TROPICAL MEDICINE IN THE BRITISH EMPIRE

SUGGESTIONS FOR THE FUTURE

By SIR PHILIP MANSON-BAHR, C.M.G.

IN an article in *Nature* of March 16 an attempt was made to outline the present position of this important branch of medicine and research, especially as regards teaching in London. There is general agreement that the identity of the School of Tropical Medicine created by Manson's genius should be preserved and its activities and usefulness in the tropical sphere expanded. No longer can there be any question of a survival, but rather of a bid for supremacy in a field of science which has become the nation's birthright. Recently it has become abundantly clear that, if some practical steps are not taken to maintain our lead in tropical medicine, it may soon be overtaken by the United States, where eager and virile minds are contemplating this subject, stimulated or even enriched by hard-won experiences and researches in many tropical lands during the agonies of a world war. Collaboration, not competition, should now be the watchword in formulating plans for the future.

The prime difficulty of provision of adequate facilities for sufferers from tropical diseases contracted during military service, as the result of exposure to untold hardships in prisoner-of-war or civilian internments camps, has been countered. During the autumn of 1945 the position appeared to be singularly unpropitious, and voices were heard sounding notes of alarm. What accommodation had been provided for the thousands who would shortly be cast upon us riddled with all forms of tropical disease? These fears proved to be to some extent unfounded, for, such are the miraculous recuperative powers of the human frame that, within three months of the internees' release, the vast majority had been restored to pristine health. The stigmata of pellagra, hunger oedema and beriberi had been removed by a generous, nourishing diet and vitamins. Many have actually doubled their starvation weight. Sound flesh and muscle once more clothed the protruding bones and a ruddy countenance had replaced the sallow sunken cheeks. Only a small minority were found to be suffering from residual infections with malaria, amoebic dysentery and worm infestations originally contracted in the Far East. One of the graver diseases, sprue, which so commonly affects Europeans in these regions and which has played so notable a part among soldiers and airmen in India and Burma, has been conspicuous by its absence among these internees. The reason for this singular exception is by no means clear.

Although the difficulties of the present economic situation have been considerable, the Board of the Seamen's Hospital Society has now provided accommodation for sufferers from tropical diseases in the new Hospital for Tropical Diseases in Devonshire Street, London, in addition to wards in the Albert Dock Hospital. The official statement of a long-term policy for a well-equipped institution in the university quarter of London has done much to allay anxiety for the future. Therefore there no longer exists any genuine justification for the statement that provision for tropical patients is lacking in London. As regards clinical teaching the position has

also improved in a manner that was scarcely thought possible. Necessity still remains the mother of improvisation, and a solution of our difficulties has been found in wholehearted and widespread collaboration.

As there exists at present an abundance of tropical patients, scattered in many directions, a scheme for clinical instruction has been evolved which embraces several institutions including the Ministry of Pensions Hospital and the hospitals of the Seamen's Hospital Society, while by permission of the military authorities clinical demonstrations have also been given at Millbank Hospital, London. This privilege, which marks a new departure, has been particularly appreciated. There are undoubtedly solid advantages in the plan outlined above—advantages which are mutual—and it is clear that this system of collaboration in clinical instruction is one which can be profitably pursued so as to provide an abundance of clinical material for teaching and research which should suffice for several years to come. One practical and much-appreciated outcome of this arrangement is that it secures a wide selection of cases, while the students receive instruction from a panel of clinical teachers with varied and independent points of view.

In order to provide opportunities for recondit research, which can best be carried out in a great medical centre such as London, there can never be a plethora of patients, so all available channels must be drained in order to maintain a constant and adequate supply, especially from the dock area of London. It is to be hoped that whenever the ultimate scheme for an organised central institution comes to full fruition, this important axiom may not be overlooked.

The close association of chemotherapeutic laboratories with tropical medicine is a necessary corollary. Such fundamental therapeutic advances as are being made can be only further developed if this liaison is maintained. We have already witnessed the success which has attended this particular kind of co-operation in the discovery and exploitation of antimalarial drugs in Germany, where the I.G. Laboratories at Elberfeld were linked with the staff of the Tropical School in Hamburg. The preliminary trials on human malaria patients were carried out in the wards of the Tropical Hospital and thereafter field trials were conducted on an extended scale in various tropical centres. This same method has been practised during the past year by Imperial Chemical Industries in Manchester, where the newly discovered drug for malaria, 'Paludrine', has been synthesized by a brilliant team of chemists. After a series of exhaustive laboratory tests on chickens infected with *Plasmodium gallinaceum*, its adaptation to man was explored on malarial patients in the hospitals attached to the Liverpool School of Tropical Medicine. The knowledge obtained by these preliminary tests is now being amplified by field trials. Therefore, it is self-evident that the closer and more intimate the connexion, both in an academic and geographical sense, between the clinical division of a tropical school and chemotherapeutic laboratories, the more successful will be the outcome of this collaboration.

There are several tropical diseases, in addition to malaria, for which a search for specific remedies is desirable. A striking example is amoebiasis. As is well known, some of the amoebic infections contracted during war service in the Middle and Far East have shown themselves particularly resistant to the well-established remedies, such as emetine and its compounds; but now that it has been found

possible to reproduce this disease in rats, it is confidently hoped that still more efficient remedies may soon be discovered.

Then there are other parasitic diseases, as for example bilharziasis, trypanosomiasis and leishmaniasis, all of which can be maintained in laboratory animals, in the treatment of which, though we already possess powerful specific drugs, further improvements may be reasonably expected. For filariasis, which is so widespread in the tropics, we possess at present no efficient antidote. The more important species of filaria (*Wuchereria bancrofti*) produces particularly loathsome, crippling effects, while the West African parasite (*Loa loa*) also leads to disagreeable disabilities. It is particularly dangerous to experiment with powerful drugs on human filarial patients for obvious reasons, so that it is necessary to have recourse to analogous or closely related parasites in animals. Fortunately such a filarial infection has been found in the cotton rat (*Sigmodon hispidus*). This is a rodent suitable for laboratory purposes. Its filarial parasite, *Litomosoides carinii*, can be utilized in tests with various antimonial preparations. This development has brought discovery of a remedy for human filariasis within the bounds of possibility.

Contemplation of this line of thought brings us to a jejune subject to which the attention of tropical workers is invited. By this is indicated the desirability of creating some central institution, or depot, for the maintenance of strains of tropical parasites and their intermediary hosts to provide material for vital work of this nature. Such a centre could be envisaged as a miniature zoological garden situated in some rural district on the outskirts of London and within easy reach of the main central research institutions. It should be equipped with the necessary hot-houses, animal houses, stables and laboratories where these lowly creatures can be tended and propagated in order to supply specimens both for teaching and research. It should be comparatively simple to design tanks and aquaria for the breeding of various freshwater molluscs which serve as hosts for pathogenic trematodes, especially those of the bilharzia group, and in these modern days of organised aerial transport it should not be a difficult matter to secure the regular dispatch of freshwater molluscs from Egypt and the Middle East to such a depot. If this could be organised on a sufficiently large scale, students of the tropical schools could then be afforded more efficient and practical instruction than can be obtained from diagrams or text-book illustrations, while abundant opportunities would be provided for testing out chemical compounds suitable for the eradication of bilharziasis in Egypt and other countries where this disease constitutes a constant menace to the inhabitants. From the Far East it should also be possible to procure snails of the genus *Oncomelania*, the intermediary of *Bilharzia japonica*, a parasite which causes untold misery in China and adjacent countries. This species of bilharzia is particularly suitable for laboratory purposes as it commonly infests domestic animals and can be maintained in cats and dogs.

Other trematodes of medical importance are also found in wild and domestic animals in Nature. Such are *Clonorchis sinensis*, the Chinese fluke, and *Paragonimus*, the long fluke, both of which could be propagated in such a depot.

There is also no valid reason why cestodes, especially the *Diphyllobothriidae*, which afford such a

valuable demonstration of helminthic evolution, should not also be considered in such a scheme.

Among nematodes, the guinea-worm, *Dracunculus*, in addition to man, also parasitizes dogs, monkeys and raccoons. It undergoes a most interesting development in the water-flea, *Cyclops*, a crustacean which can be reared in the laboratory. This is an important parasite, as the present methods of prevention and of cure of this infection are not by any means satisfactory.

The list of suitable pathogens, of which a mere outline has been given, could be greatly expanded if the imagination is permitted to run riot on this theme. The breeding and maintenance of the many tropical insects—mosquitoes, midges and flies—is a highly technical subject and necessitates the construction of elaborate insectaria which require constant care and attention. Most institutions vitally interested in this speciality find this a heavy, and some an intolerable, burden. They would welcome the organisation of a specialized centre whence stocks could be replenished and new strains secured from time to time. Should such a depot for living parasites and their hosts prove acceptable to teachers and research workers in Great Britain, a start would have to be made on a modest scale and progress secured by practical experience.

In order to explore the ground it would undoubtedly be desirable for one or more enthusiasts to visit medical centres in Africa and the Far East with the object of organising a chain of collaborators able and willing to collect and dispatch consignments from time to time. For this purpose it would be necessary to construct tanks and containers for the transport of these various creatures, and a good deal is already known about the methods which should best be employed.

In this short article the possibilities of such a scheme can be merely outlined and it would depend upon the measure of support such a proposition gains before details could be more minutely considered.

Another manifest defect in our system of teaching at the present time is to be found in the scarcity of pathological specimens of tropical interest for demonstration and museum purposes. The pathological exhibits of the London School of Hygiene and Tropical Medicine and the series collected during the First World War at the Royal College of Surgeons have been destroyed by enemy action. Although the fine tropical section of the Wellcome Museum is now being reorganised, it is evident that many specimens are missing, while many others should be replaced. Here is another avenue to which our energies could well be directed. Past experience has shown that it is necessary for the preparation and preservation of pathological specimens for museum purposes that intimate personal contact must be secured with pathologist and laboratory workers in the tropics.

The pathological laboratories and mortuaries of the great tropical centres, such as Colombo, Rangoon, Singapore, Shanghai and Hong Kong, are replete with such material, a great deal of it of outstanding pathological interest, which from lack of suitable containers, trained staff and preserving fluids has to be destroyed. It is eminently desirable, nay essential, for the tropical schools in Great Britain to collaborate in the dispatch of an expedition to visit many of these centres, provided with the necessary reagents and containers for preserving pathological specimens.

This theme is not the vapourings of a visionary, but the outcome of practical necessity. That over-worked doctors in the tropics, encumbered by so many practical difficulties and shortcomings, should collect and preserve specimens destined for institutions with which they themselves are not directly connected is to expect too much. We must now be prepared to exert our personal endeavours to obtain what is so essential for the teaching of tropical medicine. The harvest is indeed plentiful, but the labourers are few in the present disorganised state of the world. This is especially true of those Eastern countries recently released from the stringencies of war. Their medical services are now being rapidly reorganised and progress is becoming apparent. It should therefore be possible to put some of the suggestions outlined in this article into operation within the near future.

RADIO METEOROLOGY: INFLUENCE OF THE ATMOSPHERE ON THE PROPAGATION OF ULTRA-SHORT RADIO WAVES

WITH the introduction of radio waves a few metres in wave-length in the years before the Second World War, and of centimetric waves during the War, entirely new meteorological effects on propagation have come to light. The first of these is the variable, non-rectilinear propagation of metric and centimetric waves through the lower atmosphere, the range of such waves over the earth's surface often far exceeding the geometrical horizon of the transmitter. Ionospheric reflexion plays no part in this propagation, for in the wave-lengths concerned penetration of the ionosphere is almost or quite complete. The second major phenomenon is the strong reflexion and attenuation of the shorter of these waves by suspended water drops or snow crystals when present in sufficient density in or beneath a cloud. Much of the knowledge acquired on these phenomena during the War was described and discussed at a joint conference of the Royal Meteorological Society and the Physical Society held at the Royal Institution on April 8.

An introductory survey of the radio-meteorological field was made by Sir Edward Appleton. He recounted the history of the experimental and theoretical work from the pre-war results of England, Crawford and Mumford using 4 m. and 2 m. waves in the United States over land and sea to the later war-time results of the Services on centimetric radar sets. With cloudy weather and strong winds the range of a radio or radar transmitter over the earth's surface is a little more than the distance of the geometrical horizon of the transmitter aerial; but in certain other types of weather the range may be many times this value and occasionally it may be slightly less, the effect of the weather being in general greater the shorter the wave-length. Thus in July 1941, a 10 cm. radar set on the south coast of England was 'seeing' 170 miles across the Channel for several days on end in warm, settled weather, though the geometrical horizon was less than 40 miles. More striking is the performance of a 1.5-m. radar set near Bombay at a height of 80 m. above sea-level; during the monsoon season it was able to plot ships up to the expected range of 20 miles; during the hot season, however, it commonly reached shipping at 200 miles, once

attained 700 miles, and not infrequently saw the coast of Arabia at 1,000–1,500 miles. Note that both examples refer to propagation over the sea, where the meteorological effects tend to be most pronounced. How are such observations, by no means unusual, to be correlated quantitatively with the meteorological conditions?

If the atmosphere were absent the propagation of radio waves would be rectilinear and, small effects of diffraction apart, no signal would be received beneath the geometrical horizon of the transmitter. The atmosphere being present, a ray inclined to the vertical will be bent downwards if the refractive index of the air decreases with height, and conversely, downward bending producing an increased range and upward bending a shorter range along the curved surface of the earth. Such upward and downward bending has long been known for light rays, producing the so-called inferior and superior mirage respectively. But optical mirage is usually rather slight whereas radio mirage, particularly of the superior type, is quite common and, as the above examples show, large in amount as measured in range. The reason for the difference is the much greater refracting power of water vapour for radio waves than for light waves. The change in ϕ , the inclination of a ray to the earth's surface, with distance s along the surface is given by

$$\frac{d\phi}{ds} = \frac{1}{R} + \frac{1}{\mu} \frac{d\mu}{dh},$$

where h is the height of the ray above ground, R the earth's radius and μ the refractive index of the air. Since μ is almost unity, this may be written

$$\frac{d\phi}{ds} = \frac{1}{R} - \alpha,$$

where $\alpha = -d\mu/dh$ is the lapse-rate of refractive index. Now in the study of ray paths, it is convenient to regard the earth as flat, and the quantity $d\phi/ds$ is then the curvature of the ray relative to the earth's surface. In the absence of an atmosphere ($\alpha = 0$) the relative curvature is $1/R$, and with the atmosphere present $1/R - \alpha$ ($= 1/R'$ say). The vertical gradient of refractive index is usually negative (α positive) so that R' , the effective radius of the earth, is usually greater than R . If α reaches the critical value of 0.15×10^{-6} per metre, R' becomes infinite and the earth effectively flat, while for greater values of α than this R' becomes negative, the earth effectively concave, and radio vision around the curvature of the earth becomes possible. In a well-mixed atmosphere α is positive but less than the critical value, with R' equal to about $\frac{2}{3} R$. Such a value of R' implies a measure of downward bending, while a condition of super-refraction is said to exist if R' is greater than $\frac{2}{3} R$.

The gradient of refractive index is determined by the gradient of density of dry air (in terms of observables, of pressure and temperature) and of the associated water vapour. Pressure decreases with height at an almost constant rate near the earth's surface and contributes therefore a more or less constant positive amount to the lapse of density and therefore to α , namely, $0.03 \times 10^{-6} \text{ m}^{-1}$. If now the temperature decreases with height (lapse of temperature) the air density and therefore the refractive index fall off with height less rapidly than in an isothermal atmosphere, whereas if the temperature increases with height (inversion of temperature) the lapse of density and of refractive index is enhanced above isothermal