SOCIETY OF BRITISH NEUROLOGICAL SURGEONS

27TH MEETING

Held in Oxford, 18th September, 1940

PRESIDENT : MR. NORMAN DOTT

The Meeting stood in silent homage to six members who had died: Mr. Wilfred Trotter and Mr. L. Bathe Rawling (former Presidents), Dr. Harvey Cushing and Dr. Thiery de Martel (respectively Emeritus and Honorary Members), Mr. Archibald Young and Mr. A. R. D. Pattison. Forty-five members and visitors attended.

A telegram of greeting was despatched to the newly founded Society of Australian Neurological Surgeons. The programme of their inaugural meeting had been received.

1. Discussion on recent experiences with Gunshot Wounds of the head.

(Geoffrey Jefferson.)

GEoffrey JEFFERSON, in opening the discussion, said that it had been possible to obtain information from some of the special centres and that his remarks would be based on this. Further material would be disclosed as the meeting progressed. The last two decades had brought forth advances in both neurology and in surgery, so that we could surely prophesy that discoveries would be made and interesting new conceptions emerge. Although we looked to the past for guidance, we did so in a very general way, for many of our problems were new. He would refer only to penetrating wounds with dural laceration, leaving to others the scalp wounds (which had once upon a time fascinated him) and the cranial fractures.

G.S.W. HEAD—DURAL PENETRATION

<table>
<thead>
<tr>
<th>CENTRE</th>
<th>NO. OF CASES</th>
<th>DEATHS</th>
<th>F.B. PRESENT</th>
<th>F.B. REMOVED</th>
<th>C.S.F. INFECTED</th>
<th>FUNGUS</th>
<th>BRAIN ABSCES</th>
<th>NO OPN.</th>
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<tr>
<td>A</td>
<td>10</td>
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<td>15</td>
<td>2</td>
<td>4</td>
<td>11</td>
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The mortality in the 42 cases was 5 (about 12 per cent.). This was a very low figure. His own mortality in 1918 for this type had been 37-6 per cent.; Cushing's fell from 54-5 for his first 40 cases to 40-9 for the second, and then to 28-9 for the last 45. The speaker would forecast that anything under 20 per cent. would be remarkable, and under 30 per cent. good. There were two chief causes of death, (a) the primary injury and (b) infection. We could do a little to mitigate the first, but it was in the second group, the later deaths, those at over a week, that we might look to
improve on past mortality rates. As for missiles, rather less than half the cases had an indwelling foreign body and only three times was it removed at operation. In no case where the missile was deliberately left had the retention of the foreign body been an impediment to cure. Members had shown commendable discretion in leaving these metallic fragments alone. None the less, we should be chary of concluding that they never need removal. So far, we had seen very few examples of wounds by high explosive shell, such as were so frequent in the last war. Sizable pieces of steel were best removed with the electro-magnet. The small size of the metallic foreign bodies was another striking peculiarity. Further cases might confirm or correct experience so far on that point. The speaker next referred to wound infection and indriven bone fragments. He had, in the last war, often excised a wound two and three days old if the scalp did not look actively infected and if the wound edges were ragged and devitalized; infection did not spread quickly in the scalp. If the wound of entrance was very small, it would often be left alone. Indeed, in the present series, 26 per cent. had not been operated upon at all. That was because they were punctured wounds, caused by small, high-velocity fragments of bomb casing. Even indriven bone fragments would be left alone if the wound was already sealed and healthy-looking. Encephalograms of one such case were shown which demonstrated traction of the ventricular wall towards a small shower of bone splinters. It was eight weeks after wounding, but, none the less, it was an unexpected happening, because bone fragments were so commonly infected. Arising out of this point, the speaker raised an important question—whence did wound contamination and subsequent infection come? Was it carried by the missile, did it enter from the skin of scalp or face, or did the patient infect it with his hands? Neuro-surgeons might help to clarify these points by making cultures from the wounds, scalp, and fingers of the wounded, as infected clothing and underclothing did not complicate the picture. The good progress of small punctured wounds seemed to imply that surface infection was the most important factor. Larger open wounds needed more active surgical cleansing. Little reliable information was as yet obtainable about the value of sulphonamides like M. & B. 693. The general impression of its usefulness had not yet been raised to statistical certainty, though that very likely would happen. Lumbar puncture had been employed frequently though not all surgeons yet realized how much knowledge would be obtained from it. He referred not only to cytology and culture but to the estimation of albumin. Some reaction in the c.s.f. no doubt occurred in all cases of dural penetration. The course of events was mirrored in the fluid reactions; contusional and very mild inflammatory states showed in the albumin more clearly than in the cell count. The estimation of the extent of parenchymatous damage might be helped in this way. There were 5 late abscesses, a proportion of 1 in 10, a sufficiently high number to make us wary in the after-care of penetrating wounds. Confidence could be felt that members of the Society would make valuable contributions, as time passed, on the prevention as well as the pathogenesis and treatment of abscess formations.

WYLIE McKISSOCK said that, in his own cases, the foreign bodies had been very small. He had left them alone because he had felt it improbable that he would be able to discover them at the bottom of such long and narrow tracks. Another difficulty arose in the not infrequent cases where several small pieces of metal were present, and he showed an X-ray of multiple scatter in the parietal region. He had used M. & B. 693; in one case he regretted that he had started it too late (a case developing a late abscess). He had found it difficult to discover whether the patients had had sulphonamide and, if they had, how much.

K. C. EDEN: During the first year of the war, 75 cases of head injury have been treated at Centre F, and of these 35 cases were examples of open fractures and penetrating injuries.

The following analysis is confined to the last four groups in Table I. So far, unfortunately, there has been a considerable delay before the cases have reached us, and in many instances operations had already been performed. The average duration
of the wounds on admission was fifteen days. Some of these cases were from Dunkirk and the delay was unavoidable, but it is to be hoped that as the organization improves the civilian cases will reach us earlier. These figures show that the results have been impaired by the delay and in some instances by inadequate initial treatment.

**TABLE II.—ANALYSIS OF RECENT HEAD INJURIES TREATED AT CENTRE F DURING THE YEAR SEPTEMBER, 1939–1940**

<table>
<thead>
<tr>
<th>Type of Injury</th>
<th>Number of Cases</th>
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<tr>
<td>Concussion without fracture and simple scalp wounds</td>
<td>33 cases</td>
</tr>
<tr>
<td>Concussion with closed fracture</td>
<td>7 cases</td>
</tr>
<tr>
<td>Open fracture (dura intact)</td>
<td>21 cases</td>
</tr>
<tr>
<td>Penetrating injuries of the brain not involving the ventricles</td>
<td>4 cases</td>
</tr>
<tr>
<td>Penetrating injuries of the brain involving the ventricles</td>
<td>75 cases</td>
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**Note.**—This list includes the figures from Centre D.

The distribution of the wounds of entry is shown in the accompanying diagram.

Diagram to show site of wounds of entry in service cases.

No information is available about the number of these patients who were wearing steel helmets at the time of the accident, but it is interesting to note that many of the wounds were low in the frontal region or in the occipital or mastoid area.

M. & B. is known to have been given to 13 out of 35 cases before admission, but it is impossible to say whether the dosage was adequate or whether others had it also.

Half of the cases admitted to hospital had infected wounds or wounds healing by delayed union. Fragments of bone were present in all the tracks which had penetrated the dura and in a considerable number small pieces of metal were present.

It is surprising to note the number of cases with wounds not involving the dura which were complicated by signs of intracranial damage to the nervous system. In one of these cases there was a careful note of the condition of the dura at operation, which was carried out in France, and the wound was healed on admission. In this case, although the dura and underlying brain appeared quite normal, there was a profound hemiplegia, which was still recovering slowly when the patient was discharged from hospital.

The cerebrospinal fluid was examined in all the cases of wounds penetrating the dura which were admitted to the hospital at an early stage. Three of these showed a positive culture of mixed organisms (staph, coli, and strep). In 14 other cases which
were examined, 8 showed a slight reaction in the c.s.f. in the form of increased protein
or cells.

M. & B. was given to all fresh perforating injuries. It is impossible at this stage to
assess its value, but the general impression is that it was of assistance in preventing
meningitis. It failed to save 3 out of 6 patients with established meningitis, but in
one case which had an area of non-suppurative encephalitis around buried foreign
bodies with a c.s.f. containing 17 cells/cu. mm., and 0-12 per cent. protein, the fluid
rapidly became normal with M. & B. therapy.

In spite of the number of foreign bodies present and the proportion of wounds
which healed by delayed intention only one patient, a case with a track penetrating
the dura, had a fit while in hospital. It is still too early to obtain any information
about delayed fits.

Cerebral fungus was present in 6 cases of injury to the brain substance. They
were all associated with buried fragments of bone and suppuring or granulating
wounds. In some cases the brain was explored and small pockets of pus and frag-
ments of bone removed, and in all instances the brain receded and the wound healed
when the infection subsided.

Five cases developed abscesses, 3 of which communicated with the ventricle, and
these were all fatal. Two cases developed meningitis unassociated with abscess
formation, but in neither case was it fatal.

There were two examples of cerebrospinal fistulae, both with cerebrospinal
rhinorrhoea, and one with a large aerocele. The fistula was repaired by operation
in both cases.

With regard to the operations performed at this hospital only 3 cases of penetrating
injury to the brain were received early enough for excision of the wounds and debride-
ment. The chief problem was how to deal with the open infected wounds containing
foreign bodies. Seven of these cases were explored, foreign bodies removed, and
abscesses drained, and 4 of these were fatal. Of the remaining cases, which were left
alone, all but one healed in the end without fatality. As a result of this we are inclined
to treat these cases conservatively.

With penetrating injuries of the brain not involving the ventricles the prognosis is
surprisingly good, and there was only one fatality in this series. This patient had an
infected wound five days old containing several large pieces of wood, which were
removed at operation. He subsequently developed an abscess and meningitis which
proved fatal. There is no doubt, however, that most of the complications could be
avoided if the wounds were adequately debrided and sutured at an early stage. In
contrast, the perforating wounds involving the ventricles all proved fatal in spite of
M. & B. therapy. Two of these had infected tracks leading into the ventricle, one had
an abscess opening into the ventricle, and one had a massive intracranial haemorrhage.
The cranio-facial wounds were very painful and there was prolonged suppuration in
each of the 3 cases, but all healed in the end without complication.

The improvement in the c.n.s. signs was encouraging in all the cases which re-
covered. Those with slight degrees of paralysis recovered completely in a few weeks,
while there has been a marked improvement even in the most severe cases. Several
cases with hemianopia have all shown progressive improvement, and others with
varying degrees of aphasia have all shown a tendency to improve.

Recently we have made use of a mobile surgical team to deal with civilian air-raid
injuries, and the results so far have been very encouraging. All the cases have been
dealt with in twenty-four hours or less from the time of the injury, and in each case
debridement and primary suture of the wounds has been carried out. Bone fragments
have been removed in each instance, and in 2 cases the splinters of metal have also
been extracted. Three cases were comatose with deeply penetrating tracks, and these
died without recovering consciousness; the remaining 5 cases are improving steadily
and their wounds have all healed by primary intention.

HUGH CAIRNS: At Centre G we have had 29 cases of G.S.W. head, and of these
3 have died. The fatal cases were (1) a case of brain abscess after scalp wound; (2) a case of fulminating meningitis after a penetrating wound of the ventricle; and (3) a case of delayed meningitis after an inconspicuous penetrating wound of the brain through the frontal sinus. Among 9 cases of simple scalp wound there were 2 serious cases of delayed intracranial infection, one a fatal case of brain abscess following infection of the scalp wound and focal osteomyelitis beneath the wound, the other a case of local subdural abscess beneath an infected scalp wound in which the patient was almost moribund at the time of admission. These cases show the danger of infection of gunshot wounds of the scalp. It appears that after gunshot wounds of the scalp the underlying tissues are more damaged and more vulnerable to the spread of bacterial infection than they are after the scalp wounds of civil head injuries. In these circumstances surgical cleansing, excision, and suture of scalp wounds after battle is by no means a trivial operation, but should be performed with all the care of a major operation: it should be regarded as the most important cranial operation of war.

In comparing this series of head injury with the closed head injuries of civil life certain differences call for comment. In this series by far the greater number were not unconscious, or only momentarily dazed, at the moment of injury. The only cases of severe loss of consciousness were wounds involving the base of the brain. Thus one man with a fragment of metal passing in through the external auditory canal to lodge in the cerebellar vermis was unconscious for several days; others with similar pieces of metal damaging the occipital lobes were not unconscious at all. Detailed study of the situation of brain damage in patients rendered unconscious by missiles may throw some light on the cause of concussion.

In scalp and skull wounds without penetration of the dura there is often evidence that the brain is damaged, either sensory-motor signs of the type described by Jefferson after the last war, or homonymous field defects, as described in the last war by Montagu Hine. In another case of scalp wound from a bullet or bomb fragment the patient did not lose consciousness and showed no neurological signs, except diminished tendon jerks; nevertheless, the patient had free blood in his cerebrospinal fluid. Brain damage thus occurs in non-penetrating gunshot wounds of the head. In this limited series of cases the evidence is that it is present in a relatively narrow zone beneath the point of impact. The only cases of civil head injury that show similar focal injury are those due to violence applied over a very small area, as by a golf-ball, cricket-ball, etc.

Spontaneous recovery from penetrating injuries may be remarkably complete: severe hemiplegia and aphasia may subside completely after two weeks. These cases frequently make a more rapid return to normal than closed head injuries of civil life.

Information is still needed about the latest time at which primary excision of wounds can be undertaken without aggravating infection. Experience on this problem will be strengthened if it includes thorough bacteriological study of all wounds (and cerebrospinal fluid) before and after wound excision, together with accurate records of sulphonamide treatment. So far sulphonamides appear to have been given in a haphazard manner, and it is impossible to form any accurate impressions of their value.

G. C. KNIGHT said that he could add a series of cases which he had had the opportunity of treating. They consisted of 14 cases of gunshot wounds of the head; only one patient died. Ten had penetrating wounds of the dura, and in 9 metallic foreign bodies were retained (2 removed). The only death was one in which a small piece of bomb fragment had penetrated from the vertex traversing the corpus callosum and third ventricle, and involved the floor of the hypothalamus. This case was of particular interest, for the entry wound was so small that it had been missed on clinical examination and the patient was sent to the Centre as a case of closed injury. He survived for four weeks without any evidence of infection, but during that time
remained in a light coma and showed progressive wasting, suggesting a central metabolic disturbance without any localizing signs detectable in his nervous system.

In the remaining cases he had been most impressed by the value of M. & B. in checking infection when the dura was open. All the cases of which he had charge arrived three to five days after receipt of their injuries, and in 10 of them infection of the wound was already established, in some cases being gross. He would quote three examples which he believed to illustrate the value of M. & B. treatment.

The first, G. B., had the right squamous temporal bone apparently torn away from the skull, as there was no bone driven in; the mechanism of this injury is hard to understand. The dura was open over an area of 4 cm. and the brain billowed in and out of this opening, the cerebrospinal fluid escaping. He had had no treatment other than a field dressing applied over this injury. He came in three days later, having been given M. & B. regularly during transit. There was a slight reaction in the cerebrospinal fluid, but under the full course of M. & B. the wound granulated satisfactorily and was dry and healed within three weeks.

The second case was admitted five days after the injury with an extensive gunshot wound of the left occipital region from which a necrotic fungus protruded which was black and stinking. There were more than eight small metal fragments dispersed widely inside the skull. The cerebrospinal fluid showed well-marked evidence of infection and had a positive culture of staphylococci. Three days after admission the fungus sloughed off. The ulcer on the surface of the brain was below the level of the dura. The cerebrospinal fluid escaped over this and must have washed infection widely over the inner surface of the dura. He developed at this time a right hemiplegia in addition to his previous signs of aphasia and hemanopia. The condition appeared hopeless, but a second full course of M. & B. was given. His temperature fell; the cell count fell; but the protein remained high. Within five weeks his wound was completely healed and he had now recovered from his aphasia and hemiplegia, with no disability other than weakness of the right hand and hemanopia. The protein in the cerebrospinal fluid did not fall until the fungus was epithelialized.

The third case was seen on the sixth day after his injury, a penetrating wound from the right occipital region, the metal traversing the falx and lying in the left cerebral hemisphere. He had meningitis of M. & B. The fungus became sterile in the c.s.f. in two days, but the protein remained high and rose still further. Five weeks later he developed right-sided Jacksonian epilepsy with a right-sided hemiparesis, evidencing an abscess around the retained metal on the left side. He did not want to operate on the abscess at this time. A second course of M. & B. was given. His temperature subsided and his fits decreased, but increasing hemiparesis and a further rise of protein showed that the abscess was continuing to develop. After three weeks he operated through the left hemisphere and attempted to remove the piece of metal with a magnet, but despite good contact the metal would not lift; it proved to be some form of aluminium alloy. It was therefore necessary to carry out a cone excision. It is interesting that cultures from this abscess show that bacillus proteus was present.

He was convinced that none of these three patients could have survived prior to the introduction of chemotherapy, and he therefore felt that a full course of M. & B. should always be given in penetrating wounds of the head without waiting for evidence that intracranial infection had in fact occurred.

One other point occurred to him—that, with the exception of the penetrating injury involving the vertex, referred to in the first case, the entry wound in every one of his cases lay below the rim of the steel helmet—in the majority, in the right occipital region. It therefore was pertinent to enquire whether the British model was as efficient as it might be in providing protection for the back of the head. The man is standing up. Fragments from a bomb come from ground level, i.e. they strike upwards. One can clearly see in the X-rays that much of the metal had passed in an upward direction from its point of entry. Could not some form of nape extension be provided, possibly consisting of metal slats secured on a leather flap, rather like the old form of Chinese armour?

S. E. A. O’CONNELL: Professor Paterson Ross had been worried as to what to do in cases of perforating wounds of the brain coming for treatment over forty-eight hours after reception of the wound. One case which seemed to help to answer the problem. A man was admitted with a perforating wound of the right frontal region through which the cerebrum protruded, he had received the wound three days previously. He was treated by scalp excision, skull excision, and excision of the brain track by suction. His wound healed
by first intention, but whereas on his admission he had shown only a paralysis of his left arm, within four days he had a left hemiplegia. The wound was therefore re-opened and an abscess searched for without success; the wound was left open and the case treated as a cerebral fungus. Following this his neurological signs completely cleared up and he left hospital free from symptoms. This had led them to the belief that a perforating wound with exposure of the cerebrum seen forty-eight hours after the reception of the injury should be treated as a cerebral fungus, no attempts should be made to treat it in the same way as a fresh brain wound.

A point that has interested them had been the cerebrospinal fluid in cases of cerebral fungus. In almost all the cases the protein had been greatly raised, in one case to 375 mgms. per cent., whereas the increase in the cells had been very slight. As the cerebral fungus epithelialized, the cerebrospinal fluid protein fell. The reason for this dissociation of high protein and pleocytosis is not clear.

As regards the question of removal of deeply placed foreign bodies in the brain, this on the whole had not been attempted, in the hope that the F.B. might be productive of no harm. If a cerebral abscess should form around it, it would perhaps be better to delay treatment entirely, until the abscess was well encapsulated. However, the matter has occasioned some worry in view of their experience with F.Bs. in the soft tissues of the limbs. Here, of course, the fragments are usually much larger, but often after a prolonged search the situation of one of these F.Bs. has been revealed by a rush of foul fluid along a probe which has entered the small abscess cavity around the F.B. It is to be hoped, however, that the smaller F.B. in the brain will not be so likely to produce an abscess.

D. W. C. NORTHFIELD, referring to some recent cases of his own, asked whether opinion would favour the use of a flap instead of a local nibbling operation. He had tried the two methods and was impressed by the better control and exposure that was afforded by the flap. He had found haemorrhage occasionally troublesome. It was in this view the only technical difficulty. He had lost one case from bleeding in a deep wound track, so deep that he could not secure the vessel. He asked about the sterility of powdered M. & B., wondering whether it lost its properties under heat.

E. A. CARMICHAEL enquired whether there was any unanimity of opinion as to the value of the sulphonamides and, if so, by what methods should they be administered. The makers put up the product in sterile ampoules; there was no difficulty on that score. He also made some enquiries relative to the protection afforded by the steel helmet. Further, how many of the missiles were magnetic?

S. ZUCKERMAN said that non-magnetic foreign bodies must exist, for the tail-fins and some other parts of bombs (but not the casings) consisted of non-magnetic alloys. He went on to describe the physical behaviour of small metal splinters, travelling at very high velocity. He spoke of the heat generated at the compression cap of sound waves forced to travel at more than their normal speed. The velocity reached might be in the nature of 3,000 to 4,000 feet per second when a heat of 200 to 300° C. was reached. The missiles must, therefore, be sterilized in their flight. He outlined experiments which were being undertaken to elucidate the question of sterilization and re-infection of missiles in their transit.

Mr. ANDERSON wondered whether the advice given by Harvey Cushing in his classical paper, that the intact dura should be opened and contused brain sucked out, should be followed. It seemed to him that, in view of the great difference in mortality between head wounds with open and closed dura, it was a difficult decision.

GEOFFREY JEFFERSON in reply said that the mortality had not been materially altered by the new cases added in the discussion. These totals showed that there had been 10 deaths in 75 cases (13-5 per cent.). He was obliged to Mr. Northfield for having raised the question of the bone flap. He thought it advisable whenever the time needed for it could be found. In a great rush of work it would be impossible. But, as Mr. Dott had remarked privately to the speaker, the principle was similar to that of abdominal surgery, a larger or smaller incision and exposure was to be fitted to the depth of the wound. The bone flap would probably be used more in present-day neuro-surgery of wounds, but not invariably; in the last war it had been little favoured. It was clear that much of value would be added by study of the means and nature of wound infection and on the potency of chemotherapy. More consecutive studies of the c.s.f. would also enlarge our knowledge of the progress of brain wounds.

2. Experimental peripheral nerve injury. (J. Z. Young.)

J. Z. YOUNG gave an account of his experiments on nerve regeneration after section, both alone and with grafts of various kinds. He estimated the rate of growth from the central cut stump at 4-0 mm. a day. This was based on the occurrence of reflex action on pinching the re-exposed nerve. There was considerable delay in functional recovery. Thus, although an axon might be expected to arrive at a muscle in twenty-five days, it was forty-seven days before voluntary movement was possible. There was, therefore, twenty-two days' delay at the motor end-plates. Delay at the
skin he estimated at about a month. He had found no deterioration in the ability of the central and peripheral stumps to give and to receive nerve fibres, even after deliberately delayed "plasma suture." The delays, however, were short (some two months only). He gave evidence that a reciprocal tropism was involved, not only in the outgrowth of nerve fibrils from the central stump, but also in the growth of the Schwann bands from the peripheral stump. He referred further to the very successful experiments made with auto-grafts, and emphasized the uselessness of homo- and hetero-grafts. Details of this work had already been published.

E. D. ADRIAN reminded listeners that the estimated growth of the human axon was only 1-0 mm. a day. He asked what methods Mr. Young had used in estimating axonal progress.

J. Z. YOUNG replied that it was by the eliciting of reflexes by pinching the nerve.

E. D. ADRIAN said that in human beings Tinel's sign had been useful, and enquired how the return of skin sensation had been explored.

J. Z. YOUNG said that it was by the production of movement on mechanical stimulation. He thought that the excellence of the nerve bed in experimental work might explain the more rapid regeneration in animals, though it might be a characteristic of the animal.

J. G. GREENFIELD enquired as to the size of the grafts. He thought that important, because his experience of large grafts in the last war and after was that they were unsuccessful and showed heavy fibrosis histologically. J. Z. Young's grafts were small and lay in undamaged fascial planes.

H. PLATT spoke of the rate of human regeneration, which must certainly be much slower than that in the rabbit. Taking the musculospiral (radial) nerve as the best example, there was often long delay.

J. Z. YOUNG thought the delay might be at the end-plate and not in the nerve trunk.

G. R. GIRDLESTONE believed that what was true of small grafts was not applicable to large. He asked whether there was any appreciable check at the distal line of suture.

J. Z. YOUNG replied that his grafts had not shown it, but that they were not very long (2 cm.). There was no check.

3. Brain fungus. (H. W. B. Cairns, Peter Ascroft, and R. Hannah.)

H. W. B. CAIRNS spoke of the work done on brain fungus by himself in collaboration with P. B. Ascroft and R. H. Hannah. It is seen often after incomplete operations on brain abscess and other intracranial infections, also after penetrating gunshot wounds. The most important single cause is an unclosed opening in the dura. Most cases of brain fungus result from surgical operations, and this statement is probably just as true for fungus with gunshot wounds. Histological studies of human and experimental brain fungus show that the essential changes are: (1) necrosis or degeneration of the exposed brain and the cone of subjacent white matter; (2) invasion of the fungus by connective tissue; (3) the glial reaction is inconspicuous. Infection from without may occur along the sulci which are still patent, but fungus itself is not an infective process. Fungus may occasion a rise of the protein content of the cerebrospinal fluid; examination of the cerebrospinal fluid does not help to distinguish between simple fungus and fungus with abscesses.

It is a mistake to imagine that a bulging fungus is due to an underlying pathological lesion. Occasionally there is an abscess in the fungus, but more often the primary expanding lesion is at some distance. Generalized hydrocephalus occurs as a complication of fungus, and may cause the fungus to continue to bulge after the primary cause of the raised intracranial pressure, as, for example, an abscess, has subsided. The best method of investigating the cause of brain fungus is by ventriculography. The fungus itself should never be needled unless ventriculography has shown an expanding lesion in or near the fungus. Lumbar puncture is useful to control the size of fungus in the early stages; but should be used sparingly in the late (healing) stage, as it may encourage waves of meningeal infection.

W. CONE had been most interested in this presentation which was a new one. He saw now that it was a self-propagating process, and had been interested in the histological sections which illustrated the paper.

GEORGE JEFFERSON objected to the statement that infection played little part in cerebral fungus. If a non-infective basis was insisted upon, what name was to be given to the
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acute, heavily-infected wound with brain tissue protruding through the scalp wound? He entirely agreed that, in the quieter stages or types, with which the previous speaker had dealt, infection was no longer the dominating feature. In this the exposition had been of the highest value. But a parallel could be drawn between, on the one hand, loss of tissue in the limbs and, on the other, in the skull and its coverings. In both an ulcerated surface was the result, and it was a useful pathological conception to regard a cerebral fungus as an ulcer. It could not be maintained that infection played no part in it, even if it was true that severe infection had not always caused it, any more than infection always was the cause of an ulcer or unhealed surface elsewhere. He was convinced that infection was inseparable from the conditions in which fungus arose, though the infection was sometimes secondary. The fungus healed as best it could by fibrosis and epithelialization. There was, perhaps, a bar to healing in the early stages, at the point where mesoblastic tissue encountered brain, with its protection by "insulation." (Trotter.)

J. G. GREENFIELD disagreed with these views, thinking that necrosis was produced by the pressure of the bone edges on the cortical capillaries and that this led to anaemia and difficulty in healing.

DICKSON WRIGHT described his method of treating cerebral fungus by skin grafting, holding the graft in place with a marine-sponge. He strongly advocated this procedure.

CLARK-MAXWELL thought that skin grafts formed the ideal dressing for these cases. He simply washed the fungus well and applied the grafts to the granulations. In 3 cases he had not needed to repeat the operation.

JAMES HARDMAN described a case in which he had ligatured a pedunculated fungus with subsequent rapid healing. In a second case a fungus formed after excision of a thick-walled abscess. The patient finally died; at post-mortem he found ventriculitis and meningitis, indicating that the fungus and the eventual fatality were due to obstructive hydrocephalus produced by the original meningitis.

4. Technique of cisternal encephalography. (J. Schorstein.)

J. SCHORSTEIN reported on a series of over 60 encephalographies performed by suboccipital puncture and found that in 50 cases there had been 10 per cent. failures, whilst in an equal amount of lumbar encephalographies the failures had been 20 per cent. Schorstein described the technique and pointed out that recently he had given up injecting gas and instead only removed the fluid, 10 c.c. at a time. He discovered that injection was unnecessary since air was aspirated if the needle end was left free. The speaker went on to discuss the means by which air was able to enter the ventricle. He agreed with Jäungling that without pulsation and respiratory movements of the brain air would not enter. He had confirmation of this by hearing air entering intermittently. In 3 cases, no fluid was obtained on cisternal puncture, and these cases at operation proved to be posterior fossa tumours in which the cistern was occluded by tonsilar herniation. In a normal person he removed 50 to 60 c.c. of fluid, and that was about the quantity of c.s.f. contained in the skull. There were no deaths in the series, and even the posterior fossa tumours were not made worse. (This paper will appear later in full.)

JAMES BULL said that he had seen the method used in Stockholm, where they replaced only 30 c.c. of fluid with gas, and that the impression in Stockholm was that they did not get good surface filling with cisternal encephalography. They had done many thousands of cases by this method without complications and the percentage of failures was the same as in the series presented by Schorstein. In Stockholm it had been suggested that a further 20 c.c. of air should be injected by the lumbar route, with the patient lying down in order to get filling of the sulci and cisterns.

D. W. C. NORTHFIELD questioned the advisability of using a procedure which certainly had its dangers, from injuries both to the vessels and nervous elements in the posterior fossa, while it was still doubtful that the method gave better results than lumbar encephalography. He himself always felt anxious about performing cisternal puncture.

GEOFFREY JEFFERSON asked whether the suction noise could also be heard if the same method were used in lumbar puncture and, although he admitted that there was a theoretical danger in cisternal puncture, he thought that in expert hands it was a perfectly safe procedure. He thought it was unlikely that the posterior-inferior cerebellar artery would ever be lacerated. He believed that the people in Stockholm had got bad filling of the sulci and cisterns because they injected a fixed quantity of air and that a good filling could be obtained if sufficient air was injected.
J. E. A. O'CONNELL asked whether, with cisternal punctures, patients had less discomfort, and said that he himself had always performed encephalography under anaesthesia.

J. SCHORSTEIN, in reply, said that he had seen as good, if not better, surface filling in cisternal encephalography as with the lumbar method. He did not use a fixed quantity of gas, but removed as much fluid as could be obtained (it was always more than 30 c.c.), and allowed air to be aspirated until the intracranial contents had found their own pressure equilibrium. He also thought that this method caused less discomfort to patients, but he had not, as a routine, performed encephalography under general anaesthesia, although he admitted the desirability of doing it. Only once during lumbar puncture had he heard a sucking noise, and that was after very complete withdrawal of fluid.

5. Pontine haemorrhage as an irrevocable cause of death following episodes of acute hypertension. (Norman Dott.)

NORMAN DOTT described 4 cases in which crises of high intracranial pressure had led to fatality because of pontine and mid-brain haemorrhage. In the first case a frontal meningioma was operated upon after ventriculography and the session broken off, it was thought, with safety. Blood-pressure was 120/80. The patient failed to recover consciousness from nitrous-oxide anaesthesia. Five hours later the wound was re-opened, the dura incised, but without benefit, and the patient died in thirty-six hours. Post-mortem revealed that there was infarction of the brain-stem. The important factor, he felt, had been the rise of intraventricular pressure by the pneumography, the production of oedema, and probably a further rise of pressure with the induction or continuation of the anaesthetic. He went on to describe three other examples. These haemorrhages had been described by Moore and Stern, but what interested the speaker was the causation, since no existing theory was adequate. The supposed rise of blood-pressure which some had postulated had not occurred in his own cases. He believed that the explanation was to be found in vascular spasm with damage to the wall of the vessels beyond, diapedesis into and through the walls, and thrombosis. This put the condition in line with what was believed to happen in hyperpyretic states. Pathologists had been forced to invoke spasm as a cause of the vascular changes. General anaesthesia might be important in precipitating this condition, and as a result of his experience with these cases thought it was a wise thing to avoid it in severely compressed cases, in which had been left just that shade too long before operation.

6. Injuries of the trigeminal nerve. (Geoffrey Jefferson.)

GEOFFREY JEFFERSON said that during the war of 1914–1918 he had observed examples of injuries, not only of the peripheral divisions of the trigeminal nerve but, in two instances, of the ganglion itself. A further example of trigeminal injury had presented itself recently. Injuries of the divisions were commonly found in facial wounds. The ganglion contusions or destruction were rarer and more interesting. Besides his own three cases, there appear to be only three others in the literature where all divisions were affected. It is not generally known that many examples (some 30) have been reported in cases of fracture of the cranial base. He believed that sheath haemorrhages must be common, for the fracture line in the middle fossa usually passed beneath the ganglion on its way to the pituitary fossa. Some headache and soreness of teeth and face were probably due to ganglionic disturbance. He described an example of damage to the second division at the foramen rotundum and showed a diagram of the sites of election for injury in the course of trigeminus and its divisions.