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THE CHALLENGE OF TROPICAL MEDICINE

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Introduction

First I wish to express my appreciation, especially to you, Dr. Wilson, for being invited to deliver this address. My object today is to indicate the extent to which tropical medicine is indebted to the Army. That the debt is considerable is generally appreciated, for who has not heard of the achievements of Ross or Bruce or Leishman? Tropical medicine can be said to concern itself with diseases confined to the tropics and subtropics, as well as with diseases which are more prevalent, or exhibit special features, in those areas (Napier, 1946). Although but a single aspect of general medicine, its place in world health and mortality is sufficiently prominent to justify it as a subject meriting special study by those living or serving in those distant parts of the globe. It is not inappropriate to mention that, as a result of air-travel, many tropical diseases are encountered nowadays in temperate climates. In this field the disciplines of medicine and clinical pathology are inseparable, and a knowledge of medical entomology is likewise useful. In the Army we regard military medicine as being very closely associated with tropical medicine, and until a medical officer has mastered these related sciences he cannot efficiently maintain health discipline and preserve fitness in the units under his care.

Interest in the potentialities of military medicine was awakened when William Campbell McLean, a retired surgeon-general of the Indian Army, was appointed its first professor at the Army Medical School in 1860. With a wide first-hand experience of tropical countries he placed his unique knowledge at the disposal of medical officers for twenty-six years.

Research in tropical medicine is encouraged by war conditions, although most of the great discoveries in this sphere have been made in peacetime and as far as the British Army is concerned most of the great epidemic diseases were already under control before World War I began. During his service abroad, the military doctor has special opportunities for recognizing and treating tropical illness and is encouraged to learn the relevant preventive measures. That the field of tropical medicine has been conscientiously tilled and that a rich harvest has been reaped by the Army is indubitable.

I propose to restrict my remarks to developments initiated by medical officers of the British, Indian and Australian Armies, in each of which practical contributions have been made to the improvement of world health and the relief of human suffering.
The Indian Medical Service

The medical services of India followed the fortunes of the East India Company from its inception in 1600 until the Indian Medical Service was disbanded in 1947. Initially provided for servicing ships trading with the East, by 1714 it was found possible to establish a regular medical service on shore for each of the three great Presidencies of India: Madras, Bombay and Calcutta (Crawford, 1914). The experience gained by its officers, a number of whom later found employment outside the practice of medicine, makes an interesting story in itself. However, time does not permit me to follow the vicissitudes of the service or to mention by name all of the happy band of adventurers who left their impress on medicine in the vast sub-continent.

In 1858 the Crown took over the Government of India and soon a number of medical schools were founded. Appropriately enough, suitable Service doctors were appointed to fill many of the Chairs, with unique opportunities for teaching and research. The three existing medical establishments were amalgamated in 1896 into the well-known Indian Medical Service; although primarily a military body, established to provide a reserve of officers for duty with Indian Army units, it also afforded opportunities for wide experience on the civil side (McDonald, 1950). On the transfer of power to the two Dominions of India and Pakistan in 1947, this Service ceased to exist. In the sphere of public health and medical education in India their efforts were remarkably fruitful. However, I am concerned here only with problems of medical research and with some representative investigators who possessed the genius and industry to unravel those problems.

In India, organized medical research began in 1894 when plans were made to establish a series of Institutes, the first of which, opened at Kasauli in 1900, became the Central Research Institute six years later. As these Institutes expanded, individual laboratories gradually became identified with particular projects. For example, work at Coonoor in Southern India was confined almost entirely to problems of nutrition. The Calcutta School of Tropical Medicine, with its associated Research Hospital, was established in 1921 and a Central Malaria Institute in Kasauli five years later. As these facilities developed, competent investigators set to work to solve the more urgent problems, and in doing so added lustre to the record of military medicine.

Malaria

Malaria has always represented the major health problem in India, responsible for more ill-health and mortality than any other single cause. It is therefore not surprising that in respect of malaria research the record of achievement of the Indian Army is a splendid one.

In 1880 Alphonse Laveran, a young French Army doctor, first described the malarial parasite, a finding which interested Patrick Manson, who had spent many years in China, where he revealed how the embryos in the blood of patients with filaria were spread by the Culex mosquito. In London in 1894 Manson suggested to his pupil Ronald Ross of the Indian Medical Service that malaria was probably transmitted to man by the mosquito in much the same way as filaria. Ross returned to India determined to prove this one way or the other, and in Secunderabad, on 20th August, 1897, after prolonged and painstaking research, he was able to demonstrate that a female Anopheles mosquito had become infected from a patient with malaria.
The following year, working in Calcutta with a species of bird malaria, he was able to show the complete cycle of the parasite and to prove that bites of infected mosquitoes communicated the disease to man. His work, culminating in the award of the Nobel Prize in 1902, rightly enjoys pride of place in the history of tropical medicine (Scott, 1942). Many other research workers helped to solve the problems of malaria, but today we are concerned with Army contributors only. S. P. James, who had already published in 1904 a classical key to the *Anopheles* of India, founded in England for the Ministry of Health the first malaria therapy centre. In 1931 he postulated that sporozites, the infective bodies inoculated by the mosquito when it bites, might enter the reticulo-endothelial cells of the liver and blood-vessels and undergo further development there. His opinion was that this could be the nidus from which the better-known forms of malarial parasite are poured into the blood-stream, and possibly explaining the variable incubation period. By means of valuable experimental work James and his collaborators brought the problem so much nearer solution.

Until World War II quinine was the only drug regularly prescribed in the tropics to prevent or reduce the effects of malaria. For many years it had been taken for this purpose, especially in West Africa and Assam, sometimes with dire effects similar to blackwater fever. As the war developed in the Far East it was soon appreciated that not only was malaria a major menace to our forces but that existing measures to protect the soldier against it were insufficient. Furthermore, for a number of reasons quinine was likely to be in short supply. At this stage of the war the Army medical authorities recommended that one tablet of mepacrine be taken daily by each soldier exposed to malaria. When the incidence of the disease did not fall as anticipated, Hamilton Fairley and his co-workers arranged to conduct a series of urgent experiments at Cairns in Queensland, Australia, subsequently proving beyond doubt that by taking this dose of mepacrine regularly the soldier could not possibly develop symptoms of malaria, no matter how many times he had been bitten by infective mosquitoes. With this information it was soon possible to mount a successful attack on the disease on behalf of all troops committed to the highly malarious jungles of Burma and New Guinea. Army policy changed, the responsibility for taking the antimalaria drug becoming that of the individual commander, officer and soldier, with the result that the incidence of malaria fell to negligible proportions—beyond doubt a major factor in bringing the war in the Far East to a successful conclusion.

In 1948, first employing monkeys and then human volunteers, Henry Shortt and his colleagues demonstrated conclusively that for simple vivax malaria a tissue cycle took place in the reticulo-endothelial cells of the body. A volunteer who had been bitten by a large number of infected mosquitoes submitted himself a week later to an abdominal operation at which a piece of his liver was obtained for examination. A section of this liver showed tissue forms of the parasite *Plasmodium vivax*. Subsequently, these same workers proved that the three other types of human malaria underwent similar development in the tissues. It is the persistence of these tissue parasites which determines the first attack, as well as the relapses which occur months or even years later.

Among other medical officers of the Indian Service who made their mark by studying malaria was Rickard Christophers, whose researches were of special value. As
the first director of the Malaria Institute of India he planned the classical method of conducting a malaria survey. Two further names stand out in research work on malaria. Gordon Covell was largely concerned with developing methods of malaria control. As the last British Director of the Institute, he facilitated its removal from Kasauli to Delhi. John Sinton, the only F.R.S. to hold the V.C., is remembered mainly for his work on malaria eradication. His paper on “What malaria has cost India” is still the basis of plans for eradicating the disease, for in spite of notable progress in this direction probably nearly 100 million persons still suffer from malaria in India every year.

Organized through the World Health Organization, and aided by modern insecticides, campaigns directed against the insect vector have been gathering momentum. It is not surprising to learn that complete eradication of malaria from small islands has proved simpler than clearing the disease from the large land masses. Thanks to discoveries made by medical officers, especially of the Indian Medical Service, we are now well on the way to eliminating this mosquito-borne infection from the fast-developing countries of the world.

**Dysentery**

Next in order of military importance, dysentery must claim our attention. Until the last Great War, epidemics of dysentery were capable of decimating entire armies in the field. It was not until bacillary and amoebic forms of the disease were differentiated by the discovery of their causative organisms that progress could be made in their recognition and prevention. Sir John Pringle, to whom I have referred elsewhere, held firm views as to its effective control in camp. In the eighteenth century he advised treatment with Glauber’s salt in some cases of dysentery and ipecacuanha powder in others—a prescription that may surprise many who regard these remedies as of recent origin. One of the earliest observers who was enabled with a microscope to detect an amoeba in stools was Timothy Lewis, who served in India for fourteen years before being appointed Assistant Professor of Pathology at the Army Medical School in 1883. His discoveries were so varied and far-reaching that mention of him will be made again. Early in the nineteenth century a few experienced physicians had noted that in some instances dysentery was followed by liver enlargement and abscess formation. About 1868 John Murray in India is credited with being the first to test the advantages of puncturing and exploring a liver abscess.

The discovery by Schaudinn in 1903 of *Entamoeba histolytica* in the stools gave fresh impetus to the study of dysentery. Before long Sir William Osler had shown that in both its pathology and clinical picture amebiasis was a separate entity. To Leonard Rogers we owe a careful description of this disease and the introduction for its treatment of emetine, the active principle of ipecacuanha root, in the forms still in use today. In World War I the careful description by Wenyon and Dobell of intestinal protozoa facilitated their recognition in the laboratory. Zachary Cope likewise made careful observations on both the intestinal and hepatic forms of amoebic dysentery. In 1940 W. H. Hargreaves showed that the secondary pyogenic infection which accompanies amoebic dysentery could be controlled by chemotherapy, enabling specific treatment to be directed against the tissue-invading amoeba, a finding which
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gave new hope to those with chronic amebiasis. Today this form of dysentery is more easily recognized and more readily cured.

In World War II, in spite of an overall improvement in sanitation, bacillary dysentery continued to remain a primary cause of manpower wastage until the introduction of sulphaguanidine treatment in the Middle East by Boyd and Fairley in 1940. In full doses this drug rapidly controlled the symptoms of acute dysentery and brought about a rapid cure. These two medical officers also investigated the effectiveness of concentrated antitoxin in reducing the toxæmia of the fulminating case. However, once sulphaguanidine was provided for every patient at the onset of diarrhea the incidence of bacillary dysentery fell to satisfactory levels. This decision to give early treatment was to prove a major factor in saving allied manpower and winning the war.

Other Protozoal Diseases

Army medical officers have also made notable contributions to the study of other protozoa. Timothy Lewis was the first to discover a trypanosome in the blood of a healthy rat, and this flagellated protozoon now bears his name as *Trypanosoma lewisi*. Lewis also published the first pathological descriptions of cutaneous leishmaniasis, also known as oriental sore and Baghdad or Delhi boil.

Elsewhere I have referred to the work of William Leishman and his achievements in discovering the cause of kala azar. At Netley in 1901, using his modified Romanowsky strain, he found in the greatly enlarged spleen of a patient who had died of Dum-dum fever a number of tiny bodies, at first assumed to be fragmented nuclei of trypanosomes. Unfortunately he did not publish these observations until three years later, when Charles Donovan of the Indian Service, working in Madras, reported the discovery of identical parasites. Accordingly in 1903 Ronald Ross suggested that this protozoon be named *Leishmania donovani*. Soon afterwards Leishman was able to demonstrate similar bodies in scrapings from the ulcers of oriental sore. Somewhat later, Leonard Rogers, using a new method of culture on artificial media, showed that flagellated leptomonad forms could be grown from them.

Now to consider another of man's tiny enemies, the sandfly. On epidemiological grounds the sandfly, *Phlebotomus*, had long been suspected of spreading the disease. The work of Shortt and his colleagues at the Calcutta School of Tropical Medicine during World War II, demonstrating that this diminutive insect was the vector leishmaniasis, was especially noteworthy. Using volunteers and new feeding methods to keep the insects alive, they proved beyond doubt that the sandfly was responsible for transmission of the disease. With this definite proof, preventative measures against sandfly breeding and leishmaniasis itself then became possible.

Research on trypanosomal disease was perhaps the most important role undertaken by David Bruce, a keen naturalist who spent much of his service investigating difficult problems in the field. First, in 1894, while serving in Uganda he showed that nagana, or the tsetse-fly disease of cattle, was caused by a trypanosome (later named *Trypanosoma brucei*) and also that the vector was *Glossina morsitans*. Then later, in 1903, he was able to show that sleeping sickness in man was transmitted by another species of tsetse-fly, *Glossina palpalis*. His discoveries have made control of trypanosomal diseases possible in both man and animals alike.
Other Bacterial Diseases

Ever since the year 1799, when Admiral Nelson captured the island from the French, continued fevers were commonly observed among the British garrison in Malta. It was not until 1863 that J. A. Marston, an Army surgeon, published his report on Malta fever as a disease distinct from enteric fever, with which it had previously been confused.

Another twenty years passed before a young Army surgeon, David Bruce, was posted to the island, and three years later, in 1887, he was able to isolate from the spleens of nineteen out of twenty fatal cases the organism which is the cause of the infection and which is now named after him *Brucella melitensis*. Although a brilliant piece of original research, at the time Bruce was unable to show how the disease was acquired by man. In 1904, as Chairman of the Mediterranean Fever Commission, he returned to Malta, where his team isolated the organism from goats’ milk and urine, and was finally able to establish the milk as the direct source of infection. With the elimination of goats’ milk from the soldiers’ diet the incidence of the disease we now call brucellosis fell to negligible proportions. Bacteriologists have since been able to show that other organisms of this group are important causes of diseases of pigs, sheep and cattle. Even today, in many parts of the world, as you in Yorkshire are well aware, *Brucella abortus* has shown itself capable of attacking man through infected herds.

Asiatic cholera, a pandemic disease responsible for millions of deaths in India and the Far East, was a lifelong interest of Leonard Rogers of the Indian Medical Service. In 1911, in his published work on cholera, he introduced his infusion treatment with hypertonic saline, the first decisive advance and today still the basis of the recognized medical treatment. The name of Rogers is likewise associated with the forecasting of outbreaks of the disease in India, and in 1955 he completed his work on the control of cholera epidemics by the compulsory inoculation of religious pilgrims. No one man has done more to prevent this major epidemic disease spreading within and beyond that continent.

Leprosy, a disease which causes much suffering and disfigurement, likewise became an object of Rogers’s studies, perhaps because of its prevalence in India, where the number of infected persons is said to be more than a million. This resourceful pioneer helped to develop its treatment with hydnocarpus and chaulmoogra oils and to plan measures for leprosy control. At the present time, thanks to developments in chemotherapy, the outlook for these unfortunate lepers is much more hopeful than ever before.

Helminthic Diseases

Three examples in parasitology must suffice.

Mention has already been made of Lewis, who in 1872, working in Calcutta, was the first to record the presence of microfilariae in the blood, lymph and urine of a Hindu patient afflicted with elephantiasis. This was nearly four years before Bancroft reported his discovery of the adult filarial worm.

Again, R. T. Leiper, investigating bilharzia in the period 1914-18, was able to demonstrate that two distinct species of schistosome, with separate mollusc hosts for each worm, were responsible for the disease, and that man became infected by
penetration of his skin when bathing in infected water. Effective prevention of bilharzia then became possible and enforceable.

And again, William MacArthur, just before World War II, made an important contribution to neurology when he proved that epilepsy can be caused by the larval stage of the pig tapeworm, *Tania solium*, which has a special predilection to settle in the brain. In this way cysticercosis was brought to notice as a recognizable and preventable disease of soldiers who had served abroad.

**Nutrition**

Malnutrition, in the case of the Army, has rarely been encountered in modern times. The tragic siege of Kut in World War I and the experiences of prisoners in enemy hands in World War II were notable exceptions. In 1919 Robert McCarrison built up in India the nucleus of what has since become one of the most valuable international organizations for studying nutrition. He began his inquiries by studying the effects of faulty diet on the thyroid gland, but soon extended his researches to cover other aspects of nutrition, on which he published many papers. Much of his work was directed to the diets of various races of India.

**Miscellaneous Problems**

Many and varied were other forms of research in tropical diseases encouraged by the stress of war. Details are available in the medical history of both Great Wars and form highly interesting and yet often neglected sources of information (H.M.S.O. 1922; 1952). Among research which is being currently undertaken by the Army is work of the arbor viruses, malaria, sprue and heat acclimatization.

**Summary**

It will now be probably recognized from this necessarily brief survey that so far the challenge of tropical medicine has been successfully met by the Army. In the civilian applications of these discoveries the role of the Indian Medical Service has been vital to the health and welfare of mankind.

The recognition, prevention and treatment of tropical diseases still remain part of the day-to-day work of the Army medical officer, whose opportunities in this field are unbounded. Nevertheless many another cognate problem awaits solution and, although research is now a matter more for the team than the individual, the Army will no doubt continue to encourage original work in this highly rewarding field of medical advancement and human endeavour.

**REFERENCES**


