the first two years of the war 22, or 8 per cent. only, occurred in sea-going ships. In the second year of the war the serum treatment, which had proved to be a failure in the previous year, was successful; 2,500 doses were issued from Greenwich, and the mortality fell 17 per cent., to 36 per cent. of all cases. This may be largely ascribed to the use of Flexner's multivalent meningococcic serum generously supplied gratuitously by the Rockefeller Institute, New York, and of Mervyn Gordon's various serums, which were not available during the first year of the war.

A number of cases clinically suggesting cerebro-spinal fever (meningismus) occurred, but no confirmation could be obtained by laboratory methods. The cerebro-spinal fluid was clear, though under increased pressure. No organisms were observed microscopically or by culture, and the blood did not contain any antibodies to any meningococcic strains.

Venereal Disease.

In the treatment of venereal disease, which is more in evidence than in most general civil hospitals, the essential intimate association of clinical and laboratory work is well organized. The diagnosis of syphilis by the microscopical detection of the spirochaete in the initial lesion, by the Wassermann reaction of the blood in the later stages, and by the cytological examination and the Wassermann reaction of the cerebro-spinal fluid in luetic lesions of the central nervous system is an established routine in the larger hospitals and laboratories, and the treatment by intravenous injection of arsenical compounds is universally controlled by the examination of the urine for arsenic. During 1916 the total number of Wassermann tests made was 16,766; at Haslar alone during that year 1,833 injections of arsenical compounds were given for syphilis; kharsivan was given on 1,522 occasions, galyl 55, and novo-arseno-billon 256 times.

Protozoal Infections.

As a result of the large number of men serving in tropical and subtropical regions protozoal infections have been frequent. These areas of active operations may be divided into three—(1) the Eastern Mediterranean and Mesopotamia, (2) East Africa, and (3) West Africa.

1. In the Mediterranean area malarial fevers have been most abundant around Salonica where low-lying swampy ground has been chiefly occupied; the disease has been very severe, and mostly of the malignant form caused by the *P. falciparum*, and the clinical aspect has not infrequently suggested enteric, dysentery, or sunstroke. As the infection is unfortunately very resistant to quinine, the most important prophylactic measures are the destruction of mosquitos by drainage and other methods. The largest number of cases in the navy occurred among the Royal Naval Air Service who live on shore. In the Gallipoli area malaria was not common, but short fevers of the dengue or sand-fly type, often described as "Mediterranean dengue," were very frequent. The knowledge that sand-flies are so often the infective agent has enlarged the scope of preventive measures, and a great reduction of these fevers may be expected in the future. Incidentally it is noteworthy that the prophylactic measures strictly enforced against undulant fever have practically eliminated this disease, which ten years ago would have filled the Mediterranean hospitals. This result emphasizes the value of the work done by a well-organized scientific Commission and of the practical application of its recommendations. The occurrence of many cases of beri-beri in the forces in this area proves the importance of an extended study of the food question and other factors concerned in such deficiency diseases.

2. In East Africa the necessity of thorough measures in the prophylactic issue of quinine is most important, as the prevailing type of fever is best controlled by this drug, which should be given both before and during the whole period that men are employed in the endemic area.

3. In West Africa, particularly in the Cameroon area, the varieties and frequency of protozoal and filarial diseases have been very noticeable, and prophylactic measures against them are therefore essential. Of malaria, which is very common, two types are constantly present, quartan and subtertian, the double infection being almost always found in the same case, frequently associated with Calabar swellings and filariae in the blood. In this region

tsetse flies are abundant and trypanosome infections have occurred in Europeans. Early search for these parasites is, therefore, most necessary, and appropriate treatment should be given as soon as possible. A case now at Greenwich of over eighteen months' duration shows how persistent treatment can control the disease, for there are practically no symptoms, although the parasite is pathogenic to white rats in eighteen days. The occurrence of mixed blood infections should therefore be suspected; benign and malignant malaria with trypanosomes or filariae have been found together, always associated with a high eosinophilia (up to 50 per cent.). The quartan malarial parasite is most difficult to eradicate and is very resistant to arsenic, recurring in the blood of those with trypanosome infections after a year's treatment with intravenous and intramuscular injections of antimony and arsenic.

No case of small-pox has been recorded in the navy during the period of the war, thus proving the value of vaccination, which has been compulsory since about 1858.

SURGERY.

BY

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The equipment of naval hospitals and their treatment of the wounded are on the same lines as in the best British and Continental institutions. If Haslar be taken as an example, the critical visitor would see that all cases of bacteriological importance are diagnosed and treated in association with a perfectly equipped laboratory, in which discharges are stained, cultures are made from blood and wound discharges, vaccines are prepared, and sections are cut of tissues removed from the body for the purpose of microscopical examination. Hence it is needless to point out further how great is the importance attached to the relation between the laboratory and the treatment of surgical disease in this hospital.

Treatment of Wounds Received in War.

The whole question of aseptic and antiseptic treatment has been revised and judgements passed upon the different methods of accomplishing each branch. On the whole, authorities are not satisfied with the aseptic treatment of these wounds. Although it appears successful in some cases, it fails too often in others to encourage its general use. The hypertonic salt solution has been given complete trial, with the result just stated. Wounds undergoing this treatment are liable to secondary or mixed infections. At one time the wounds in one of the wards at Haslar became secondarily infected with *B. pyocyaneus*; the appearance of this micro-organism was at once detected, and it soon disappeared by substituting the antiseptic for the aseptic method. Secondary infections very rarely occur in efficient antiseptic treatment.

In the early part of the war an investigation was carried out in the laboratories of Greenwich and Chatham Hospitals as to the best methods of treating war wounds with various antiseptics.¹ The real problem was to find a diffusible substance which could be applied at, or as shortly as possible after, the time of infliction, and which would inhibit bacterial growth until thorough disinfection and cleansing could be effected at a field hospital. Of the various substances tested, cresol and salicylic acid produced the best results, and appeared to be the most useful for the purpose required. A cresol paste (20 per cent. in lanolin and wax base) and a powder containing equal parts of boric and salicylic acids ("borsal") were introduced. These had given excellent results in laboratory infections, but met with less success in cases from the front, on account of the difficulties of time and places incident to war conditions. Successful cases have been reported from the Gallipoli campaign in which the treatment was adopted, severe gunshot and shell wounds remaining free from suppuration and healing readily.² That a cresol or carbolic acid paste is a valuable treatment for wounds on board ship is shown in a report on various cases so treated in a battleship,³ and wounds, including compound fractures, treated in Chatham Hospital by carbolic acid cleansing and liberal introduction of cresol paste healed well without suppuration.

At Haslar a "green spray" composed of equal parts of 2 per cent. malachite green dissolved in 80 per cent. rectified spirit and water, and 2 per cent. perchloride of mercury dissolved in 80 per cent. rectified spirit and water, has proved satisfactory. It is advisable to keep the two solutions separate, unless the antiseptic mixture is in constant use. The mixture contains 1 per cent. each of malachite green and mercuric chloride in the form of a compound— $C_{23}H_{25}N_2Cl_4$ (Micklethwait)—each molecule of malachite green combining with two of mercury. The compound is easily dissociated, and when it comes in contact with the tissues probably forms an albuminate of mercury and an albuminate of malachite green. The malachite green is reduced by living tissues to the leuco-compound, and therefore becomes invisible in a wound but still maintains its activity. Sloughs and necrosed tissues do not reduce the stain. The albuminate of mercury remains in the wounds as a *dépôt*, and is slowly dissolved by the exudates, and then exerts its antiseptic action. The bacteriological work on which the use of this compound is based and satisfactory clinical results were published in 1915.⁴ The mixture is non-toxic and can be applied to mucous membrane. It is a trustworthy germicide for sterilizing the skin before operations, and is applied by means of a spray. As it stains the skin green the area so treated is clearly marked out. When applied to septic wounds it practically stops secondary infection and steadily diminishes the number of pre-existing micro-organisms. Its value has also been proved in osteomyelitis, septic compound fractures, burns, ulcers, boils, and carbuncles.

The treatment of infected war wounds by physiological methods was inaugurated by Colonel Sir Almoth Wright, who introduced the physiological saline solution (0.85 per cent. sodium chloride) and the hypertonic solution containing 5 per cent. of the salt. He argues that the hypertonic solution inhibits and arrests bacterial growth, produces a lymphagoc action, and sets free a tryptic ferment for the digestive cleansing of the wound. Dressings should be applied warm, very wet, and covered with an impermeable tissue. If the position of the wound render it practicable, immersion in a 5 per cent. saline bath is the best procedure. The bath should be intermittent to allow of the alternating lymphagoc and digestive cleansing action. Normal saline dressing is used in the intervals. Extensive lacerated wounds with fracture caused by shell or bomb have more recently been packed with salt tablets wrapped in gauze folds, the whole being covered with jaconet. This dressing, which usually causes pain for some hours, can be left for two or three days provided the outer covering is moist with discharge, showing that lymph flow is active.

The use of hypochlorous acid as an antiseptic has come into prominence during the war, and chiefly in the form of eusol—a solution containing approximately 0.5 per cent. of the acid—has been extensively employed in naval hospitals. It is a powerful germicidal agent as proved by laboratory experiments, is non-toxic to the tissues, and being gaseous penetrates deeply to all parts of the wound. The solution of hypochlorite of sodium, 0.5 to 0.6 per cent., introduced by Dakin and Carrel is also in use together with the special method of injection tubes and light gauze packing to ensure contact of the fluid with the whole surface of the wound. Good results have been obtained from this treatment, the wounds cleaning quickly and a healthy granulating action appears. If employed for a long period both solutions have in a few cases produced oedema and irritation of skin. This can be prevented by vaseline smears.

The clinical results obtained by the use of a bismuth, iodoform, and paraffin paste⁵ in septic wounds, including compound fractures, has led to its employment in the naval hospitals with encouraging results. Though a less powerful and less soluble antiseptic agent than the hypochlorites, observation has shown that it maintains a continuous antiseptic action in the wound. It excites a free exudation of serum, and granulation tissue grows freely in contact with it. The wound after thorough cleansing is swabbed with ether or rectified spirit, a little of the paste is rubbed into the tissues, a thin layer being left in the deeper parts, and a gauze dressing applied. The dressing can be left on and the wound undisturbed for seven days or longer. This is an advantage, especially in compound fractures; it saves labour, dressings, and much distress

to patients. Drainage tubes are not required, as the paste does not prevent the escape of discharge. The constituents are toxic if freely absorbed; the quantity used, therefore, should not exceed two drachms.

At Haslar successful drainage of wounds has been obtained with a four-way drainage rubber staff, which in transverse section is a cross.⁶ It overcomes the accumulation of discharge which occurs in a tube if the opening be not dependent. When using the four-way staff the pressure exerted by the contraction of surrounding tissues is directed upon the discharges, which are forced out. With regard to the dressing applied to septic wounds generally, constant and repeated change is always the practice.

Burns.

Hitherto picric acid as a first dressing has been unrivalled, and septic burns treated by hot saline baths and boric fomentations, followed by a mildly antiseptic ointment of soft consistence, have healed readily and well. Médecin-major Barthe de Sandfort's "ambrine" treatment (vide p. 540) is now under trial.

Equipment.

For the treatment of the after-effects of severe injuries such as stiff joints, atrophied musculature, and nerve lesions, the naval hospitals are fully equipped. Surgical gymnasiums have been established and fitted with medico-mechanical apparatus to aid in the restoration of articular and muscular function. The forms of apparatus were designed to carry out by mechanical means the various movements and manipulations of the Swedish system of physical exercises, and include a combination weight and pulley apparatus—stationary bicycle—apparatus for foot circumduction, knee and foot flexion and extension, elbow pendulum with shoulder extension, frictional wrist machine, finger machine, shoulder circling movements, etc. The machinery can be set at any desired resistance by the aid of graduated levers and adjustable weights. For impaired articular movement radiant heat treatment (solarium bath) is also employed. Electrically the interrupted and continuous current in its various forms is in use, as well as the high frequency current, including diathermy. The system of testing muscle reaction by condenser discharges has been adopted. Ionization is practised extensively in a great number of injuries, and has been found particularly useful in obstinate healing wounds and in relaxing scar tissue. An excellent and complete x-ray apparatus is in use, with improved means for the localization of foreign bodies. All of the most recently invented splints are also available. Hey Groves's instruments for inducing and maintaining correct adjustments in fractured bones are in use.

The Wildey hypodermic syringe, designed by Deputy Surgeon-General A. G. Wildey, R.N., has been used with great satisfaction both in naval actions and in the field. The syringe with needle fixed is fitted into a metal sheath with safety-pin attachment by which it can be fastened to the coat and thus be readily available at any moment. The sheath, which can be quickly removed and replaced, protects it from dust and dirt. A spare needle fits neatly into the hollow piston. The syringe is used in conjunction with a solution bottle fitted with rubber cap, through which the needle is passed and the syringe rapidly charged.

The assistance afforded by accurately applied pressure in tourniquet work is shown by a metal tourniquet designed in Haslar.⁷ The freedom and simplicity with which its pressure can be increased or diminished with delicacy should encourage a more constant use of the tourniquet without fear of damage to tissues or of oozing of blood after the operations. Its advantages are best displayed during operations upon cases of traumatic aneurysm, aneurysmal varix, and varicose aneurysms. A rubber tourniquet is difficult to apply and remove, and when applied its pressure is greater than required and maintained longer than necessary. These drawbacks are abolished by the use of this new metal tourniquet.

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