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THE SURGICAL TREATMENT OF CERTAIN CONVULSIVE AND PSYCHICAL DISORDERS.*

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INTRODUCTION.

SUFFICIENT time having elapsed since a number of quasi-empirical operations were performed in certain cases of convulsive and psychical disorder, a few are here reported, together with some remarks and deductions.

In classifying cases of this kind it is so difficult to trace the direct relation between progress and operation, and also to keep in touch with the individuals concerned, that a great many cases have to be omitted as inconclusive. Those described are fairly representative as to pathology.

Statistically, of 51 such apparently hopeless cases operated upon in Los Angeles prior to 1922, the patients in 17 cases were apparently cured; of these 13 are still under observation and well at the time of writing (January, 1927).

Fourteen were 'improved,' and of these five were greatly better, while one died, after five years of great improvement, with a 'stroke.' In this case there was a dense traumatic arachnitis due to a fall five years before operation, and treated through a left parietal osteoplastic flap, June, 1921.

Three deaths were directly attributable to operation; one patient, an alcoholic of 43 with arachnitis, died on the day after operation, of cerebral hæmorrhage, and two infants with gross external hydrocephalus died on the day of operation from too sudden release of the fluid. Four cases of severe grade progressed to deterioration, after immunity varying from three months to eighteen months after operation. Thirteen others remained unchanged after operation, being neither better nor worse.

*Revision to date of a Paper read before the American Medical Association, June, 1923.

None of the 'cures' received medication after operation, to my knowledge, unless so stated; and all the cases herein described, cured or otherwise, were free from clinical and serological signs of syphilis, except where it is stated to the contrary.

CASE HISTORIES.

CASE 1. *Occult Internal Hydrocephalus (intermittent)*. H. L. S., female, married, age 34 when first seen by me on July 12, 1913, was then under the care of Dr. Alfred Fellows and Dr. H. G. Brainerd, who had treated her with large doses of potassium iodide.

She had suffered from headache and opisthotonic fits, with drawing up of the arms, since the age of two years. Usually there was unconsciousness, but sometimes this was only partial. The right arm was chiefly affected in the fits, and the right fingers were numb in the intervals. Vomiting, diplopia, and papilloedema developed, and she rapidly became emaciated and exhausted. On July 12, 1913, I performed a right subtemporal decompression and found very great intracerebral pressure. This soon subsided, the sight returned, and she has been in good health since. There have been no more fits.

This case was reported in detail in the *California State Journal*, November, 1914.

*CASE 2. *Occult External Hydrocephalus*. E. P., female, age 13, was sent to me by Drs. John Ferbert and William Molony. She is right-handed.

Patient was healthy until she suffered from a severe fever at the age of 18 months, during which she had a tonic fit with unconsciousness lasting one hour. These fits recurred every three months, with a superadded clonic element, until in July, 1917, she was having twenty or more such fits per night, with permanent right hemiplegia, speechlessness, and apparent imbecility. Spinal fluid, examined on November 6, 1917, was normal in all respects.

November 1917. Left Rolandic osteoplastic flap revealed much external hydrocephalus, both subdural and subarachnoid. Dural flap was left unstitched and bone-scalp flap replaced.

Result: The fits ceased entirely after 36 hours. The hemiplegia and aphasia rapidly cleared up and there have been no further symptoms to date, except that during 1924 the patient had occasional bilateral myoclonus without affection of consciousness, which ceased under small doses of luminal. Mentally and physically she appears normal, and takes no medicines.

This case was reported in *International Clinics*, Vol. 3, series 28.

CASE 3. *Occult External Hydrocephalus*. L. H., female, age 15, was sent to me by Dr. J. Lee Hagadorn. Right-handed. Heredity excellent.

The patient was healthy until she had whooping cough, June, 1916; a tonsillectomy of acutely inflamed tonsils was performed in January, 1917. Immediately after the operation she would cry out nightly in sleep, and this was followed within two months by flexor spasm of the right hand during the day, without affection of consciousness. Two weeks later it was discovered that she was having nocturnal attacks of tonic emprosthotonus followed by clonus of the right arm, head and eyes moving rhythmically to the right, associated with alteration of consciousness for a varying period after relaxation. For the next 18 months she had from five to 20 such attacks every night. There was headache, nausea, constipation, and nose-bleeding. On October 18, 1918, she remained in a state of coma with cyanosis for over an hour. Spinal fluid normal in all respects.

*See further in Addendum at end of this paper.

After consultation with Dr. J. H. Utley and Dr. William A. Edwards, I turned down a left osteoplastic flap over the Rolandic area on October 24, 1918, revealing a marked excess of subdural and subarachnoid fluid over a healthy cortex. The dura was left unstitched and flap replaced.

Result : The tonic element of the fits persisted, but the clonic element soon after became left-sided, for the first time. The right arm was now extended above the head instead of abducted as formerly during the tonic phase (Fig. 1).

December 4, 1918. Right Rolandic osteoplastic flap performed in the same way above a right subtemporal decompression made on November 1; and a bi-flanged gold tube inserted to make communication between the subcutaneous and the subarachnoid spaces, on December 7, in the region behind and above the right mastoid.

Fig. 1

Case 3. Attitude in basal fit.

Fig. 2

Case 3. Facies in cortical fit.

Facies in basal fit.

Result : The clonic element of the fits disappeared altogether, but the tonic emprosthotonus persisted. During the tonic fits the mouth was evenly puckered, the eyeballs upturned, and the eyelids flickered (Fig. 2). It was now observed that, although consciousness was instantly lost at the onset of these tonic fits, orientation was perfect immediately after relaxation. This was in marked contrasts to the hebétude and aphasia which used to follow the cortical clonic fits. At each operation the brain expanded after the fluid had drained off.

December 20, 1918. Bilateral suboccipital deduralization revealed subacute arachnoiditis of the cisterna magna and was followed by complete and immediate cessation of the remaining tonic fits. (The occipital sinus was not divided.) The patient has enjoyed perfect health up to the present time (January, 1927). She is exceptionally bright in mind and is well grown.

The etiology of this case is clear. A septic process from the tonsils via, perhaps, the ascending pharyngeal artery, caused the unisotonic state of the basal membranes, which in turn caused the external hydrocephalus. She had for long been condemned to deteriorating drugs, as a case of 'epilepsy,' before operation.

This case was reported in greater detail in the *British Medical Journal*, July 16, 1921.

CASE 4.—*Multiple Arachnoid Cysts*. D. D., male, right-handed, age 34, when sent by Dr. J. Lee Hagadorn.

The patient had scarlet fever at the age of 12. When 14 years old he jumped from a shed, four feet above the ground, on to his feet. He at once felt nauseated and queer in the head. That night he had his first fits, 16 in succession. The fits commenced in the right leg, spread upwards, and terminated in tonic opisthotonus. Consciousness was retained until the onset of the tonic opisthotonus. For a while he had six fits every night and thereafter one per night for twenty years. Many fits were followed by maniacal attacks and some were aborted by constricting the leg. An X-ray photograph showed a faint shadow in the left Rolandic region, but the bone (inner table) was normal. On the right, a Babinski response was obtained.

October, 1920. Left Rolandic osteoplastic flap revealed opaque yellow and white arachnoid with many cysts over this area, chiefly in its upper part near the sagittal sinus. As much as possible of the thickening and the cysts was dissected off and the bone-flap replaced.

Result: No fits for nine months after the second post-operative day. Then he had a few slight attacks during one week following heat prostration. These spontaneously ceased and he was perfectly well, without medicine, for the next three years, after which he was lost sight of. His mentality became excellent. Dr. Isaac Jones investigated the vestibular functions in 1924 and found them normal; the turning and douching had no tendency to induce a fit, as has occurred in some cases.

CASE 5.—*Pathology Obscure*. N. G., female, married, age 26; right-handed. Father died of T.B.; an aunt died of pernicious anemia with glandular disorder.

Poliomyelitis at two years had caused atrophy of the right shoulder girdle, and slightly of the left. The knee jerks have remained absent. The patient menstruated normally at 14 and was otherwise in perfect health until an attack of typhoid a year later. During convalescence she commenced myoclonic jerking of hands at intervals, and soon had an attack of sudden unconsciousness, with tonic rigidity and slight opisthotonus and a bitten tongue. There was never any clonic movement in the attacks. The bowels required nightly laxative ever since the typhoid, until after the operation, November, 1920.

After the first attack the myoclonic jerking continued, being worse at night, and one year later the second attack with unconsciousness occurred. The attacks became more frequent and between them the myoclonic jerkings also increased. There was marked tremor of the hands and the muscles of the neck at all times,

Bromides had a beneficial effect, but were discontinued after three years. For some months before I first saw her, in March, 1920, the myoclonus was so persistent as scarcely to allow any sleep; the attacks of decerebrate rigidity with sudden total unconsciousness, wide open mouth followed by slow tonic closure, risus sardonius, and flickering eyelids, succeeded by cyanosis and stertor, were averaging one in every two weeks. Each attack was followed by transitory internal strabismus, and widening of the right palpebral fissure and right pupil, with ecchymosis of neck, face, and shoulders. Widening of both palpebral fissures and pupils preceded attacks. In the intervals, the right pupil was the smaller. Just before attacks, the hands were cold and the pulse infrequent and thready: after attacks the hands were warm and the pulse soft and frequent. General shivering also followed them.

Searching analysis failed to reveal any trace of hysteria. The patient was and is highly intelligent and socially popular.

The appendix had been removed and a part of the left ovary resected by Dr. Howard Andrews of Hollywood. Later she was curetted and had the tonsils removed by Dr. F. L. Anton, all without effect. Also glandular and other therapy was without avail; so that, rather than take increasing doses of bromide for the rest of her life, she decided to try operation.

November, 1920. Subtemporal, followed by bilateral suboccipital deduralization revealed perfectly healthy membranes, excessive subdural and subarachnoid fluid not under pressure, and very pale cerebrum and cerebellum, with strikingly constricted arteries. (The occipital sinus was not divided.)

Result: The marked tremor of the hands and neck disappeared almost at once and has never recurred. The attacks gradually diminished in frequency so that there were only two light ones in 1922, and one more during the succeeding four years. Rarely she experiences a slight myoclonic shock on the point of dropping off to sleep. She sleeps very well and requires no laxatives. She took 10 grains of mixed bromides four nights a week up to December, 1923, and has required none since. I attribute much benefit to the use of iodine as a vaginal douche after the periods, at which time the myoclonus and proneness to attacks used to be greatest. A liberal meat diet is allowed. The subtemporal window used to bulge before attacks and collapse afterwards, which is the rule with most cases, but is occasionally reversed in others.

This patient was married in 1922 and leads an active life. Her memory and alertness have been completely restored.

I do not give the operations entire credit in this case, but think their main value was in improving the circulation of the brain and allowing the fluctuation in volume which is necessary in circulatory disorders of the brain. I think that menstruation acts unfavourably in such cases by depletion of circulation and ovarian hormones, as well as by fatiguing the midbrain.

There was also a toxic factor, but in such cases it is difficult to determine whether it is primary or secondary. Alcohol was the most effectual means of immediately preventing attacks, in this case, before operation.

CASE 6.—*Arachnoiditis and Cyst-formation.* L. L., male, age 20, right-handed.

At the age of 10 years, during whooping cough, he had an attack of prolonged coma. Attacks of dazedness or of unconsciousness recurred every 20 days for four months, when he had a typical grand mal fit, with opisthotonus and clonus, preceded by blinking and 'nodding' and jerking of the right shoulder. During the first year of fits he had headache and vomiting.

These fits recurred every 16 days thereafter, and he had three on the day I first saw him, in May, 1920. He then gave a right Babinski plantar reflex; the nasal margins of the optic discs were hazy; and X-ray showed a very small and enclosed sella turcica. Intelligence was good, but the patient was rather sleepy. He had not grown an inch since the whooping cough, four years before. The fits could often be prevented by a small dose of whisky when the 'nodding' began. Pituitary extract had no effect.

His physical signs were very variable, being sometimes present between the fits, sometimes absent. These variable signs were a paretic right face (Fig. 3), an exaggerated right knee-jerk, a right Babinski toe reflex, rarely bilateral; sometimes there was decided Rombergism and ataxy of the right arm and occasionally headache and nausea. The nasal margins of the optic discs were blurred and the left retinal veins markedly enlarged. In the fits, the head and eyes sometimes went to the left, sometimes to the right, and sometimes back and up.

Fig. 3

Case 6. Note asymmetry of face.

Dr. Isaac Jones examined the vestibular apparatus and found markedly impaired vestibular responses. The turning and caloric tests showed subnormal nystagmus, vertigo, past-pointing, and all constitutional responses. No pallor, sweat, or nausea was produced except very slightly at the end of prolonged douching of the left ear. There was no spontaneous nystagmus or past-pointing, or vertigo; no perverted nystagmus, no incoordination of ocular movement, no suggestion of conjugate deviation after ear stimulation.

In sharp contrast to this vestibular defect, the hearing was unusually acute in each ear. Dr. Jones regarded the defect as being within the brain-stem. (This examination was made in April, 1922, one year after the suboccipital operation.)

The surgical treatment had been as follows: Subtemporal deduralization in December, 1920, and suboccipital deduralization, May, 1921, at California Hospital, revealed marked intracerebral pressure, a localized cyst over the right cerebellum, and thickened and opaque arachnoid over the medulla and vermis. (The occipital sinus was divided.)

Result: Sudden increase of height of one foot in less than a year. Fits gradually diminished and finally ceased in November, 1922. The former marked coldness of the extremities has quite disappeared. He is now a strapping lad of about six feet, and intelligent. Three-quarters of a grain of phenobarbital nightly were allowed for a year after operation. No drugs had any appreciable effect before operation. Among those tried were bromides, luminal, borax, *œnanthe crotata*, pituitary gland, etc.

CASE 7.—*Occult Internal Hydrocephalus.* D. T., female, age 21, left-handed; sent to me by Dr. F. L. Anton.

Patient was in perfect health until tonsils removed in 1917, by an osteopath. Fits began three weeks later. They were typical grand mal fits, the head and eyes usually going to the left. For one year before operation she averaged 12 major attacks per month, with petit mal in the interval, medication notwithstanding. After attacks, the left palpebral fissure was widened.

November, 1920. Left subtemporal deduralization at California Hospital revealed much yellowish subdural fluid and intracerebral pressure. Subsequently, bilateral suboccipital operation, in February, 1921, and later a right osteoplastic flap operation, leaving the dura unstitched, were performed.

Result: The fits rapidly diminished in frequency and severity, so that during the period 1922–1924 she was free for seven months at a time.

Unfortunately, in July, 1925, she had a severe emotional shock, since when the attacks have been rather more frequent, varying from one to two months to one per month. She continues in her occupation, which she commenced in 1922, since such fits as she has are very much lighter. She married in October, 1926. She has not thought the present attacks of sufficient importance to try the effect of any medicines whatever, although I have advised medication.

This case is inserted on account of the relation between tonsillectomy and convulsions, when the tonsils were acutely inflamed at the time of operation. In this respect it is parallel to Case 3 of this series.

CASE 8.—*Arachnoid Cysts of Left Frontal Lobe.* J. W., born 1886, right-handed, was sent to me by Dr. G. P. Waller of Los Angeles.

Developed grand mal fits immediately after scarlet fever at the age of six years. The fits spontaneously ceased one year later, after which he became an incorrigible boy, although apparently very intelligent.

For years past he had been in constant trouble on account of various crimes and had spent a large part of his time in San Quentin prison on account of forgery and polygamy. He was released from San Quentin for military purposes and went to France, but in spite of a good position deserted from France to England. On his return to California he again committed bigamy and forged a cheque against his own family. He was brought to me on February 6, 1921. He told me, with apparent candour and truth, that he committed the offences in a twilight state. He knew he was doing wrong, but acted as though in a dream.

The first abnormality discernible was a marked asymmetry of the face, so that there was a lack of expression on the right side. The tongue protruded slightly to the right; the right mouth was weaker, both at rest and on voluntary effort.

Fig. 4

Case 8. J.W. Photograph taken the day before operation. Note right facial weakness.

Fig. 5

Case 8. J.W. About one month after operation.

Emotional effort was not recorded. The right knee-jerk was brisker than the left and there was a slight clonus of the right ankle. The right plantar reflex was variable, the left absent. Pointing was better with the left hand and there was some loss of position sense on the right side. Bone conduction was poor in the right ear. The nasal margins of the discs were hazy and that of the right contracted. The right pupil was larger and reacted better to light.

Operation, February 10, 1921, at California Hospital, Los Angeles. Osteoplastic flap turned down over the upper and mid-frontal lobes. On opening dura, a bluish, transparent arachnoid cyst the size of a pigeon's egg presented over the superior frontal gyrus, with much surrounding œdema. On further reflection of the dura, another similar cyst was discovered at the lower posterior angle of the mid-frontal gyrus. The vessels were covered with thickened, white, opaque arachnoid, and some sulci that should have held vessels had only thickened pia-arachnoid visible.

The cysts were opened and the dura left unstitched. Bone-scalp flap replaced.

Result: Personality and face remarkably altered. (See Figs. 4 and 5.) For the ensuing two years he did satisfactory service as teller in two local banks. He then, by competitive examination, gained the position of private secretary to the chief of one of the largest corporations in Los Angeles, which position he still holds after four years. His original wife has returned to him. He tells me that he has never had a glimmer of a desire to return to his old ways, which seem incomprehensible to him now.

CASE 9.—Frontal Arachnoiditis (? Syphilitic). G. W. B., male, sent by Dr. W. B. Kern. Patient is a tall, strong man, born 1878; married, with five children, all well in 1921 (but one went into convulsions in 1923, and died in acute status).

In 1904 he fell 40 feet, striking head, and dislocated the third cervical vertebra, but he had seen military service since. For years he had had steady, dull headache of a congestive character. During 1919 and 1920 this had been supplemented by violent frontal pain, with maniacal attacks and suicidal tendencies. For this he had been confined in Norwalk Asylum under the care of Dr. Kern, who sent him to me on January 19, 1921.

He had "had a good bit of alcohol" in his time and the Wassermann test in the serum was 2 plus. However, the asylum treatment had little effect on the headaches, and the mind was rapidly deteriorating. It seemed highly probable that he would commit suicide at the first opportunity.

Physical signs were as follows: Double papilloœdema of low grade. Marked ataxy of right hand; less marked left. Marked Romberg's sign, the patient falling backward. Pupils equal and normal, reacting to light and accommodation. Movements of right side of mouth slightly stronger than left.

Operation at the White Memorial Hospital, April 1921. Left osteoplastic frontal and prefrontal flap in two stages. Much subdural fluid; moderate streaky arachnoiditis. Dura left unstitched and flap replaced.

Result: Complete freedom from pain up to the present time (January, 1927), in spite of no antisyphilitic treatment. Patient has built up a considerable business of his own in metal ware and seems mentally normal.

CASE 10.—Opaque Cerebral Arachnoiditis, of unknown origin. D. B. P., male, age 28, right-handed; sent by Dr. H. C. Stinchfield.

The patient has suffered from grand mal fits since 1912. He had typhoid at the age of three, enteritis at six, whooping cough at eight. During the enteritis he was comatose for six days.

His mother had two attacks of a convulsive character, 24 years and three years prior to November, 1920; probably hysterical, as one occurred just after marriage and the other just after seeing her son in a fit. She died of apoplexy, May 1922.

The boy's attacks averaged one in six weeks, sometimes four in two weeks, but he was once free for 10 months under bromide. The fits were opisthotonic, with turning of the head and eyes to the left. Sometimes myoclonic jerks of the arms upward preceded the attacks and sometimes occurred without attacks. He had a slight and brief aura, "like going under ether." The attacks were more frequent at night and on first rising. The only physical signs of note were a contracted left disc with hazy nasal margin, marked clonus of eyelids on closure, and marked nystagmus to right and left. Blood pressure 110/60.

Operation, November 26, 1920, at the Clara Barton Hospital. A right subtemporal decompression and a right Rolandic osteoplastic flap revealed such a dense arachnoiditis that the cortex was almost completely obscured by the creamy-looking deposit. Interspersed were small arachnoid cysts and adhesions to the visceral surface of the dura, both old and fibrous, and soft and recent in appearance. These adhesions bled dark blood freely when separated. The inner aspect of the dura also was dotted with white spots. The fluid round the vessels in the sulci, where such was visible, was of a deep yellow colour.

The dura was left unstitched, the flap replaced, and the temporal muscle closed where it had been separated in the direction of its fibres. The brain was collapsed and pulsating well when the wound was closed.

Result: He had fits for about two years as frequently as before; then they gradually diminished, and at the time of writing (January, 1927), he has been quite free for over a year. His father (Dr. A. B. Pierce) tells me, however, that he is taking "one tablet of luminal a week."

Dr. Isaac Jones found by the Bárány tests that the functions of vestibular pathways within the brain-stem were markedly subnormal; cochlear function on both sides was excellent.

CASE 11.—*Post-typhoid Epilepsy (pathology uncertain).* J. H., male, age 40, left-handed; was sent by Dr. Barnes, November, 1920. Good heredity; normal birth.

At the age of two years he had bowel trouble with "spasms" for two weeks. He had perfect health after measles and whooping cough at four years, until an attack of typhoid, May 1908, after which he grew very stout. The first fit occurred in December, 1908, in his 22nd year; at noon, after work, he was found unconscious on the ground, but quickly rallied. Thereafter he had attacks every two weeks, which resembled simple fainting fits. These merged into convulsions one year later. The fits were very regular every two weeks, but bromides and various proprietary medicines reduced their frequency to one every five weeks for a time. He was never free for more than six weeks, and that only once, between December, 1908, and November, 1920, when I first saw him. The character of the fits was tonic opisthotonus, preceded by a scream and followed by cyanosis and tremor. He underwent an operation for gall-bladder affection by Dr. H. E. Southworth in 1912, which had no effect on the fits.

After each attack he had herpes of the ball of the left thumb. The optic discs were normal, as also were all other physical signs, except that the position sense and pointing of the right arm were defective; there was some Rombergism, and a fine tremor of both hands. Plantar reflexes absent. Wassermann test was negative. Occasionally the right palpebral fissure was slightly wider than the left.

Operation, January, 1921, at the French Hospital, Los Angeles, was decided upon on account of the close relation to typhoid fever, the intolerable frequency of the fits, and the complete failure of many years of medical treatment, including my own. Moreover, the mental state was becoming dangerous.

Subtemporal deduralization revealed normal amount of subdural and subarachnoid fluid, increased intracerebral pressure, and thickening of the arachnoid round the sylvian artery. Since he was left-handed, as also his father before him, the operation was done on the left side. To my astonishment, he was aphasic to the extent of complete dumbness for three days. There has been no affection of speech since. This phenomenon had never before occurred in my experience as a result of subtemporal operation.

In view of the marked general pressure and the continuance of the fits, a bilateral suboccipital deduralization was later performed. The dura on both sides presented like hard cricket balls and the tension after releasing all the fluid from the fourth ventricle remained very great. By allowing slow seepage, however, the muscles could eventually be brought together over the cerebellum without danger of herniation of the latter. The occipital sinus was not divided in this case, but the dura was left open on both sides of it.

On September 3, 1921, at the Methodist Hospital, Los Angeles, on account of continuance of fits and the continued bulging of the subtemporal window, a large right parietal osteoplastic flap was turned down and the dura left open (two-stage operation) in order to allow further room for the chronic gliosis that is one cause of continuance of fits in old-standing cases. Bone-scalp flap replaced slightly raised.

Result: Attacks continued at about the same intervals for over a year. Then he gradually improved and for the last two years has had no attacks at all. He is highly proficient in his art of scenery painting, much of his work exhibiting very fine detail which has been quite unimpaired by either his former illness or operations.

All of this he attributes, rightly or wrongly, to his having taken the "Epilepsy Cure" tablets of the Western Medical Company of Chicago. (Two other cases, outside of this series, have reported benefit from this proprietary medicine, without apparent harm.)

Dr. Isaac Jones examined the vestibular apparatus on March 27, 1922, and reported as follows:

"Neuro-otological examination shows definite vestibular impairment, bilateral. This is demonstrated by both turning and caloric tests. There are certain peculiarities about this impairment:

(1) The caloric test of each ear shows a disproportion between the nystagmus, which is poor, and the pastpointing, which is good.

(2) There was, after all turning and caloric tests, a striking absence of constitutional responses. Turning and douching produced no pallor, sweat, or nausea. For example, after douching the ear, although the patient would show a normal falling response, yet he would say, "I think I will go now," and acted at once as though nothing had been done to disturb him.

(3) On douching each ear, there was a curious phenomenon. After 35 seconds the eyes began to twitch. (This is sooner than normal, which is usually 40 to 45 seconds.) This nystagmus, although of small amplitude, was definitely observed and the amplitude increased to a fair nystagmus after a little more than one minute of douching. Then, as the douching was continued, the nystagmus disappeared entirely, instead of increasing. This phenomenon was true of each ear.

This impairment is central in type rather than peripheral, but is not suggestive of gross lesion of any kind. The cochlear portion of each 8th nerve is normal."

Incidentally, it may be here stated that this absence of constitutional response is highly characteristic of epileptics. In some cases, however, a fit is induced.

CASE 12.—*Syphilitic Meningeal Adhesions.* Mrs. F., age 53; three healthy children.

The patient had been under treatment for many years for very severe motor attacks of migraine. The last three attacks had been accompanied by tonic spasm of the arms and hands into the Parkinsonian attitude, cyanosis, dilated pupils, clouded consciousness, and sense of impending death. She had latterly been attended by Dr. H. G. Brainerd.

When I was first called, in November, 1920, she had been in this tetanoid condition for about two hours, with intense headache and vomiting. As she was sinking into coma, I performed a subtemporal deduralization (right) the same night. There was great intracerebral pressure and marked subdural adhesions.

Result: She has been in excellent health since, although medical treatment for a positive Wassermann, discovered for the first time during the week in hospital after operation, was refused. She has mild migraine once in three to six months, which in no wise incapacitates her as formerly. She has had no more spasms.

It is highly probable that the pressure, the adhesions, and the migraine were of a syphilitic basis and could have been cured in the beginning by appropriate medical treatment. However, I doubt if medication would have sufficed at the time at which I first examined her.

Her photographs showed that she had, for years past, a marked widening of the right palpebral fissure, which disappeared after operation.

CASE 13.—*Occult External Hydrocephalus.* B. C., male, age 11, left-handed; seen by Dr. Leo Schroeder. Family history good.

He was in good health until he and his brother, a year younger, both contracted diphtheria, December, 1917. Each received 10,000 units of antitoxin, and the patient became delirious. Both children developed fits of great severity and frequency. Those of the patient were tonic emprosthotonus, followed by tonic clonic jerkings, in which the head and eyes jerked to the left, and were preceded by an aura of a whistle and of a blow over the right ear. From being tonic fits, they increased to 30 in the 24 hours, mostly nocturnal. He was observed at the Michael Reese Hospital in Chicago from September 17, 1918, until October 1918, and a diagnosis of right-sided brain tumour was made, but no operation was performed. The spinal fluid examined at this hospital was reported as follows:

Ross-Jones test	..	..	..	negative.
Noguchi test	..	..	..	negative.
Wassermann and Lange test	..	..	..	negative.
Cell count	..	..	..	3.

The tonsils were removed in 1919, after which he improved greatly for four months, then the fits continued with varying frequency until, in April and May, 1920, he became as paralyzed as in 1918, and paralysis supervened.

As the paralysis became more general, the fits lessened in frequency and severity. When I first saw him in Los Angeles, on July 21, 1920 (Fig. 6), the fits were tonic, but he was quite unable to move any part of the body except the eyes, which followed the observer's movements. He was speechless and had to be fed by a tube. The limbs were limp, but the knee-jerks were exaggerated and a Babinski sign was present. The discs were rather pale and slightly oedematous and the pupils were rather full. There was a well-marked internal strabismus, alternating. The tongue was kept slightly protruded and saliva dribbled down the chin. The pupils were equal and reacted to light.

A subtemporal deduralization was at once performed, revealing marked excess of subdural and subarachnoid fluid. Two days later a bilateral suboccipital deduralization (with division of the occipital sinus) was performed. Again an excess of fluid was found, but no macroscopic disease of the membranes nor

Fig. 6
Case 13. B.C. July 21, 1920.

Fig. 7
Case 13. B.C. November 10, 1920, after operations.

Result: Smooth post-operative course. On the fifth post-operative day, he was able to draw up his legs and his arms to the shoulders by voluntary effort. On the tenth day he was able to play clumsily with toys. He had diminishing fits for about two weeks after operation and it was most evident that the paralysis diminished in spurts after each fit. I have come to regard this phenomenon as a kind of "fits of recovery," and believe it substantiates the theory that the purpose of fits is to restore adequate circulation to the brain and overcome the anoxæmia.

Speech returned gradually after two weeks, commencing with laborious framing of syllables and later with stammering, which disappeared after the first six weeks. By August 5, 1920, all fits had ceased and by November 10, 1920, he was apparently a normal boy (Fig. 7), a little backward in his lessons.

He remained normal in all respects until July, 1921, when, again in Chicago, the fits gradually recommenced and continued so that in April, 1922, he was again having 30 to 40 fits per 24 hours, chiefly nocturnal. In August, 1922, it is alleged

Fig. 8

Case 13. B.C. Onset of fit. Photograph taken in 1924.

that he passed a quantity of thick, creamy material from the bladder, and the fits again ceased thereafter and he picked up to almost normal until December 1922. Thereafter he had fits again and continued until he was brought to Los Angeles for the second time, February, 1925. At this time he was still able to walk with assistance, but was markedly ataxic and there was more spasticity than when I first saw him in 1920. He was having tonic emprosthotonic fits, followed by left-sided clonus, daily (Fig. 8).

Dr. Isaac Jones investigated the vestibular functions on February 15, 1925. His notes are as follows:

"Turning showed distinct difference between right and left. Right showed small 23; left showed large 31,

"After three turnings, pallor, vomiting, and clonic convulsion. Douching the right ear for four minutes produced no constitutional responses whatever. Falling backward and to the right. Douching left ear produced only slight pallor and nothing more. Falling backward and to the left.

"No perverted nystagmus under any circumstances, but a definite block or interference with vestibular impulses, especially for vertigo, pallor, and nausea.

"There was impaired nystagmus after douching, but no definite block along any vestibulo-ocular pathway.

"No spontaneous nystagmus. Auditory tests impossible. Mother has never noted any ear trouble.

"Dr. T. Lyster reported the eye-grounds normal, pupils of normal size, equal and regular, and react normally to light. Facial movements lag on left, central type. Speech absent.

"Knee-jerks exaggerated, abdominal reflexes exaggerated, ankle clonus left, and double Babinski response."

In February and March I inspected the cerebellum through opening up the old incisions, and also the cerebral cortex later through an osteoplastic window. In both instances there was the same excess of fluid as in 1920, but the cortex of both cerebrum and cerebellum was much paler and 'boggier' and the whole brain appeared to have lost its 'tone' and did not expand after draining the fluid as it formerly did.

The operations were followed by only transitory improvement. His speech returned for a few weeks, but is now (January, 1927) absent, and he is in a condition of generalized diplegia, much more obviously spastic than the paralysis of 1920.

This case well illustrates the rule that in general excess of extracerebral fluid, the most highly educated hemisphere is the first to rebel. In this case the boy was left-handed and the clonus was on the left side, with head and eyes to the left. In Cases 1, 2, and 3 of this series, the patients were right-handed and the predominance of symptoms were on the right side, and the head and eyes jerked to the right.

This case was reported in *International Clinics*, Vol. 3, series 31.

CASE 14.—*Occult External Hydrocephalus*. J. H., female, age 23.

The patient had severe tonsillitis in August, 1910. The disease took the usual course, beginning with "hysteria" as it was thought, then fits developed which increased in frequency and severity.

In 1917 a surgeon in an eastern hospital turned down a left Rolandic osteoplastic flap, on account of the right-sided clonus of the fits (she was right-handed), and on account of the right facial paresis which is evident in the photograph (Fig. 9). He found nothing but abundant fluid. Unfortunately, he sewed back the dura and the fits continued, she lost her speech, and eventually became paralyzed to the extent shown in the illustration (Fig. 10), taken the day I first saw her, April, 1920. She presented extreme diplegia with incontinence. After subtemporal drainage on the right side, I turned down the old left Rolandic flap and left the dura open. There was much encysted fluid beneath the dura on the left side, and free fluid on the right.

Result: A few weeks later she was walking about, could sew and do some household duties (Fig. 11.) Her speech was slow and limited.

The tonic element of the fits persisted, so I did a bilateral suboccipital exposure in two stages (as always). As expected on account of the advanced nature of the

case, when the dura was opened there was an alarming gush of fluid, due to the arachnoid cistern having been torn to shreds by the prolonged fluid pressure, and the vermis had been compressed upwards so that the rhomboid fossa at once met the eye. Naturally, the blood pressure dropped rapidly to 40 systolic. Had not the dura been pinpricked at the first stage, the change of pressure would have been fatal, for the iter of Sylvius was also dilated. However, by rapid replacement of the muscles of the neck and accurate suturing of the skin, she was soon restored.

Result: She improved some more and gained weight. Unfortunately, the improvement was not maintained for more than 18 months, after which the family disappeared.

Fig. 9

Case 14. J.H. 1911, Soon after tonsillitis. Note paresis of right face.

In such an extreme case the improvement could hardly be expected to last, but the facts are worth recording because of their physiological interest. The case is very similar to Case 13.

The outcome seems to depend largely upon the general power of resistance of the patient. In healthy, strong children, like those of Cases 2 and 3, with well-to-do parents who could provide the best food, etc., the inflammatory process ceased after drainage. Both in Case 13 and Case 14 the patients were of poor families and anæmic, although both received unremitting care at home.

About the time the patient (Case 14) began to decline for the last time, her mother developed a bad cancer of the breast, and this must have interfered with the child's care. If the disease process continues, the arachnoid becomes completely unosmotic and the fluid continues to accumulate. In

Case 14 there was no arachnoid left to the cisterna magna, so that she was entirely dependent, for absorption in this region, upon the neck muscles. When these are marred by a transverse scar, their powers of absorption are limited.

This case was reported in *International Clinics*, Vol. 3, series 31, and is chiefly of academic interest, as showing the degree of at least temporary reclamation possible to an extreme diplegic of this etiology.

Fig. 10

Case 14. J.H. April, 1920. Diplegic and speechless.

Fig. 11

Case 14. J.H. Aug. 1921. After operation.

The next case does not belong to this series, since the patient came under treatment after January, 1922, but I have decided to include it because of the unusual developments and because the case is a companion one to Case 9 (Mr. J. W.), and both are of forensic as well as medical interest.

CASE 15.—*Traumatic Dural and Arachnoid Scarring.* E. F. M., male, age 26, right-handed. He was paroled to my care by Superior Judge Edwin F. Hahn of Los Angeles in October, 1924.

Family history excellent. Father, mother, two brothers and two sisters all alive and well and in good social position.

In 1914 he was hit over the left post-parietal region by the butt of a pistol in the hands of a bandit. The blood pouring down his clothes made a great impression upon his dazed mind. He vomited and was attended by a doctor in his home. He had pain over the left post-parietal region on and off since, with severe occipital and frontal headaches about once a week.

Subsequently he committed meaningless crimes. The most noteworthy were the following: There was an automobile accident near his home in which a woman was hurt and bled profusely. He helped her to the sidewalk and the sight of blood sickened him. He then went home and took a pistol belonging to an official who roomed with him, went out of doors, and concealed himself in the back of an automobile belonging to his own barber. When the barber got into the driver's seat,

the patient ordered him to throw up his hands. The barber shouted for help and the patient handed him the gun, by which he was himself held prisoner until the police arrived. For this he was confined in San Quentin prison for 17 months. He had previously been arrested for impersonating a naval officer. The crime for which he was held when Judge Hahn paroled him for treatment was that of stealing cheques, which he kept for a week in his car, so they could not have been cashed.

Fig. 12

Case 15. E.F.M. Showing operation scar and also the angular scar of the old assault wound in centre of flap.

On examination : Optic discs and vessels normal. Fine lateral nystagmus, best seen to the right. Pupils equal and normal in reaction. Slight Romberg's sign. Finger-nose test good on both sides. Later, the Romberg sign became more marked. Knee-jerks equal and rather exaggerated. Plantars sluggish flexor. Position sense of right arm with eyes shut markedly impaired. Right grip 90, left 115, by repeated dynamometer tests. There was a large angular scar of the scalp over the left angular and supramarginal gyri, very tender on deep pressure. He was always in a somewhat euphoric state, as if he had had alcohol, which was impossible under the circumstances. B.P. 132/90.

Operation, October, 1924, at the Methodist Hospital, Los Angeles. A left post-parietal osteoplastic flap turned down, revealing a dense scar upon the dura mater underlying the scalp wound. The dura was opened a week later and a further

white, opaque thickening was found upon the arachnoid. This was incised and raised, but not removed, and the dura replaced without stitching. Bone-scalp flap replaced (Fig. 12). Recovery uneventful.

Result: It was at once observed that the euphoria had disappeared, and the patient became more serious-minded. He has been free from headaches and in steady employment with the Bent Concrete Pipe Company of Los Angeles since.

Mr. Bent reports at present that the patient is steady and reliable in every way, which is suggestive in view of the fact that it is two years and three months since operation. Mr. Bent was responsible for enlisting the interest of the Court in the medical possibilities of this case.

The next case is reported on account of the unexpected relation between the heredity of the patient and the result of operation.

CASE 16.—*Generalized Arachnoiditis.* F. W., male, age 34, right-handed. His father (a New York policeman) died of alcoholism and drank before patient was born. A paternal aunt had epilepsy. His maternal grandmother's cousin had epilepsy.

At the age of seven months the patient started twitchings and nightmares, but after a fall on the head at the age of three years, which left a scar in the left frontoparietal region, the attacks became worse. They varied from tonic opisthotonus with coma, to Jacksonian attacks of the right leg which spread upwards but often were unaccompanied by unconsciousness. He had these nearly every night all his life up to the time I first saw him, in November, 1921, and during my observation of him at first he sometimes had 30 or more severe Jacksonian convulsions per night. They were always mostly nocturnal. He had an aura of distress in the stomach. Sometimes he remained in status for 48 hours. He is fairly intelligent, though not up to the average.

Headaches only occurred after the fits as a rule. On examination the blood and spinal Wassermann tests were negative.

The eyes were reported on by Dr. Lloyd Mills as follows (December 12, 1921):

(1) Lack of normal amplitude of reaction of accommodation.

(2) Slight reddening and nasal blur of both discs, more in the left, where there is also a slight venous fullness and tortuosity which is lacking in the right fundus.

No spontaneous nystagmus or pastpointing. The knee-jerks were exaggerated, more on the right. Plantars, left flexor, right indefinite. Marked Romberg's sign; falls to left and back. Finger-nose test good on both sides. The vestibular pathways, examined by Dr. Isaac Jones, were reported to be "open," but some impairment of the vestibular end-organs, especially left, and impairment of both cochleas. Chronic otitis media both sides. He had normal responses to turning, but impaired responses to douching.

I witnessed many of this patient's attacks. In the Jacksonian fits, the face at first became very pale, and later very red and congested, and the exertion looked tremendous. In most fits there was clonic jerking of the head and eyes to the right, but even in these he retained consciousness very often, and could evidently understand what was said to him. They usually began with tonic straightening of the right leg. When coma supervened he became cyanotic. Drugs such as bromide, luminal, borax, etc., in reasonable doses were unavailing.

Operation December 1921. A right subtemporal decompression revealed much intracerebral pressure, and diffuse arachnoiditis round the vessels. A left frontoparietal osteoplastic flap revealed more marked arachnoiditis especially just above the Sylvian point, but beyond this and the pressure no gross pathological change was found.

Result : The fits gradually widened apart, occurring weekly, then monthly, and during the past year he has only had one attack. He has taken 30 grains of mixed bromides per night.

This result cannot be attributed to the bromide, since every kind of medication including much larger doses of bromide had failed before operation. Moreover every kind of hygienic and dietetic measure had been tried. In 1917 he was in the Mayo Clinic at Rochester, and his mother was specifically informed when he left that his case was hopeless.

DISCUSSION.

The foregoing clear-cut cases, all but two being still under observation, are sufficient upon which to base some theoretical deductions. Of the remaining cases, which I might quote, many are difficult to get in personal touch with ; in others, a detailed recital would be inconclusive or repetitive.

Cases of convulsions due to tumour, or to acute injury, or to obvious hæmorrhage, some of which have been already reported in this JOURNAL (May, 1925), are omitted as being confusing to the issues, even though equally pertinent to the theories which follow.

In regard to cases of acute injuries, both in adults and in infants injured by forceps, who have developed frequent convulsions, sometimes within a few hours, sometimes after the lapse of weeks, treatment by opening the dura and draining the excess of clear fluid by leaving it open has resulted in prompt and permanent cure. Prompt and complete first intention healing of the scalp is, of course, essential.

Let me state, at the outset, my belief in the following views :—

- (1) That all fits are due to anoxæmia of some portion of the cerebrospinal axis. If the anoxæmia is complete and absolute, so as to cause paralysis, as in embolism, no fit would be expected to ensue.
- (2) That the purpose of fits is to correct this anoxæmia before permanent damage occurs to the neurones.
- (3) That in the so-called 'epileptic' self-limiting fit, the fit due to external hydrocephalus, or to vertical meningitis which partially occludes the arterioles, or to intracerebral pressure, or to emotion, etc.—there is a diminution of arterial blood-flow through the cerebral arterioles and capillaries, and that this is probably the chief cause of the anoxæmia. The more gradual the onset and the more incomplete the anæmia, the more likely are convulsions to ensue. The more complete the paralysis, the less the convulsions.
- (4) That in the continuous or rapidly repeated convulsions of acute toxæmia, such as follows the drinking of American 'moonshine' and used often to follow the administration of salvarsan, as well as the acute intestinal disorders of infancy, the anoxæmia is due to chemical displacement of oxygen rather than to arteriospasm, and the fits continue into status in spite of the most intense dilatation of the cerebral arterioles.

I have seen these different conditions of the cerebral vessels by direct inspection of the cortex, as well as by inspection of the retinal vessels just before and during a fit. I was myself responsible in one case, 13 years ago, for exposing the cortex in a case of delayed salvarsan poisoning, on account of erroneous diagnosis of cerebral gumma, and found the cerebral arterioles and capillaries intensely engorged. I had not learned at that time that acute toxic fits are Jacksonian. Other similar cases that I have had the same opportunity to see were exposed through a similar error by others. The appearance in the above instance was in marked contrast to the cases reported in this paper, in most of which the arteries were markedly constricted and the veins full.

The crux of the problem seems to be this: What is the cause of the diminished arterial flow in the self-limiting fits?

It would seem that in some cases the vice arises in the vasomotor centres; in others, the arterioles are locally affected, and again in others the assault upon the vasomotor centre comes from elsewhere.

Considering the case of L. H. (Case 3 of this series), which is not only the most typical of the External Hydrocephalus group, but also the best studied, clinically and surgically, reference to the original report (*British Medical Journal*, July 16, 1921) reveals that each operation carried its physiological lesson.

Her grand mal attacks, before any operation, consisted of (1) tonic emprostotonus, in which she remained rigidly anteflexed and silent for about 20 seconds; then (2), as the trunk relaxed, the head and eyes commenced to jerk clonically to the right and the right hand entered into clonus. Then (3), the movements became slower and ceased and she wept as if frightened, was disoriented, made movements of defence, and was aphasic; and then slept for a variable period until the next fit commenced in the same way.

Now, quite apart from other evidence that the tonic phase was probably carried out by the cerebellar vermis or nuclei of the brain-stem adjoining, and that the later clonic phase was carried out by the left Rolandic cortex, I was able, by operating and draining the cerebral cortex above the tentorium, to dispel the clonic element altogether and leave only the basal tonic element of the fits, which continued as pure emprosthotonic fits for two weeks. Then, after more than 20 of these purely tonic fits, bilateral suboccipital drainage of the arachnoid space immediately and permanently dispelled this residuum and she has never had either kind of fit since.

Quite apart from numerous other cases of this kind, I hold that this case alone furnishes almost conclusive evidence that the fits were due to fluid pressure upon the various parts of the brain. There was never a discoverable or suspected toxæmia. Granting this, and bearing in mind that the fluid was normal cerebrospinal fluid and that at operation I saw constricted

arterioles, I claim that it is at least probable that the fits were due to compression of the fine terminal filaments of the cortical arteries, producing the clonic element, and of the cerebellar and midbrain arteries, producing the tonic element. It is to be remembered also that in this and all similar cases vaso-dilators, such as alcohol and chloroform, can temporarily check the fits; but in order to do so, the vaso-dilatation has to be sufficiently powerful to displace some of the excess fluids external to the brain into the impaired lymph channels of the arachnoid and into the veins.

Other strong evidence can be adduced from the effect of change of posture in this child after the various operations as described in the original report. Her state of consciousness during and after the different kinds of fit is instructive. As already stated, she was disoriented, unruly, and aphasic after the pre-operative 'mixed fits.' In a few purely clonic fits of the right mouth and right arm she did not lose consciousness, but was very exhausted afterwards. In the purely tonic fits, consciousness was lost instantly at the onset, but she was well oriented immediately after the trunk relaxed and once asked, within 20 seconds, if a stranger who had come into the room had noticed anything wrong.

The state of consciousness after these pure emprosthotonic fits may well be considered in conjunction with that of N. G. (Case 6 of this series), who suffered from pure opisthotonic fits and who was rapidly oriented afterwards. Everything in the clinical history and subsequent cure of Case 6 pointed to a vascular disturbance of the brain. Hers was the palest cerebrum and cerebellum that I have ever inspected. Also her attacks were more easily staved off by small doses of whisky than in any other case of which I have had experience. Whether the fact that she is a strong-minded lady of great intelligence and calmness had anything to do with the stability of the cerebral cortex, that it did not participate in the convulsions, I do not speculate; but she used to fight valiantly to prevent the upward march of the myoclonus that so often terminated in purely tonic opisthotonus but never in clonus.

Assuming for the moment that attacks as in Case 6 are due to angiospasm of the midbrain arteries, causing a complete break in conductivity immediately above the colliculi, then the unconsciousness is most likely due to the cutting off of all afferent stimuli to the cerebral cortex, but the cells of the cerebral cortex are not exhausted as they are during a cortical clonic fit. Hence, as soon as the circulation is restored to the afferent tracts in the midbrain, the cortex is able to resume its functions, because it is not loaded with the products of violent katabolism. (There is no way of gauging the "inward awareness," as Pearce Bailey calls it, during this state of decerebrate rigidity.)

Stated in another way: In the purely tonic fit, the patient is unconscious because the cerebral cortex is wholly unoccupied; the coma is sudden and the recovery rapid. In the clonic fit, the patient is (sometimes) unconscious

because the cerebral cortex is over-occupied—in restoring its capillary circulation or, at least, in trying to regain oxygen; the coma is often incomplete and the recovery is tardy, as is usual with exhausted tissue. Also, transient ophthalmoplegia and bulbar paresis may follow a tonic fit, but paresis of arm or face commonly follows a cerebral clonic fit.

Anatomy provides a certain support for the angiospastic theory of a typical fit. The central ganglionic systems of arteries have no peripheral anastomosis with each other or with the cortical arterial system. If, then, we assume a slow wave of spasm to be passing out from the vasomotor centre in the medulla, it is likely that the proximal fine terminal arteries of the mid-brain will become occluded before the larger, more distal anastomosing middle cerebrals. If this be so, is it not an adequate explanation of the fact that tonic spasms usually precede the clonic in a typical fit, but that in some fits the tonic element is never followed by clonic movements at all?

In regard to the surgical treatment of convulsions in general, no man did more work and wrote so comparatively little as Sir Victor Horsley. As long ago as in the 1901 edition of *Principles and Practice of Medicine*, Sir William Osler, speaking of Horsley, MacEwen, and Keen, says that of 50 cases of trephining for epilepsy in which nothing abnormal was found to account for the symptoms, 25 were reported as cured and 18 as improved (page 1101).

It would be unfortunate if reports such as the present were construed as advocating indiscriminate surgery in cases of convulsions. Probably not more than one-third of the cases would derive the slightest benefit, and some might be further handicapped, quite apart from the danger and inconvenience. Moreover, our present knowledge of sources of toxæmia, of the action of the ductless glands and of the emotions has greatly improved the medical outlook of a great number of cases. Also, there is always a residuum of 'declining stock' whose medulla oblongata could never be improved by any measures whatever.

It is impossible to lay down any rules whereby the surgically promising cases can be segregated. A careful history, combined with a broad survey of the individual himself, and a careful examination in all cases will, in conjunction with the operative findings, eventually develop that clinical sense necessary for dealing with this particular symptom-complex. Most important is to see and analyse the fit as often as possible. Even then, discouraging mistakes will occasionally occur, and the surgical results are apt to be the more discouraging because the inclination of the surgeon will naturally be to select only the most hopeless and long-standing cases which have resisted every other form of treatment.

The surgeon, however, will have this theoretical consolation, that a delicate organ like the brain, which has for years been the seat of all the major

symptoms, is not likely to recover imprisoned as it is in a sealed ivory box. The circulation of this organ can obviously adjust itself more readily when it has room to expand and contract. When the skull is intact, the brain can only adjust the circulation in co-operation with the volume of the cerebrospinal fluid and the venous flow. Both these latter factors are delicate mechanisms, easily thrown out of gear. Especially delicate is the balance of production and absorption of the cerebrospinal fluid. Hence experimental surgery, even in the most unpromising cases, is apt to be followed by unexpectedly favourable results.

For this reason I have thought it well to record a few facts sufficiently established by lapse of time and still easy of verification by anyone interested, and am content to leave the scientific deductions to those better equipped than myself.

ADDENDUM—While this paper was in the press additional information has come to hand in respect of Case 2 in the series. Since May, 1926, the patient has had five attacks of tonic basal spasm, the first since November, 1917. On re-examination at the end of January, 1927, I obtained a history of headache and vomiting before each attack, and found both optic discs to be oedematous. The knee-jerks were absent. I performed a bilateral suboccipital decompression on March 31st, with division of the occipital sinus, and so far the patient has done extremely well.—C.E.R.