Summary

A plan of treatment for infantile diarrhoea and vomiting which has worked with encouraging results is put forward as a basis for use by those in charge of sick infants. One hundred infants were treated by this method, with a mortality of 23%. Certain interesting figures of prognostic value are recorded, including the high death rate of 32.6% in infants developing the disease in hospital compared with those developing it at home. In view of this and the recorded high mortality in institutional epidemics, measures for the prevention of the disease in hospital and nurseries are given.

Adequate treatment demands team-work and probably presents as highly skilled a form of nursing as any in diseases of children.

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MILITARY MEDICINE IN THE MIDDLE EAST

AN EXPERIENCE OF 13,542 CASES

BY

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This paper is based on the work of the medical division of a large hospital situated in a base area in the Egyptian desert, and covers a period of eighteen months (March, 1941, to Sept., 1942); the cases were unselected admissions from local camps and from convoys from the forward areas. It seemed to me that a brief survey of the medical problems out here might be of interest in England. This climate, while on the whole healthy, is unsuitable for those prone to certain diseases, which should be better known to those selecting troops for service here. We work with limited clerical and much-depleted medical staffs. The turnover of patients is very large, and elaborate statistical analyses are impracticable. From official and private records a good idea of the larger disease groups can be got, but the rare diseases have had to take their proper place against the utilitarian background of war and will only be touched upon here.

The relation between medical and surgical admissions has ebbed and flowed with the tide of battle, but there have been roughly three medical to two surgical admissions. The types of case dealt with will be considered in large groups, and conclusions will be given rather than the arguments supporting them. Some of the conclusions will be at variance with accepted tropical teaching, but the controversial opinions expressed upon dysentery will be discussed in a fuller paper when time permits.

The approximate incidence of the cases, expressed in percentages, is given in Table I.

TABLE I.—Percentage Distribution of Disease; 13,542 Cases

Tropical diseases	45%
Acute and chronic respiratory diseases	17%
Skin diseases (including scabies)	15%
Functional and organic nervous diseases	7%
Infectious diseases	5%
Chronic digestive disorders	4%
Chronic rheumatism—articular and non-articular	3%
Diseases of kidneys and bladder	1%
Circulatory diseases	0.7%

Tropical Diseases

The figures relating to the various tropical diseases are given in Table II.

TABLE II.—6,144 Cases of Tropical Disease

Dysentery group	4,178 (2 deaths)
Short-term fevers	1,153
Malaria	735 (1 death)
Avitaminoses	34
Relapsing fever	19
Bilharziasis	18
Kala-azar	5
Leprosy	1
Effects of heat	1 (1 death)

The Dysentery Group

Diarrhoea is the most important disease of the Middle East, and nearly one-third of medical admissions were due to it. Although it is probable that, apart from a few cases of food poisoning, the cause is the dysentery bacillus, cases are divided into two groups according to whether blood and mucus are visible in the stools or not. If they are, the condition is called "dysentery"; if absent, "acute catarrhal enteritis" or "Gippy tummy." The distinction is useful, as it makes a rapid assessment of severity easy, and is to be objected to only when different causes are postulated. The duration of stay in hospital of 600 cases of dysentery was 19.5 days, and of 600 cases of acute enteritis 11.5 days.

Laboratories are overburdened by the routine attempt to isolate the dysentery bacillus; success varies, and depends upon collaboration between the laboratory and the ward, which is seldom perfect. A strong plea could be made for limiting laboratory examinations to a search for *Entamoeba histolytica*; dysentery can be adequately managed with minimal laboratory help, as severe cases must be treated on clinical indications just as urgently as must diphtheria.

TABLE III.—Dysentery Group; 4,178 Cases

Amoebic dysentery, including hepatic amoebiasis	36, or 1%
Acute catarrhal enteritis	2,313, or 55%
Bacillary dysentery	1,829, or 44% (2 deaths)
(Of positive isolations, Flexner 70%, Shiga 19%, Sonne 6%, Schmitz 5%)	

Treatment.—The contribution which this war will make to dysentery will be an appraisal of the value of specific chemotherapy and probably the abandonment of the use of castor oil and salts. On my responsibility—it was then almost a crime—saline treatment was stopped in this hospital in the summer of 1941; I do not think the treatment is of value, and on theoretical grounds it has much to condemn and little to commend it. Our usual treatment is rest in bed, ample fluids, a bland diet, and morphine to relieve colic in a few cases; dysentery has not, on the whole, been severe, so that in only about 10% of cases is any further treatment necessary. In patients whose diarrhoea persists more than seven days and who show active inflammation on sigmoidoscopy, and in all severe cases, one of the sulphonamide group has been given. Sulphaguanidine has been available since April, 1941, and both sulphanilamide and sulphapyridine have been used more recently. The conclusions we have reached are that sulphanilamide in tablets is of limited value; sulphapyridine and sulphaguanidine seem to be of equal value, and as specific in dysentery as the former is in pneumonia. As sulphaguanidine does not upset the patient it is the drug of choice in both acute and chronic dysentery; in the few cases of non-specific ulcerative colitis treated there has been no improvement. While the use of Shiga serum in very severe cases is compulsory, I have treated a few with double doses of sulphaguanidine, and recovery has taken place in attacks which were likely to have proved fatal.

Results.—There have been two deaths—one from exhaustion when adequate supplies of sulphaguanidine were not available, and the other that of a patient who already had a pericolic abscess when he reached us from the Western Desert. One patient was invalided home after a very severe dysentery, as he developed ulcerative colitis; a second patient was invalided home to South Africa owing to impairment in his health—he had been a prisoner of war; three patients were temporarily re-graded for base duties for three months. The remaining patients made a complete recovery. I regard this as a creditable record in such a disease, and I think it must be attributed to the use of sulphaguanidine in all the severe and prolonged cases: chronicity with permanent ulceration was not allowed

to occur. Every case with diarrhoea lasting for more than 10 days was sigmoidoscoped.

Short-term Fevers

Approximately 2,000 patients (15% of the series) were admitted with "P.U.O."—pyrexia often heralded by a rigor, headache, and perhaps vomiting, but without signs or symptoms pointing to inflammation of throat, lungs, bowels, or other organs. Naturally a routine procedure has been adopted for these cases: repeated physical examination, especially for splenic enlargement; twice-daily blood films for three days; an accurate temperature record. With such numbers blood counts are impossible except where there are special indications. From this group of 2,000 cases either the progress or the laboratory findings excluded malaria, meningitis, the enteric group, relapsing fever, and a certain number of cases of dysentery with a febrile onset without diarrhoea at first. An alarmingly large residue of 1,153 cases is left. Of these, 805 have been called "sandfly fever," a diagnosis which in most of them is probably correct, but as we have not had an epidemic it is not easy to be certain of sporadic cases. I feel that textbooks have claimed too much for the clinical picture of sandfly fever, for I have seen typical cases prove to be malaria, relapsing fever, and once poliomyelitis; in the absence of an epidemic it is wise to make the diagnosis with reservations. The other 348 cases of short-term fever remain an unexplained problem and offer a fruitful field for research; they have not borne any resemblance to true influenza.

The short-term fevers are the cause of much morbidity but no mortality, and require the services of a good laboratory; they must not be treated as malaria, as to do so trebles their stay in hospital and would be a serious waste of man-power. They are sources of anxiety only when they last more than four or five days, as more serious diseases have then to be considered.

Malaria

TABLE IV.—Malaria; 735 Cases

Benign tertian	597, or 81%
Malignant tertian	44, or 6%
Quartan	9, or 1%
Ovale	1
Clinical	84, or 11% (1 death)

Malaria has been mild, and very few cases of the pernicious type have been seen. It has not been a difficult disease once it was realized that almost any febrile condition could be malarial, and its response to treatment has been so dramatic that in a few days no further anxiety was felt. I am aware that in other theatres of war the problem is different. The treatment has been to give quinine in solution in doses of 10 gr. thrice daily until the patient is afebrile, then mepacrine hydrochloride (atebrin) 0.1 g. thrice daily for five days, and after two days' rest a sterilizing and anti-relapse course of pamaquin (plasmoquine), 0.01 g. thrice daily for three days. With a constantly changing population it is not possible to give rates of relapse after this standard course, but they would seem to be low. I was impressed with the number of relapses occurring among those who had not received the pamaquin course.

There has been one death; it resulted from acute haemolytic anaemia with haemoglobinuria during the pamaquin course—haemolysis was checked, but the patient died from pneumonia. Too much stress need not be laid on this case of blackwater fever, as we had a similar case during the treatment of pneumonia with sulphapyridine, and a second case without a discoverable cause: both recovered.

The guiding principle in malaria has been to withhold quinine until the diagnosis has been established by the laboratory, unless (1) the patient is very ill and delay may prove fatal, or (2) the clinical picture together with an enlarged spleen makes malaria probable although repeated blood films have been negative. Eleven per cent. of the cases fell into this group of "clinical" malaria.

Avitaminoses

It is a tribute to the supply services that so few cases of deficiency disease have occurred: of the 34 cases admitted 31 were due to severe pellagra in non-British troops—there were no deaths. Nicotinic acid was given to the worst ones, and prompt modification of the diets in their camp put a stop to the outbreak.

Three cases of beriberi were admitted from the Western Desert; one was of the fulminating type with oedema and peripheral neuritis: this man died before we could treat him. The other two cases were mixed beriberi—one severe with great cardiac enlargement on x-ray examination, and the other mild; one of these patients had been for many months on desert patrols, and the other had been in the besieged Tobruk garrison. Response to injections of B₁ was rapid.

Relapsing Fever

It was not until we had been out here for some months that it became recognized that a tick-borne type of relapsing fever occurred in the Western Desert and was transmitted to troops living in caves and in holes in the ground. The disease is presumably similar to that found in Palestine and Iraq, but differs from louse-borne and African tick-borne relapsing fever. We have diagnosed 19 cases, but undoubtedly some were missed. The spirochaetes are very scanty in the blood, and large numbers of films, in several bouts, may have to be examined before they are found. The paroxysms of fever are brief, seldom lasting more than 24 hours, and resemble those of malaria; one patient at different times had both diseases, and was unable to distinguish between them. The resemblance to sandfly fever is close, as headache is severe in both diseases: many mistakes have probably been made, as patients with sandfly fever are usually discharged before the twelfth day, the usual date of the next paroxysm of relapsing fever.

This type of relapsing fever is characterized by brief bouts of fever with severe headache, giddiness, and usually splenic enlargement; the interval between attacks is 10 to 14 days. In a fair proportion of cases after a few paroxysms there are signs of involvement of the nervous system—lymphocytic meningitis or cranial nerve palsies, or a combination of both. The course of the disease seems to be unaffected by intravenous arsenical preparations, and there is a proved case in which 17 relapses occurred in spite of treatment. Stovarsol by mouth is at present being tried, and appears to be efficacious. The practical points about this type of fever are its frequent confusion with malaria and with sandfly fever and the difficulties of laboratory diagnosis in the absence of a supply of experimental animals; if prolonged observation is practicable the syndrome is characteristic enough to warrant a clinical diagnosis, especially if the nervous system becomes involved.

Bilharziasis

Although 18 cases of bilharziasis have been admitted, the only British soldier infected had caught it in South Africa: troops are aware of the dangers of fresh water in Egypt. The remaining 17 patients were Mauritians who had been infected in their own country. All the cases were due to *S. haematobium*. The only symptom was haematuria, and treatment with injections of tartar emetic was effective.

Kala-azar

In certain areas of Africa there is endemic kala-azar which is resistant to antimony and which gives rise to a curious clinical picture; one such area in the Sudan provided many cases, and five were admitted to us. The first case was quite baffling: the patient had a continued fever, splenomegaly, and leucopenia, and was regarded as a case of enteric-group fever until the persistence of the temperature began to raise very grave doubts—all laboratory tests had been negative. Brigadier Sidney Smith, the Consultant in Tropical Medicine, saw the patient and recognized his case as similar to the ones he had seen from the Sudan. Three other cases were later admitted from the same district, all presenting the same picture; it is unlikely that there will be more, as the area is no longer of military importance. In addition to the above-mentioned features the daily temperature charts showed a double rise in 24 hours, which is typical of kala-azar. The leucopenia and neutropenia were noted in all cases; but, apart from a positive formol-gel test in two cases, laboratory investigations were negative. We were unable to find Leishman-Donovan bodies in the spleen, marrow, or lymph glands, nor could we culture them from the blood. A fifth case similar to the other four occurred in a negro from the Cameroons, another recognized endemic focus.

We did not have an opportunity of treating our cases, as they were all transferred to one hospital in Cairo, where they were treated with neostibene, a new synthetic drug; the results were, I understand, excellent.

Effects of Heat

In this inland desert district the summer temperature is very high, usually over 105° and occasionally rising to almost 120° in the shade, but the humidity is low. No case of heat stroke (hyperpyrexia) has been admitted, nor has the condition developed in any patient under medical treatment in the wards. On the surgical side there have been a few cases of post-operative hyperpyrexia, probably due to heat stroke. Numerous cases have been sent into hospital as heat stroke, but every one proved to be an infection—malaria, sandfly fever, or septicaemia. I have constantly urged that, while the usual measures for reducing temperature should be at once adopted, a search for the infection must be made, and an intravenous injection of quinine be given if there is even the flimsiest suggestion of malaria. In other districts in the Middle East heat stroke has, I understand, occurred.

One case of heat exhaustion has been admitted to hospital. This occurred in a man who had had heat exhaustion in the Red Sea, from which he had only partially recovered on disembarkation; his arrival in this area unhappily corresponded with the record heat wave in May, 1941, when the shade temperature was just under 120°. His symptoms were marked weakness and complete anorexia; he was wasted and dehydrated, the systolic blood pressure was 62 mm. Hg, the temperature was subnormal, and the blood showed marked haemoconcentration. He was vigorously treated with saline solutions by all routes, adrenaline, and cortin; but he failed to respond, and died of suppression of urine on the fifth day of his stay. The necropsy showed no macroscopic changes in any organ, and the pituitary and suprarenal glands were normal.

Respiratory Diseases

TABLE V.—2,402 Cases of Respiratory Disease

<i>Acute:</i>		
Tonsillitis and pharyngitis	1,171	
Laryngitis, tracheitis, bronchitis	620	
Primary pneumonia	169 (4 deaths)	
Coryza	65	
<i>Chronic:</i>		
Bronchitis, asthma, emphysema, bronchiectasis	337	
Pulmonary tuberculosis	40 (2 deaths)	

Respiratory diseases were responsible for 17% of the medical admissions. There is nothing remarkable about the acute group except the high incidence of tonsillitis. Every case of pneumonia was treated with sulphapyridine, and the mortality was very low. While there were many atypical cases, I did not think the disease was different from what it is in England. The number of chronic chest cases was not very high, but the group is most important, as 126 had to be either invalided to the United Kingdom or re-graded for limited service in the Middle East. Too much stress cannot be laid on the fact that chronic chest conditions are greatly aggravated by the climate in Egypt and Libya, and men prone to such troubles should not be sent out here.

Skin Diseases

Of the 2,142 cases admitted to the skin wards 639 had scabies, which seems to be less common than in England; the routine treatment was with Marcussen's ointment. Most of the skin diseases were the common ones seen in England; prickly heat has been uncommon.

Desert sores have been a big problem in the Middle East, and many cases have been admitted to the skin wards. While I am not competent to disentangle this dermatological puzzle, the clinical aspects are simple: the sores are indolent ones, usually multiple, on exposed parts, chiefly forearms and legs, and often due to infected abrasions or insect-bites. The factor common to all types is their slowness to heal outside of hospital, their rapid healing in hospital, and their satisfactory response to a variety of remedies in hospital. Any sore or wound may be infected with the diphtheria bacillus by droplet infection, and, rarely, this happens in desert sores. The single very indolent sore has been suspect, so we swab them as a routine measure. We have had at least two cases of extensive

peripheral neuritis and one case of fatal heart failure in these diphtheritic desert sores.

Infectious Diseases

TABLE VI.—703 Cases of Infectious Diseases

Acute infective hepatitis	341 (1 death)
Diphtheria (faucial)	130 (4 deaths)
Mumps	118
Acute rheumatism	30
Enteric group	24 (6 deaths)
Measles (all forms)	17
Meningitis, benign lymphocytic	16
Polio-myelitis and encephalitis	8 (1 death)
Erysipelas	8
Meningitis, cerebrospinal	6
Scarlet fever	4
Meningitis, streptococcal	1 (1 death)

This table needs little explanation; the high incidence of acute infective hepatitis (epidemic jaundice), the very few cases of enteric fever, and the negligible occurrence of cerebrospinal fever and scarlet fever are obvious. It is probable that some of the patients with benign lymphocytic meningitis were unrecognized cases of relapsing fever. Mumps was almost limited to Seychellois and East African troops.

Acute Infective Hepatitis.—Although this has been the commonest infectious disease its aetiology is obscure and will remain so until a susceptible experimental animal is found. The disease is similar to the English variety, and no new treatment has been found; few cases are admitted in the pre-icteric febrile phase, when it is impossible to distinguish it from a short-term fever. The fatal case was admitted after a few days of jaundice; the patient did not seem particularly ill; but suddenly he became cholaemic and died within the first 24 hours.

Diphtheria.—Among so many cases of diphtheria in adults it is not surprising that the throat signs have often been atypical and resembled acute coccal infections or even quincy—suspicious throats are oftener swabbed than at home. It is not possible to give figures showing the incidence of paralyses, but they have been of a severity that was quite outside my previous experience: recovery has been slow, but in all cases it was complete, and even two cases of diaphragmatic paralysis recovered. The mortality of 3% from diphtheria is not high.

Enteric Group.—The 24 cases include typhoid, paratyphoid, and clinical typhoid fever, without laboratory confirmation. The low incidence is the result of the satisfactory state of the troops with respect to inoculation, but I have been impressed with the severity of the cases due to *B. typhosus*: inoculation did not seem to have modified the course of the disease once it was contracted. The mortality rate of 25% would be much higher if only cases of typhoid fever were considered. The disease remains uninfluenced by any treatment but good nursing, and the sulphonamide group is ineffectual.

Other Causes of Illness

There is a small unanalysed group of cases—surgical conditions overflowing to the medical division, miscellaneous diseases, and rarities—which will not be dealt with. Table VII contains an analysis of conditions which would bulk large in an English hospital but which accounted for only 16% of the admissions here; the figures are available for only the last 7,190 admissions, but there has been no significant change in their admission rate over the whole period.

TABLE VII.—Other Causes of Illness among 7,190 Admissions

<i>Nervous diseases</i>		
Organic	16	487
Psychosis	15	
Psychoneurosis	456	
<i>Chronic digestive diseases</i>		
Peptic ulcer	56	291
X-ray-negative dyspepsia	213	
Other diseases	22	
<i>Circulatory diseases</i>		
Effort syndrome	30	54
V.D.H. and other diseases	24	
<i>Chronic articular and non-articular rheumatism</i>		
Urinary diseases	73	240
Acute nephritis	13	
Renal colic, oxaluria, etc.	60	

Causes of Death

Thirty-two deaths have occurred, but seven were in untreatable diseases: cerebral tumour (2), cancer of stomach (1), cancer of hepatic ducts (1), acute monocytic leukaemia (1),

acute myeloid leukaemia (1), tuberculous meningitis (1). Table VIII shows the causes of death in the other cases, and, where applicable, the percentage mortality of the disease.

TABLE VIII.—Causes of 25 Deaths

Diphtheria (faucial)	4 (3%)
Diphtheria (cutaneous)	1
Acute primary pneumonia	4 (2.4%)
Malaria—blackwater fever	1 (0.13%)
Pulmonary tuberculosis	2
Bacillary dysentery	2 (0.10%)
Enteric group	6 (25%)
Acute infective hepatitis	1 (0.3%)
Streptococcal meningitis	1
Heat exhaustion	1
Encephalitis	1
Staphylococcal septicaemia	1

Conclusion

I have tried to condense eighteen months' work into a few thousand words, and have had, perforce, to appeal to figures and tables—always dull things; it is hoped that the main problems of Middle East medicine have been made clear.

We have not been working under conditions to which we were accustomed in peacetime. This hospital is built on desert which was uninhabitable three years ago; every possible amenity has been provided and we have ample safe water, a good hot-water system to the wards, electric lighting from a mains supply, and every reasonable drug and instrument. Three-quarters of the patients have been treated in tents and only the minority in the few hutted wards, conditions which would be impossible in England but are by no means ill adapted to this climate. I feel that the results of treatment could hardly have been bettered under our peacetime civilian conditions.

To practise in a country where tropical disease is rife is to get a glimpse into the future which is opening out before the advances of chemotherapy. While much of tropical specific therapy is old, much is new, and it has been a unique experience to treat bacillary dysentery with the newer sulphonamides. If from the cases treated here the ones amenable to specific chemotherapy are excluded—malaria, amoebiasis, bilharziasis, kala-azar, the avitaminoses, pneumonia, cerebrospinal meningitis, tonsillitis, and bacillary dysentery—there are only small groups of cases still remaining refractory. There is no specific treatment for enteric fever, or such virus diseases as acute infective hepatitis, coryza, and encephalitis or poliomyelitis. Sandfly fever is not important from the point of view of treatment, as it is so brief. Finally, I would again draw attention to the adverse effect of this climate on chronic chest diseases.

SPECIFIC IDENTIFICATION OF THE CHIEF PATHOGENIC CLOSTRIDIA OF GAS GANGRENE

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The isolation in a pure state and the identification of the chief anaerobes of gas gangrene—namely, *Cl. welchii*, *Cl. septicum*, and *Cl. oedematiens*—are everywhere recognized as being beset with peculiar difficulties, owing partly to the need of these bacteria for oxygen-free conditions of cultivation, and partly to their tendency to grow in cryptic association with other anaerobes in spite of prolonged efforts to obtain pure cultures. The method described below is likely to aid in their identification, since it depends upon the highly specific, lethal, and antigenic toxin which is characteristic of each of them. This method consists in growing the bacterial inoculum on the surface of agar to which an appropriate amount of one of the specific antitoxins has been added. During the growth of the colony toxin is produced, diffuses outwards from the

colony, and interacts with the homologous antitoxin to form a delicate but unmistakable precipitate resembling a halo round the colony.*

The method is identical with that which was found by one of us (Petrie, 1932) to serve as a differential test for rough and smooth strains of meningococcus, pneumococcus, and *B. dysenteriae* (Shiga) and to establish a clear distinction between group 1 strains (type 1 and type 3) and group 2 strains of meningococcus (cf. Branham, 1940). When, for example, a smooth strain of group 1 meningococcus is grown on an agar plate containing 5% of the homologous immune serum a precipitate is formed round the colonies which is composed of the polysaccharide complex (the somatic antigen) in union with the protein of the specific antibody, whereas in the anaerobic group under discussion the precipitate consists, in the final analysis, of a purely protein aggregate—namely, the toxin molecule in combination with a variable number of the specific molecules of the homologous antitoxin. Molecular aggregates of each kind, irrespective of the chemical nature of the reacting substances, become linked together to appear as a macroscopic precipitate in agar, as described below; in a fluid medium the product of the reaction takes the form of floccules. Soon after the publication of the earlier paper the author made a limited number of observations on the effect of seeding the Park-Williams No. 8 strain of *C. diphtheriae* on agar plates containing diphtheria antitoxin, when ring-like precipitates were noted round the colonies.

Technical Details of the Method

The method is essentially a simple one, and any difficulties that may be encountered are likely to be due to the strict necessity for providing a high degree of anaerobiosis in order to obtain adequate surface growths on agar plates; this proviso applies particularly to *Cl. oedematiens*.

The medium used is 2.5% agar containing the ingredients that are added for the routine production in this Institute of high-grade toxins of the three anaerobes. The basal medium is a horse-meat infusion broth (1 lb. to 1 litre of tap-water heated to 95° C. with 0.5% acetic acid, neutralized and filtered) together with 3.5% Evans peptone and 0.5% sodium chloride; pH adjusted to 7.8, 2.5% agar added, and the medium tubed in 17-c.cm. amounts and steamed or autoclaved. Before pouring the melted agar the following ingredients are added to it in sterile solution when the temperature has fallen to about 45° C.

For *Cl. welchii*: 2 c.cm. of a mixture containing 5 g. glucose in 100 c.cm. of a sulphated horse-muscle extract (Macfarlane and Knight, 1941), bringing the final concentration of the extract in the medium to 10% and of the glucose to 0.5%. For *Cl. oedematiens*: 2 c.cm. of the sulphated horse-muscle extract, but without glucose.† For *Cl. septicum*: 2 c.cm. of a mixture containing 5 g. glucose in 100 c.cm. heated normal horse serum (56° C. one hour) so that the final concentration of serum in the medium is 10% and of the glucose 0.5%.

Lastly, there is added at the same time 1 c.cm. of a dilution in broth of the appropriate antitoxin, which, when added to 17 c.cm. of agar and 2 c.cm. of extract or serum mixture, represents approximately 8 I.U. per c.cm. of the final medium. The special ingredients can be mixed to provide a sterile solution, and it is doubtless an advantage to add to each mixture an amount of *l*-ascorbic acid, which favours anaerobic growth by virtue of its being a reducing substance, to give a concentration of 0.025% in the final medium.‡

After the plates are poured they should be dried in an incubator at 37° C. for at least 5 hours in order to prevent motile organisms from filming over the surface. The plates may be spread in the usual way, or a heavy inoculation with a platinum loopful of a pure or reasonably pure culture may be implanted on the agar at any chosen site. The plates are examined after 24 or 48 hours' incubation at 37° C. anaerobically. If the resulting colonies are well grown but show no precipitate the plates should be placed at room tem-

* The Nagler reaction resulting from the diffusion of toxin from colonies of *Cl. welchii* on human serum agar plates is used to identify this bacterium (Hayward, 1941).

† There is reason to believe that for both *Cl. welchii* and *Cl. oedematiens* equally good results can be obtained by omitting the sulphated horse-muscle extract from the medium; the agar to be tubed should then be increased from 17 c.cm. to 19 c.cm.

‡ The special ingredients and antitoxin solutions should be kept preferably in a refrigerator, or otherwise in the coolest place available, and great care should be taken to preserve their sterility. Assistance will gladly be given in the technical application of the method if inquiries are addressed to the Lister Institute, Elstree, Herts.