THE WORK OF BRITISH PATHOLOGY IN RELATION TO THE WAR.

BY

F. W. ANDREWES, M.D., F.R.S.,

PROFESSOR OF PATHOLOGY IN THE UNIVERSITY OF LONDON.

IN forming any estimate of the work carried out by British pathologists during the past two years it is necessary to bear in mind the position of medical research in this country when the war broke out. The numerous and important medical and pathological discoveries which have had their birth in England have chiefly been the work of individual men, and have owed little to co-ordinated research, though admirable work was done in the laboratories of the different universities, of the Royal College of Physicians in Edinburgh, and in many other places. Up to the year 1913 the State did hardly anything to advance knowledge in medical science; a small sum doled out yearly by the Local Government Board and some assistance given by the Colonial Office to the Schools of Tropical Medicine represented almost all that was done, though it would be unjust to ignore the valuable research work carried out by the pathological staff of the Royal Army Medical Corps. Apart from the State, such endowed institutions as the Lister Institute and the Imperial Cancer Research Fund proved that as a race we were capable of sustained and not unfruitful effort on the lines of co-ordinated research where the opportunities for this existed. Nevertheless, individualism was the rule, and each pathologist tended to devote his energies to the research which happened to appeal to him whenever he had the necessary time and freedom from financial cares. Even under these conditions the output of good research work in medical science was by no means discreditable, and Englishmen have good reason for pride in the share which this country has taken in the advance of our knowledge of disease and of its treatment.

The Insurance Act, however, promised a revolution in research. For the first time the State set aside a considerable annual sum, between fifty and sixty thousand pounds a year, for the express purpose of advancing medical knowledge, and the Act organized machinery for its intelligent expenditure. The guiding hand was exercised by a body of nine persons, the Medical Research Committee, established in 1913, and carefully chosen from amongst those known to have the power of organizing research or distinguished in its prosecution. Much time and thought were expended by this committee in elaborating their schemes of action, but scarcely had the machinery begun to move when the war broke out and interrupted most of their projects.

A gigantic war, carried out under conditions largely new, necessarily presents a continuous series of new medical, surgical, and pathological problems requiring immediate solution. It was a fortunate thing for the country that the Army Medical Service was well organized and efficient. Many of the problems which would confront us had been foreseen and their solution thought out. In particular the pathological branch of the service was well developed and excellently officered by a staff trained in the well-equipped laboratories of the Royal Army Medical College. At the onset of the war, however, the Army Medical Service found itself more than fully occupied with the necessary administrative duties which it was called upon to fulfil, so that it was impossible for its staff to deal at once with all the new questions which arose. It was now that the Medical Research Committee proved its value. It was already a "going concern," and was in a position to divert the energies which were to have been expended on research into the medical problems of a country at peace to the solution of those which arose in consequence of war. The committee therefore placed itself at the disposal of the nation, and especially at the service of the military authorities; its flexible organization enabled it to attack new problems at short notice and with maximum effect, and the value of the results which have been attained under its auspices has been in many cases immediate and remarkable, as will appear in the following pages. It will be convenient to group the chief pathological problems which have been met during the war and discuss them seriatim.

The Control of Enteric Fever.

Enteric fever, the great medical scourge of all former wars, has been reduced in this, the greatest of all wars, to insignificant proportions. Two factors have contributed to this: one was a knowledge of the "carrier" danger, which was met from the outset by the bacteriological examination of all suspected persons and their prompt segregation; the other and more important factor was prophylactic inoculation. The practice of inoculation against typhoid fever, which we owe to Sir Almroth Wright, had been tried on a small and inadequate scale in the South African war, with not wholly convincing results. It had since proved its worth in our Indian army, and the most effective methods for securing protection had been worked out in detail by the pathologists of the R.A.M.C. under Colonel Sir W. B. Leishman. The methods devised were put into practice from the beginning of the war, and in the course of a few months practically the whole army was inoculated. Small local outbreaks of enteric were promptly suppressed, and the total number of cases was extremely small in comparison with what might have been anticipated. The inoculation, however, was carried out with vaccines of *B. typhosus* alone, and the protection afforded against infection with *B. paratyphosus* (A and B) was not of high degree. During the first year of the war actually more paratyphoid than typhoid was observed amongst our troops. As the result of this experience the War Office appointed a small committee of pathologists to consider the advisability of including paratyphoid bacilli in the prophylactic inoculation. The question of dosage was carefully considered, and groups of men were experimentally inoculated with the mixed vaccine to make sure that the constitutional reaction was not too severe. The tests were satisfactory, and from the beginning of 1916 the new triple vaccine, known as T.A.B., has been the sole official vaccine for the British army, and has proved itself efficient in controlling paratyphoid as well as typhoid fever.

The pathological diagnosis of enteric fever has been complicated by the fact that practically all soldiers were inoculated men, so that the old methods of serum diagnosis became untrustworthy. At an early period of the war Professor Dreyer of Oxford drew attention to the method of carrying out agglutination reactions macroscopically with standardized killed cultures, which he had elaborated in Copenhagen some years previously. The advocacy of this method by Professor Dreyer and his colleague, Dr. Ainley Walker, led to its widespread use, and its accuracy proved such that a diagnosis could be made even in triply-inoculated men, provided that two or three observations were made at intervals of a few days, so as to follow the agglutination titres of the blood against the three bacilli respectively. The Medical Research Committee took the matter up and established at Oxford a laboratory from which standardized emulsions together with the requisite outfit for carrying out the test have been supplied free to all military pathologists, Dreyer's technique being now used almost universally. Much valuable information about the course and diagnosis of the different forms of enteric fever has resulted from the widespread use of this standard method, which has the advantage that the observations of different workers are strictly comparable.

That the freedom from enteric which has been enjoyed by our armies on the Western front is due to the care taken in ensuring inoculation, and to the sanitary precautions which have been enforced, is shown by the condition of affairs where this care was impossible and inoculation incomplete, notably in the Gallipoli expedition. Here, although there was little typhoid, the amount of paratyphoid was by no means inconsiderable, but exact figures are wanting owing to the lack of facilities for diagnosis.

Dysentery.

Of this second great medical scourge of war a less favourable tale can be told, inasmuch as no specific preventive measures have yet been devised. It has not been found practicable to employ prophylactic inoculation against bacillary dysentery, chiefly on account of the high toxicity of Shiga's bacillus, though research work on this subject is in progress, and mention may be made of the method of reducing this toxicity by the action of hypochlorites, as suggested by Professor Dean of Manchester. Prevention has therefore been reduced to hygienic precautions and to

the search for carriers, and on the Western front these measures have hitherto sufficed to prevent any serious outbreak of dysentery, in spite of the return to France of large bodies of troops from the Mediterranean area. In the Eastern Mediterranean, and in Mesopotamia, dysentery has prevailed largely, both amoebic and bacillary, and has offered an opportunity for careful study, particularly in the cases returning home to this country. In the autumn of 1915 an immense number of cases of the disease returned home from the Mediterranean area, and, in order to avoid any risk of spread, were concentrated by the War Office in certain centres scattered over England. The Medical Research Committee provided laboratory assistance at these centres and were able to organize courses of instruction in protozoology for the numerous workers who were comparatively unversed in that subject. In the London district over a thousand cases were studied in full detail, and the facts which have been collected will afford a mine of valuable information on dysentery and allied diseases. Some of the work has already been published by the Medical Research Committee, namely, Dobell's report on amoebic dysentery, and that by the workers at the London Hospital on the investigation of 878 cases of bacillary enteritis from the Eastern Mediterranean. No such opportunity has ever occurred for the study of the tropical forms of dysentery in England, and many new facts have been brought to light.

The value of emetine in the treatment of amoebic dysentery has been abundantly confirmed, and Dr. Dale has introduced the double iodide of bismuth and emetine for the treatment of amoebic carriers, upon whom it has been used with successful results. Dr. Dale has also shown that the persistent administration of emetine may lead to symptoms not unlike those of the dysentery it is designed to cure.

Cerebro-spinal Fever.

Although this fever has been present amongst the British forces on the Western front, anxiety has chiefly been felt about the troops in training in England. For the first time the disease has prevailed epidemically over the whole of this country, affecting equally the civil and military populations. Strenuous efforts have been made by the War Office to control its spread, and invaluable assistance has been furnished by the Medical Research Committee in the provision and equipment of bacteriological laboratories for the purpose. Lieut.-Colonel M. H. Gordon was placed in control of the scientific work, and he organized laboratories for the diagnosis and study of cerebro-spinal fever at numerous centres throughout the country, while he himself and his immediate staff carried out research work at the Central Laboratory at Millbank. The outcome of Lieutenant-Colonel Gordon's researches promises a distinct advance in our methods of combating the spread of the disease. New, cheap, and easily prepared media for the growth of the meningococcus have been devised. A serological study of the races of this organism concerned in the epidemic has been carried out, with the result that the chief epidemic strains have been determined and a simple means for their diagnosis by agglutination placed within the reach of all pathologists. The importance of these observations is twofold. The value of a curative serum in cerebro-spinal fever depends upon whether the particular epidemic strain concerned in a given case of the disease has been employed in producing the serum. The serum available at the beginning of the epidemic, largely American in origin, was found of little value in treatment, but that prepared during 1915 from a due admixture of current epidemic strains proved of considerable curative potency. In the second place, the problem of the segregation of carriers of the meningococcus is simplified. So numerous may such carriers be at certain times that their isolation is almost impracticable. Gordon therefore proposed the isolation of those carriers only who bore epidemic strains of the meningococcus. Although certain risks may be run by such limitation, it has the merit of reducing the numbers to be isolated within practicable limits, and it has been found possible to carry out this policy, at least in a military population, with satisfactory results as regards the spread of the disease, for the more dangerous carriers have been eliminated. Another useful research carried out by Lieutenant-Colonel Gordon has been in relation to the cure of chronic carriers: by causing them to breathe for a short time every day the air of a room saturated with a fine spray containing

chloramine-T he found it possible to cure the majority, though not all, of such carriers within a fortnight; a special spraying apparatus has been devised for this purpose. It may be added that valuable work on the races of the meningococcus has been carried out in military laboratories in France by Arkwright and by Ellis; and, further, that a very thorough study of the same subject amongst the civil population has been going on for two years in the laboratories of the Local Government Board by Drs. Eastwood, F. Griffiths, and Scott.

Other Medical Diseases Incident on Trench Warfare.

The conditions under which the troops have fought for the past two years have been associated with the appearance of epidemic diseases some of which have been known before while others have previously escaped recognition. The chief work on diseases of this character has necessarily been carried on at the front, where they are encountered in the acute stage; their clinical features have been defined by the work of the physicians and their etiology studied by pathologists at the base hospitals. Lack of space prevents our doing much more than to allude to them here, and indeed so much remains to be found out concerning most of them that few positive assertions can be made.

Trench nephritis has been exceedingly prevalent, and its course and symptomatology are now familiar, but we have failed to discover the exciting cause in spite of a large amount of work both in France and in England. The balance of evidence is in favour of the view that it is an infective malady, but no definite microbe is demonstrable, and efforts to transmit the disease to animals have so far proved unsuccessful. A very complete clinical study of this form of nephritis has been made by Captain Langdon Brown at St. Bartholomew's Hospital, so far as concerns the stages at which cases reach England, while the chemical pathology of the urine has been elaborately investigated by Captain Mackenzie Wallis. Two meetings have been held for the discussion of the disease, one at the Royal Society of Medicine and one at the Medical Society of London. At the last of these meetings Lieutenant Dunn showed a valuable series of histological preparations which he had made from recent cases in France.

Trench fever is a novel disease which received this name towards the end of 1915, when Captain Hunt and Major A. C. Rankin published an account of thirty cases. It appears to be distinct from any fever hitherto recognized, and, according to Captain McNee and Lieutenant Renshaw, who published a careful account of it in April, 1916, it assumes two forms, the second being the relapsing variety. The two latter observers were able to reproduce the disease in man by injecting the blood from active cases into volunteers for the experiment, and they further showed that the infecting property resided in the corpuscles and not in the serum. Nevertheless, they were unable to demonstrate any visible parasite in the blood, and the natural mode in which the disease is conveyed is still a matter of conjecture. Captains Davies and Weldon have, however, in one case reproduced the disease in man through the intermediation of the louse.

Infective jaundice, often known as "Weil's disease," has been of not infrequent occurrence in France, as well as in the Mediterranean area, and the infecting agent—*Spirochaeta icterohaemorrhagiae*—has been repeatedly demonstrated. *Cholera* and *typhus fever* have fortunately been conspicuous by their absence among the British forces, but admirable work was done in the control of typhus by the British hospital units in Serbia, chiefly by eliminating lice.

The Study and Treatment of Wound Infections.

This subject has naturally occupied a foremost position in the present war. The majority of modern surgeons, trained in the aseptic school, found themselves confronted by totally novel problems in the vast numbers of severe wounds, grossly contaminated by faecal bacteria, including the most dangerous anaerobes. From the first, both surgeons and pathologists set themselves to work to overcome difficulties which had never before been presented in bulk since the rise of aseptic surgery. And almost from the first two schools of treatment arose, the one condemning the use of antiseptics as a means of purging a wound of its bacteria and trusting in "physiological methods" of treatment, the other advocating germicides of one sort or another.

The apostle of physiological methods was Colonel Sir Almroth E. Wright, the chief of the Bacteriological Department of the Medical Research Committee, who was liberated for service as a consultant at the front. He occupied a pathological laboratory at Boulogne, and commenced, with the assistance of a number of fellow-workers, mostly his own trained pupils, a laborious investigation of the conditions obtaining in wounds from the point of view of pathological physiology. Whatever view may be held as to the best treatment for infected wounds, which, for the surgeon, is a matter of practical experience, it must be admitted on all hands that the study carried out by Colonel Sir Almroth Wright and his colleagues at Boulogne was a brilliant and suggestive piece of work. Various new technical methods were devised for this study, the outcome of which has been published in detail. From a surgical point of view the methods of treatment to which it gave rise consisted essentially in the encouragement of a free flow of lymph into the wound, for which purpose hypertonic salt solutions were chiefly employed. Pursued to its most extreme degree, this method developed into the packing of septic wounds with tablets of solid salt, with or without the addition of sodium citrate; such treatment was, of course, temporary, the amount of salt used being reduced after a few days. Excellent results have been recorded by those who have employed this mode of treatment in selected cases. Sir Almroth Wright has devoted much attention to the problem of the continuous irrigation of wounds with saline solutions, and has devised methods by which very successful results have been achieved.

On the other hand, a vast amount of work on antiseptics in their application to wound surgery has been carried out by pathologists and surgeons both in England and at the front. The crude attempts at sterilizing wounds by single applications of such powerful germicides as carbolic acid have been largely abandoned, though applications of a mixture of equal parts of pure carbolic and camphor have proved useful in cases where the nature of the wound permits. The most successful results, however, have been obtained through researches into the properties of the hypochlorites. Two separate sets of researches on these lines have been supported by the Medical Research Committee and have proved fruitful, and largely identical in their practical outcome. Working in Edinburgh, Professor Lorrain Smith, with the aid of three colleagues, devised a combination of bleaching powder and calcium borate which proved exceedingly efficacious in the treatment of septic wounds; they published formulæ for a solution which they termed "eusol," and a powder, "eupad," which have now been extensively used, and with marked success. Quite independently, Dr. Dakin, working at Compiègne, produced a very similar solution, equally successful in its application. On the surgical side he became associated with Dr. Carrel, and the collaboration of these two workers, who have introduced a special technique for the continuous irrigation of wounds with the hypochlorous solution, has issued in a method of wound treatment which has led to marvellous results, under which, when the bacterial flora of a wound has been lowered to a certain defined point, it is safe to perform secondary closure and suture. This method of treatment, which does not conflict with that by hypertonic saline, has become increasingly popular amongst surgeons at the front, and, in the judgement of many, is the most efficient method yet introduced for dealing with septic wounds.

Dr. Dakin's researches did not end with the introduction of the hypochlorous solution, for he proceeded later, in conjunction with Professor Cohen of Leeds, to study its mode of action in the presence of proteins. It was found that the hypochlorous acid acted, not, as formerly supposed, as an oxidizing agent, but by the formation of chloramines. Amongst the chloramines whose properties were investigated were found several of considerable disinfectant power, and one of them—toluene-sodium sulphochloramide—has been introduced into medical and surgical practice on a commercial scale under the name of chloramine-T. This substance, though of fairly high germicidal value, is almost non-toxic, and has no action on albumin. It has thus been found of special value in dealing with wounds involving the mouth, and it has proved the most efficient drug, when atomized by a steam spray, in ridding chronic meningococcus carriers of their infection. It is, further, absorbed in notable amount by textiles, and

chloramine gauze has been found to possess a much higher germicidal value than any other antiseptic gauze previously in use. Incidentally, Dr. Dakin found chloramine-T a useful reagent in the study of the chemistry of proteins, and he has been able to form cyanides from amino-acids.

Another important application of the hypochlorites has lain in the disinfection of hospital ships. The crowding of large numbers of cases, many of them suffering or convalescent from enteric fever or dysentery, in these vessels led to a good deal of secondary infection during the voyage. The process of generating hypochlorites by the electrolysis of sea water has long been known, and Dr. Dakin devised a simple plant for this purpose, using the ordinary ship's current. This was installed experimentally on the *Aquitania*, and gave such admirable results that the method is now widely employed. One of the advantages presented by the hypochlorites as disinfectants is their extreme cheapness: the saving in carbolic acid and cresol in one voyage of the *Aquitania* was estimated to exceed the cost of the electrolytic cell and its upkeep, and the efficiency of the disinfectant produced was so great as practically to abolish cases of secondary infection.

One other disinfectant introduced during the war which deserves special mention is flavine, now termed "acri-flavine." This substance, originally prepared by Benda at Ehrlich's suggestion, for the treatment of trypanosomiasis, had never been subject to proper study as a bactericide. This study was undertaken for the Medical Research Committee at the Middlesex Hospital, by Dr. Carl Browning and several of his colleagues. The research included a number of acridine compounds besides flavine, and embraced also brilliant green and aniline dyes, but the properties of flavine place it almost apart from other germicides. Nearly all the chemical substances which destroy bacteria are inimical also to living tissue cells, and impair the phagocytic functions of the leucocytes. Flavine, according to Dr. Browning's report, is largely free from these objections; that is to say, it is effective as a germicide in dilutions which are harmless to the tissues, and do not impair the phagocytic powers of leucocytes. More than this, almost all other disinfectants are subject to the grave disadvantage that their activity is hindered or even abolished in presence of albumins; it is claimed for flavine that it is a more active germicide in serum than in distilled water. The clinical trials of flavine at the Middlesex Hospital appear to support these laboratory investigations, but at the moment the stock of flavine available is not sufficient for wider trials, though its commercial production has been begun.

It need hardly be said that the opportunities for studying the bacteriology of septic wounds which have so freely offered themselves have led to a large amount of research work, the most important, because the most novel, part of which has been the study of anaërobic infections. The universality of such infections has attracted attention to them in almost every pathological laboratory, and the opportunities for investigating gas gangrene in the base hospitals in France have been well utilized, though the results have, perhaps, been of surgical rather than pathological novelty. An important observation is that of Dr. Dale, who has brought forward evidence that the so-called "toxins" of certain of the anaërobic bacilli connected with gas gangrene are really salts of ammonia. Specific studies of the anaërobic infections of wounds have been carried out for the Medical Research Committee by several groups of observers in this country, notably by Drs. McIntosh and Fildes at the London Hospital, and by Professor Dean at Manchester; while at the Lister Institute Miss Robertson has been similarly occupied. Our knowledge of the classification and characters of these bacilli has gained much in precision and extent.

Tetanus.

In the early days of the war tetanus of a severe type was common amongst the wounded, and the control of this disease by the prompt administration of a prophylactic dose of antitoxic serum to all wounded men will rank as one of the triumphs of preventive medicine in the present war. Early in 1916 the War Office appointed a Committee for the Study of Tetanus under the chairmanship of Surgeon-General Sir David Bruce, C.B., F.R.S. This Committee has met at short intervals, and being furnished with the data as to all cases occurring in military hospitals

in England, is accomplishing good work in connexion with prophylaxis and treatment, to which the appointment of tetanus inspectors in all the different military commands has been of assistance. The practice of prophylactic inoculation has not only greatly diminished the incidence of tetanus, but in large numbers of cases has profoundly modified its nature and course when it does occur. The recognition of "local tetanus" as opposed to the generalized disease was first made by French observers as a phenomenon of partial protection, and their observations have been fully confirmed by the occurrence of similar cases in this country and amongst our wounded abroad. Every gradation has been observed between a tetanus strictly limited to the wounded limb and the general disease, and it has been found that the more localized the tetanus the better is the prognosis. With regard to the treatment of declared tetanus there is still considerable dispute as to the best route for administering the specific antitoxin. The War Office Committee has from the first advocated the intrathecal route, and has instigated experimental work relating to this matter, which is not yet sufficiently advanced for publication.

The Life-History of Bilharzia.

The presence in Egypt of large numbers of Imperial Forces was attended by grave risks of the outbreak amongst them of certain of the endemic diseases of that country, and not the least of these was infection by bilharzia. The complete life history of this parasite was unknown, and had baffled Looss and other investigators, so that there was no knowledge of the special precautions that ought to be taken. In these circumstances the Medical Research Committee co-operated with the War Office and the London School of Tropical Medicine in sending out a special mission, headed by Dr. Leiper, to study the subject. This mission successfully solved, in a few months' work, the main problem involved, proving that the intermediate host of the worm is a fresh-water mollusc; and further work during 1916 has shown that the two main species of bilharzia in Egypt have distinct intermediate hosts: that of *Bilharzia mansoni* being *Planorbis boissyi*, while *Bilharzia haematobium* has two, and perhaps three, species of *Bullinus* (*B. contortus*, *B. dybowskyi*, and probably *B. innesi*) as intermediate hosts. Cheap and efficient means have been found for rendering infected waters safe, and have been brought into use in all military camps. For the first time the way is opened up for the eradication of this grievous infection from the country, a result all the more earnestly to be desired, since no means of destroying the worm has been found when once it has established itself in the human body.

Trench Foot.

Very large numbers of men were invalided from the Western front during the winter of 1914-15 with the condition at first regarded as frost-bite, but now commonly termed "trench foot." Professor Delépine investigated this subject at Manchester, while Professors Lorrain Smith and Ritchie with Dr. Dawson carried on a research for the Medical Research Committee at Edinburgh. It has been shown that "trench foot" is a minor state of frost-bite, the damage inflicted being usually short of immediate death of the tissues. The experimental work of Lorrain Smith and his colleagues upon the rabbit shows that the primary lesion is vascular, with a secondary inflammatory reaction when the subject is removed from the causal environment. The difference between this and true frost-bite is one of degree only, and the severer forms of trench foot end in gangrene. Professor Delépine has shown the importance of a layer of air surrounding the lower extremity in preventing trench foot, and has devised a simple and light bag of oiled silk which can be worn by those exposed to continuous wet and cold in the trenches, and which has proved a considerable safeguard.

The foregoing short account of what has been accomplished during the war by British pathologists is necessarily incomplete. Much that has been done may not yet be written about, and no attempt has been made to enter into full details as to that which is already public property. This slight sketch of some of the more important work which has been accomplished will suffice to show that in pathology, no less than in the other sciences, advances have been made, under the stress of national necessity,

during the two years and a half of war which could hardly have been expected in twenty years of ordinary work; and although it has been "war work," it represents a solid contribution to science which will be valid for the years of peace to come.

BACTERIOLOGY AT THE FRONT.

BY

COLONEL SIR W. P. HERRINGHAM, C.B., M.D.,

CONSULTING PHYSICIAN.

BACTERIOLOGICAL investigation in hospitals of the front line has been a novel feature of this war. Nothing of the kind has been practised in any of our previous campaigns. It has been rendered possible by equipping motor vans as mobile laboratories. The first, which was sent out in October, 1914, had been a pleasure caravan. It was gutted and fitted with incubators and all the other apparatus of bacteriological work, and was followed by many others of the same type. They have been attached to a clearing station or a group of clearing stations, and the officer in charge is provided with a small motor car, so that he can go to any place in his area where his services may be wanted.

These officers perform three functions:

1. They examine all kinds of morbid products from the hospital wards, and thus aid in the diagnosis of enteric fevers and other epidemic diseases on the medical side, and of the various forms of infection that attack surgical wounds.

2. They examine contacts in cases of infectious fever and search for carriers both among the troops and in the civil population.

3. They investigate new forms of disease that appear among the troops in order to discover their causes and the means of prevention.

Instances of the first class of work are the examinations made of the blood and excreta in cases suspected of enteric fever, of malaria, or of dysentery, and of the cerebro-spinal fluid, or the nasal mucus where cerebro-spinal fever is in question.

In the first year of the war the diagnosis of enteric at the front was comparatively easy. But when, in January, 1916, the triple inoculation against typhoid and paratyphoid A and B came into use, it became much more difficult. Firstly, the culture of the bacilli from the blood is very uncertain in inoculated men after the first three days of fever, and, since the early symptoms are slight and are not distinguishable from those of many other fevers that prevail, few patients arrive at a clearing station within that time. Secondly, the triple inoculation so complicates the agglutination test that it is only after three or four trials and a comparison of the results that a conclusion can be reached. As this takes twelve or fourteen days it is only carried out at the front in the comparatively few cases that are retained in the infectious hospitals there, nor is it, even with the repeated examination of the excreta in addition, always possible to obtain bacteriological evidence in cases where the clinical symptoms render the diagnosis certain.

In the case of cerebro-spinal fever, Captain Ellis, of the Canadian Mobile Field Laboratory, established at the same time as Lieutenant-Colonel Mervyn Gordon at home the existence of different types of the meningococcus distinguishable by agglutination and absorption tests.

During 1915 cases were also observed in which, with acute symptoms just like those of cerebro-spinal fever, the cerebro-spinal fluid, though under high pressure, contained no polymorphs and no meningococci, but lymphocytes in excess. This condition we called lymphocytic meningitis. It was never fatal. Later on several cases of meningococcal septicaemia, which is a very acute and rapidly fatal disease, were discovered by the bacteriologists.

Certain cases of dysentery occurred and were accompanied by a considerable amount of non-dysenteric diarrhoea. A large amount of diagnostic work was carried out by the mobile laboratories of this area.

The next function of these officers is to discover the source of an infection, and to stop it from spreading. In cases of enteric the work was very elaborate. In the first place, a systematic search was made for recent or chronic