to a smaller hospital ship which came alongside or by the ship herself proceeding to a port with rail facilities. In the latter case, the number and class of cases having previously been telegraphed, a fleet of motor ambulances and baggage lorries is in attendance on the jetty as soon as the ship is tied up. The clerical work, sorting of baggage, labelling for the different base hospitals, etc., has all been completed on the voyage, so that little time is spent over the actual disembarkation. The requisite number of cots are placed in readiness in each ward, and the patients who are unable to walk placed in them. Baggage and walking cases are got out first, the latter proceeding down a brow or the ship's gangway ladder. The cot cases are then brought up in rapid succession in the lifts, transferred to the tray, and hoisted out. Padded trestles are placed on the jetty to receive the tray, and the cots are transferred to the waiting ambulances (Figs. 12, 13). The canvas cots are uniform and interchangeable with those of the ambulance train, so that there is no further disturbance of the patient, the same number of empty cots being received from the train.

The Naval Medical Transport Department now takes charge of the cases, so that when the last patient and kit-bag are over the side the professional work of the ship ceases for a short space, and a proportion of the staff are enabled to get well-earned leave as the last weeks of the round trip are always strenuous.

ACCOUNT OF LAND MEDICAL TRANSPORT ARRANGEMENTS OF THE NAVY.

BY
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AND

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THE removal of sick and wounded from the scenes of their activities to the seclusion of a hospital is no small factor

in the general work of the Medical Department of the Navy.

To deal with this phase of medical work a special medical transport organization has been created. There

is a central office at the Admiralty for the Principal Medical Transport Officer, and thus in immediate touch with the department. Medical Transport Officers are established at the chief naval ports, and finally Assistant Medical Transport Officers have been appointed at all places round the coast where wounded are likely to be landed after action. At each of these places provision has been made for establishing dressing stations and temporary hospital accommodation for a certain number of cases until such time as an ambulance train can be sent to remove them to base hospitals elsewhere.

One of the difficulties of the problem of dealing with naval cases after action is the impossibility of arranging in advance or foretelling exactly at which spot and in what numbers wounded will be landed. Certain obvious bases, it is true, exist, to which ships able to do so would naturally return after an action. But at the same time these bases are wide apart,

leaving large gaps of coast line with many ports, into any one of which rescue vessels and smaller damaged vessels might be compelled to enter and discharge their wounded. Hence the establishment of what are termed emergency medical dépôts, with Medical Transport Officers in charge of each at various places along the coasts. Thus no likely place is left without means of coping with a sudden inrush of wounded and rendering medical aid to them.

Briefly, from the time a wounded man is landed from a ship until he is finally placed in hospital, he is in the charge of the Land Medical Transport branch of the Naval Medical Service. The system adopted by the Navy differs from others in so far that when a man is wounded severely enough to require immediate treatment in bed, after having received medical attention, he is, so to speak, put to bed in

FIG. 14.—Showing cots slung in ambulance train.

FIG. 15.—Showing method of carrying cot. Summer dress.

FIG. 16.—Showing method of carrying cot. Winter dress.

his ship in a standard naval cot and made as comfortable as possible in the circumstances. The naval standard pattern cot is composed of canvas stretched over a wooden frame and laced together. At each end of the cot the

FIG. 17.—"Gripe" and method of diminishing vibration for fracture cases. *a*, Anchor hook; *b*, chain; *c*, spiral spring; *d*, traveller; *e*, side of coach; *f*, fracture slat.

canvas is extended into a triangle, the apex of which is fitted with a lanyard and an "eye" for slinging purposes, while the canvas at the sides is wide enough to overlap, and so affords extra warmth and protection to the occupant. Each cot is fitted with a mattress, pillow, pillow-case, and two blankets. Thus it is in itself a complete bed wherever situated. From the time a patient is placed in a cot on board a fighting ship until he is finally put to bed in a hospital he is never moved out of it. He and his cot travel together all the way, thus saving much of the pain and suffering involved in the frequent transfers by stretchers, ambulances and trains.

To carry this out all the ambulance trains, motor ambulances, bearer-parties, and so forth, have been specially organized in a standard and uniform manner with regard to each individual link of the transport chain. This may be best described by tracing the journey of a patient from the commencement. The patient and his cot complete with bed and bedding are landed from the ship and turned over to bearers specially trained in the handling of cots. These bearers are drawn from ratings of the Royal Naval Auxiliary Sick Berth Reserve attached to the Medical Transport branch in the case of large naval centres, and in other places they are drawn from Voluntary Aid Detachments of the Order of St. John of Jerusalem in England and the British Red Cross Society. The bearers carry the cot to the ambulance or ambulance train as the case may be, and there it is placed in position. In exchange for the "loaded cot" the ambulance or the ambulance train gives a clean, empty, and fully-equipped standard cot for return to the ship from which the patient was received. In this manner the fighting ship always maintains her complement of clean cots.

When an ambulance or train is filled it moves off to its destination, and on arrival, the same exchange of cots is made as before, and so on throughout each link until the patient is finally taken out of his original cot and put in bed in hospital. By this method there is a constant outgoing stream of clean cots from the base to the ships at sea all ready for further service. Everything connected with the land transport of wounded is maintained in a state of immediate readiness, and finally, and most important of all, the wounded themselves are spared the sufferings caused by repeated transfers from ambulance stretcher to ambulance train and back again to another ambulance stretcher, etc. Also the time taken thus to empty an ambulance train is very brief, and the delay to ordinary passenger traffic practically nil. At the large naval bases arrangements exist for the cleaning of all cots and bedding, and a store of clean cots for exchange purposes is also established.

In the ambulance trains the cots are suspended in two

tiers from the roofs of the coaches. They are prevented from swinging by a spring clip, devised by Staff Surgeon Elder, which presses the cot against two padded buffers built in to the side of the coach. By this method the cot and patient do not form a component part of the coach. The jolting of the train over the metals is largely taken up by the suspension, while lateral jars when rounding curves and the like are absorbed by the padded buffers. Thus the cot has just enough "play" for comfort and no more, while the train is under way. The tension of the spring clip is adjustable at will, and, unlike the "fixed bunk" of military ambulance trains, every jarring movement of the coach is so minimized as practically not to disturb or distress the patient. Moreover, the coaches themselves when empty of cots have no fittings except a few chains and hooks, and are easily cleaned and disinfected.

As regards the ambulances in general, beyond being fitted specially to take naval cots instead of the military stretcher, they present nothing else of interest except a squadron of thirty motor buses. These buses were taken over from the London General Omnibus Company at the commencement of hostilities and were fitted with spring trestles on which the cots rest. They have proved satisfactory in every way and are just as comfortable for patients as the latest pattern specially built ambulances.

The emergency medical dépôts previously referred to and located at various places along the coast are supplied with "cot," "clothing," "hospital," and "medical units" respectively. The cot unit consists of completely equipped service cots, which can be used to form the nucleus of a temporary hospital in suitable local buildings selected in advance for this purpose. The hospital and medical units containing all the necessary utensils, drugs, and dressings, etc., are kept available for immediate use in these extemporized hospitals. The clothing unit, as its name implies, is for use of men suffering from immersion and lack of clothing, so as to enable them to proceed in dry clothes to wherever they may be sent.

In addition to preparedness for "The Day," the Medical Transport Department is continuously engaged in the removal of ordinary sick from the fleet at the various ports. The unloading of hospital ships from the fleet and overseas is also part of its duties. As far as the sick from

FIG. 18.—Interior of Naval Ambulance.

the fleet are concerned, an ambulance train leaves Edinburgh once a week, travels down the East Coast, picking up cases at towns previously notifying cases for removal, and then proceeds to Plymouth, where cases belonging to

that port are transferred to hospital. From Plymouth the train goes to Gosport, and thence to Chatham, where the journey ends, landing cases at their respective hospitals in each place. Thus the sick are taken each to his home port, and in close touch with friends and relatives. The round journey from Edinburgh to Chatham takes about thirty-four hours. During this time the patients are fed, each according to his prescribed dietary scale. In fact, everything is done for them while in the train. No stops are made except for gas and water or railway requirements when they arise. Owing to the pressure on the railway systems in the north of Scotland the full-sized ambulance trains do not as a rule proceed north of Edinburgh. Cases are brought as far south as Edinburgh from the north by a smaller train, a class of conveyance also found convenient and economical for distributing smaller numbers of cases to auxiliary hospitals, and so aiding in keeping the sea coast hospitals from congestion in emergency.

A full-sized naval ambulance train carries 136 cots and a smaller sized train 40 cots and 36 sitting cases. On routine journeys only the number of patients which a train has cot accommodation for are carried as a rule, so that every patient has a cot to sleep in at night. During daylight hours sitting accommodation is provided for non-cot cases by stacking two cots on the floor all along one side of the coach, a third cot being placed sideways on the uppermost one, and resting against the side wall of the coach. This forms a back-rest, and by this means very comfortable sitting accommodation is obtained which allows the men to sit back and stretch their legs, without interfering with or being disturbed by the ordinary traffic through the coach. Washable canvas covers are supplied for use when cots are thus stacked to keep them from being soiled. At night the cots are slung in position and the coach transformed into a dormitory.

All the trains are self-contained and, when in motion, self-supporting, carrying everything in the way of provisions, stores, and so forth, likely to be required on the journey.

The staff consists of two medical officers and thirty-six men, including cooks, clerks—all Auxiliary Sick Berth Reserve ratings—who live in the train continuously. In fact, the trains are practically commissioned like ships and worked as such in the way of duty, regular sea watches being kept day and night. For ordinary routine journeys nursing sisters are not carried, but a cabin is set apart for two in each train for use when required, as after a naval engagement or when any cases calling for their presence are being transported. The nursing itself is done, as in the navy afloat, by trained male Sick Berth ratings.

An interesting feature of the large naval ambulance trains is what is known as the "Day Coach."

It is fitted along the sides with sections of flap tables, lifting upwards, at which non-cot cases can sit and have their meals or do anything else. Under these tables is a row of wash-basins connected with water supply. These are for use after a night journey or as required, and become available by lifting up the flap table. At one end of each of these coaches two padded rooms are fitted for the more violent mental cases.

A small dressing station supplied with instruments and drugs is also provided. It may, however, be stated here that, practically speaking, there is very little to be done in the way of "dressings" except while

the train is at rest. For this reason also no "operating theatre" has been arranged, on the assumption that a case likely to require operation would not be travelling, and also, if such a case were encountered, operative measures would probably have to be applied at the cot side—time would not permit of the case being taken to the "theatre"; or, alternatively, the patient would be landed at the first opportunity.

A portable electric signalling device is fitted at each end of the train and coupled

up with the engine, so that communication can be made with the driver by means of a code of signals with reference to speed, heating, etc. The principal parts of the train are connected by intercommunicating telephone. The trains are lighted by electricity—dynamo while running and accumulator when at rest. Electric fans are fitted where requisite, and portable lights are

FIG. 19.—Sitting accommodation, ambulance train.

FIG. 20.—Day Coach, ambulance train.

arranged for in all the ward coaches. Gas is used for cooking only, and is carried under the kitchen cars and one car adjoining each kitchen, the cylinders being coupled up together; thus the danger of fire is reduced to a minimum. Heating of the coaches is by steam from the engine, carried in overhead pipes suspended from the roof. While running the internal air current circulates the heat very evenly, and at the same time the floor space is clear of any obstacle which might get in the way of a bearer party while handling a cot. Sanitary arrangements are ample—about 10 per cent. of the carrying capacity of each train, and consist of water-sealed pans. Arrangements are made for "trapping" these while trains come to a halt for any length of time. Large storage capacity for water, domestic and sanitary, is supplied to each train. For administrative purposes a small office is fitted up centrally in the train, and contains typewriter, safe, and the usual office furniture.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

INTRAVENOUS INJECTION OF SODIUM BICARBONATE IN DELAYED CHLOROFORM POISONING.

On January 12th, 1916, I removed a gangrenous appendix from a soldier who had been gassed. The anaesthetist began with ether, as chloroform is avoided at this hospital in acute appendicitis and also in cases where there has been starvation or vomiting for some days before operation. It was soon found, however, that ether was dangerous in this case, causing extreme cyanosis and profuse bronchial secretion, owing probably to the bronchitis that still remained from the "gassing," and it was decided to continue with chloroform, which the patient took well.

Next day the temperature had fallen, the pulse was good, there had been little or no vomiting, the abdominal condition was quite satisfactory, and the patient seemed much better and was reading the newspaper on my arrival. He had been getting sodium bicarbonate by the mouth and was taking fluids well.

Two days after the operation the house-surgeon reported that the patient was very sleepy, and was beginning to get jaundiced. Calomel and enemata were given, but the drowsiness increased. On the third day he was very yellow and in a state of coma, from which he could not be roused; it was accompanied by restless movements of the head and body when attempts were made to examine the pupils or to pass the catheter. Urine and faeces were passed involuntarily, and no specimen was procured to be tested for acetone and diacetic acid. To all the surgeons who saw him the diagnosis seemed obvious—secondary chloroform poisoning—and the outlook hopeless. His relatives had come from another town to see him, but he could not be roused. Hoping for a temporary rally, I decided to inject intravenously a solution of sodium bicarbonate, as recommended by Langdon Brown in diabetic coma.

The incision was unnoticed by the patient, and two pints of sterile water containing five drachms in all of sodium bicarbonate were injected into the median basilic vein. Before leaving the table the patient drawled out the words "Oh, I say," again and again, but still could not be roused, and continued to pass urine and faeces unconsciously till next day, when a slight return to consciousness was noticed, and he tried to answer questions, but at first with no sign of understanding them. A pint of sodium bicarbonate solution was given subcutaneously every six hours and also occasionally by the rectum.

Two days after the intravenous injection the return to consciousness became more marked and he began to talk a little, but seemed childish. On the third day the mental condition was practically normal. The appendix wound healed by first intention, but convalescence was delayed somewhat by an abscess in the pectoral region caused by the repeated subcutaneous injections, when the patient was restless, making it difficult to avoid sepsis. Otherwise recovery was uneventful and complete.

The interest of the case lies in the fact that recovery took place even after the onset of coma with involuntary passage of urine and faeces. In most cases of delayed chloroform poisoning (of which I have, unfortunately, seen several), the pulse is rapid and weak, the patient is breath-

less before the onset of coma, and death is almost certain when this stage is reached. Whether intravenous injection of sodium bicarbonate solution can avert a fatal ending in any of these is doubtful, as in the case recorded above the pulse was never weak and running, but the treatment is, at any rate, worth a trial.

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CASE OF TETANUS SUCCESSFULLY TREATED WITH ANTITOXIN.

THE following case is interesting not only on account of the success of the treatment adopted, but also owing to the probable mode of infection. The patient was a boy, aged 16, who worked in the gardens of a reformatory school, and probably infected himself with tetanus by scratching irritable vaccination marks with fingers contaminated with garden soil:

He was vaccinated with calf lymph on August 29th. The vaccination ran an ordinary course until September 10th, when the two scabs were knocked off by a boy in play. On September 14th he complained to the nurse matron that his arm was painful. When it was found that the arm was swollen and inflamed and the vaccination sores were discharging pus, mild antiseptic dressings were applied, and in a few days the arm was apparently quite well.

On September 23rd the boy reported himself sick to me, when I saw him for the first time since his admission. He complained of pain in the back, and that his vaccinated arm was sore; there was no pyrexia and the tongue was clean, but the vaccination marks showed as two ulcers with surrounding local inflammation, and the axillary glands were swollen and tender. He was sent into the school hospital for observation, and the arm was dressed with weak lysol. On September 25th he complained of severe pain in the back and stiffness in the muscles, which he said "passed off and then came back again." I was called in the afternoon and saw him at 6 p.m., when tetanus was evident. The spasms were characteristic, and risus sardonicus was present. Serum was not obtainable until 12.30 a.m., and then only 1,500 units. The dose was injected under the skin without chloroform anaesthesia. When I began to withdraw the needle it broke off in its entire length (1½ in.) owing to a very violent spasm; the needle was left *in situ* (the skin of the thigh). On September 26th more serum was not available, but the boy's condition was worse, the spasms being more frequent and more intense. His temperature was 99.2°, pulse 100 to 120. Slides from the discharging sores on the arm showed club-shaped bacilli; these were recognized as "presumably *B. tetani*" by Mr. W. Gough of Leeds.

On September 27th serum was at last obtained; 3,000 units were given in the early morning and another 1,500 at night. All injections were given hypodermically under chloroform anaesthesia.

The boy had become progressively worse (twenty-eight spasms were noted within three hours at night), there was marked opisthotonos, and occasionally pleurothotonos was noted; there was cyanosis, most intense during the spasms, with profuse perspiration. The breathing was much embarrassed, and he had bitten his tongue, which was a source of much trouble in feeding. The temperature was 99.8° (the highest recorded during the illness), the pulse-rate 100 to 140; chlorotone in 5-grain doses every two or three hours and chloroform inhalation during the spasms were ordered as the occasion required. On September 28th there was no change; 3,000 units were injected. The tongue was much swollen, with septic lacerations on either lateral margin; hydrogen peroxide and thymol were used frequently for swabbing, etc.

On September 29th the spasms were less frequent; he had begun to improve. On October 3rd he was covered with urticaria (13,500 units were injected from September 26th to October 2nd). On October 6th there were two spasms, the last recorded. After this he made an uneventful recovery. The broken needle was removed on October 20th through a superficial incision.

The great difficulty in treating this case was to obtain serum. There was a Zeppelin raid in progress on the night of September 25th; I only got serum, and that in an insufficient quantity, by motoring thirty-six miles; the night journey was enlivened by the activities of the Zeppelin, and the zeal of the policeman professional and otherwise.

In treating the case, the lacerated tongue rendered feeding most difficult; any form of gag—for example, a piece of wood or other substance—provoked spasm.

Chlorotone made the spasms less painful, and chloroform inhalation was useful. I may here pay a tribute to the nursing, which was most excellent night and day throughout the critical time.

The incubation period was probably from nine to eleven days until the first local muscular rigidity, which I did not recognize as being due to tetanus until the superadded clonic spasm appeared on September 25th.

A "sore arm" after vaccination in this school is not uncommon by reason of the boys "ragging." This is the first case of tetanus recorded in the school since its institution in 1856.

Malton.

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