GUNSHOT WOUNDS OF THE HEAD IN 1940.

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In a recent series of gunshot wounds of the head certain points emerged which call for comment at the present time. The classification followed is that of Cushing (1918), but with the small number of cases involved it has not been necessary to use all of Cushing's types. In addition, the cases have been subdivided into two main groups: non-penetrating or penetrating, depending on the integrity or otherwise of the dura mater. In gunshot wounds of the head the condition of the dura is the most important item of information required by those responsible for treatment and assessment of the amount of disability. If the dura is penetrated the liability to intracranial infection is greatly increased and the risk of subsequent epilepsy is probably also enhanced.

TABLE I.—GUNSHOT WOUNDS OF THE HEAD.

<table>
<thead>
<tr>
<th>Variety</th>
<th>No. of Cases</th>
<th>Complications</th>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>NON-PENETRATING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scalp wound</td>
<td>9</td>
<td>Local osteomyelitis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local osteomyelitis and subdural abscess</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Local osteomyelitis and brain abscess</td>
<td>1*</td>
</tr>
<tr>
<td>Local fracture with intact dura</td>
<td>6</td>
<td>Local osteomyelitis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abscess around F.B. in scalp</td>
<td>1</td>
</tr>
<tr>
<td>PENETRATING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressed fracture with dural tear</td>
<td>1</td>
<td>Subdural hematoma and brain fungus</td>
<td>1</td>
</tr>
<tr>
<td>Penetration of brain with fragments of bone</td>
<td>6</td>
<td>Brain ærocele and fungus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brain fungus</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purulent leptomeningitis</td>
<td>1*</td>
</tr>
<tr>
<td>Penetration of brain with fragments of bone and metal</td>
<td>6</td>
<td>Brain ærocele and fungus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Purulent leptomeningitis</td>
<td>1*</td>
</tr>
<tr>
<td>Cranio-cerebro-orbital</td>
<td>1</td>
<td>Brain fungus and abscess</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td></td>
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</tbody>
</table>

* Deaths.

THE EFFECT OF GUNSHOT WOUNDS ON CONSCIOUSNESS.

This series of cases shows some striking differences from the closed head injuries of civil life. The first of these is the frequency with which consciousness is retained at the moment of impact. Seventeen of the twenty-

1 From the Military Hospital (Head Injuries), Oxford.
nine patients did not lose consciousness at the time of injury; they remembered and could describe its effects. The usual story was that the patient was knocked over by the impact and then got to his feet, to continue fighting, or to walk back to the aid post. Some of these patients lost consciousness fairly soon after injury, e.g. after walking 150 yards, or at a later stage, especially if given morphia in dosage of $\frac{1}{2}$ to $\frac{1}{3}$ grain; but the typical unconsciousness of concussion, as seen in civil cases, was absent. In a further 6 cases unconsciousness did occur, but was only momentary. Thus, 23 of 29 patients did not have the clinical syndrome of concussion.

The absence of concussion is not to be explained by the high incidence of non-penetrating wounds. The cases without initial loss of consciousness include 3 penetrating frontal lobe injuries; and 5 of the 6 cases with only fleeting loss of consciousness were cases of penetrating injury (2 frontal, 2 occipital, and 1 temporal). Moreover, in the majority of the scalp wounds there is distinct evidence of brain damage, as illustrated by the following case:

Case 1.—Guardsman J. D. (Serial No. 46) received a scalp wound in the right parietal region, and immediately his left arm and hand became numb and useless. He did not lose consciousness, and his leg was not affected. During the next week his upper limb gradually recovered, though he often dropped things from his hand. Then the wound suppurated and he developed a right parietal subdural abscess, with return of brachial monoplegia and later considerable motor and sensory weakness of the left leg. The subdural abscess was opened and drained twenty-nine days after injury. The patient recovered and returned to duty four months after his injury.

In many scalp wounds the evidence for brain damage is in the focal signs such as those described above. In cases of scalp wound in which there are no focal signs there may still be intracranial damage, as in the following case:

Case 2.—B. McN., a civilian, aged 25 (R.I. No. 9709), received a long scalp wound of the vertex from bullet or bomb fragment. He did not lose consciousness, but suffered from frontal headache of gradually increasing intensity. Four hours after injury there were no neurological signs except diminished tendon jerks, but lumbar puncture showed slightly but uniformly blood-stained fluid under an initial pressure of 200 mm. water. Thirteen days after the injury the cerebrospinal fluid was normal (initial pressure 100 mm.). The patient made a complete recovery.

In spite of the absence of concussion effect, consciousness may frequently be lost at a later stage, from a variety of causes. The assessment of delayed unconsciousness may be difficult, and it is important to recognize that extreme fatigue may play a considerable part in producing it, especially when combined with routine injections of morphia.

Of the six patients with a story of prolonged unconsciousness after injury (duration between eight hours and several days), one was an unreliable witness, another was probably hit by falling masonry as well as by a missile, and a third was dysphasic and his field card notes were incomplete. The remaining cases were as follows:—
Gunshot Wounds of the Head in 1940

Case 3.—Pte. H. R. (Serial No. 226). Gunshot wound of left external auditory meatus. A fragment of metal penetrated and lodged in the vermis of the cerebellum. His last memory was of carrying a message for his platoon commander, until he awoke in hospital in England. He was unconscious for several days.

Case 4.—Pte. D. G. D. (Serial No. 34). Tangential wound of right temple, the missile shattering the right side of the frontal bone and right orbit, with exposure of a large area of the right frontal lobe. The patient was unconscious for five days.

Case 5.—Pte. A. D. (Serial No. 49). Left parieto-occipital gunshot wound, with indriven bone fragments. Blood in the left middle ear (with temporary deafness on recovery of consciousness). This patient was unconscious for twelve hours after the injury and had further lapses of consciousness during the next few days.

It is difficult to draw conclusions from such a small and to some extent selected group of cases, especially in the absence of accurate notes on the state of consciousness during the first few days after injury. But it is remarkable that cases of foreign body penetrating the frontal and parietal lobes showed no loss of consciousness, whereas a foreign body passing through the petrous bone into the cerebellum (Case 3) produced unconsciousness which lasted several days. Is the unconsciousness (concussion) of closed head injuries of civil life due to commotion of the whole brain, or to damage to some part of it, such as the brain stem? A carefully documented study of the state of consciousness after penetrating gunshot wounds may throw some light on this problem. The case notes should record the degree and duration of the unconsciousness from the earliest possible moment after injury. Does the patient respond to questions in a normal or drowsy manner? Or does he only respond to loud shouts, or to painful stimuli?

Focal Symptoms.

Another respect in which gunshot wounds differ from closed head injuries is in the frequency with which they are followed by symptoms of a focal character. The following cases illustrate this point.

Case 6.—Sergeant J. H. (Serial No. 157) was struck in the right occipital region by a shell fragment. The bone was fractured and fragments of it penetrated the right occipital lobe. He does not recall the noise of the shell-burst, but remembers feeling himself moving, and he was thrown two and a half yards by the explosion. He saw a moving mass of red and black colours. For a few seconds after striking the ground he was unable to move. He rapidly regained movement, first of his right arm and then of his whole body, and he was able to speak and get up. He found that he was completely blind and he had to be led back to the command post seventy yards away. Here he was able to make out the light of a paraffin lamp, but nothing more. By the time he had reached the Field Ambulance one hour later he was still unable to distinguish more than light or dark. On the following day he was operated on; the skin wound was excised and sutured, after presenting bone fragments and pulped brain had been removed.

On the second day after injury some sight returned in his right upper visual fields. On the fourth day after injury he could make out faces and other objects to his right side, but these were still blurred. On the tenth day he could read printed words on his field card and could see clearly in his right fields and not at
Hugh Cairns

all in his left fields. During the next eight weeks there was gradual improvement of the left upper visual fields and his ability to read became almost normal.

When seen by us about ten weeks after the injury he had a steep-edged congenial left lower quadrant hemianopic hemianopia, and his visual acuity was 6/5 in each eye. There were no other neurological signs. X-rays showed fragments of bone in the right occipital lobe.

After the injury this patient had deafness, tinnitus, and some discharge from the right ear which gradually passed off completely.

This case illustrates the well-known fact that focal damage to the brain after gunshot wound is by no means solely due to the penetrating foreign body. Bone fragments entered the right occipital lobe, breaking up the upper half of the right geniculo-calcarine pathway with a resultant left lower quadrant hemianopia of permanent character. The initial symptoms, however, were those of complete blindness. During the following days vision recovered in an orderly manner: first in the right upper fields, then in the right lower fields, and finally, after some weeks, in the left upper fields. The permanent damage was of very limited extent and corresponded to the track of the foreign body. The temporary damage affected a wider, but, if we may judge from the clinical evidence, fairly sharply defined zone; and the severity of this completely reversible process varied inversely with the distance from the site of injury.

The focal damage that can be produced without penetration of the brain is illustrated by the following case:—

Case 7.—Guardman A. C. (Serial No. 78) was struck by a bullet which made a large hole in the back of his steel helmet and produced a scalp wound and fissured fracture in the left occipital region, without any depression or penetration. He did not lose consciousness, but his sight became misty. He was able to walk back unaided about one mile, but his sight then failed so that he could only perceive light. Thereafter his sight gradually recovered, but he could not read small print until three weeks after the injury. Two months after the injury his fields and acuity were normal and he showed no neurological signs.

Cases of this type were reported during the 1914-18 war by Hine (1918), who was able to trace the recovery from homonymous hemianopia by day-to-day perimetry. It is interesting to note that in Case 7 the focal damage was gradual in onset, and this has been observed in other cases. It suggests that the cause is cerebral or meningeal hemorrhage of limited extent. Examples of focal damage are seen affecting parts of the brain other than the occipital region.

Case 8.—Lt. G. H. M. (R.I. No. 9311) was hit by a shell fragment which pierced his steel helmet in the right Rolandic region and fractured the bone without penetrating the dura. He was not unconscious and continued fighting for some time, although his face was paralysed on the left side and he was grossly dysarthric. Three days after injury the missile was removed from the skull. Two months later the wound was reopened on account of persistent discharge, and five loose fragments of bone, most of them dead, were removed from between skull and dura. The left facial paralysis cleared up almost completely in the first three weeks, but traces of it were still distinctly visible four months after the injury.

The brain damage associated with scalp wounds was described by
Jefferson (1919) in an important paper at the end of the last war. Among 54 cases of scalp wound treated by him there were seventeen which showed signs of local contusion. "In the Rolandic region," he writes, "such signs can be traced through all grades of severity, from a local increase of the tendon jerks . . . up through slight aphasias, numbnesses, and pareses, finally culminating in definite palsies and Jacksonian fits." He points out that while it is easy to recognize the signs of contusion of the Rolandic and occipital regions it is extremely difficult to recognize contusion of silent areas. In some cases of focal brain injury an extradural or subdural clot is found, but in others inspection of the dura at operation has shown no evidence of abnormality, and it is probable that the primary pathological lesion is a bruising of a limited area of cortex and meninges below the site of the injury.

In the cases of this series there has been only one showing evidence of contre-coup damage, but Jefferson had four cases in which there was increase of tendon reflexes on the side of the scalp wound. In penetrating wounds, Dupéryé (1916) reported homolateral signs, such as Jacksonian epilepsy and hemiplegia, and in necropsies he found contre-coup damage in 17 of 100 cases. This type of damage appears to be more common in the severe cases; of Dupéryé's sixteen patients showing homolateral signs, seven died. In the one case of our series a patient with a deeply penetrating bomb wound of the left frontal lobe and right hemiplegia also had complete paralysis of the left lower limb. At operation the sagittal sinus was patent and there was no evidence of fracture, or of extradural or subdural haemorrhage over the right hemisphere.

**Spontaneous Recovery from Focal Symptoms.**

It appears that after gunshot wound there is a strong tendency for the focal signs to undergo spontaneous improvement or recovery. This applies to penetrating brain wounds as well as to wounds of the scalp and skull. The tendency may be more evident in this war than in earlier ones, owing to the relatively greater incidence of small metal fragments of high velocity.

**Case 9.—Penetrating bifrontal wound with retained metal foreign body. Severe aphasia. Spontaneous recovery.—A. A. S., a civilian, aged 32 (Serial No. 60), was wounded by a bomb which landed about thirty feet from him. He received multiple superficial wounds, and one metal fragment, in size slightly less than 10 by 3 by 5 mm., penetrated the left side of the frontal bone and lodged in the right hemisphere (fig. 1). Subsequent encephalograms showed that its track through the brain crossed the lateral ventricle and the corpus callosum. A reliable observer states that after being hit the patient was still standing, hanging on to a support. He was able to walk with assistance; he was unable to speak, but made signs to indicate his wants. In the left frontal region there was a wound from which blood and brain tissue were protruding, and there was another superficial wound in the left parieto-occipital region. Five hours after injury the scalp wounds were excised, and blood-clot and bone fragments were removed from the superficial part of the penetrating frontal wound, but no attempt was made to remove the foreign body. The patient was given antitetanic serum and a course of sulphonamides.
When first seen by us about forty-eight hours after the injury the patient looked ill. Temperature 99·6° F., pulse-rate 106. He was conscious and understood simple commands, but motor speech was limited to a few single words, such as his surname. There was a leak of cerebrospinal fluid from the penetrating left frontal wound. He had considerable neck stiffness. There was slight weakness of the right side of the face, coarse tremor of both hands, more so on the right side, and slight weakness of toe movements on the right side. The abdominal reflexes were absent, both plantar reflexes were extensor in type, and he had retention of urine. As far as could be tested, sensory function was intact. Lumbar puncture yielded blood-stained fluid under an initial pressure of 190 mm.; total...
The outlook in this case at first appeared grave, but within three days the improvement in speech, the cessation of the cerebrospinal leak from the wound and the diminution of the white cell count in the cerebrospinal fluid showed that our initial fears of fulminating meningitis were groundless. On the fourth day after injury voluntary control of micturition returned. By the fifth day he could read simple sentences slowly, and could understand simple commands, though his performance was inhibited very easily. He named most objects correctly but slowly. There was profound disturbance in writing and in calculation. Spontaneous speech was absent. There was also a notable absence of spontaneous and semi-automatic movements. He was confused as to time and place. For the first two weeks after the injury he could not recall any events since going to work on the morning of the injury.

Recovery progressed gradually and by four weeks after the injury he had recovered spontaneity in speech and action and had regained his mental faculties and confidence sufficiently to mix freely with the other patients. There was still difficulty in calculating and in reproducing what he had read. Spelling mistakes were frequent, especially in writing words out of context. Three and a half months after the injury there was further recovery, but he was still slow in calculating and still showed complete lack of understanding of mathematical symbols. He was, however, able to do light work in his garden.

In this case a small fragment entered the left frontal lobe just in front of the precentral gyrus, traversed both lateral ventricles, and lodged deep in the right hemisphere. There was at first a profound aphasia and also a leakage of cerebrospinal fluid from the wound. During the next four weeks there was a rapid and steady recovery of speech. Excision of the foreign body was out of the question owing to its depth, and the degree of spontaneous improvement was greater than had been expected.

Spontaneous recovery from hemianopia after penetration of the occipital lobe has already been noted in Case 6. In Cases 6 and 9 the residual functional damage was so slight that it could not have been bettered, and might easily have been aggravated, by early operation on the brain itself.

In the last war complete excision of the foreign body and its track of damaged brain was advocated and practised by experts on the following grounds:—

1. To remove infective material which might otherwise produce meningitis or brain abscess, and dead brain tissue which would act as a favourable nidus for infection.

2. To remove massive clot, extradural, subdural, or intracerebral, which might otherwise be fatal or produce further local brain damage.

3. To diminish the liability to epilepsy occasioned by a retained foreign body.

The third point still remains to be proved, and in any case it does not necessarily bear on the question of early operation, for experience may show that, if foreign bodies are to be excised with the idea of diminishing the
liability to epilepsy, the best time for doing so is some weeks or months after the injury, when the wound of entry has healed.

The indications to remove clot and septic material remain valid, but it is clear that in a number of cases of this war, infection and massive clot do not develop; the changed conditions of warfare, chemotherapy, and, possibly, a relative decrease in size of high velocity missiles may contribute to this. Another indication also comes more clearly into the picture from recent experience, and that is that operations on brain wounds should not interfere with the spontaneous recovery of brain function that tends to occur in the days following injury. To judge from the literature of the last war, functional recovery after operation was often ascribed to operation. Our experience is sufficient to show that operation cannot cure focal signs which are the immediate sequel of penetrating wounds. The presence of such signs is not an indication for operation. It is only the signs of delayed onset and progressive course, due to clot, infection, or aerocele, which may be amenable to surgery.

Our experience of this war is so far small, particularly in regard to the more severe cases that tend to die in the first few days after being wounded, and no hard and fast rules for the treatment of penetrating brain wounds can yet be made. There is a suggestion, however, that a conservative policy may often be of value, particularly when the penetrating body is small; and there is an absolutely clear indication for the most careful observation of the development and course of the neurological signs in the first hours and days after the injury, together with thorough bacteriological studies of the wound.

Meanwhile the case for early operation to clean surgically the skin and superficial parts of every head wound, and where possible to do primary suture, remains clear. The sooner the wound is thoroughly cleaned of hair, dirt, bone splinters, and other foreign bodies down to the dural level, the less the risk of subsequent complications. Within the brain every manipulation potentially increases the brain damage and diminishes the extent of functional recovery, and therefore the utmost caution and gentleness must be exercised.

**The Treatment of Scalp Wounds.**

The experiences of this series show the extreme importance of surgical treatment of scalp wounds in the early stages. There were 15 cases of non-penetrating injury in 9 of which the laceration was confined to the scalp, while in the remaining 6 the skull also showed a small, usually linear, fracture. In 5 of these superficial wounds complications occurred, owing to inadequate treatment of the wound in the early stages; one patient died and another almost died from these complications (Table I).

This last case has already been mentioned (Case 1). The patient had a subdural abscess following a right parietal scalp wound, without fracture of the skull and without loss of consciousness. The wound was never excised. The notes state that on the day following injury the wound was "dirty, but showed no signs
of gross infection. Hypertonic saline dressings." Seven days after injury the wound was purulent and oedematous, and discharged pus containing a heavy growth of haemolytic streptococcus; there was fever and malaise; sulphonamide treatment was now begun. Two weeks later the patient developed left hemiparesis, together with signs of meningitis (turbid cerebrospinal fluid which was sterile on culture). On admission to this hospital he was semicomatose, and showed early papilloedema, severe motor and sensory loss of the left arm, and, to a less extent, of the left leg. The cerebrospinal fluid contained 273 white cells per c.mm. At operation (Major P. B. Ascroft) beneath the granulating scalp wound a subdural abscess was found. It contained about 15 c.c. of pus from which streptococci were grown. After operation recovery was not absolutely complete, some slight sensory disability persisting in the left hand.

If, when this man reached hospital twenty-four hours after injury, his scalp wound had been excised, dusted with sulphonamides, and sutured; there is little doubt that the subdural abscess would not have developed.

The fatal case of scalp wound was as follows.

Case 10.—Pte. H. W. (Serial No. 58) was wounded in the right occipital region by a shell fragment on June 1, 1940. His helmet was impacted in his scalp and a scale of metal, 1 cm. in diameter, was embedded in the outer table of the skull, but there was no radiating fracture. He was not unconscious. The wound was excised and sutured on June 3. On June 8 he had an epileptic fit, and next day, for the first time, severe headaches, followed by progressive drowsiness. On admission to this hospital on June 11, there was an indolent scalp wound in the right occipital region. The patient was drowsy and showed complete left homonymous hemianopia and slight neck rigidity. The lumbar cerebrospinal fluid showed 3,200 white cells per c.mm. Sulphonamides were started. On June 14, the wound was opened and an extradural abscess was drained (pus contained Staph. aureus and streptococcus). The wound was excised and was dusted with pron- tosil powder. The patient improved for a time and his wound became cleaner, but after some days he became progressively more drowsy. On June 24, a right occipital abscess was drained through the old wound. Progress was not satisfactory and further loculi of pus were drained on July 6 and 9. The patient died on July 10. At post-mortem there was a collapsed abscess cavity and intense oedema of the white matter of the whole hemisphere.

That the excision of the wound on the second day after injury was rather perfunctory is shown by the fact that, at the second operation on June 14, a large flake of metal was found in the depths of the wound, embedded in the outer table of the skull. Even two weeks after injury, dusting of the wound with sulphonamides seemed to improve its condition, but this had no influence on the course of the patient’s illness, for by that time he had an extensive cerebral abscess.

These cases suggest that in scalp wounds the risk of infection spreading through the intact skull and dura is greater after gunshot wound than after blunt injury. The high incidence of focal signs in gunshot wounds of the scalp indicates that the underlying zone of brain tissue is severely damaged, much more so than in scalp wounds due to blunt injury, and the resistance of this part of the brain to bacterial infection is correspondingly reduced. The skull at the site of impact is probably similarly affected, even though it may not be fractured.
In the other three cases the complications of scalp wounds were mild; in two there was local osteomyelitis, with persistent discharge from the wound until sequestra were removed; in the third an abscess formed about two fragments of bomb-casing in the scalp. The frequency with which bone and brain became infected after gunshot wounds of the scalp and skull in this series indicates clearly the importance of careful operative treatment of what are apt to be regarded as trivial wounds. From the point of view of conserving man-power, the operation of cleaning and closing a scalp wound is much more important than the operation of removing a foreign body from the brain.

This simple operation is badly done by many surgeons. The most common mistake is to regard the operation as a minor one which may be performed in an aid-post or in a casualty room. The skin around the wound is shaved in a perfunctory manner and over a small area. If manipulation of the wound is painful, as when no anaesthetic is given, it is inevitable that the wound is not thoroughly explored and that it is cleaned and excised imperfectly.

Many surgeons still adhere to the method of closing the scalp by a single layer of widely spaced and tight sutures. By this procedure the blood supply of the wound edges is impaired and the sutures, which must be retained for several days, tend to cut through the skin. The result is an unsightly scar with ugly cross marks; and often there is failure of primary union in part of the scar.

A standard method of scalp closure has now been adopted by surgeons accustomed to operating on the head. The main principle is to close the scalp in two layers with interrupted stitches of fine silk or thread (Commercial size, No. 28, black silk). The deep layer of sutures joins the thin but firm galea aponeurotica and the sutures are placed 1 cm. apart; this approximates the scalp and takes all the tension. The sutures are cut close to their knots and are buried in the wound. The superficial stitches are then tied only tightly enough to bring the superficial edges of the wound together, and they can all be removed within forty-eight to seventy-two hours. The two layers are effectively haemostatic, and it is not necessary to ligate scalp vessels. As the wound heals its scar is small and there are no cross marks; on the forehead the scar should eventually be almost invisible. The buried stitches are not irritating even in a scalp wound that is slightly infected, and they do not give trouble if cut close to the knot. If silk or thread cannot be obtained, very fine catgut (00) may be used, though catgut produces more reaction in the tissues than does silk or thread.

Cleansing and excision of scalp wounds can only be carried out satisfactorily in an operating theatre and with good regional or general anaesthesia. The first step is to shave the scalp for a wide area (4 to 5 inches) around the wound. The wound edges are then opened and the depths are carefully examined for dirt, hairs, glass, bone and metal fragments. All of these should be meticulously removed, and, when it has been established that the dura is
intact, forcible irrigation with normal saline or Ringer's solution, or with a mild antiseptic such as proflavine sulphate (1:1000), will assist. Ingrained dirt cannot be removed except by excision; in scalp wounds the peri­cranium and loose connective tissue can be excised freely, but removal of the more superficial layers should be done as sparingly as possible, otherwise it may be difficult to get approximation without excessive tension. Not infrequently in gunshot wounds the missile destroys part of the skin, and then the cleaned excised scalp wound must be left open, or may be closed by a sliding graft. Light dusting of the wound with sulphonamides before closure is not irritating and is evidently a helpful measure against infection, particularly in those cases which arrive late at the C.C.S. and in which the wound edges are already reddened and oedematous. Scalp wounds can be excised up to three days and longer after injury. In the forward area, where no operating facilities are available, it is better to apply a moist flavine pack with firm bandage than to close the scalp imperfectly and without cleaning the depths of the wound.

SUMMARY.

A series of twenty-nine cases of recent gunshot wound of the head is described. The clinical syndrome of concussion is usually absent and careful study of those gunshot wounds in which immediate and sustained unconsciousness occurs may throw light on the mechanism of production of unconsciousness in blunt head injuries. In gunshot wounds, both those with dura intact (non-penetrating injuries) and with dura penetrated, focal neurological symptoms are more common than in blunt injury. These symptoms show a strong tendency to spontaneous recovery and this fact should be taken into account when considering the operative removal of foreign bodies and dead brain tissue from the brain itself. At this stage of the war no rules can be made about the operative treatment of intracerebral damage, though the case for early and thorough treatment of the parts of the wound superficial to the dura is clear enough.

Gunshot wounds of the scalp tend to be followed by infection of the underlying skull, subdural space, and brain unless they are thoroughly treated. The apparently trivial operation of cleaning and suturing a wound of the scalp is probably the most important neurosurgical operation of war.

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