to a deviated nasal septum, a kink in the intestine; or microscopical changes in the ovary.

"The letter killeth but the Spirit giveth life." Let us recognize that the old order has passed away from medicine, and the reign of the New Spirit has begun.

MEDICAL AND SURGICAL WORK AS A PRISONER OF WAR.

BY

ALEXANDER T. I. MACDONALD, M.D., D.P.H.,
TEMPORARY CAPTAIN R.A.M.C.

IN theory the latter part of the title of this article is perhaps not strictly correct. Under the Geneva Convention medical personnel taken by the enemy are not prisoners of war in the ordinary sense. They should be detained only so long as they are required to look after their own sick and wounded. But experience has taught us in this war not to place reliance on the binding force on our opponents of any international agreement to which they were parties, and in practice we found that this standpoint was not wanting in justification.

These notes are not intended to provide any comprehensive survey of German medical organization and work among the prisoners of war. They are rather an account, albeit somewhat fragmentary, of my individual experiences, which throw some light on the vaunted "efficiency" of our opponents, and show how their methods differ from our own.

The writer was taken prisoner at an advanced dressing station in France, along with a colleague, in March, 1918, the number of wounded urgently claiming attention at the time precluding any thought of getting away, even had the intense barrage permitted it. We had been working under difficult conditions at high pressure for some little time before the Germans made their appearance. Our dressing station was quite a new one and in apple-pie order on the morning of the attack. The windows of oiled silk material were the first things to be knocked out. During the preliminary bombardment with high explosive and gas shells they were quickly torn to ribbons, and they had to be replaced by pieces of blanket. Then when the barrage rested on the bank under which our three huts sheltered, our newly hung doors played us false and collapsed with a crash under the concussion of the shell bursts, allowing cascades of earth to enter the dressing hut from above. The blankets we had nailed over the windows were also blown off, and the earth entered these also. The carrying of patients who had been dressed into the "evacuation" hut was at this time rather an unpleasant business. Two bombs were thrown into this hut by the Germans as they approached the sunken road from above before they recognized that they were dealing with a dressing station.

We were held prisoners all day in our dressing station, treating our own and German wounded alike. Two men of the German medical corps were the only medical personnel with us during most of the time apart from a sergeant and two men of our own staff. The remainder of our own non-commissioned officers and men—dressers and stretcher-bearers—were ordered back immediately, and I am sorry to say that some of them were killed during the tramp over the battlefield through the German lines. Of the remainder, a number were kept in the captured ground for days, burying dead and making roads, living without shelter on the most meagre allowance of food. The two German *Sanitäts* repeatedly brought their wounded compatriots to us for dressing or advice. We injected antitetanic serum, as in the case of our own wounded, and though the operation was regarded at first with suspicion it was submitted to for the most part.

There seemed to be no medical officer with the German battalion, but only these men of the medical corps, or *Sanitäts* personnel. They carry a small bag of dressings containing among other things a hypodermic syringe and solution of morphine. The former is fitted into a bottle containing absolute alcohol to sterilize the needle. Stretcher-bearing, on our part of the line at least, was rather a crude operation as carried out by the Germans. A ground sheet, slung on a pole borne on the shoulders of two bearers, contained the unfortunate patient, whose

sufferings, if he had a fracture, must have been extreme. Other stretcher substitutes were also used—duckboards, for example. The stretchers used by the Germans further back are heavier than ours, but have certain advantages in the way of support for head, hinges for folding, and sliding handles; the two latter modifications enabled them to be packed in small space.

The German medical officers remain relatively far back, at the *Verbandplatz* or dressing station, and are attached to the regimental unit which corresponds more to our brigade. Thus we did not see a German medical officer at our advanced dressing station until nightfall, and he requested us to "carry on" while he busied himself with some food. He and two younger medical officers were much impressed by the completeness of our equipment and also by the quality of the dressings.

Going back in the dark we were taken to the *Verbandplatz*, a deep dug-out some four kilometres back. We wandered round the ruined village outside which it was situated for an hour and a half trying to find it, for our guide's bump of locality was but poorly developed. When we eventually reached it we were passed on elsewhere, a process which seems to have attained a high state of perfection in the German army. The meagre provision of surgical material at this station struck us forcibly. Splints consisted of pliable wire—two thick pieces joined ladder fashion by thinner pieces. This, while readily adaptable for fractures of bones of arm and forearm, is far too pliable when applied to the thigh and leg, as it often is. Another splint, Volkmann's iron gutter, is available for fractures of the thigh, but it does not secure extension or immobility in transport as does our own Thomas's splint.

Marching further back from this dressing station we passed the long line of German transport ready to move forward. Amidst a wonderful conglomeration of vehicles, including a brougham and pair, open landaus, Russian *droshkies*, we noticed the ambulance transport, consisting of small wagons each capable of taking two stretcher cases, drawn by two ponies, presumably of Russian or Rumanian origin, and each flying a small Red Cross flag. Thus it will be seen that the Germans adhere to the system of separating bearers and transport in their ambulance organization in the field. The *Feldlazarett* takes the place of our old field hospital.

Motor ambulances were not seen so far forward as they are in our own lines. Their deficiency in numbers is to some extent made up by attaching to each a string of two-wheeled trailers. The jolting in these must be hard on the patients.

After a tedious march spread over two days, and a dolorous experience of front line cages and prison lagers, we went for duty in a hospital for prisoners of war attached to one of the Bavarian *Kriegslazaretts*. The section for prisoners was established in a portion of a French hospital erected on the pavilion system. This hospital had been nearing completion at the beginning of the war. We found it full to overflowing with British wounded who were urgently in need of attention, as they had received no further dressing than the first. They lay on the beds, on stretchers, and on palliasses on all the available floor space in the wards above ground, as well as in the basement cellars. Our operating and dressing room was, to begin with, very dirty and sparsely furnished. A small coal stove served for the supply of hot water and the sterilization of instruments. A wash-hand basin was already fitted with a supply of cold water only, but as the waste pipe had not been fixed we had to run waste water into a bucket. The instruments provided were old, few in number, and partly denuded of plating; but this was remedied after two months or so as a result of a request to the *Chef-arzt*, who provided a set suitable for ordinary purposes. A gas stove was fitted later and the provision of electric light was completed.

After a time two sisters were sent to the hospital for duty, one of whom spoke English with some fluency, having spent a year in America. They made a considerable improvement in the arrangement and cleanliness of the theatre, confining themselves largely to work in it. The most rigid economy was entailed in the use of surgical materials. Sutures were of silk or plain catgut. Soap for washing hands was hard to obtain and varied much in appearance and cleansing powers. Soap powder with

sand, powdered washing soda, cakes made of a sort of clayey earth and of fine gritty material admixed with soap were supplied to us at various times, but sometimes none was available, and we went through the formality of hand-washing with hot water alone, trusting to prolonged immersion in sublimate solution to afford a degree of surgical cleanliness. For the latter reason, extensive use was made of dissecting and bullet forceps in doing dressings, and the wounds were not touched with the fingers as a rule. For the first month or so in the hospital we had long spells of hard work, for the most part draining wounds and compound fractures and removing foreign bodies. Rubber drainage tubes were scanty and were not supposed to be cut if not of suitable length. The bandages used were chiefly of paper. For securing splints, roller bandages made from lace curtains or cotton dress materials were used, albeit of necessity sparingly. These were collected from time to time, washed, and rolled again for use. A substitute for cotton-wool was provided in the shape of *Selkstoff*, made from paper. The better qualities of this were soft and absorbent, but the poorer, harder qualities were very bad substitutes. Benzol (substitute) was largely used in the process of preparing the skin, with tincture of iodine as a final application. For cleansing open wounds irrigation with diluted hydrogen peroxide was employed almost exclusively. Moist dressings of dilute solution of aluminium acetate on lint covered with jaconet were used for cellulitis. I endeavoured to obtain Dakin's solution for dressings, and succeeded in getting it for use in a case of gas gangrene.

There was no shortage of anaesthetics at the two hospitals at which I worked. Chloroform, ether, and ethyl chloride were available. In many German hospitals the latter is administered by the sisters for certain dressings. The patient's arm is raised at right angles to the body, and the administration of the anaesthetic ceases directly after the arm drops.

I may add to what I have said regarding splints that in fractures of the femur extension from a clamp applied to the skin over the lower end of the bone just above the condyles on either side is much employed by the Germans. So far as one could judge the skin over the points of pressure often became septic and sloughed, and the end results, seen later at another hospital, were marked by great deformity and shortening.

It is, I think, a testimony to the value of injection of antitetanic serum that we had few cases of tetanus among many hundreds of wounded. Four cases developed in succession in one ward. Two cases of gas gangrene were admitted, but no other cases were met with during five months.

Among the medical cases a variety of nephritis, and a condition (the result of slow starvation) characterized by weakness, shortness of breath, emaciation, oedema of the feet and legs, and anaemia, was frequently met, as was influenza, often followed by pneumonia. The latter occurred as a primary disease, too, and in the poor starved men, who sometimes remained at their camps without treatment for days before admission to hospital, was often rapidly fatal. Diarrhoea and dysentery were rife, especially the former. Impetigo, furunculosis, and scabies were, as might be expected, relatively common. The conditions first mentioned were especially noticeable among the newly captured men from the working camps around, who were not only starved but also dirty and ill clad, having disposed of part of their clothing for food. Many of these men before coming back to those prison camps had worked at the front in shelled areas, sleeping in shell holes with no means of washing, and on the poorest of food doled out in a fashion which would have delighted the heart of Mr. Squeers. They were not, of course, in receipt of Red Cross parcels, and their condition was very different from that of the older prisoners in the camp next to our hospital, who had been brought from Germany, and who had parcels with food, soap, and good warm clothing supplied to them from home.

The drugs, supplied chiefly in tablet form, were of good quality—acetyl salicylic acid, veronal (substitute), pyramidon, morphine, dionine, ipecacuhana and opium powder, "solvent tablets" (ammonium chloride and extract of liquorice), bismuth subgallate, subnitrate, and carbonate; sodium bicarbonate, urotropine (substitute), theobromine salicylate (diuretin), and so on. Great reliance was placed

by the Germans on the injection of oily solution of camphor as a stimulant.

Hospital Dietary under three Main Heads.

Form 1 (ordinary diet).—Breakfast: Black bread and coffee. Dinner: Half a bowl of vegetable or macaroni soup containing a small quantity of meat. On Friday this was replaced by boiled rice with a spoonful or two of dried fruit. Tea: Black bread with jam, "tea," or "coffee." Supper: Black bread, with occasionally a small piece of sausage, or bread and meal gruel.

The black bread was accountable for much diarrhoea. Often it was sour and contained a percentage of quite indigestible irritating gritty material. The latter came partly from adherent sawdust in which the loaves were rolled on baking. Coffee and tea were substitutes for the real article, of course.

Form 2.—This diet was similar to *Form 1*, except that three thin slices of white war bread with margarine were given in lieu of black, and a rather more digestible kind of soup was provided. In our hospital extras, such as a small amount of milk, an egg, or a small glass of wine, could be ordered. The eggs, however, were often bad, and the supply ceased during the summer.

Form 3.—This diet was supposed to be suitable for diarrhoea cases. It consisted of thin gruel, purée of potatoes, etc.

The white bread given was insufficient in quantity, and patients who became more fit usually asked to go on *Form 1*, even though the bread was black, for the sake of the larger quantity obtained.

The beds in the wards were of wood and roughly constructed. The mattresses were made of paper sackcloth filled with wood shavings, over which a sheet was placed. When the wood shavings became broken and flattened out by the patient's weight the bed was extremely hard, and bedsores were almost inevitable in helpless patients in spite of prophylactic care of the skin. The only air ring cushion in the hospital was leaking beyond repair and no other rubber cushions or water beds could be obtained. A shift was made with rings of straw covered by bandage.

Clean bed-linen was a rare commodity, and as there was no means of disinfection of clothing for bed cases lice were present in large numbers. After a time the *Generalarzt* of the Bavarian army, who inspected the hospital, provided a portable steam disinfector.

Baths were given to walking cases and personnel at a large factory in the town which had been fitted with a bathing and disinfecting station. The system here was good. When the soldier went in he undressed and put his leather articles and valuables in a numbered compartment of a large rack. His clothes he hung on a numbered coat-hanger, and this was then placed in one of several large steam disinfectors. The man then went to the bathroom, which was fitted with hot and cold water sprays and a limited number of body baths. On coming out he went into a room heated by steam pipes for a time until his clothes were ready. Later we had a couple of sprays fitted in a room in the hospital for the use of such patients as could stand a cold douche.

The conservancy system in the hospital was crude. Large pits were dug and lined with brick and cement; over these the latrine houses and seats were built. From time to time these cesspits were pumped out into horse-drawn tanks, an unpleasant operation. Needless to say these latrines were also a source of nuisance at other times. During the summer flies gathered in force.

We left this hospital at the end of August and spent several days at a prison at Condé on the French frontier, where our unpleasant recollections of poor food and vermin-infested blankets are tempered by the memory of the kindness of a French lady, living opposite the prison, who smuggled in to us bread, lard, vegetable soup and a ragout of haricot beans and potatoes as often as she could. We then travelled by way of Brussels, Namur, Luxembourg, Metz and Strasbourg to Karlsruhe; from there we went to Rastatt in Baden, our place of captivity for the next two months. From Rastatt five medical officers were sent early in November to Langensalza in Thuringia, but the day after arrival I was sent on with a colleague to Ohrdruf.

There was a marked difference between our journey from France to Baden and our later journeys by rail. Whereas on the first we travelled fourth class, and received one hot meal only—a bowl of soup—at a soldiers' refreshment room, on the later journeys we travelled second class and were permitted to have meals at the station restaurants. The last stage of our journey coincided with

the outbreak of the revolution. At the railway station our guard was deprived of his shoulder straps showing the number of his regiment, and his cap badges were also removed. Trains flying the red flag, crowded with troops without arms and badgeless, passed through the station. The red flag was flying over an aeroplane factory at Gotha, over the station and over various barracks. Aeroplanes flying low dropped leaflets over all towns and villages requesting the troops to join in the movement.

As a result of this change we were informed on arrival at our destination by a private soldier wearing a red armlet that he was now head of the hospital, and that all requests must be addressed to him. A new *Chef-arzt* of socialistic opinions was introduced to the hospital, but as he was closely supervised by the *Soldatenrat*, or soldiers' council, he was more or less powerless, and we had few dealings with him beyond drawing his attention to various matters in connexion with the sanitation of the hospital.

We left this hospital on Christmas Day by hospital train, taking all the British with us. Lying cases were conveyed to the station in pantechnicons, the floors of which were covered with mattresses. The hospital train provided by the Germans was good of its kind, and had enough bunks, with clean bed-linen, for the majority of the patients. A day and a half later we ran alongside the naval hospital ship *Garth Castle* at Stettin, where we were warmly welcomed, and on her we travelled in all comfort.

We returned from Germany with a higher opinion of British organization than ever before.

THE ADJUSTMENT OF RESPONSE TO NERVE STIMULUS IN VOLUNTARY MUSCLES.

BY

SURGEON COMMANDER G. M. LEVICK, R.N.,

MEDICAL OFFICER IN CHARGE, ELECTRO-THERAPEUTIC DEPARTMENT,
MILITARY ORTHOPAEDIC HOSPITAL, SHEPHERD'S BUSH;
CLINICAL ASSISTANT, ELECTRICAL DEPARTMENT,
ST. THOMAS'S HOSPITAL.

THIS paper is founded on the result of tests made upon many hundreds of men wounded in the present war, in the electricity departments of two of the largest military orthopaedic hospitals. The patients pass through these departments to be tested and treated for every grade of nerve injury, ranging from slight shock or compression to complete division. Nerves are sutured in the operating theatres, and their subsequent regeneration and the reaction of the muscles they supply observed through all the stages of recovery, while oncoming compression from formation of fibrous tissue in healing wounds may be observed with all its resulting effects upon the response of the muscles to various forms of stimulus.

The observations here recorded were made by means of an apparatus the essentials of which are a transmitting rod resting upon the skin over the muscle observed and attached to a tambour connected with a pen tracing its movements upon a revolving drum. This apparatus records the character of each muscle contraction with accuracy and reliability.

The electrical stimulus used was the closure of the circuit of a galvanic current by a metronome interrupter with mercury make and break. This gives a stimulus of indefinite duration.

Unless otherwise stated, both electrodes were placed over the muscle. When the term "normal" occurs in describing the contraction of a muscle, it is used to denote equality with the opposite and uninjured side. The metronome has in all cases been timed to interrupt sixty times a minute, so that the resulting contraction can, when desired, be expressed in fractions of a second.

It has not been considered necessary to record the temperature of the room or other details which might alter the character of the response in a small degree, because the value of the tests depends upon the comparisons between the muscles of the two sides, and the conditions have been identical for these in all cases. The tracings are reproduced from the original records made by the pen on the paper of the revolving drum.

The Contraction of Normal Muscle.

The first tracing (Fig. 1) shows the contraction of a normal muscle (biceps brachialis). The upstroke and

downstroke show that the contraction and decontraction of the muscle occupy practically the same length of time.

FIG. 1.

Never in this long series of tests has a muscle supplied by a normal nerve been found to show any visible difference in character from the same muscle on the opposite side, even though it may be so much wasted (as in a limb splinted for long periods for compound fractures) that a galvanic response is only obtained with great difficulty.

FIG. 2.

Fig. 2 shows the succession of contractions in a normal muscle produced by stimuli the strength of which has been gradually increased, and the tracings show that the smallest contraction produced by the weakest stimulus is exactly equal in length to the greatest contraction produced by the strongest stimulus. In other words, it shows that within certain limits the duration of contraction in a muscle is the same whatever its strength.

On one side of this limit are contractions excited by a stimulus so small that the resulting movement is partly lost by the yielding of the surrounding tissues, and on the other, contractions so violent that the surrounding tissues take appreciable time in returning to their resting position.

The wide range in the records shown in this figure are enough to demonstrate that slight variations in the height of the contraction when comparing two sides are quite immaterial. Another fact observed is that, except in cases of disease of the muscle, which do not come within the scope of this paper, successive contractions recorded from any muscle, whether the nerve be injured or not, are always the same length at any given observation.

FIG. 3.—Polar reversal (extensor carpi radialis longior).

Fig. 3 shows tracings taken when one electrode was placed over the normal muscle and the other at a distance. By means of a reversing key the poles were reversed before each stimulus, so that the contractions were excited alternately by the short sharp stimulus produced at the negative pole, and the diffuse stimulus of a virtual negative deep in the tissues. It will be seen that the length of the resulting contraction is the same in each case.

Abnormal Contraction of Muscle.

Palmaris longus (affected side).

Palmaris longus (normal side).

Flexor carpi radialis (affected side).

Flexor carpi radialis (normal side).

FIG. 4.

Figure 4 shows tracings taken from the palmaris longus and flexor carpi radialis of a patient whose median nerve had been involved in scar tissue. An exploratory operation had been performed, and the nerve was inspected and found to be as stated.

In this case, although the fibres of the nerve were compressed by the scar, they were not destroyed, because they were found to transmit a stimulus to the muscles they supplied when excited immediately below the constriction by the faradic current.

On comparing the contractions of palmaris longus on the affected side with the normal side, it is seen that