in ambulant personnel is described, for which the term "subclinical malaria" is proposed. Specific treatment is also briefly described.

I have much pleasure in thanking the Director-General of the Royal Air Force Medical Service for permission to publish this paper. I am deeply indebted to many for help in the work. In particular I wish to thank Wing. Cmdr. W. P. Stamm for numerous useful suggestions, Fl. Lieut. R. D. Tonkin for assistance in the wards, Squad. Ldrs. R. J. O'Connor and M. Nelson and their able technicians for examining thousands of slides, and Sister M. Giles for suggestions about treatment. Finally a special word of thanks to Dr. Greer of the Colonial Service for constant advice and support.

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REMOVAL OF PROJECTILE FRAGMENTS AND IMMOBILIZATION OF WOUNDS IN FORWARD AREAS

BY

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Trueta has applied John Hilton's principle of rest to the treatment of war wounds, through the agency of the plaster cast. This factor, immobilization, and another one in the attainment of rest in wounds in forward areas—the removal of the causal projectile foreign body—form the subject of this paper.

The Projectile Foreign Body

Trueta (1944) quotes Friedrich as aiming at complete excision of wounds, removing bacteria by excising the contaminated tissues in a single mass, like a malignant ulcer. Even those who attempt to carry out this aim most faithfully (Yudin, 1943) cannot do so in most instances without imperilling vital structures. Trimming and laying open for drainage is the best that can be done in the vast majority of cases. Incidental to this is the removal of projectile fragments. "The length and direction of a penetrating wound are unknown till the projectile has been located, nor has the tract been laid open throughout its extent till it has been removed" (*Lancet*, 1944). The attempt to remove the foreign bodies which act as guides to those "very complicated cavities," wound tracts, will help to establish the true nature of the wound (revealing, for example, a severed nerve, a torn joint synovial membrane, or a crack fracture), hitherto unsuspected.

"Time spent on reconnaissance" by x rays is "seldom wasted." "A forward operating centre without an x-ray unit is incompletely equipped, and only under exceptional circumstances can the omission of this important accessory service be justified" (*Lancet*, 1944). The passage of shell or mortar fragments often opens areolar planes, splitting fascia longitudinally, which closes behind them. This split may well be missed in the initial operation on the wound, and unless skiagrams are taken the presence of the foreign body may not be suspected. Fatty areolar tissue, moreover, opens before the entering projectile fragments and closes behind them as if never penetrated, and the fasciculi of coarse fibres of the deltoid and gluteal muscles rearrange themselves after the passage of a projectile, rendering a "blind" search uncertain of success. No surgeon can write complacently "Wound excised" on the patient's card unless he has had the patient x-rayed and the causal projectile demonstrated and removed. A blister or discoloured patch in the skin often acts as a guide for subcutaneous projectile fragments, and an incision there will reveal the foreign body and drain the wound tract. But deeper fragments have no such stigmata, and skiagrams are necessary. In the field the time required for accurate location as in hospitals at the base may not be possible. But views in two planes can always be taken, giving a sufficient guide.

A recent tragic case illustrates the complications that may ensue through leaving projectile fragments *in situ*.

Case History.—A C.C.S. orderly, wounded on March 17, 1944, in the C.C.S., was taken to the theatre two hours after wounding. He was found to have a shell wound at the outer aspect of the left

thigh, through the superficial fibres of the vastus lateralis. The wound was considered tangential, and layer by layer its edges were trimmed and then left open. Routine sulphanilamide powder, vaselined gauze, and a light plaster-of-Paris bandage were applied. He was evacuated on March 19 in fair condition; no undue pain had been complained of. Lieut.-Col. W. M. Capper, O.C., surgical division of a general hospital, has supplied the further history. "Admitted March 20, 1944, obviously ill and in pain. Pulse 140. Left leg tender and swollen; dark-brown oedema extending up thigh and over abdominal wall almost to umbilicus, and present in popliteal space also. Plaster removed. Local wound clean and not tender." After blood transfusion: "Operation. Wound explored locally and found to pass across thigh. There was escape of considerable amount of gas. . . . A large F.B. (about 2 in. by 1 in.) was found in an abscess cavity behind the femoral vessels. Pus and anaerobic oedema had tracked up and down the femoral sheath, and it was therefore present in the upper thigh and in the popliteal space; sartorius, rectus femoris, and vastus externus were excised, and part of the adductor magnus; he was too ill for amputation. In spite of parenteral sodium penicillin in large doses and A.G.G. serum, the patient died on March 21."

The foreign body was unfortunately missed at the primary operation. Even in a wound considered merely tangential, a skiagram should have been taken. The attempt to remove the F.B., guided by the skiagrams—antero-posterior and lateral views—would have opened the tract and given the required drainage in an area peculiarly liable to anaerobic infection.

In treating abdominal wounds the actual foreign body is often ignored. "The discovery of foreign bodies in these cases is of little importance. They may be difficult to locate in the posterior abdominal wall, and time spent in searching for them is wasted. They may also be difficult to distinguish from fragments of bone where part of the spine or pelvic girdle has been fractured in the tract" (Blackburn, 1944). But in the abdominal cavity, where vital structures are involved, the role of the foreign body, acting as a signpost directing the track of the wound, is most important. If the attempt to see the foreign body and actually feel it in the open wound is not considered essential, the preliminary view of its shadow on an x-ray plate is most valuable. It gives a clue to the probable viscera injured, and a guide to the position of the incision in the abdominal parietes.

In one campaign criteria for the removal of foreign bodies were when they were provoking pain, causing pressure on important structures, or aggravating sepsis (Mason Brown, Dennison, Ross, and Divine, 1940). Sooner or later the majority—H.E. shell fragments, mortar, bomb, or grenade fragments, pieces of projectiles from long-range artillery such as "Anzio Annies and Archies"—give rise to trouble. They press on nerves and erode blood vessels. The poisonous nature of certain projectiles, moreover, must be remembered. Blaxland (1942) describes a case of fatal phosphorus poisoning from a bullet.

If embedded near sphincters or in joints the constant movement in these places greatly reduces the chance of the foreign body being walled off by fibrosis. Not being walled off, the foreign body will act as a continual source of irritation and delay healing. At all times they are a potential source of sepsis liable to acute exacerbation. Though the "primary" metallic foreign bodies themselves may be sterile owing to their heat (and the familiar blister in the skin overlying the fragment that has not quite perforated testifies to this frequent high temperature), the "secondary" foreign bodies they carry in—mud, bits of equipment—are teeming with organisms. "Many of the most serious complications of infection, particularly secondary haemorrhage, can be traced to retained foreign bodies and the contaminated clothing around them" (Donald, 1944). The search for the metallic foreign bodies visible in the skiagram will help to find these non-opaque "secondary missiles, such as clothing" (Law, 1944).

A prolonged hunt for foreign bodies in shocked patients is unjustifiable, and the field surgeon leaves those in certain areas—i.e., the thorax and the head—to his colleagues with special facilities at their own centres. But in the general toilet of wounds as many as possible must be removed. The search is also advisable for psychological reasons, for patients invariably want to know if the bullet has been removed, and ask for the gory relics as souvenirs: extracted shrapnel demonstrates to the patient that his treatment has not been skimmed.

In compound fractures the examining finger almost certainly will not be able to distinguish between projectile fragments and loose portions of bone, but, as such bony fragments require removal, nothing is lost by removing the loose hard lumps found in the depths of such wounds. Special instruments—e.g., Bergonié's electric vibrator, D. A. Willis forceps (Hamilton Bailey, 1942)—are not available or required in forward areas: a long pair of artery forceps or bullet forceps are sufficient.

Immobilization

Transportation of wounded is an administrative task. Field surgeons must assist this by making their patients fit for transportation. In the Middle East campaigns 1940–3 "travel over rough desert tracks was generally regarded as the most serious ordeal for the badly wounded man" (Wilson, 1944). Methods of immobilization had to be learnt that would stand up to the gruelling test of a long evacuation line. Once again, with recent Allied advances, the same rules apply. In the rows of patients laid on stretchers in the tents of a staging unit the faces of men correctly splinted contrast strongly with the apprehensive haggard appearance of those in whom a loosely fixed Cramer wire splint or an insufficient plaster slab has utterly failed to prevent every jolt and bump shaking up their wounds. "I had a stiff journey, sir, as it went bouncing up and down," is the usual expression of patients, pointing to an unsplinted limb. Careful plaster technique pays on the line of communication: firm, evenly applied plasters are far more comfortable than crumpled, cracked, and ragged-ended efforts.

All *flesh wounds* of any extent should be adequately protected. A penetrating wound over the scapular angles or the point of the heel will become the seat of cellulitis unless carefully padded. Wounds of the flank need covering by a plaster plaque—not merely a many-tailed bandage, which rucks up so easily. Penetrating wounds of the shin region treated without x-ray facilities should invariably be immobilized in a plaster. Cracks in the tibia occur very often with modern projectiles, and, if immobilized, many hours of misery are saved before reaching a centre where a skiagram puts the diagnosis beyond doubt. In addition, reactionary haemorrhage from the crural arteries is apt to occur in calf wounds if these are not immobilized in plaster casts. Light plaster casts are also advisable to protect amputation stumps on their journey down, and now plaster corsets are recommended for abdominal wounds (H. Rogers, 1944).

Gunshot wounds of the vertebrae should be immobilized in a padded posterior shell. With partial injuries of the spinal cord, and when the cauda equina is involved, any chance there may be of recovery when the patient reaches a neurosurgical centre is irrevocably lost if no attempt is made to prevent further damage to the nerve tissue by broken laminae fragments and foreign bodies. The risk of pressure sores in a well-padded plaster shell is a minor matter compared with this much graver possibility. The plaster may be a dorsal shell, extending as far forwards as the anterior axillary line at the sides and including the legs and feet to prevent foot-drop, or a lesser shell fixing the trunk only, if there are no neurological signs. A fractured spinous process travels much better in a posterior shell than lying on a stretcher merely protected by cotton-wool. When complete paraplegia is present, however, rigid immobilization is not so necessary, because irremediable damage has occurred; still, such a case will travel better in a well-padded plaster shell.

Fractured pelvic bones should be similarly fixed; a few turns of elastoplast and a rolled-up blanket on each side are most inefficient immobilizing agents in such cases.

"A striking feature of war injuries is the preponderance of wounds of the extremities" (Trueta, 1944). "All forward surgeons must be orthopaedists up to a point" (Donald, 1944). Limb wounds should therefore receive as much attention as more spectacular abdominal injuries. In a C.C.S. recently, over a period of 4 months, in 687 patients with 873 lesions, 717 were limb wounds—i.e., 82%. In another 3-months period, in 204 patients with 299 lesions, 237 were limb wounds—i.e., 79%.

In *fractures of the acetabulum and upper third of the femur*, often with large gluteal wounds, the Thomas splint is unsatis-

factory, and a Whitman plaster should be applied. Two standard methods for fractures of the shaft of the femur are fully described by Buxton (1942, 1943). The complete "Tobruk" plaster—i.e., enclosing the limb in a plaster case and then fixing this in a Thomas splint by further plaster bandages—gives the best immobilization in cases with gross comminution. The "double cuff" method—i.e., a cylinder of plaster-of-Paris round the limb and bars of the Thomas splint, incorporating the adhesive strapping extension already applied—gives adequate immobilization in most cases. Rotation of the limb outwards in this method is prevented by rolls of cotton-wool on each side of the limb between it and the Thomas splint bars underneath the plaster. Some prefer strapping applied to the unshaven skin for better traction; but as secondary suture at the base is favoured by a clean-shaven skin shaving is preferable. In the cuff method, moderate tension is maintained on the fracture by inserting the usual "Spanish windlass" stick between the tapes or cord leading from the extension strapping to the end of the splint. A fixed extension after the principle of one method used at orthopaedic centres (Charnley, 1944) is therefore obtained. If the tapes are carried round the side bars of the Thomas splint before knotting over the end of the splint the effect of extension is largely lost. The foot and heel are generally left out in this method except when foot-drop is present owing to sciatic-nerve injury. Meticulous attention must be applied to the sling under the heel; if carelessly applied, and twisted, a pressure sore will form in 24 hours. The Thomas splint, slightly bent at the knee, is preferable to the straight splint in those appliances, as the knee-joint is thus kept in the optimum position of slight flexion.

Compound fractures of the tibia are immobilized in an above-knee plaster. This, however, in itself is not enough. Such plasters have the knee slightly flexed. A pillow or folded blanket is required under this bend to prevent the limb rolling outwards and the main weight being borne on the heel. Such a pillow or blanket often shifts, and the heavy, slightly angled plaster then lies loose on the stretcher. The patient invariably tries to twist himself over on one side to let the leg lie outwards, flat. With other wounds present as well, this may be difficult or impossible. In any case, the patient lies in an awkward strained position. The problem is solved by placing the limb encased in a plaster on a Thomas splint supported by the method L. S. Rogers (1943) devised. A foot-piece of a large size is taken and plastered firmly to the splint with the circle end downwards. A piece of Cramer wire 2 ft. long is plastered across the base as a horizontal rest. With this support, which is a self-contained apparatus, the patient can be moved from a stretcher to a bed without disturbing the position. The limb is elevated in this method; "I consider this precaution [elevation] of the utmost importance in preventing oedema and consequent constriction" (Trueta, 1944). The contraindication to this method is when grave vascular damage has occurred—i.e., when the posterior tibial artery has been involved. Such cases require the limb to be below the heart level, to conserve the blood supply.

All *penetrating or perforating wounds of the foot*, with compound fractures of tarsal and metatarsal bones and phalanges, should be immobilized in plaster casts. Wounds dressed merely with cotton-wool and gauze become painful: the foot swells and the patient tends to hold it in an equinus position unless immobilized. Sepsis also is rendered liable, in spite of penicillin and chemotherapy, and secondary suture at the base is jeopardized. This applies especially to wounds of the tarsal bones, so liable to osteomyelitis. 100% of compound fractures of the os calcis arriving in South Africa (D.M.S. Middle East, 1943) required amputation. The plaster boot stopping half-way up the leg is not sufficient; unless the cast is carried up over the curve of the calf muscles to the level of the tibial tubercle it is quite insecure. A Cramer wire splint is a most unsatisfactory immobilizing agent, except for the most temporary occasions. It is too apt to work loose, as it cannot be moulded accurately to the limb contours like a plaster.

Compound fractures of the scapula, clavicle, and humerus should be immobilized in a thoraco-brachial plaster. Flannel bandages are not sufficient; they have a great tendency to unwind in this position with restless patients. The application

of this plaster cast has been greatly facilitated by Jack's (1943) contrivance. The axilla is well padded. The humerus itself is immobilized by a "plaster from the nape of the neck down over the elbow and up to the axilla" (Buxton, 1942) and approximated to the side. The elbow is fixed at a right-angle and the forearm brought across the front of the lower chest. The forearm is immobilized by an ulnar plaster gutter extending to the heads of the metacarpals, with fingers free for full movements. The whole, including the shoulder on the affected side, is incorporated in a circular plaster round trunk and limb. A patient thus fixed can travel comfortably, and is more portable than in the aeroplane-splint position, with shoulder abducted to 90°.

Wounds of the carpus and forearm require padded split plasters, immobilizing the joint above and below the site of the fracture; the metacarpo-phalangeal joints should remain free. Metacarpal fractures, if not fixed with a firm dorsal slab but merely by a gauze bandage, will invariably arrive at base with the hand in an acutely palmar-flexed position—the worst possible for rehabilitation if not corrected immediately.

Wounded joints also need immobilization. Several severe reactionary haemorrhages have been observed from the deltoid muscle in wounds of that muscle also involving the shoulder-joint that were not placed in a thoraco-brachial plaster. When a foreign body is present in a joint, failure to immobilize is inexcusable. All penetrating wounds of the knee-joint should have strapping extension applied and the limb put in a Thomas splint. Any case in which the knee-joint has been aspirated should be similarly treated: a perfunctory plaster slab or Cramer wire splint is inadequate, and indeed inhumane.

Elevation of the limb in plaster limits oedema and constriction; often simple elevation in itself is equivalent to the administration of a sedative for relief of pain. It is safe, in addition, to pad and split plasters. "Don't use unpadded plaster casts in the early stage of treatment; even if it is proposed to split the cast and to elevate it, don't use an unpadded cast" (McIndoe and Watson-Jones, 1944). This applies especially to wounds of the hands; the rapid and extensive swelling of the dorsal subaponeurotic space with injuries as well as in whitlows makes splitting of a plaster enclosing the hand imperative. The splitting means not merely a division of the plaster cast by a slender knife-cut and not a partial splitting leaving upper and lower ends of the cast intact, but freely opening the cut at least 1/4 in. to allow for expansion the whole way down. An unpadded, unsplit plaster, enclosing the toes and forefoot for injuries there, should never be used. It is similar to the old Scottish instrument of torture "the boot," and a patient in one suffers accordingly. Splitting of the plaster cast itself may not be sufficient. Circular gauze bandages underneath the plaster must be cut, for when caked with drying blood they form constriction bands like iron rings.

Lack of immobilization may mean an endeavour to maintain free finger, toe, and joint movements. It has been noted that excessive splinting has done much harm during the war, especially through its effect in causing stiffness of the joints of the hand (Ritchie Russell and Harrington, 1944). But pros and cons of early movement, particularly in the treatment of fractures, recently under discussion again (Burns and Young, 1944), are not the concern of the surgeon in forward areas. Without immobilization the more immediate risks of shock, haemorrhage, and grave infections are run. Firm immobilization must therefore be one of the most important tasks of the forward surgical team.

In conclusion, one criticism of the plaster cast must be remembered: "The early stages of gas gangrene are easily overlooked or discounted, and the risk is increased by the modern closed methods of treatment" (Osborn, 1943). In a recent series of 44 cases of gas gangrene, however (MacLennan, 1944), in no case was the onset attributed to too tight a plaster. Keeping the warning in mind, the use of the padded split plaster is safe and sound.

I am grateful to Brig. F. A. R. Stammers for his advice and discussion over many of the problems discussed above. I am also grateful to Lieut.-Col. D. M. Mitchell for permission to record the above observations; to Capt. R. W. Ross for many suggestions; and to Pte. J. H. Foulds, R.A.M.C., for his painstaking and accurate recording of the case histories on which the above opinions are based.

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THE RISE IN INCIDENCE OF SCABIES IN A CLOSED COMMUNITY USING ORDINARY SOAP, AND ITS SUBSEQUENT FALL ON THE SUBSTITUTION OF 5% TETMOSOL SOAP

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In a series of previously published papers Davey, Gordon, and Unsworth (1944) have shown that soap impregnated with tetmosol (tetraethylthiuram monosulphide) to the extent of 5, 10, or 20% cures a high proportion of animals infected with mange due to *Notoedres*. The same authors and their colleagues (Gordon, Davey, Unsworth, *et al.*, 1944) proved that soap similarly impregnated with 20% tetmosol cured 80% of established human cases of scabies due to *Sarcoptes scabiei*.

In addition to proving the curative value of tetmosol soap these authors made a much more important observation, in that they proved that tetmosol soap completely protected animals against the acquirement of scabies due to *Notoedres*. This fact, considered in conjunction with the remarkable curative properties of tetmosol soap when employed in connexion with human cases of scabies, caused them to make the recommendation that this soap should be used in infected communities to prevent the spread of the disease. The idea of employing such a universally used substance as soap as a vehicle for the sarcophticide has obvious advantages, for, if it could be shown that it protected against scabies and that little risk of dermatitis attended its use, the soap could be issued to the population without the necessity for parades or any other medical supervision. This method would be not only of great value in wartime but of still greater value in post-war Europe, when dealing with crowds of homeless refugees. At our suggestion Dr. Kenneth Mellanby (1945) carried out a test of the prophylactic and curative value of 10% tetmosol soap in a mental hospital where scabies was endemic. Of 1,213 patients who acted as controls, 1.8% were infected at the start of the experiment, 2.1% after six weeks, and 3.5% after 11 weeks, a total of 24 new cases having occurred in the community. Seven hundred and five patients, of whom 13.2% were infected, had 10% tetmosol soap issued to them in place of ordinary soap; at the end of six weeks the percentage of infected had fallen to 1.3, and was found to be at the same level after a further five weeks. In contrast to those using non-medicated soap, not a single new case had occurred. As a result of his investigations Mellanby came to the conclusion that: "These experiments show that tetmosol soap can act as a very efficient means of

* Working under a grant from Imperial Chemical (Pharmaceuticals) Ltd.