Frequent myotatic excess but no contractures.
Late speech troubles.
Acute excitement with frequent convulsions.
Very rapidly fatal course. (Preponderance of syphilitic history.)

GROUP 3.

Spastic myosis; a complete reflex iridoplegia.
Absent or greatly impaired knee-jerk.
Failure of equilibration; locomotor ataxy, defective sensibility.
Very defective articulation.
Much optimism and excitement.

GROUP 4.

Late eye symptoms: paralytic mydriasis, a partial reflex iridoplegia (for light only).
Ataxic paraplegia confined to lower extremities. (Arms do not participate.)
Great facial ataxy with extreme troubles of speech.
Epileptiform seizures ushering in pronounced mental enfeeblement.

GROUP 5.

No oculo-motor symptoms beyond occasional inequality.
No contractures, but notable myotatic excess.
No disturbance of equilibration, locomotion, or sensation.
Speech troubles not pronounced.
Epileptiform seizures very rare, but from the first progressive deepening dementia.

VERTEBRAL PUNCTURE IN GENERAL PARALYSIS OF THE INSANE,

WITH SOME REMARKS ON THE PRESSURE AND COMPOSITION OF THE CEREBRO-SPINAL FLUID IN THIS DISEASE.

By JOHN TURNER, M.B. ABERD.,

Senior Assistant Medical Officer, Essex County Asylum.

IN 1889 Dr. Claye Shaw¹ trephined in a case of general paralysis, and shortly afterwards Dr. Batty Tuke reported cases on which he had operated by trephining, and strenuously upheld the new departure.²

The normal pressure of the cerebro-spinal fluid in man is stated by Leyden³ to be equal to a column of water 10 to 12 centimetres high. But this is very probably somewhat underestimated, as Dr. Dean, experimenting with dogs weighing from 30 to 60 lbs. found that in them the normal pressure varied between 7 and 15 centimetres of water.⁴ Foster (p. 1129) gives the pressure in dogs as equal to 10 to 11 millimetres of mercury. Later on it will be seen that rarely in the cases here recorded was the pressure in excess of that found by Dr. Dean in his larger dogs.

During the last year or two very little has been heard of trephining in general paralysis. The operation at first excited considerable discussion; those who looked upon the excess of fluid in this disease as compensatory could see no object in the procedure; but, nevertheless, if beneficial results followed as they did, for a time at least in most of the cases, these results would have to override any speculative views as to the nature of the fluid. It was on this account, although believing that the fluid was compensatory, that I undertook to test the effects of lumbar puncture in general paralysis. The operation is simple, is apparently in most cases unattended with danger, and most certainly will relieve pressure in the cranium; it thus fulfils, at least temporarily, all the conditions that result from trephining, or the more elaborate operation of laminectomy.

Vertebral puncture was, I believe, introduced by von Ziemssen for the relief of pressure in cerebro-spinal meningitis, cerebral tumour, hydrocephalus, etc., and various notes respecting it occur in the *EPITOME OF THE BRITISH MEDICAL JOURNAL* from 1893 to the present date. One important statement in reference to the subject here treated is made by von

Ziemssen,⁵ that in cases where the pressure is high the fluid issues in a fine jet from the trochar; where it is low it comes away in drops.

CASES.

I have performed the operation on 14 cases of general paralysis—7 males and 7 females; and, speaking broadly, I may say that it has not been followed by any appreciable amelioration in the condition of the patient, either in the bodily or the mental aspects of the case. One woman, who was usually very noisy at night, was quiet for a few nights after the puncture, and slept better, but became noisy again after a few days. She was punctured a second time, six weeks later, and again became quiet at night, but the only other effect produced was, according to her own account at the time of puncture, "a splitting headache." I have noticed no alteration either in the size or the reaction to light of the pupils afterwards. Nor is the speech in any way improved. One patient (No. xiv in the list) was punctured on February 22nd, at 12.30 P.M., and 44 c.cm. of fluid withdrawn. The following day, at 3 P.M., he had a succession of strong convulsive seizures lasting with short intervals for more than an hour, and affecting his left side, during which his temperature rose to 102.8° F. This of itself would seem to negative the idea that the symptoms in the seizures were due to any excess of pressure. All the cases punctured were between the ages of 31 and 57. The majority (Nos. i, ii, iii, iv, v, vii, xi, xii, and xiii), although in an advanced stage of the disease, were in good bodily condition, and still possessed considerable intelligence and memory. They had all had seizures. In Nos. xi and xiii the total duration of the disease, as far as could be ascertained, was short—just over one year in No. xi and only six months in xiii. Both had the characteristic grandiose delusions of general paralysis, and had been engaged at their respective occupations almost up to the time of their admission to the asylum. The remaining cases were quite demented, and all of these except No. vi were bedridden.

Now although from a therapeutic point of view vertebral puncture must be regarded as a failure, yet the facts obtained by noting the pressure in each case as well as from the subsequent examination of the fluid are full of interest. They are directly opposed, on the one hand, to the idea that the excess of fluid in general paralysis is pressure fluid, and, on the other, to the idea that this fluid is an inflammatory product. They show that in the cases examined, with perhaps two exceptions, there was no pressure present beyond that likely to belong to the blood pressure, and that the nature of the fluid, as regard at least its proteid constituents, did not differ from normal cerebro-spinal fluid, and that it had none of the characters of an inflammatory exudation.

PRESSURE.

The procedure in puncturing was as follows: The patient was placed on his right side with his legs drawn up, his head was either supported on a low pillow (Nos. iii, v, vi, vii, ix, and x), or else rested directly on the mattress. A fine hollow needle about 4 inches long was inserted a little to one side of the middle line between the second and third lumbar spines, and in a direction slightly upwards and towards the middle line. A long glass tube, bent near one end at right angles and marked on its long portion in centimetres (the diameter of the tube was 4 millimetres), was arranged so that its bent end could easily be connected with the needle as soon as the dura was punctured, which was shown by the clear fluid welling slowly out from the end of the cannula. In every case it came away in drops, not in a continuous stream or fine jet, as von Ziemssen observed it to do in cases where the pressure was high. Thus the tube could be connected with the needle without losing more than a drop or two of the fluid. On connecting the glass tube with the needle, and holding the long arm of it vertically, the fluid rose in it, and in some cases presented well marked but slight movements synchronous with the pulse. This was observed only, however, in three of the cases (Nos. iv, ix, xi); each of these had recently had a seizure; No. ix a transient convulsive seizure the day before, and this man was, as subsequently determined, in the initial stage of an attack of pneumonia from which he died four days after. During the operation his temperature was 100.2° F., rising in the evening to 103.6°. No. iv an apoplectiform seizure the day before, and No. xi a strong convulsive seizure five days previously. No. xii, in whose case the pressure was the highest recorded, had had an apoplectiform seizure three days before.

In every case talking and screaming raised the pressure, and with one woman (No. i), who at my suggestion took two or three inspirations, the fluid rose from 14 to 19 centimetres, and remained at the latter level all the time she held her breath. I mention this as Dr. Dean states in his paper (*v.s.*, p. 29) that with inspiration the pressure falls. Pas-

¹ BRITISH MEDICAL JOURNAL, June 14th, 1890.

² BRITISH MEDICAL JOURNAL, January 16th, 1892.

³ Quoted by Drs. Macpherson and Wallace, BRITISH MEDICAL JOURNAL, July 23rd, 1892.

⁴ Jour. of Path. and Bact., vol. i, pp. 30-31.

TABLE I.

Case.	Sex.	Initials.	Date of Vertebral Puncture.	Height (in millimetres) to which the Fluid rose in a Vertical Tube.	Fluid Collected (c.cm.)	Height of the Fluid at the end of the Operation.	Remarks.
I	F.	A. A. H.	Dec. 20th, 1895	—	80	—	The fluid as in every case came away in drops quickly at first, but rapidly getting slower.
"	"	"	Feb. 16th, 1896	140	40	30	No fluctuations synchronous with heart beats. Pulse at start = 94, full, fair tension; at end = 74, small, no tension.
II	"	E. B.	Dec. 23rd, 1895	—	80	—	No fluctuations in the column of fluid synchronous with heart beats.
III	"	M. A. P.	Jan. 11th, 1896	70	—	—	The column of fluid fluctuated synchronously with the heart beats. Screaming caused it to rise to the full length of the tube (300 mm.) and flow over.
IV	"	F. A.	Jan. 12th, 1896	100	50	—	Very irritable; when talking and crying the fluid rose to full length of tube (300 mm.) and flowed over. No blood-pressure fluctuations.
V	"	J. S.	Jan. 14th, 1896	150	30 to 35	—	No blood-pressure fluctuations.
VI	"	M. C.	Jan. 25th, 1896	125	43	20	" " " "
VII	"	A. E. S.	Jan. 26th, 1896	150	45	Nil.	" " " "
VIII	M.	R. D.	Dec. 31st, 1895	—	50	—	Well-marked blood-pressure fluctuations.
IX	"	W. C.	Jan. 4th, 1896	230	60	—	Head on a low pillow, when it was placed flat on the bed the fluid fell to 50 mm. No blood-pressure fluctuations.
X	"	T. C.	Jan. 31st, 1896	120	42	60	Well-marked blood-pressure fluctuations at the beginning of the operation, but not at the end.
XI	"	G. P. M.	Jan. 31st, 1896	140	42	80	Pulse at wrist weak. No blood-pressure variations.
XII	"	G. H.	Feb. 5th, 1896	320	63	115	Pulse 82, full, fair tension. No blood-pressure fluctuations;
XIII	"	J. W.	Feb. 8th, 1896	150	50	Nil.	38 c.cm. came away in 12 minutes.
XIV	"	C. G.	[Feb. 22nd, 1896	180	42	Nil.	Pulse 84, fair tension at beginning, and at the end of the operation, 66; tension not very markedly affected.

TABLE II.

Case.	Date of Examination.	S. G.	Total Proteids per cent.	Serum albumen.	Copper reducing substance.	Equivalent to Pyrocatechin. Per cent.
I	December 20th, 1895.	1006	—	—	10 c.cm. reduced 17.0 mg.	0.062
Id	February 16th, 1896.	—	0.0763	None	" " 12.5 "	0.046
II	December 23rd, 1895.	1007	—	—	" " 20.0 "	0.073
IV	January 12th, 1896.	—	—	Very faint trace*	—	—
VI	" 25th, "	—	—	None	Absent.	—
VII	" 26th, "	—	—	None	Traces.	—
VIII	December 31st, 1895.	1006	—	—	Abundant.	—
VIIIa	January 16th, 1896, 8 hours after death.	—	—	None	Absent.	—
IX	" 4th, "	1006	—	Traces	Small amount.	—
X	" 31st, "	—	—	None	10 c.cm. reduced 22.0 mg.	0.080
Xa	February 2nd, 1896, 13½ hours after death.	1007	0.0850	Traces	Absent.	—
XI	January 31st, "	—	—	Very faint trace	10 c.cm. reduced 16.0 mg.	0.058
XII	February 5th, "	1007	0.0450	None	" " 15.0 "	0.054
XIII	" 8th, "	—	0.0400	None	" " 15.0 "	0.054
XIV	" 22nd, "	—	0.0550	None	" " 16.5 "	0.060
A.	January 15th, 1896, 4 hours after death.	1007	—	None	Some (amount not estimated).	—
B.	February 24th, 1896, 16 hours after death.	1010	0.0385	Decided opacity on boiling	Absent.	—

* = 0.046 per cent. (in terms of dextrose).

The numbers refer to the cases in Table I. A. A case of Imbecility, with ovarian tumour, died aged 55. B. A case of Acute Melancholia, with pneumonia, aged 49. In all the cases during life the fluid was alkaline.

sively raising the head and shoulders invariably caused a rise in pressure; thus in No. ix, when the head and shoulders were slightly raised from the bed, the fluid rose from 23 centimetres to the full height (30 centimetres) of the tube, and flowed over. In No. iiii it rose from 7 to 18. In No. iv, an intensely irritable woman, it rose from 10 to 25 centimetres, and when she screamed it flowed over the end of the 30-centimetre tube. This screaming was not in any way due to the pain of the puncture, as it was her custom to scream at intervals all day long.

It will be seen on referring to Table I that only in 3 out of the 14 cases was the pressure higher than Dr. Dean found normally in dogs weighing from 30 to 60 lbs.; and beyond Nos. ix and xii the difference in the height is too small to constitute any serious excess over that found by Leyden in men, when we take into consideration that merely raising the head passively will produce such marked variations in the height of the column of fluid as already referred to.

In 8 of the cases, after collecting the cerebro-spinal fluid, the manometer tube was again inserted into the cannula, and the level of the fluid again noted. Now, even in a semi-recumbent position of the body, it only rose very slightly in the tube compared to what it did at the beginning. In 3 cases the pressure was practically nothing.

To determine whether there was any pressure exerted by the excess of cerebro-spinal fluid I punctured the dural sac in the lumbar region in two of the cases after death. In the first one (No. viii) 80 c.cm. of fluid had been withdrawn sixteen days before his death, when it came away freely. Eight hours after death, when the cadaver was punctured, no fluid came out; the needle was left in and the skull cap removed; immediately this was done drops came quickly away through the inserted needle, and 36 c.cm. were collected. In the second case (No. x), thirteen hours and a quarter after death, the same thing occurred. In this man's case there was a large excess of fluid. I collected from the inserted needle 160 to 170 c.cm. His lateral ventricles were also widely dilated and full of fluid.

Now, unless, as has been pointed out to me, the supposed pressure exerted by the excess of cerebro-spinal fluid is enabled after death to expend itself against the now flaccid blood vessels, which is improbable in face of the frequency with which in general paralysis the small vessels and capillaries of the cortex and pia mater are found on microscopical examination packed with blood cells, I say, unless this occurs then the fact that the fluid fails to come away after death shows that it is not exerting any pressure in the cranial cavity. This is a point which might be with certainty deter-

mined should an opportunity arise of puncturing the vertebral sac immediately after death in a suitable case.

EXAMINATION OF THE FLUID.

Appearance, Colour, etc.—In all the cases of general paralysis tapped during life the fluid was perfectly clear and pellucid, and of a very faint straw tint (only noticed on looking through a fairly long column of the fluid in a glass cylinder) or else colourless. In one case, after flowing for a short time it became tinged with blood. After death (Nos. VIIIa, xa, A. B.) it becomes turbid, and the turbidity seems to increase with the time that elapses after death before tapping. Shaking the fluid up with ether removes most of this turbidity.

Reaction.—Normal cerebro-spinal fluid is neutral or faintly alkaline, becoming after death acid, and Meynert⁶ states that probably in certain pathological conditions the same change occurs during life. Dr. Batty Tuke assumes that in general paralysis the nerve cells are bathed in a poisonous acid fluid. As the pericellular and perivascular spaces are continuous with the subarachnoid space, this would mean that the reaction of the latter would be acid, but in every one of the cases I tapped it was distinctly alkaline. The reaction was tested in most of the cases with litmus, but in No. xiv with phenolphthalein as well. The specific gravity presented no departure from the normal.

Proteids.—Fibrinogen was not tested for in all cases; in the two cases in which I did test for it, it was absent. Serum globulin was practically the only proteid present beyond traces (not tested for in all cases) of albumen.

I adopted Hammersten's method to determine the presence or not of serum albumen. The fluid was saturated with magnesium sulphate, and the tube which contained the mixture was shaken continuously for two hours to ensure thorough saturation with the salt. This procedure precipitates the serum globulin and albumose, leaving any serum albumen there may be in the solution. The mixture was filtered, and the perfectly clear filtrate, mixed with an equal volume of water, rendered faintly acid with acetic acid, and boiled.

Of the 14 cases 2 were not tested, 8 showed absolutely no trace of serum albumen, and the remaining 4 showed a very faint trace; that is, the fluid became very slightly opaque on boiling; but the opacity was so slight as only to be noticeable if the tube was held in a favourable position in front of a dark surface.

The total proteids were estimated by Hoppe-Seyler's method described in Halliburton's and Gamgee's textbooks. To 20 c.cm. of the fluid 80 c.cm. of spirits of wine were added, and the mixture allowed to stand till the precipitate formed had settled. This takes several hours. The mixture was then filtered through a previously dried (120° C) and weighed filter paper, the precipitate thoroughly washed out of the beaker with more spirits of wine, then the precipitate on the filtered paper washed with hot alcohol, then with ether, and then with warm water. Finally, the paper and precipitate were washed with more spirits of wine, and then dried for four or five hours (till it no longer lost weight) in a hot oven at 120° C., then cooled in an exsiccator, and weighed. Subsequently the filter paper and precipitate were burnt in a platinum crucible, and the weight of the ash deducted from the weight of the dried precipitate.

It will be seen, on referring to Table II, that the amount of proteid present is small, and does not materially differ from that which Halliburton obtained in his analysis of normal cerebro-spinal fluids. The amount is too small to give any countenance to the idea that the cerebro-spinal fluid in general paralysis is an inflammatory product.

The reason I specially tested for the presence of serum albumen was that this proteid is, as far as I know, invariably present in all inflammatory exudations. Although Halliburton (p. 344) states that the ratio of serum albumen to serum globulin (the proteid quotient) is of no importance in determining whether a fluid is or is not of an inflammatory character, I venture to think that the complete absence of serum albumen in a fluid is of some diagnostic importance in this respect.

COPPER REDUCING SUBSTANCE.

This, which is stated to be pyrocatechin, is an aromatic substance of the benzene group, and is a product of proteid decomposition. It is supposed to be a normal constituent of cerebro-spinal fluid. Halliburton found it, although sometimes in very small amount, in all the samples of cerebro-spinal fluid that he examined; and he always found it in increased quantities in second and subsequent tappings.

Probably other copper reducing bodies besides pyrocatechin may sometimes be present. In nine out of twelve of my cases it was present in what I should consider large amounts; in two in small quantities, and in one it was absent (that is, no reduction took place in the unconcentrated fluid). After death even in those cases where its presence had been demonstrated during life it was absent, except in one in which the fluid taken four hours after death contained a copper reducing substance in very small amount.

The amount of copper reducing substance was determined as follows: An excess (5 c.cm.) of Fehling's solution diluted to 40 or 50 c.cm. was boiled; to this was added 10 c.cm. of the fluid, which had been freed from its proteid matter by acidulation and boiling, and subsequent filtering. The boiling of the mixed Fehling and cerebro-spinal fluid was then continued till no more copper was reduced, then filtered through an ashless filter paper, thoroughly washed with hot water, dried, and burnt in a platinum capsule. Some experiments were made with solutions of pyrocatechin of known strength to find out how much was equivalent to a milligramme of CuO. The pure pyrocatechin in solution reduces the Fehling much more slowly than the cerebro-spinal fluid. I found that 10 c.cm. of a 0.1 per cent. solution reduced 27 milligrammes of CuO; 9 c.cm. reduced 25 milligrammes, and in a third trial 20 c.cm. reduced 53 milligrammes. The average of these three experiments shows that 10 milligrammes of pyrocatechin reduced 27.1 milligrammes of CuO.

It was on the supposition that pyrocatechin was the only reducing substance present, and that it behaves in the cerebro-spinal fluid in the same manner towards Fehling's as when in pure solution, that I worked out the percentages in the last column of Table II. In only one case, No. iv, was it estimated volumetrically in terms of dextrose, giving a percentage of 0.046. This is high when compared with that obtained by Halliburton (0.002) in a first tapping in a case of chronic hydrocephalus.

Pyrocatechin has an acid reaction, so that its presence in an uncombined form to any great amount would render the cerebro-spinal fluid acid. But, as we have shown, all the fluids examined were alkaline, so that it would appear that its amount, if in excess, was not sufficiently large to materially influence their reaction. In the analysis of some urines of general paralytics⁷ I found that in an advanced stage of the disease the combinations of the aromatic substances with potash and soda were markedly increased, and that this increase was most noticeable just before or during seizures. It would be interesting in this connection to determine definitely whether pyrocatechin, also an allied aromatic substance, was in excess in the cerebro-spinal fluid in general paralysis.

SUMMARY.

The observations here recorded seem to show conclusively that, at any rate in fairly advanced general paralysis—and it was in just such stages that the operation of trephining was performed—the injurious pressure that Drs. Claye Shaw and Batty Tuke postulate does not exist. By this I mean that there is no evidence of any pressure beyond that due to the blood pressure. Further, the results obtained from the analysis of the fluid lend no support to, if they do not, indeed, negative, the assertion that it is an inflammable product.

ON A CASE IN WHICH THE UPPER HALF OF THE FIBULA WAS EXCISED FOR A SARCOMA.

By J. BLAND SUTTON, F.R.C.S.,
Assistant-Surgeon to the Middlesex Hospital.

CONCERNING tumours of long bones there is nothing more astonishing than the fact that a periosteal sarcoma of the femur or the humerus is the most malignant tumour known to surgeons, such a tumour being three times more deadly than a sarcoma identical in histologic details growing from the bones of the leg or foot. In the face of these facts it has often seemed to me a very severe measure when surgeons amputate the leg for sarcoma of the fibula. The upper two-thirds of the fibula is in man almost vestigial, and its persistence is probably mainly due to the fact that it affords attachment to the muscles of the leg. The lower one-third has undergone excessive development to meet the demand of the ankle-joint for greater security, necessitated by the upright position of man.

⁶ Quoted by Macpherson and Wallace, BRITISH MEDICAL JOURNAL, July 23rd, 1894.

⁷ Journ. Ment. Sci., January, 1895.