two volumes, on which Lieutenant-Colonel D. G. Crawford, I.M.S., has been engaged since his retirement three years ago. The book will be published during the next few months by Messrs. Thacker and Co.

THE IMPERIAL BACTERIOLOGICAL LABORATORY, MUKTESAR, INDIA.

The description of the Imperial Bacteriological Laboratory which has been written by the Director, Major J. D. E. Holmes, M.A., D.Sc., M.R.C.V.S., C.I.E., and published by the Government of India, will be read with interest by all concerned with the study of immunity and interested in the developments of bacteriology and serum and vaccine therapy. The laboratory has been established for the investigation of the diseases of stock in India and for the preparation of those prophylactics which have been shown to be of value in the control of epidemics.

In 1890 Dr. Lingard was appointed Imperial Bacteriologist, and worked for some years at Poona. Five years later the laboratory at Muktesar was completed, and since then the development has been very rapid. Three years ago a new wing was added to the main laboratory building, and separate laboratories have been built for the work in connexion with anthrax, black quarter, and glanders. Numerous sheds for the accommodation of cattle and horses are situated near the laboratory, and there are six large out-kraals situated some two miles away. These out-kraals are for the accommodation of a reserve supply of cattle and for animals which have been used for experiments, and are being kept under observation for long periods. There are separate buildings, near the main laboratory, for the preparation of media, sterilization, centrifugalization, storage of serum, and for the accommodation of small animals. The main laboratory is a two-storied stone building, with wide verandahs along the south and west sides. The workrooms are thoroughly equipped with all necessary apparatus, and provided with gas, water, and electric light. The walls are lined with glazed tiles, and the floors laid with marble slabs.

The staff consists of three European officers—the director, an assistant bacteriologist, and a physiological chemist—three European laboratory assistants, an engineer, a farm manager, and a large number of native subordinates. The appointment of a pathologist has recently been sanctioned, and as this officer, when appointed, will visit actual outbreaks of disease, the usefulness of the laboratory will be still further extended by being brought into closer touch with field operations.

The routine work of the laboratory is concerned chiefly with the preparation of anti-rinderpest serum. In 1896 Koch visited Muktesar and demonstrated his bile method for inoculation against rinderpest. During the succeeding three years Lingard made a comprehensive study of rinderpest, and succeeded in preparing a potent anti-rinderpest serum. This was first used in field epidemics in 1899, when about 2,000 doses were issued. The use of this serum has proved of very great value in controlling the spread of infection, and that this fact has been realized by the owners of stock is shown by the popularity of the serum treatment and the rapidly increasing demands for the prophylactic. During the last official year over a million doses of anti-rinderpest serum were prepared in the laboratory and issued for use in the field. In addition to anti-rinderpest serum, a vaccine and serum for haemorrhagic septicaemia, a serum for anthrax, a vaccine for black quarter, tuberculin, and mallein, are also prepared.

The officers of the laboratory have carried out numerous investigations on the diseases of stock, and the results of these researches have been published in various reports to Government and in scientific journals in India and in Europe. Rinderpest is the most prevalent and destructive disease of stock in India, and has been the subject of much research. Lingard succeeded in preparing an efficient antiserum, and made important observations on the different degrees of susceptibility to rinderpest exhibited by different breeds of Indian cattle. The serum prepared by Lingard was satisfactory as regards potency, but was expensive to make. The rapidly increasing demand for the serum rendered its preparation in a more economic manner a matter of urgent necessity. In recent years Holmes has devoted himself to the study of this aspect of the question, and his experiments have met with

striking success. Under the old methods of serum preparation the annual maximum production of the laboratory was half a million doses. In 1910 the results of Holmes's experiments were applied to the routine preparation of serum, with the result that the output of serum from the laboratory was doubled, at the same cost as was previously necessary for half this amount. During the past year the results of other investigations have been applied, and a further reduction in the cost of production has been effected. The investigation of surra was begun by Lingard in 1890, and the results of his experiments were published in numerous reports to Government. Holmes took up the study of the subject in 1907 on his appointment as director of the laboratory, and investigated the treatment of the disease. He has discovered a method of treatment which yields 75 per cent. of recoveries.

The success of the laboratory at Muktesar must be gratifying alike to the Government of India, which has provided an up-to-date, well equipped institute for the investigation of the diseases of animals, and to the officers of the laboratory whose energies have contributed so largely to its rapid development. The difficulties which have been encountered have been considerable. Muktesar is situated on a hill in the inner Himalayas, 7,500 feet above sea level, and is so badly served in the matter of roads that transport is a matter of some difficulty. Formerly some opposition was met with from the natives with respect to the treatment of their stock, but this has now disappeared, and the use of serum is accepted to-day without opposition in most districts of India.

TROPICAL MEDICINE—A CRISIS.

BY

SIR RONALD ROSS, K.C.B., M.D., F.R.S.,

Professor of Tropical Sanitation, University of Liverpool.

THE Editor has asked me to write a short note on the Liverpool School of Tropical Medicine; and I am glad to accept, because, as a matter of fact, the moment is rather a critical one for the whole of the great movement of tropical medicine which has done so much for the Empire. This will be best understood after a perusal of the following history of the movement.

The history of its origin has not always been correctly given. The movement really commenced with the work of the old parasitologists rather than with that of the bacteriologists, and from the first was divided into two classes—first, the identification of pathogenic organisms; and, secondly, the determination of their life-history. To the first class belong the discoveries of many animal parasites, especially certain filariae, trypanosomes, spirochaetes, the malaria parasites, the leishmania, and many allied parasites of animals. But while these distinguished discoveries were of great importance in zoology and medicine, they did not directly help the sanitarian until the life-histories were worked out. This branch of the subject really commences with the discovery of *metacery*, or change of host, especially by Küchenmeister in 1851-53. A little later Leuckart extended the general law to intermediary hosts among the Arthropoda, and Fiedschenko, following his instructions, determined the life-history of *Filaria medinensis*, or the guinea-worm, in *Cyclops* (published in 1869). This work was followed by a succession of discoveries which extended the same law to many parasites, namely, the development of *Filaria bancrofti* in mosquitos by Manson (1877); the discovery of the *Piroplasma* of cattle by Smith and Kilborne, and of its carriage by ticks (1889); the similar discovery of Bruce regarding the tsetse fly disease of cattle (1894); my solution of the malaria problem (1891-99); the determination of the carriage of yellow fever by *Stegomyia* (1900); the carriage of plague by rat fleas and of relapsing fevers by ticks, and similar discoveries regarding many diseases of animals. These advances have evidently opened an entirely new chapter in the sanitation of tropical countries, inasmuch as they showed us how the most important diseases of such countries may be reduced.

I think it was especially the work of Bruce and of myself which led in 1899 to the foundation of the two schools of tropical medicine in Liverpool and London.

Mr. Chamberlain then issued a circular suggesting that this study might be taken up at the principal British ports. It is important to note that in other countries the whole of the movement would have been paid for by Government, as, for example, was the case in regard to the Tropical School of Hamburg; but Mr. Chamberlain's scheme suggested that the English schools should be paid for chiefly from private contributions. The Liverpool School was started in accordance with this idea, chiefly by the late Sir Rubert Boyce, the late Sir Alfred Jones, and the African merchants of Liverpool; and the London School had a similar origin under the influence of Manson and Mr. Chamberlain himself.

I was appointed the chief lecturer of the Liverpool School at its commencement in 1899. It was evident that we had a great campaign before us; and my first effort was to organize an expedition to Freetown, Sierra Leone, for the purpose of attempting to apply my researches on malaria to the actual prevention of the disease by the method of mosquito reduction, which I had already carefully considered in India. The BRITISH MEDICAL JOURNAL gave me from the first the fullest support both in my previous work and in this difficult new departure; and readers who are interested in the subject are referred especially to the series of articles which will be found in it in the numbers for February 1st, 1896; March, 1896; January 30th, 1897; December 18th, 1897; February 26th, 1898; June 18th, 1898; September 24th, 1898; July 1st, 1899. The work at Sierra Leone was fully described by me (anonymously, by previous arrangement) in the BRITISH MEDICAL JOURNAL for September 4th, 16th, 30th, and October 14th, 1899.

The methods which I then laid down have formed the basis of all similar work since then; but, obvious as they were, they received little credence at the time. The discovery of the carriage of yellow fever by *Stegomyia* in 1900, however, started the Americans upon the same lines of sanitation. In the next year Dr. Logan Taylor and myself gave an object lesson on the method in Freetown; and the Liverpool School thereafter sent out a long succession of expeditions to various parts of the world, chiefly to West Africa. These, with the practical sanitary work of Sir William MacGregor and Dr. Strachan in Lagos, the researches of Stephens and Christophers in India and West Africa, the riddance of malaria from Ismailia by my method in 1902, the important investigations of Koch, the discovery of human trypanosomes by Forde and Dutton, and the researches of Bruce, Theobald, Leishman, Donovan, Rogers, Bentley, and many others, threw the light of science into the dark corners of disease in many parts of the tropical world. In all this work I think that we of Liverpool can claim that our expeditions took a leading part, although we were backed merely by the voluntary contributions of a single city.

Another part of the work done was to found permanent centres for teaching the new discoveries, which, of course, meant the endowment or payment of teachers, the provision of buildings, the collection of museums, the publication of special journals, and the maintenance of experts to advise on Government committees. With regard to the teaching of students, it was always apparent that in Liverpool we could never hope for as many students as our friendly rival, the London School, could obtain, and therefore we made expeditions and research our principal line of effort. Nevertheless, Liverpool laid down funds for a permanent institution on the lines indicated above, and this with much less support from Governments than the London School has received. Two endowed chairs have been provided, and a third temporary professorship is arranged for, besides a number of junior posts. A permanent laboratory has long been in existence at Runcorn, near Liverpool. Our *Annals of Tropical Medicine and Parasitology* have been published since 1907, and we have sent out something like thirty expeditions to various parts of the world. Needless to say, as I am writing only of the Liverpool School, I do not refer here to the distinguished labours in the same cause of the officers of the Indian, Naval and Army Medical Services, or the London School, the universities of Cambridge and London, and of numbers of foreign workers. The school has now reached a very high stage of efficiency. Highly qualified teachers and investigators are employed; the recent bequest of Sir Alfred Jones is being used for making very fine new

laboratories and a new hospital building, and also, I believe, another research institute in the tropics. At one period we were employing about twenty-five teachers and research workers at once. The Secretary (Mr. A. H. Milne, C.M.G.) informs me that he has collected altogether about £140,000 (of which only about £10,000 have been given by British Governments), but, of course, nearly all this has gone in current expenses and in endowments and buildings. We have also taught a large number of students from various parts of the world; in fact, as many as our present laboratory holds and as our teachers feel justified in undertaking. Our staff now consists of Professor Stephens (tropical medicine), Professor Newstead (entomology), Dr. Fantham (parasitology), Dr. Seidelin (yellow fever), Mr. Carter (entomology), Mr. Stott (statistician), Mr. Drawz (bibliography), besides Drs. Yorke and Blacklock at Runcorn, Dr. Wolferstan Thomas at Manaos, and Drs. Prout, Blood, and Hope (honorary lecturers), and the associated medical staff of the Royal Southern Hospital in Liverpool, and myself (malaria and tropical sanitation). The chairman is Mr. F. C. Danson, J.P.

Summed up, the work of the school has been of great imperial significance. At the time we started, our administrators in the tropics were certainly not keen either upon sanitation or upon medical science. Doctors were generally called "pills," were supposed to know all about the cure of disease by intuition, and were allowed little or no power, even in connexion with sanitation. Frankly, from my experiences of tropical sanitation since 1881, this was in a shockingly bad state. Scarcely any intelligent attempt was made to deal with the great problems regarding the housing of the poor, conservancy, drainage, and water supply. Tropical towns were chiefly collections of slums with an enormous death-rate. Little or no investigation was being done except by a few individuals (at their own expense). When we ventured to express an opinion on sanitary matters we were told to mind our own business, and the same spirit has not entirely died out even yet. But the principal power for good of a school such as ours, practically independent of Government, and consisting of a non-official medical staff, has lain in its capacity for boldly drawing attention to these defects. We have not hesitated to speak out on these matters, and the experience given to us by our expeditions has fully justified us in doing so. The result has certainly been an immense amelioration, as witness the action of the African Committee of the Colonial Office, and the scientific and other committees of the Indian Government. The total amelioration in the public health of many parts of our dominions has been testified to in many reports, by the Secretaries of State for the Colonies, and by the public at large, and the saving to all branches of Government in the cost of death, sickness, and invaliding must be very considerable.

Nevertheless, I am of opinion that the original enthusiasm for the cause is now ceasing, chiefly for the simple economical reason that no attempt is made to give adequate remuneration to the men who have done such exceptional service to the Empire. For years they have accepted for their work payment which is much below what ordinarily successful clinicians can obtain. The highest salary paid in either of the schools during the fifteen years of their existence has been £800 a year, without pension or share of students' fees, and that only for three years. The highest salaries now paid are £600 a year without fees, but with a possible small pension at sixty-five years of age. Many of the expeditions have been carried out for little more than the payment of current expenses. Numbers of the lecturers and other officials receive nothing or next to nothing, and the payment of the junior posts no longer tempts the best men. And this is for a movement which has probably done, and will do, more for our Empire and the tropics than the work of any number of our highly paid and pensioned "proconsuls" put together! But then we are only "pills"!

The fault does not lie with the subscribers to the schools, who, after all, were not obliged to give anything. They have, however, subscribed over a quarter of a million sterling, which, but for their generosity, should have come out of the revenues of the Colonies and the British Exchequer, just as the costs of the Army and Naval Medical Schools do. The committees which

administer these public subscriptions naturally say that the money is given for maintenance at market values, and not for pensions and rewards. Thus the workers, who have actually been doing Government work of high importance for years, find themselves debarred from any adequate remuneration; while, on the other hand, the Colonies and the wealthy British Empire have done a good stroke of business by obtaining their professional services for next to nothing, at the expense partly of private donors, but chiefly of the workers themselves! I venture to maintain, therefore, that the time has now come when the State should begin to see this matter in a true light, and should pay for its "medical benefit"; and I hope that the medical profession will interest itself in seeing that the obligation is not lost sight of.

LONDON SCHOOL OF TROPICAL MEDICINE.

The Conception.

IN an introductory address delivered at St. George's Hospital in 1897, and reported in the *BRITISH MEDICAL JOURNAL* of October 9th of that year, p. 985, Dr. (now Sir) Patrick Manson dwelt on the necessity for special education in tropical medicine. It may seem strange that in a country which had been founding colonies in tropical regions for more than three centuries, the problem of the diseases peculiar to hot countries should not have forced itself long before on the attention of those in power. It must be remembered, however, that till the mid-Victorian period medical education of any kind was very fragmentary and inadequate. The requirements of the licensing bodies were so meagre that the description given by Albert Smith in the *Physiology of the London Medical Student* of the process of passing the "College and Hall" is hardly a caricature. Nor were the demands of other bodies in the United Kingdom or of the Universities—with the brilliant exception of that of London—much more exacting. Books had indeed been written on tropical diseases, but they were few and appealed only to a limited number of readers. One cannot help wondering, however, that at least in India, where there had long been a well-organized medical service, nothing in the way of systematic instruction in the diseases peculiar to that country had been attempted. It was still true less than twenty years ago that doctors went to the colonies knowing little or nothing of the special diseases they would have to deal with, and had to gain their experience at a terrible cost of human suffering and a needless sacrifice of life.

In his address Manson preached a new gospel which, at first received with ridicule and indifference, seemed to have fallen among thorns. Some of it, however, fell on good soil, and gradually it bore fruit in the minds of men far-seeing enough to perceive how closely a knowledge of tropical medicine and hygiene was bound up with the welfare of our colonial empire. Manson indicated the reason why till then so little had been done in supplying instruction in tropical pathology. He said:

Candidates for medical degrees know very well that they will not be asked any questions about tropical disease by their examiners, and so they have not demanded instruction in this subject. And the reason why questions are rarely put on tropical medicine is that the leaders of the profession—those who man our hospitals, who fill the teaching chairs, who examine for degrees, who grant licences to practise, who make the regulations for the education of the youth of the profession—are, in almost every instance, men who have never practised in warm countries and who themselves have never felt the necessity for a wider and more practical knowledge of the diseases peculiar to these climates. Not having themselves felt the want, they have been slow to acknowledge that such a want exists, slower still to apply the remedy.

But ask those who are best qualified to express an opinion on this subject. Ask the medical men who have themselves felt the responsibilities of practice in the tropics, and more especially those of them who have endeavoured to follow recent developments in tropical pathology. Ask them if they do not think that the medical man who goes out to battle with tropical disease should have some special instruction and training for the very special and responsible work he has before him, and if they do not think that the medical authorities should take care that the men who do so go out to practise should be properly qualified so far as teaching can qualify. I am sure of their answer. Unfortunately, most of the men of tropical experience live and practise away from the great medical centres. They are hardly represented on the medical teaching,

graduating, or legislating bodies, and so it comes that their opinions do not make themselves felt and that a much-needed reform is delayed.

Manson went on to say that the course of instruction in general medicine usually received in this country was utterly inadequate to qualify for tropical practice. He said so emphatically, basing his assertion on his own experience, his own mistakes, and what he had seen and still daily saw of the mistakes of others. He quoted Dr. Andrew Davidson as urging that lectures on the hygiene and diseases of warm climates should be instituted in each medical school. He added that St. George's Hospital had done its share to encourage this necessary reform in medical teaching, and that other medical schools were following its lead.

It soon became clear, however, that something more than lectureships, which were not likely to attract many, would be utterly insufficient for the purpose in view. Fortunately Manson had the ear of Mr. Joseph Chamberlain, then Secretary of State for the Colonies. In Mr. Chamberlain he found a statesman who could appreciate his scheme and who saw the enormous benefits it would confer on the Colonies. The story is so clearly told in a circular addressed by Mr. Chamberlain to the Governors of all Colonies, on May 28th, 1903, that a summary of that document will be sufficient for our purpose.

Action of Mr. Joseph Chamberlain.

In that circular Mr. Chamberlain, after summarizing the steps that had been taken, and the results which had followed suggestions made by him in previous dispatches on medical and sanitary subjects, more especially in connexion with the investigation of malaria and the training of medical officers in the treatment and prevention of tropical diseases, went on to say:

2. The great mortality among Europeans in such climates as those of the West African Colonies and Protectorates had not failed to attract my notice from the first as it had that of my predecessors in office, and towards the end of the year 1897, largely through the interest taken in the matter by Dr. Manson, who had succeeded Sir Charles Gage-Brown as medical adviser of the Colonial Office, my attention was more definitely directed to the importance of scientific inquiry into the causes of malaria, and of special education in tropical medicine for the medical officers of the Crown Colonies.

3. In pursuance of the second of these two objects, it was clearly advisable (a) that a special training school in tropical medicine should be established, where officers, newly appointed to the medical services of the Colonies and Protectorates, might be given systematic instruction with special facilities for clinical study, before leaving England to take up their appointments, and where doctors already in the service might, when on leave, have opportunities of bringing their professional knowledge up to date; (b) that all the leading medical schools in the United Kingdom should be invited to give greater prominence than hitherto in their schemes of study to tropical medicine; (c) that the medical reports periodically sent from the tropical Colonies and Protectorates should be recast on one uniform type, designed to throw light on the diseases which are most prevalent in tropical countries, and to indicate the methods likely to be most successful in preventing or curing such diseases.

4. With reference to the first of these three objects—the provision of a special training school—it was considered that the Albert Dock Branch of the Seamen's Hospital, which was about to be enlarged, was likely to offer the facilities required, standing as it does at the dock gates, admitting sufferers from tropical diseases direct from ships from all parts of the world, and being moreover within easy reach of the Colonial Office, and therefore likely to be in close touch with that office. These considerations decided me to approach the managers of this hospital in preference to endeavouring to make whatever arrangements might be possible for attaining the object in view, at the Royal Naval Hospital at Haslar or the Royal Victoria Hospital for soldiers at Netley, at which latter hospital officers of the Indian Medical Service receive instruction in tropical diseases.

Negotiations.

On February 2nd, 1898, Mr. Chamberlain wrote to the Secretary of the Seamen's Hospital Society asking whether, in the enlargement of its Branch Hospital at the Albert Docks, it might not be possible to provide accommodation for the contemplated tropical school. He added that it was not probable that more than six officers would be under instruction at any one time, and that the course would last for three or four months. The

¹ Colonies: Miscellaneous. Papers relating to the Investigation of Malaria and other Tropical Diseases and the Establishment of Schools of Tropical Medicine. Presented to both Houses of Parliament by command of His Majesty, June, 1903.