I became imbued with strong impressions regarding the morphology of the lepra organism. From a survey of my own results, together with a consideration of the work of Rost and Deycke, I became of opinion that leprosy was most probably caused by some species of streptothrix, and that the acid-fast bacillary masses, which were so well known, were merely phases of such a streptothrix, and that, moreover, they represented a resting and resistant stage of the organism. Since the beginning of 1909 I have grown from lepers in Persia and India apparently different organisms, which, in my own opinion, and in that also of others who have seen my work, I have been able to connect up into one organism—namely, the *Streptothrix leproides*. I have grown the following phases of the organism:

- (a) A non-acid-fast streptothrix in the mycelial stage, and producing acid-fast rods.
- (b) A non-acid-fast diphtheroid bacillus, producing also acid-fast rods. This is really a streptothrix.
- (c) An acid-fast bacillus, which is but the broken down stage of a streptothrix, and
- (d) An acid-fast mycelium.

Illustrations in colours of these micro-organisms may be seen in the number of the *Indian Medical Gazette* for May, 1911.

A. The Non-acid-fast Streptothrix in the Mycelial Stage.

This has been grown by me several times in ordinary broth media and in potato broth. From two cases I have grown (a) in ordinary media this mycelial form, and (b) in my imitation of Rost's medium and thence on to solid media the non-acid-fast diphtheroid form. Further, by subculturing the latter into ordinary media, I have changed it into the non-acid-fast mycelial form. Incubated at room temperature this non-acid-fast mycelial form appeared in eight weeks. Incubated at 37° C. growth was visible in ten days. In the first cultures, nests of acid-fast bacilli were present lying in the meshes of the mycelium. These diminished in number on subculture, and after the third subculture they were not found.

If grown on the surface of milk at 37° C. it appears in ten to fourteen days as a definite membrane which varies in colour according to the medium from which subculture was made.

If subcultured from potato broth the colour of the membrane was orange yellow, as compared with the orange

red of Deycke's organism. After about four weeks' growth some portions of it become very strongly acid-fast, and after six to eight weeks it breaks down into rods, which may be acid-fast or non-acid-fast. If injected into lepers in its non-acid-fast phase it produced no effect, whereas when a considerable amount of it had become acid-fast, then injection caused considerable reaction in lepers, producing both general effects and local manifestations in the leprosy lesions. Control injections on apparently healthy individuals pointed to the specific nature of the reaction.

B. The Non-acid-fast Diphtheroid Bacillus Phase.

For this series of experiments I used either Major Rost's original medium, or an imitation prepared for me at Parel. The medium prepared at Parel was as follows:

(a) Lemco broth without addition of salt or peptone	...	...	250 c.cm.
(b) Distilled water	...	...	250 c.cm.
(c) Milk	...	...	50 c.cm.

In Major Rost's original medium, instead of 250 c.cm. distilled water, he added 250 c.cm. of a distillate obtained by blowing steam over rotten fish. This fluid contains aniline bodies, and, in view of other results tending to show that end products of digestion such as the amino acids may have some influence on one phase of the organism, I am inclined to lay much more stress than formerly on this distillate as an important constituent of the medium.

Using this medium, then, more especially my imitation, I have now on numerous occasions succeeded in growing a non-acid-fast diphtheroid organism from cases of leprosy.

All inoculations were made from non-ulcerated lepromata, and were controlled by ordinary media. The tubes were incubated at 37° C. After seven days, roughly, a very small flocculent membrane could be made out at the bottom of the tubes. This was seen to consist of masses of lepra bacilli lying in a zoogloea substance. Extended observation showed that the basis of the membrane was a streptothrix varying as to its acid-fastness. Morphologically, then, we had at this period a mycelium producing acid-fast nests, and it is quite comparable to the similar mycelium which I have already described as having been grown in ordinary media. This membrane never became large, and, as the medium is very opaque, it could only be seen with difficulty and in certain lights. From this stage matters seemed to remain dormant for a long period. At last, after two and a half to three months' incubation, it was noticed that in some tubes non-acid-fast organisms commenced to appear among the acid-fasts. These were identical with the lepra bacilli morphologically, but differed in being non-acid-fast. This form appeared too frequently to be considered as an accidental contamination, and when growth was obtained on solid media we were confirmed in this view. It was only with great difficulty that I obtained a growth of this phase on solid media. I used for this purpose tubes of lemco-glucose-agar, without salt or peptone, and inoculated them from tubes of Rost's medium, showing a good growth. They were incubated at 37° C. After eight to ten days' incubation, it was thought that there was a suspicion of growth. This was subcultured, and eventually a very delicate growth was obtained. The single colony is small, dense in the centre, and has a wavy irregular margin. Microscopically, these growths consisted at first of acid-fast and non-acid-fast bacilli, similar to those in the Rost's medium tubes from which subculture was made. As subculture succeeded subculture the acid-fasts gradually died out, and eventually a typical growth consisted of non-acid-fast bacilli. I found it difficult to convince people that this was the lepra organism in a non-acid-fast phase. Eventually, through the kindness of Major Glen Liston, I.M.S., who supplied me with amoebae, I was able to produce a strong argument to back my statements. It was found that if this non-acid-fast diphtheroid organism were mixed with amoebae, then, at the end of about forty-eight hours, the amoebae were full of acid-fast organisms. The amoebae further had a distinct influence on the organisms which had not been ingested. Some were entirely acid-fast, and in others the dots had become acid-fast. Also, in two to three months' old pure cultures of this non-acid-fast bacillus, the dotted bacilli tended to die out, while the so-called involution forms became more numerous and in many cases distinctly acid-fast. There is no difficulty in

making out forms which show that this non-acid-fast bacillus is in reality a streptothrix.

C. An Acid-fast Bacillus Phase, which is the Broken-down Stage of a Streptothrix.

This I have grown from the non-acid-fast diphtheroid bacillus phase just referred to. This growth was obtained on several occasions by taking tubes of Rost's medium, in which there was a good growth of the acid-fast and non-acid-fast bacilli, and continuing to subculture them into Rost's medium instead of on to solid media. A time was reached when the balance between the acid-fasts and non-acid-fasts seemed to be settling in favour of the acid-fasts. The proportion of acid-fasts was for some time noted to be increasing in relation to the non-acid-fasts, and eventually I obtained a strong yellow coherent growth in the bottom of the tubes. This growth was strongly acid-fast, but by careful study the stages from the non-acid-fast diphtheroid to the acid-fast stage could be made out. At first one saw microscopically acid-fast cocci and coccobacilli. Extended observation has shown that these are merely broken-down phases of an acid-fast streptothrix. This phase now grows well on solid media, and it is very similar to one of Rost's varieties in its acid-fastness, its pleomorphism, its yellow colour on solid media, and in its power of producing severe reaction in leper patients. Generally it grows as a yellow sticky growth. It may, however, grow also as a yellow wrinkled membrane. This variation is also shown by Rost's organism.

D. The Acid-fast Mycelial Stage.

This phase I have produced from the non-acid-fast mycelium, and in conjunction with Major Liston I have grown it directly from a leper. This latter case was particularly interesting, as we found a streptothrix in the leper's spleen, from which spleen we made our inoculations. The streptothrix was lying in a blood space, and it could be seen penetrating into the pulp and ramifying amongst the masses of lepra bacilli lying in the pulp. The whole spleen was sectioned, but the streptothrix form was certainly confined to one small piece of splenic tissue. In this case growth was obtained on Dorset's egg medium. This streptothrix was extremely interesting, as it passed through respectively all the phases which I am describing. In original culture it was an acid-fast mycelium, rapidly losing its acid-fastness and breaking up into acid-fast and non-acid-fast bacilli. In subculture on ordinary agar it became a purely non-acid-fast bacillus. By putting it back into Rost's original medium it again became a beautiful acid-fast filamentous streptothrix.

Such, then, are the various organisms which I have cultivated, and at first sight it may seem difficult to believe that they are really but phases of the same organism, namely, the streptothrix of leprosy. If, however, the varied structure possible in a streptothrix be recalled, it will be admitted that it is quite possible for all these apparently different organisms to be but different phases of the same organism. The manner in which I have cultivated the different forms from the same cases of leprosy, and then again have changed the forms in subcultures, leaves no doubt in my mind that they are but phases of one organism, whatever may be the opinion as to the relationship of that organism to leprosy.

Regarding pigment formation in these growths I should like to say that pigment formation varies so much, even in the same streptothrix, when the conditions are slightly altered, as to make colour of the growth of practically no value in differentiating between these organisms.

Animal Experiments.

My animal experiments have been made with the organism in its acid-fast bacillary form. In this form, when injected subcutaneously into guinea-pigs in large doses, I have produced lesions somewhat resembling leprosy, with large numbers of coccobacilli appearing in the connective tissue cells. Moreover, Major Rost, with his organism, has produced all the clinical features of tubercular leprosy in a monkey, and in the nodules acid-fast bacilli were found, situated as in leprosy. I made a few experiments with the organism in its non-acid-fast mycelial form, but in view of the results obtained by Kedrowsky, I see that I did not allow anything like sufficient time for these experiments.

II. COMPARISON OF MY BACTERIOLOGICAL RESULTS WITH THOSE OBTAINED BY OTHER WORKERS.

I think we may take it that, with the exception of this school, the general teaching as to the causation of leprosy is still the textbook view—that is, that it is due to an acid-fast bacillus belonging to the fission fungi. Because we find the lepra organism parasitically as an acid-fast bacillus, it is not necessarily a fission fungus. A study of the Streptotricheae will show that while a disease may be caused by a streptothrix, yet the obvious parasitic form found may be a bacillus or some other broken down form. The following extract from a paper by Unna, read at the Bombay Medical Congress, 1909, is extremely interesting in connexion with the foregoing. He says:

As a matter of fact the leprosy organism includes a large and varied series of forms, which not only include the known bacilli and globi, but also others, different in morphology and staining reactions and transitional forms, which are inseparable from the growth of the leprosy bacilli in the skin. I will not enter further into the peculiar morphological shapes, coccus-like granules and granular threads (coccothrix), which were found in my laboratory by Lutz and studied more closely by me and my pupil Spengel.

Also it is important to note that there is definite evidence by Herrman and Unna to the effect that the lepra bacilli themselves are not always acid-fast. In the article on Leprosy in Allbutt and Rolleston's *System of Medicine* Dr. Abraham says:

Herrman has also shown that in young or recent nodules similar masses of bacilli exist, which do not retain the red stain after immersion in weak acid, but are easily subsequently coloured with methylene blue. If, as he supposes, it is only the older (fuchsin-stained) bacilli that are resistant to the acid treatment, we may have some explanation of the general failure to recognize leprosy bacilli in the attempted cultivations.

I will now take the organism in its varying phases, and see how the work of others fits in:

1. Non-acid-fast Streptothrix in Mycelial Formation, capable of being Converted into an Acid-fast Streptothrix.

I have grown this several times under conditions which, in my opinion, point to its being merely a phase of the *Streptothrix leproides*. It varies between being non-acid-fast and acid-fast. Similar organisms have been grown by Kedrowsky, Deycke, and Bayon. Kedrowski's results are extremely interesting. He describes the growth of cultures showing long branching filaments, like those of a streptothrix, with also short bacillary forms. They varied between being non-acid-fast and acid-fast. He notes that the non-acid-fast become acid-fast on inoculation into animals. By inoculating his streptothrix into rabbits he produced very suggestive lesions. Lesions were produced containing acid-fast bacilli very like those of leprosy. From these lesions he cultivated organisms which were similar in morphology to the bacillary forms found in the tissues, but which differed in their reaction to Ziehl-Neelsen staining. All variations were seen, from acid-fastness to non-acid-fastness. In subcultures of these organisms definite branching was observed. He concludes by saying that he thinks the lepra parasite belongs to the Streptotricheae rather than to the bacilli.

2. Non-acid-fast Diphtheroid Bacillus.

As stated previously, I have grown this many times. I have demonstrated definitely that it is capable of becoming acid-fast. I have grown it into a non-acid-fast mycelial form and into an acid-fast bacillary form. In my opinion this is at present the most interesting phase of the organism, and the one through which the largest amount of connexion can be shown between my work and that of other investigators.

If we turn to the literature of the subject we find that many workers, whose technique is beyond question, although they have failed to grow an acid-fast bacillus, have all described the growth of a non-acid-fast diphtheroid organism. Amongst those describing the growth of such an organism are Babes, Levy, Czaplowsky, Spronk, Kedrowsky, Shiga, Rost, Bannerman, and Bayon. The last named has done some most important work on this subject, and his animal experiments with his

diphtheroid organism should go far to convince the most sceptical as to the fact of there being more phases of the lepra organism than the acid-fast bacillus of the textbooks. Furthermore, Shiga describes also the presence of acid-fast bacilli among the non-acid-fast bacilli, and he proved it to be a pure culture. Agglutination tests by Shiga and Babes agree with my own, that is, that the organism is distinctly agglutinated by leprosy and healthy serums, but in about the same degree.

Babes has grown this diphtheroid many times, and according to the last reference to his work with which I am acquainted, he considered that although it was probably the lepra bacillus, yet it could not be considered seriously unless—

1. It could be grown into the acid-fast state;
2. It could produce a tuberculin-like reaction in lepers; and
3. It could produce leprosy in animals.

These conditions have now been realized. It is true that it only produces a "tuberculin-like" reaction in its acid-fast state; but that is immaterial to the argument. The animal experiments of Kedrowsky, Rost, and Bayon are very definite, and leave very little room for doubt as to the connexion of these various phases to the disease.

3. The Acid-fast Streptothrix.

As already pointed out, this may occur as a mycelium, or in broken down form as a bacillus.

In its *mycelial* form it has been grown by Deycke, by myself separately, and in conjunction with Major Glen Liston, I.M.S.

In its *bacillary* form it has been grown by Rost, Clegg, Duval, Bayon, and myself.

A typical tuberculin-like reaction has been described for this acid-fast phase by Rost, Deycke, Clegg, and myself.

A further point of interest is the fact that Rost and Deycke published their original papers about the same time, that is, Rost in 1904, and Deycke in 1905. If their papers are read carefully, and their clinical results compared, the similarity is striking.

I think, then, that Rost and Deycke both grew the organism in 1904 and 1905 respectively. Rost produced it in bacillary form, and Deycke in mycelial form. While Rost definitely claimed his organism as the leprosy bacillus, Deycke, in later papers, expressed the opinion that his streptothrix had no relationship to the leprosy bacillus.

In my opinion Major Rost is entitled to the credit of being the first to introduce a successful specific treatment for this disease, and that as far back as 1904.

So much for the organism in its individual phases. The accompanying chart illustrates the various phases of the leprosy streptothrix as they have been grown by me, and it will be seen that the work of many investigators fits into that chart. The arrows indicate that the organism towards which the arrowhead points has been grown from the leper or organism at the opposite end of the arrow. It will be noticed that in some cases the arrows are pointed at each end, indicating that the phases at each end of the arrow have been converted one into the other.

Shortly, it will be seen that the three phases—

1. Non-acid-fast mycelium,
2. Non-acid-fast diphtheroid organism,
3. Acid-fast streptothrix (bacillary or mycelial)—

have been grown separately from lepers. Then it will be seen that the non-acid-fast diphtheroid has been grown into an acid-fast phase and into a non-acid-fast mycelium,

which latter itself was further changed into an acid-fast mycelium.

I think that with this short explanation, in view of what I have already said, the chart will be understood.

III. THE APPLICATION OF THE BACTERIOLOGICAL RESULTS TO THE TREATMENT OF LEPRO PATIENTS.

The first thing I set out to determine was whether the streptothrix, used as a vaccine, could produce any reaction, of the nature of a tuberculin reaction, and, if so, to control it by similar doses of vaccine given to apparently healthy people.

It was found that the streptothrix, in its non-acid-fast form, whether mycelial or bacillary, did not produce any reaction; when, however, the organism was used in its acid-fast state, a very definite reaction was produced. The reaction in typical cases was manifested by general symptoms such as fever, malaise, etc., and by distinct reaction in the leprosy lesions. In the *Indian Medical Gazette* for May, 1911, temperature charts showing typical leprolin reactions are given, and also twelve charts of apparently healthy individuals, who received large and frequent doses of the vaccine. It will be seen that, whereas in leprosy a definite temperature reaction was produced, the injections in the apparently healthy persons produced no appreciable effect.

The reaction in leprosy varies within wide limits. It may be very slight or it may be so severe as to endanger life. With the general symptoms of reaction, the local manifestations in the leprosy lesions also vary, from a slight feeling of itching and heat in the nodules, to acute inflammation, with suppuration. Similar reactions are described by Rost, Deycke, and Clegg for their organisms.

Having obtained such results, which seemed to point to the specific nature of the organism, I proceeded to examine its therapeutic possibilities. At this point I may mention that, quite apart from the work forming the subject of this lecture, I have had considerable experience in the treatment of this disease, both with the older remedies and with the nastin treatment of Professor Deycke. During the last three years I have treated over sixty cases, for lengthy periods, by means of the nastin method, and I should like you to know that our latest results have been contrasted with those obtainable by other methods of treatment.

Prolonged investigation has shown that it is possible, with a vaccine made from the acid-fast phase of the organism, to influence the disease materially, and to cause, in many cases, marked retrogression, and even complete disappearance of the outward signs of the disease. These results confirm those obtained by Major Rost, with a vaccine made from his organism.

It is not possible here to give you much detailed information regarding the clinical results already obtained, but improvement has been observed in both nodular and anaesthetic cases.

These beneficial results have been obtained so definitely in relation to treatment, and in so many cases, that there is no question of their being accidental or due to spontaneous cure. There is no doubt that the vaccine can exercise beneficial effects on the disease, even up to complete disappearance of the clinical signs, and I have now had a few cases sufficiently long under observation to justify me in venturing the opinion that by means of vaccine methods we can prevent further exacerbations of the disease.

At present I recommend (except in very early cases) that the vaccine treatment should be adopted mainly with the idea of preventing further progress of the disease.

It is obvious that where massive lesions have been formed during several years we cannot expect very rapid improvement. In early cases, however, I think that, by a combination of vaccine therapy with surgical methods, we can cause a total disappearance of the symptoms, and, if my hopes as to the immunizing power of the vaccine are justified, we shall be able in such cases, by judicious use of the vaccine, to prevent fresh exacerbations of the disease.

I do not think it is wise at present to lay much stress on the possibility of "cure." The moment we introduce the word "cure" we are liable to be led on to various side-issues, discussion of which would tend to obscure the value of the actual results at present attainable.

However good may be the clinical results achieved in any individual case by vaccine treatment, I think it is probable that there must remain for a very long time a number of lepra bacilli capable of producing a recrudescence of the symptoms if the state of immunity be not kept up by the use of the vaccine. I draw attention to this now in order to ask medical men using the vaccine method of treatment to be satisfied so long as they are getting clinical improvement, and not to despair if they cannot get rid entirely of the "acid-fast bacillus."

Those who may use the vaccine will find that its effects seem to vary a good deal. The vaccine must not be used in any "rule of thumb" manner, but the patient and his lesions must also be considered. For instance, in a case with very definite localized tubercles it will be found by cupping that the tubercle has a very defective blood supply. It remains pallid in the midst of its engorged surroundings.

Obviously, in such a patient, the blood may be strengthened against the lepra parasite; but as the blood cannot get at the lesions the results will be poor. In such cases I have used cupping with marked benefit.

From this stage with very defective blood supply all grades of lesions may be met with up to the diffused infiltrations where the blood supply is little, if at all, interfered with. The nearer to a good blood supply, the better will be the results. The best reactions and clinical improvement will be obtained in patients in whom the lesions are "juicy." As far as my experience goes, the more "juicy" the lesions, the more definite the reaction and subsequent improvement. The old sclerosed cases may be with difficulty affected.

The vaccine is now being made at the Bombay Bacteriological Laboratory, Parel, Bombay. The dose recommended at present for routine use is about 1 c.cm. I use doses varying from 1 to 5 c.cm., but with the higher doses, in certain juicy cases, very dangerous and even fatal reactions may occur.

Briefly, then, these are the results which I have obtained, and I think that when the results are compared with those of other investigators, a case is made out for a revision of the generally accepted views as to the bacteriology and treatment of this disease.

If these views become generally accepted, then it is obvious that we must examine anew all the clinical manifestations of the disease, to determine the part played in them by the differing phases of the streptothrix. Further, when the various suggested modes of transmission of the disease are examined from this new point of view, it is possible that more tangible results will be achieved in the elucidation of this very interesting and important problem.

It would appear from the accounts presented at the annual general meeting of Livingstone College on December 5th that the year 1910-11 was hardly satisfactory from a financial point of view. In this respect its experience is on a par with that of allied bodies, for there has been a falling off, we understand, in the receipts of most missionary associations for some years past; indeed, one purpose of the World Missionary Conference at Edinburgh was to consider its causes and how they could be met. Still, Livingstone College would never find difficulty in paying its way if missionary bodies duly recognized that the elementary knowledge of medicine and hygiene it supplies was a necessary part of the education of those they dispatch to tropical countries. This, however, has hitherto not been the case; their attitude towards this enterprise has, indeed, been much less reasonable and gracious, so to speak, than that of the medical profession, which, so soon as assurance was offered that its authorities set their face strictly against old students practising medicine when within reach of properly qualified medical men, at once afforded it support. One fact in particular in the record of events of the past year is somewhat striking evidence of this circumstance: the principal of the college, Dr. Charles Harford, has, with the full approval of the medical men concerned, been appointed to hold simultaneously a post under the Church Missionary Society, which will involve his supervision of its medical missions. We note, too, that the students of the college continue to be welcomed at the Seamen's Hospital, the Poplar Hospital, and other institutions, and that several well-known medical men are assisting in their education.