carbonic acid in the blood stimulates the respiratory centre and keeps up the pump action.

INFLUENZA.

Some of the most prominent features of the late epidemic of influenza, especially in those cases accompanied by bronchopneumonia, were extreme nervous prostration, loss of the knee-jerks, and a paretic condition of the chest walls, so that the patients became very livid without much respiratory distress. The best results were attained by respiratory stimulants, such as strychnine and atropine, and the lime salts.

LARYNGEAL DIPHTHERIA AND CROUP.

When there is any acute obstruction to the entrance of air to the chest the negative pressure becomes so great that the pliant chest walls are driven in, the diaphragm raised, and the lower end of the sternum caved in.

ADENOIDS.

In this case the obstruction is a slowly increasing process, which leads to defective development of the chest, high palate, and narrow throat.

WHOOPIING-COUGH.

This resembles the Valsalva experiment carried out in spasmodic efforts, and when the spasm is over the long crowing inspiration to fill the expanding chest represents a modified Müller's experiment. The result is that the lower part of the chest is pulled in during the expiratory phase and driven in during inspiration; in the pliant chest walls of children we may thus get permanent deformity.

MEDIASTINITIS.

In this condition we get a modified Müller's experiment, with a diminution in the volume of the pulse at the wrist during inspiration—the so-called pulsus paradoxus. When the chest is expanding, the adherent lungs cannot fill up the vacant space in the mediastinum, hence it is filled by the blood being retained in the great veins, the right side of the heart and the lungs, and the amount passing through the left side of the heart is temporarily diminished. I dealt very fully with this subject in the *BRITISH MEDICAL JOURNAL* of April 20th, 1907.

REFERENCE.

¹ *BRITISH MEDICAL JOURNAL*, November 9th, 1907.

WAR HEADACHE AND ITS SURGICAL TREATMENT.

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IN the *JOURNAL* of May 4th, 1918, I published an article on Cerebral Oedema (excess cerebro-spinal fluid) the material for which was based on experience derived from the many cases of headache, severe and persistent, that came under my care when serving in India.

In some cases, influenced by the gravity of the headache and by my inability to bring about any appreciable relief in other ways, I advised operation. This procedure was followed by such immediate improvement and by such generally satisfactory late results that, although these operations were conducted on patients invalided from Mesopotamia for heat-stroke and cerebral malaria, I retained an open mind as to the benefits that might result from a more general use of decompression in the treatment of other types of war headache.

Since my return home, a year ago, some hundreds of cases suffering from head injuries have passed through my hands, and at the present time I have over 250 in my wards. A large proportion of these cases have open wounds—from slight to the most severe—and nearly every patient complains of headache and giddiness. However, my remarks in this paper apply solely to the more chronic cases of headache, all head wounds having been healed for months or years.

It is necessary, however, to recapitulate some points raised in my previous paper, for, although my remarks then applied in the main to headache of malarial and heat-

stroke origin, further experience shows that they possess a far wider bearing.

With regard to those patients subjected to operation in India, all ordinary measures were carried out previous to undertaking operative measures. The first patient was in so miserable a state by reason of the severity and persistency of his headache that he eagerly accepted the chance of cure by other methods. I carried out subtemporal decompression; cerebral oedema of a marked degree was found at the operation, and the headache was practically cured within two days, and this in spite of the fact that the symptoms had persisted for many months, originating from the day of the injury. The relief was fully maintained during the remainder of his stay in India. In six cases cerebral oedema of a marked degree was found, and the diminution of intracranial pressure afforded by the operation resulted in the almost immediate relief of all headache, with no recurrence in India, and with no serious relapse since—carrying on the history of the cases for a period varying from one and a half to two years.

Two explanations were advanced to account for the excess cerebro-spinal fluid, with the following fact as a basis. Cerebro-spinal fluid is secreted continuously, and, under normal conditions, it is absorbed at the same rate, into the cerebral venous system in the main, more especially through the Pacchionian bodies into the superior longitudinal venous sinus, these bodies acting as a kind of filter for the absorption of the fluid. First, under abnormal conditions—for example, heat-stroke and malaria, in both of which states the absorptive capacity of the surface cerebral vessels might well be expected to be markedly impaired—cerebro-spinal fluid is being secreted at a normal rate without absorption in direct ratio. In consequence, it accumulates in the subarachnoid spaces, bogs the surface of the brain, and even forces its way into the adventitious subdural space. Secondly, the diseases mentioned lead to excess secretion, the absorptive capacity of the cerebral vessels remaining as usual. The fluid, therefore, collects in excess. The first explanation was the one accepted, for reasons which it is not my purpose to repeat, and the evidence supplied by the cases of war headache, as here narrated, adds confirmation to the hypothesis.

With these facts behind me, and with the great material to hand, I approached the broader question of war headache and its surgical treatment with considerable confidence.

All the cases of war headache here recounted were secondary to gunshot wounds, concussion, fractured base, etc. However, out of the maze of injuries certain facts appear.

1. The more severe headaches are associated with an intact skull (closed box) or with small defects. With large deficiencies headaches are less frequent.
2. Frontal and temporal injuries are more commonly accompanied by headache than injuries in the parietal, occipital, and cerebellar regions.
3. Wounds near the vertex, in relation to the superior longitudinal sinus, are frequently associated with a severe type of headache.
4. The presence of foreign bodies within the skull is commonly accompanied by chronic headache, more especially when the foreign body is situated in relation to the ventricles of the brain.

Origin of Headache.

In the great majority of cases the headache dates from the moment of recovery from unconsciousness, either from the injury itself or from the operation carried out for the injury. The very first thing that the patient remembers is headache, at first very severe. In many cases special note is made of that point, and in some cases lumbar puncture was carried out for its relief. Previous to transference home the pains abated somewhat, and soon after arrival reached a certain standard. It is on this standard that I gauge the diminution, chronicity, or increase of the pains.

In view of the extreme severity of headache in the Mesopotamian cases, reported in my previous paper, it is interesting to note that of the twenty additional cases now reported seven came from Eastern fronts.

Severity of Headache.

This varies greatly, from mild and inconstant attacks through every degree and grade of headache to the most severe and persistent pains. Perhaps the most common type is as follows—a "cyclic" headache. Two or three days' comparative immunity, followed, without warning, by an attack severe even at its inception. This culminates

within a few hours with more or less complete prostration, the patient retiring to bed completely bowled over. This exacerbation terminates within twenty-four hours, leaving the patient still suffering from some degree of headache, perhaps a sense of oppression only. Further improvement then takes place, bringing the patient back again to the period of comparative immunity.

In explanation of this "cyclic" headache, it would seem probable that the cerebro-spinal fluid, by reason of insufficient absorption, slowly increases in quantity, finally arriving at a certain maximum, this coinciding with the period of maximum intensity of headache. By this time the fluid leads to such increase of intracranial pressure that some relief takes place automatically, the various channels being opened up whereby some excess fluid can escape. The intracranial pressure is correspondingly relieved and the symptoms diminish proportionately.

In other instances the pains show little variation in degree, persisting both day and night without intermission; the patient is never free from some degree of headache, varying from "dragging," "weight," "tearing" sensations to a constant dull ache. To these pains, after months and even years of suffering, some men seem to become accustomed, despairing of cure, procuring temporary alleviation with aspirin, etc., and regarding the headache as a thing that must be endured. I have had patients under my care who have put up with these miseries ever since 1914.

Position of Headache.

Wherever the injury, these headaches tend to become localized to the frontal region—behind the eyes—perhaps more acute on the side injured. Often, also, reference is made to the temples. Sometimes also there is a maximum "bursting" pain over the summit of the vertex. Local tenderness over the wound must not be confused with the site of headache proper. Severe occipital headache, with stiffness of the nuchal muscles, is altogether apart from these chronic headaches; such symptoms are more suggestive of a spreading cerebritis, ventriculitis, or meningitis.

Time of Onset.

In addition to the fact that mental or bodily exertion, noises, joltings (motor bus drives), concerts, and especially cinematographs, all tend to start the headache or add to its severity, there appear to be two special times of headache development—in the early morning on awaking, and in the evening between tea and bedtime. In most cases, as stated previously, the onset is rapid, the pains soon reaching their maximum.

Association with other Symptoms.

As space is limited, and as I am dealing essentially with headache, I must confine myself to a mere enumeration of associated symptoms. The complete syndrome is seldom present. Headache may be the sole evidence of the conditions existent.

1. Slowing of the pulse-rate, with but little raising of blood pressure.
2. Marked giddiness.
3. Elevation of temperature frequent, 99° to 100°, night after night. This may persist for months on end.
4. Insomnia.
5. Slow cerebration. Listlessness, anxiety, uncertain temper, depression. Patient unable to undergo any exertion, all attempts being followed at once by headache exacerbation.
6. Tendency to exaggeration of all reflexes.
7. Nausea uncommon. Vomiting rare.
8. Slight blurring of the discs—retinal veins engorged and tortuous. Diminution of the visual fields. True papilloedema rare, unless the case is complicated by the presence of foreign bodies in the brain substance, especially when related to the ventricular spaces.
9. Bowels natural, except for some constipation. Urine normal.
10. Appetite good, except during an extra severe attack.
11. Fits, generalized, epileptiform.

Causation of the Headache.

These headaches are dependent on some general increase of intracranial pressure, and this in turn is due in the great majority of cases to excess cerebro-spinal fluid—cerebral oedema. I think that this, without question, is the correct interpretation—the oedema is very apparent at the decompression operation, and the symptoms are relieved or cured within a few hours of the drainage supplied by the decompression. In some few cases, even where a

diagnosis of cerebral oedema was made, no oedema has been found—merely a tense dura mater and a brain under pressure. It is to be presumed that, in these somewhat exceptional cases, there is a condition of ventricular distension due probably to interference in the normal channels at the base of the brain, with perhaps some ventricular hypersecretion. So far as my present experience goes, there are two points in the differential diagnosis between headache due to cerebral oedema and headache dependent on ventricular distension. In the later condition true papilloedema is more likely to be present, and the patient evidences more marked apathy and somnolence—a more defined state of slow cerebration. However, operative measures are indicated in both conditions, and the results obtained by operation (decompression) are almost equally favourable.

Treatment.

This may be considered under three heads: Rest, with dietetics and drugs, lumbar puncture, and decompression. Unless the conditions are exceptionally severe, the routine course adopted occupies about three months, the patient first passing through a probationary period of rest in bed, with careful dieting and with such medicinal treatment as seems fitted to the case. The results obtained are often very disappointing, for, although the patient may keep fairly comfortable so long as he is in bed, no sooner does he get up than the old headaches recur immediately. However, during this period full opportunity is afforded for the framing of a sound opinion as to the genuine character of the symptoms complained of, together with a record of the temperature changes, blood pressure, pulse rate, ocular conditions, etc.

Even when this course is only moderately successful in its results, it is customary to discharge the patient from the army and to give him instructions as to mode of living, together with advice as to reporting back in the event of relapse, etc.

Lumbar puncture has been carried out frequently. It would be expected that excess cerebro-spinal fluid, as represented by cerebral oedema, would be capable of confirmation by means of lumbar puncture. This, however, is by no means the case. Lumbar puncture may show a fluid of considerable excess and at high pressure with a perfectly dry cortex, as revealed by subsequent decompression operation. In other cases a puncture yielding negative results may be associated with a high degree of cerebral oedema. When considered also from the point of view of headache relief, lumbar puncture is equally unreliable. Sometimes it brings about alleviation, even marked relief, but this endures for a short time only, the headache soon returning, often more severe than before. Sometimes also the effect of lumbar puncture is to produce immediate exacerbation of headache. Consequently, from both points of view, diagnosis and treatment, lumbar puncture has proved, in my hands, unreliable. I obtained the same general results in the cases treated in India.

After all, cerebral oedema is primarily a cerebral manifestation, and, if my views as to causation are correct, cerebral symptoms may become manifest previous to any real increase of fluid in the spinal canal.

Rest, dietetics, drugs, and lumbar puncture failing, is there any hope of relief for this intolerable and persistent headache? The answer to this question is that subtemporal decompression will almost certainly bring about relief or cure within forty-eight hours of the operation without in any way risking the patient's life and well-being.

I do not propose to enter into details of the operation, which will form the subject of a future paper. It suffices to urge:

1. That all other measures should be given free and fair trial, with a probationary period of about three months, unless urgency prevails.
2. That operation should be reserved for the more acute cases, and for those more severe chronic cases where the patient is rendered miserable by reason of headache and associated incapacity.
3. That the operation should be so conducted as to provide adequate decompression effect, and that the trephining should be carried out under cover of the temporal muscle. There should be such removal of bone and such dural incision as shall allow of the escape into the temporal tissues of the excess cerebro-spinal fluid, sufficing to lower adequately the intracranial pressure.

The question of surgical treatment is put before the patient, together with the statement that, so far as my personal experience goes, these more severe cases of war headache do not undergo spontaneous cure, and that the operation, besides being devoid of any serious risk to life, is almost certain to bring about alleviation or cure within twenty-four to forty-eight hours.

Warning is also given as to the "new" pains which may develop as the immediate result of the operation, and as to their gradual disappearance subsequently.

Results of Operation.

Within twenty-four to forty-eight hours or so of the operation it is customary to find that the "old" headache, however many months or even years it may have existed, has completely disappeared or else that it is of so mild a description as to be almost negligible. The immediate effect of the operation is most marked. During the next three weeks or so, in the convalescing stage, mild recurrences of the "old" headache have been observed, of short duration and readily controlled by aspirin, etc. The patient becomes bright and cheerful, full of gratitude for the relief obtained. It is quite common, however, for the patient to complain within a day or two of the operation of a "new" pain, sometimes quite severe, neuralgic in type, in the temporal region, with some stiffness in the masticatory muscles, and a "thumping" pain in the immediate vicinity of the decompression opening. These new pains are obviously associated with the operation directly, dependent on the division of the temporal muscle, interference with the nerves of the region, and the trephine opening itself. Any sudden exertion may bring on the "thumpings." It is quite unusual, however, for these "new" pains to persist for more than a few days. In the few cases in which the "new" pains have proved unusually severe there has been some trouble at the operation from bleeding, or else the patient has suffered from vomiting after the operation. In these cases, also, palpation over the decompression opening has shown a degree of tenseness which should not be present in the ordinary straightforward case. This tenseness is either due to an effusion of blood or is dependent on the free escape of cerebro-spinal fluid and a too slow absorption thereof. Within three weeks both "old" and "new" pains should have disappeared, the patient being bright and cheerful, hopeful of the future.

On following up these patients, in their after-history it has been found that, taking all in all, the late results are equally encouraging, as can be seen from the summary given below. Any real relapse is very rare, though now and again complaints are made of mild recurrences, both of the "old" and "new" pains. All patients have expressed themselves in terms of gratitude for the relief or cure obtained.

The following is a brief summary of twenty cases of subtemporal decompression carried out for the relief of headache, chronic and severe, the result of gunshot wound or other injury of the head, the headache leading to total incapacitation and rendering the sufferer utterly miserable. In the majority of cases the patient has himself requested operative measures, all other remedies having failed.

ABSTRACT OF CASE HISTORIES.

1. Gunshot wound, left temporal, August, 1916. Constant headache. Decompression two years after injury.
2. Gunshot wound, frontal, July, 1917. Constant headache. Decompression eight months after injury.
3. Gunshot wound, orbito-frontal, and "buried," October, 1917. Headaches ever since. Decompression five months after injury.
4. Gunshot wound, frontal, November, 1917. Headaches severe and persistent. Decompression three months after injury.
5. Gunshot wound, occipital, April, 1918. Headaches constant. Decompression four months after injury.
6. Gunshot wound, frontal, and hernia cerebri, June, 1918. Headaches severe. Decompression four months after injury.
7. Gunshot wound, temporo-occipital, numerous small foreign bodies in brain, November, 1917. Persistent headache. Decompression five months after injury.
8. Gunshot wound, frontal, and "blown up," November, 1917. Persistent headaches. Decompression ten months after injury.
9. Head injury in 1910, followed by headache and fits. Much worse after service in India. Decompression twelve months after going to India. Invalided home.
10. Gunshot wound, frontal, April, 1915. Headache and fits ever since. Decompression three and a quarter years after injury.
11. Gunshot wound, mastoid, in Palestine, May, 1917. Headaches incessant. Decompression seven months after injury.
12. Injury to head in 1910. Headache and fits ever since; worse after service in India. Invalided home. Decompression fourteen months after proceeding to India.
13. Injury to head in 1915. Occasional headaches at first; after service in the East, headaches continuous. Invalided home. Decompression after one to two years' service.

14. Gunshot wound, fronto-parietal, April, 1918. Never free from headaches. Decompression three weeks after injury.
15. Fractured base, August, 1917. Headaches persistent. Decompression ten months after injury.
16. Gunshot wound, orbito-frontal, August, 1917. Persistent headaches. Decompression, right and left, six and sixteen months after injury.
17. Gunshot wound, frontal, May, 1918. Headaches very severe. Decompression five months after injury.
18. Gunshot wound, parieto-occipital, July, 1918, foreign body in cortex. Headaches severe. Decompression four months after injury.
19. "Blown up," concussion, August, 1918. Headaches persistent. Decompression two months after injury.
20. Gunshot wound, frontal, October, 1918. Headaches very severe. Decompression two weeks after injury.

INFLUENZA AMONG POISON GAS WORKERS.

BY

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(A Report to the Medical Research Committee.)

THE general impression which has been created that workpeople employed in the various processes connected with the production of poison gases enjoy a large degree of immunity from influenza has led me to make an investigation at the various factories, filling stations, and stores where poison gases are manufactured or handled, with a view to ascertaining the prevalence of influenza and the severity of the symptoms among this class of worker, and I am much indebted to the medical officers of these factories for valuable information which they have placed at my disposal.

I will deal first with a factory situated in a large Midland town where influenza was very prevalent during the two last epidemics. At this factory workers were engaged in processes in which sulphuretted hydrogen, chloro-picrin and chlorine were involved. On the sulphuretted hydrogen and chloro-picrin plants twenty-seven workpeople were employed; during both epidemics only one man was reported as suffering from influenza, and this case was very mild. With this exception, the health record among these workers was extremely good. On the chlorine plant 142 girls were employed, working on three shifts, and out of this number only six cases of influenza arose, and all of a mild form.

The medical officer of this factory has been good enough to give me details with regard to the incidence and severity of influenza among his own private practice in the same town. Out of a panel of 1,143 insured persons, no fewer than 802 contracted influenza, of whom 42 suffered from pneumonia as a complication, and of these pneumonia cases 6 were fatal. Three of these cases were men over 60 years old, two were men aged 31 and 24 respectively, and the remaining one suffered from tuberculosis of the lung. Apart from the panel practice, the same medical officer was called in to see 177 private cases of influenza. Pneumonia supervened in 14 of these cases, and there were 4 deaths, 3 in children; the fourth case was a man aged 74. With regard to the complications of this epidemic, pneumonia was not only the most frequent but the most serious. The other complications were: rheumatism, otorrhoea, severe neuralgia, pleurisy, colitis, gastritis in various forms, and one case of melancholia.

From these figures it is abundantly clear that poison gas workers were practically immune from influenza in this district, as only 4 per cent. of this class of worker contracted influenza of a very mild type, while 68 per cent. of the medical officer's panel patients were attacked, and the various complications indicate that the epidemic among these persons was of a serious character.

The second example I shall give will be taken from the workpeople employed in a factory in Staffordshire where similar poison gases were dealt with. In this case about 200 men and women were employed, and during the two epidemics there were only two cases of influenza. One of these contracted the disease on the way from Scotland; the second was fatal owing to the man insisting on returning to work before recovery. The medical officer of this factory reports that in his private practice in the same district, out of a panel of 2,500 he had 620 patients suffering from influenza, of whom 18 contracted pneumonia, with 5 deaths. In addition, he attended at home 150 private patients, of whom 13 had pneumonia as a sequel; one of these cases was fatal. The complications of the epidemic in this district were pneumonia, pleurisy,