FIELD SURGERY IN THE JUNGLE
(KALADAN RIVER, ARAKAN, BURMA, 1944).

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[Received June 11, 1945.]

This paper is a record of the way in which the Medical Services were adapted to meet the demands of jungle warfare in circumstances probably not previously encountered.

A division of West African troops was instructed to make a Jeep track across the Arakan Hills, from the coast to the Kaladan River, where they were to conduct operations.

The country over which we moved has its own peculiar characteristics. Along the lower Kaladan River, the lower Pi Chaung and, in the Kalapanzin valley, are large areas of paddy field; all the rest of the territory is hill tract. The Arakan Hills are never high, few are over 3,000 ft. They are steep, sandy, ridges and peaks packed together as tightly as nature could compress them and divided by narrow deep valleys. Hills and valleys alike are covered by dense mixed jungle, mainly bamboo, the bamboo being as thick as stalks in a cornfield. Everywhere the monsoon torrents have cut deep, vertical, sinuous channels or chaungs through the sandy soil, some as small as ditches, others the size of large rivers. The native hill "paths" were paths in name only, climbing up hills with footholds cut into the steep hillside, along ridges scarce wide enough to give foot room or through chaungs filled with boulders, or interrupted by pools thigh deep in mud. They were hard going, yet it was through country often like this the African stretcher bearers carried their patients. There are, of course, no roads and, except in the areas of paddy cultivation, hardly any people.

For transportation we were limited to what could be carried on the heads of the Africans. Auxiliary groups of unarmed carriers and pioneers came with us and each man was able to carry a headload of forty pounds.

COMMUNICATION.—The operational zone was so extensive, so mountainous, and so thickly covered with bamboo that it was impossible to keep the rear free from enemy troops; many were by-passed. Infiltration by the enemy, with small or large bodies, was easy and it was soon apparent that no collection of wounded could be held or moved without strong protection. One C.C.S. was destroyed and the other evacuated, so that the Field Ambulances, and the R.M.O.s became responsible for all treatment of casualties. As casualties were assembled they had to be carried forwards by stretcher bearers, until the military position and the nature of the ground allowed an air strip to be built. One could never be sure when the wounded would be cleared; often they had to be carried for a week or more. Sometimes it was only possible to build a small "strip," suitable for Moths, which only took one case each trip; as there were not many of these 'planes, casualty clearance was an anxious and tedious business, but on occasion it was possible to make a large "strip" and big transport 'planes could clear the sick twenty or thirty at a time. This delay and uncertainty in evacuation had a considerable effect upon the nature of the surgical treatment called for. Many casualties occurred whilst the men were on patrol. If a wounded man was not too far removed from his Headquarters or, if he were a stretcher case, he could be sent back with an accompanying guard; otherwise he might have to await surgical treatment until the patrol returned. The battalions were operating on a wide front; rearward evacuation to the M.D.S. would have caused delay and would need a considerable number of troops employed in giving protection.

MEDICAL ARRANGEMENTS.—The Field Ambulance consisted of three companies and Headquarters. Normally the Headquarters would set up a M.D.S. where essential treatment
could be given and a company would be attached to each operating battalion, where it would form an A.D.S. It was decided to make a Jungle Surgical Team, fully mobile, which would

1. Have the minimum personnel able to set up and operate a theatre, with carriers for its loads.
2. Take with it all the surgical equipment, with a limited supply of drugs and dressings.
3. Attach itself to an A.D.S. which would supply an anaesthetist, a stretcher to serve as an operating table, and be responsible for the after-care of the patients, the replenishing of drugs and dressings and the rationing of the team.
4. The team would consist of a surgeon, a sergeant assistant, four nursing orderlies, two servants and eight carriers.

The personal baggage of each European was restricted to twenty pounds and the surgical load to two hundred and forty pounds. Instruments, drugs, dressings, schimmelbusch steriliser, splints and plaster, transfusion sets, pots and pans, ground sheets and blankets were packed into six forty-pound loads by the four nursing orderlies who deserve mention by name. They were Agbewodie, Aboadgye, Awusavi, and Gellie.

Theatre Set Up.—Arriving at the A.D.S. under the direction of Agbewodie a theatre would be built at the chosen site in the A.D.S. Two pairs of forked sticks were stuck in the ground, each supporting a crossbar, and on this a stretcher would be laid for an operating table. Two bamboo or brushwood tables to hold instruments and dressings would be made by the carriers, whilst others collected firewood and water in empty ration tins. Within an hour and a half the instruments were boiled, anaesthetics and dressings laid out, and the first case "On the table." Later, a thatch would be added over the "table" to give cover from the sun. At times, when there was a great deal of movement, as many as three of these "Theatres" were built in four days, but if it appeared likely that we would be stationary for a week or longer a more elaborate affair was constructed. Usually a dry chaung or a hillside was chosen in which a room was dug out, deep enough to give protection from mortar or artillery fire and thatched with grass or bamboo leaves. In the walls of the room recesses were dug to act as tables for instruments and dressings. These were lined with a blanket to prevent the earth dropping in, a jaconet cloth spread over the base and a sterile towel placed upon it in the usual way. This took one to two days to build but it was worth it to feel secure, even when the noise of battle was some distance away. It was not practicable to operate at night. Lights and fires were forbidden after sundown. The only means of sterilizing was with a small schimmelbusch sterilizer, heated over a fire of wood; the theatre could be blacked out with blankets but the poverty of illumination, the heat in the confined space and the difficulties of movement without breaking the blackout made night work too difficult to be worth while.

The water supply when it came from the streams was good, fit in an emergency to be used for the making of intravenous salines but, in the paddy, the tanks and pools usually contained liquid mud; cloth filtration made no improvement but it partially sedimentated after boiling. This water, which normally would not be used for the meanest purpose, served to make up lotions, to use in the sterilizer, and from it prodigious quantities of tea were made. In the hills at times there were cholera outbreaks, but it was difficult to believe that the epidemics could be waterborne; the country was very sparsely populated and the streams crystal clear and water hygiene good. Most probably it was spread by flies. These pests abounded in the secondary scrub, they even travelled with us on the packs and headloads and refused to be dislodged. When camp was made, they bred at a alarming rate, invading everywhere; the theatre was always a favoured place and one man was detailed to chase them during operations.

The hospital at the A.D.S. was as primitive as the theatre. Litters of bamboo supported on forked sticks served as beds and a slit trench was provided alongside; the only cover from the sun was the shade that the jungle provided. Little nursing could be given and little comfort provided, although the patients were always most appreciative of what was done.
MOVEMENT.—Everybody engaged in this campaign was constantly on the move. Casualties usually had a difficult stretcher journey to the R.M.O. and A.D.S. The A.D.S. was constantly packing to move with the troops; the patients had to be carried with them until an air strip was provided. On several occasions over two hundred casualties were collected. If the theatre had packed up when wounded were brought in, they had to wait until the move was completed before surgical attention could be given. Little nursing could be done on the way. The following case is illustrative of the effect that movement had on treatment.

An African was brought to the A.D.S. twenty hours after being wounded. He had a penetrating G.S.W. of the abdomen; there was no air evacuation available and he had to be operated upon. After resuscitation, two large tears of the ileum were sewn up and the remains of an Ascaris removed from the peritoneal cavity. During the ensuing twenty-four hours there were so many casualties that scant attention could be given to him. The next evening he was carried to a newly made air-strip, six miles away over rough country, to be ready for evacuation early the next morning. On arrival it was found that protection could not be given against the enemy patrols that were operating so he was brought back over the same six miles. The journey was more successfully repeated the next morning, and he reached a Base Hospital five days after being wounded. It is a tribute to the African constitution to report that by the time he emplaned he was drinking copiously and demanding food.

Evacuation to a Base Hospital was preferable to jungle treatment, but the uncertainty of air evacuation soon convinced one that, if treatment was to be given quickly, it had to be done by the Jungle Team in spite of all its limitations. On one occasion this was not done, and the result was almost fatal.

An officer with a compound comminuted fracture of the humerus, badly shocked, was carried to the A.D.S. over a long and difficult stretch of country. He arrived seventeen hours after being wounded. He responded a little to resuscitation, but operation was delayed since a plane was expected to land at a newly completed air strip. It did not come until two days later, during which time the operation was postponed repeatedly, and he had received two further wounds in the thighs caused by the enemy mortaring the A.D.S. By this time he was too ill for treatment. He was eventually evacuated, his arm amputated, and his life saved.

MONSOON CONDITIONS.—Enough of the rains were experienced to realize that the method of setting up a theatre in the dry season would not then work. A theatre, on one occasion, had been made on the reverse side of a hill on raised ground. A large tarpaulin was firmly secured to cover the operating stretcher and instrument tables. A soldier wounded by mortar fire was brought in six hours after he had received his injury. Amongst others there were two tiny penetrating wounds of the abdomen which appeared to have penetrated the ascending colon. He was prepared for operation, a continuous drip plasma started, and he was anaesthetized. At the moment when we were about to begin operating the sky became black and the rain torrential. The wind, violent and gusty, blew rain all over the patient; everybody was shivering. Moreover, it lifted leeches from the paddy and deposited one on the bared chest of the anaesthetist! Darkness, cold and leeches were too strong an opposition so the operation was abandoned. He reached a C.C.S. within forty-eight hours, was operated upon and two perforations found. I believe that he survived.

The material from which this report is compiled is obtained from eighty-five serious cases of which a personal record was kept; unfortunately it was not found possible to record them all and no record could be made of a large number of the less seriously wounded.

THEATRE TECHNIQUE was dictated by transport restrictions but certain elementary principles were kept in mind. Effort was made to avoid wound contamination. The skin around the wounds was washed and shaved, skin towels of pocket handkerchief size were used, digital contact either with the wound or with the working ends of the instruments carefully avoided. After gaining a little experience the four African nursing orderlies became as skin conscious as the most particular orthopaedic surgeon. Gloves were used, whilst they were available, since they could be sterilized in stronger lysol and scrubbed more vigorously than
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hands could be. They were boiled only in exceptional cases, but climatic heat and humidity spilt them and they could not be replaced. The shimmelbusch sterilizer consists of an oblong box, about two feet by one foot, in which instruments are boiled, inside which can be tightly fitted another box about ten inches high. This receptacle holds two dressing drums with the usual perforated ends. If a good fire is burning a strong current of steam saturates the dressing boxes, and dry "sterile" swabs and towels can be obtained. The antiseptics carried were lysolates (used for gloves and bowls) and flavine. All water used was heavily chlorinated. Sulphonamide was introduced into all wounds as a cream surface covering, and given by mouth. Lastly, every effort was made to conserve limbs. No lower limb was amputated and only one upper limb removed.

The sites at which injuries occurred are shown below.

<table>
<thead>
<tr>
<th>Thigh</th>
<th>Calf</th>
<th>Arm</th>
<th>Forearm</th>
<th>Face</th>
<th>P.</th>
<th>N.P.</th>
<th>P.</th>
<th>N.P.</th>
<th>P.</th>
<th>N.P.</th>
<th>Other Sites</th>
<th>Burns</th>
<th>Multiple injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>12</td>
<td>17</td>
<td>9</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>24</td>
<td>28%</td>
<td>2%</td>
<td>25%</td>
</tr>
<tr>
<td>20%</td>
<td>14%</td>
<td>20%</td>
<td>11%</td>
<td>2%</td>
<td>6%</td>
<td>6%</td>
<td>34%</td>
<td>6%</td>
<td>1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P = Penetrating Wound. N.P. = Non-penetrating wound.

Fractures.

<table>
<thead>
<tr>
<th>Femur</th>
<th>Tibia and/or Fibula</th>
<th>Humerus</th>
<th>Radius and/or Ulna</th>
<th>Other sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

FIRST AID.—When the measures available for first-aid are considered, it should be remembered that all equipment had to be head loaded, that water was never "on tap," and that the combat zone was always moving long distances over rugged country. Many were wounded on patrol; a patrol might last a day or a week. Immediate wound toilet was impracticable, but sulphonamide powder was applied to the wound surface and a sterile dressing put on, and an improvised splint applied if required. Sulphonamide tablets were given by mouth. In this unpopulated country pyogenic organisms were uncommon. The average time a case took to reach the A.D.S. was twenty-two hours, excluding four cases which took from sixteen to four days.

CONDITION WHEN FIRST SEEN.—The local condition of the wounds was good. Only in three cases was pus seen. It was present in a compound fracture of the femur, untreated for sixteen days, in a compound fracture of the ulna and in an abscess formed in a small subcutaneous splinter wound, considered by the soldier to be too slight to need attention, until the abscess formed. The amount of tissue necrosis was considerable and putrefaction of a dead muscle occurred with surprising rapidity. One flesh wound of the calf stank from the diffuent dark flesh eighteen hours after the injury was received.

SHOCK.—In many cases this was severe; in the absence of a sphygmnomanometer, the chief guides were the pulse rate and volume. I found it most difficult to estimate in the African and most serious operations were preceded by a plasma drip. Many factors aggravated it. Often there was the stretcher carry, before skilled first aid was available, over the usual troublesome tracks; heavy fluid loss due to heat and the difficulty of providing enough to drink aggravated this. One case gave dramatic illustration to this. A disengaging action was being carried out, loads were packed, and the troops ready to march. As the column was moving off a European was brought to the A.D.S. with extensive superficial burns of the face, both arms, neck and chest, back and patches on the abdomen and legs. The M.O. applied an emergency dressing of tannifax, the only treatment then available, and gave morphia. For the next seventy-two hours he was carried on a stretcher, the morphia was repeated at suitable intervals, but he was unable to absorb fluid since he started vomiting. Unfortunately little could be done on the line of march, except to replace the dressings which he tore off in his restlessness. The last ten miles of the march took place during the hottest part of the day across paddy field heated to a furnace temperature. The patient's restlessness became delirium and the delirium changed into coma. On arrival in harbour he was moribund. As
quickly as possible an intravenous glucose saline drip was set up and within a quarter of an hour he was conscious, rational and cheerful. The drip was continued during the night and in the morning a full toilet was made; twenty-four hours later he was evacuated by plane, in good condition and eating well. Subsequently he recovered without disability.

**Wounds.**—When a bullet meets with little resistance during its passage through the body it makes a "clean drill," for which little treatment is needed, but when underlying bone is struck or the shot is tangential, there is commonly a wide laying open of tissue demanding a full debridement. Fragments from Japanese grenades seemed to produce small, superficial wounds with little tissue damage, often confined to peppering of the skin, whilst those from other missiles gave the more typical deep internal pulping.

**Operative Procedures.**—With the "clean drills," excision of the wounds, with a gauze pull-through to clean the track, followed by the insertion of a small amount of sulphonamide powder was the usual procedure. This I have called "Wound Excision." The term debridement is here only used when the entire wound is exposed, after a suitable skin toilet, all foreign matter removed, dead and damaged tissue excised and the area made haemostatic. A high proportion of wounds receiving debridement were sutured either completely or partially and usually immobilized by plaster of Paris or Cramner wire splinting.

In many cases full debridement was impracticable or perhaps there were numerous small injuries that merited no more than first-aid treatment; these are classified as Wound Toilets. Tables referring to the nature of the operative procedures employed, and to the causative agent are given here.

**Operative Procedures.**

<table>
<thead>
<tr>
<th>Debridement</th>
<th>Wound excision</th>
<th>Wound toilet</th>
<th>Other procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>21</td>
<td>13</td>
<td>18</td>
</tr>
</tbody>
</table>

**Causative Agents.**

<table>
<thead>
<tr>
<th>Bullets</th>
<th>Fragments</th>
<th>Burns</th>
<th>Non-battle</th>
<th>Multiple wounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>37</td>
<td>2</td>
<td>8</td>
<td>21</td>
</tr>
</tbody>
</table>

**Consideration of Special Injuries.**

Fractured femora were put up satisfactorily in a "Tobruk" splint but fractures of the humerus were difficult to deal with. It was not often possible to immobilize them in a plaster spica, though injuries of the shoulder joint had to be done this way. A reasonable degree of comfort was given using Cramner wire, a U-splint on the inner and outer sides, and a long L at the back, the whole wall supported and firmly bound to the chest; but I was dissatisfied with this. Other limb fractures were immobilized with bivalved plasters. The only penetrating head injuries were moribund on arrival and I have no record of them. None was operated upon. The majority of the penetrating chest wounds were associated with haemo- or pneumo-thorax. Debridement of extensive chest lacerations was usually impracticable although it was done for the smaller ones. These large wounds received a thorough cleaning, some excision, and a liberal sprinkling with sulphonamide and were closed with an airtight suture. They are classified as "Toilets." Aspiration could not be wisely done with the instruments available and, although no infection was seen whilst they remained in my care, I think it probable that some became subsequently purulent. Of the wounds of the abdomen two were obviously unsuited for operative treatment and both died whilst receiving "resuscitation." One twenty hours old was treated successfully, and another forty hours old operated upon under the stimulus of the previous success. There was little peritoneal soiling from the multiple perforations but he died from secondary shock, in spite of a transfusion begun at the moment of arrival at the A.D.S. Chloroform anaesthesia, the only one practicable, did not help these cases. A monsoon storm caused the abandonment of another operation. Few non-lethal facio-maxillary injuries were met with; the Dental Officer provided splinting with wire when required.
Infection.—The infrequency with which pyogenic infections occurred has been commented upon, and it is not surprising that no case either of tetanus gas or gangrene was noted.

Apart from the injuries to the integument of the genitals, there were only two genito-urinary cases of interest. In one there had been a "clean drill" of the corpus cavernosa, passing through the urethra and doing only trivial damage. An indwelling catheter for three days cured that. Another had a burst of machine gun fire through the upper thigh. One shot had penetrated the sacrum, the bladder, and the pubic bone. Circumstances did not allow an exploration of the bladder and suprapubic drainage was useless since he could not be nursed on his face, for artillery fire kept him in his slit trench most of the time, and he still leaked through the sacrum when the bladder was drained.

Anaesthetics.—Under the prevailing conditions it had been decided that anaesthetics should be limited to chloroform, local and pentothal. The doctor most readily available was the anaesthetist, and the Chaplain frequently and most efficiently gave the anaesthetic when there was no doctor. Local was increasingly used, either to provide a wide regional block, or a nerve block. The following anaesthetics were given.

<table>
<thead>
<tr>
<th>Anaesthetic</th>
<th>Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloroform</td>
<td>42</td>
</tr>
<tr>
<td>Local</td>
<td>29</td>
</tr>
<tr>
<td>Pentothal</td>
<td>2</td>
</tr>
<tr>
<td>None used, except Morphia</td>
<td>13</td>
</tr>
</tbody>
</table>

Sickness unfortunately interrupted an effort to trace the end-result of these cases, and no figures can be given, but the opinion made by contacting a few of them, and by discussion, was that the end-results were largely as anticipated. Late sepsis was not observed in any appreciable degree.