THE SIGNIFICANCE OF THE PROTEIN CONTENT OF THE CEREBRO-SPINAL FLUID

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It is the purpose of this communication to lay special stress on the value of protein determinations in the cerebro-spinal fluid both on account of the rapidity with which they can be done and the information they yield if properly interpreted. Two specimens should be provided so that there may be a second tube to work on while the first is left in the incubator undisturbed for the formation of coagulum.

Protein.—The examination of a large number of specimens of cerebro-spinal fluid has brought out the great diagnostic value of accurate protein determinations. A method is proposed whereby it is possible within a few minutes to decide whether a meningitis may be ruled out. The following simple and rapid method is sufficiently accurate for this purpose :

A series of 12 small tubes ($\frac{3}{8}$ in. bore) are set up containing from .010 to .100 mgrm. albumin in 1 c.cm. saline. To each tube .1 c.cm. of 25 per cent. salicyl-sulphonic acid is added. The tubes are sealed off and act as opacity standards which keep well, for although the protein settles, shaking will restore the colloidal dispersion for more than the time required for the test. The opacity produced by adding .1 c.cm. of salicyl-sulphonic acid to 1 c.cm. of cerebro-spinal fluid is read against the standards. Dilutions with measured volumes of saline will be made if necessary. The outfit may be obtained from Messrs. Baird and Tatlock.

The following table of 101 cases, in all of which protein and salt were measured and the cytology and bacteriology done, shews :—

- (1) that all (55) cases showing less than 0.04 per cent. protein are normal ;
- (2) that those lying between 0.050 per cent. and 0.15 per cent. are, without exception, cases of tuberculous meningitis (plus four at 0.040) ; and
- (3) that those (9) lying between 0.30 per cent. and 0.72 per cent. are cases either of pneumococcal or meningococcal meningitis.

Search for tubercle bacilli.

Meanwhile another tube has been left undisturbed in the incubator. It is inspected at intervals, without agitation, and a coagulum, if one is going to form, may be expected at any time between 2 to 24 hours. I am indebted to the ingenuity of my assistant, Mr. Nathaniel Smith, for the following very valuable modification of Canti's method :

Pour the fluid carefully into a clean watch glass, avoiding agitation, when the coagulum will be seen to retain its cobweb form ; cut a piece of

Case No.	Protein	NaCl	Cells	Organisms
2982/27	20	720	—	—
106/28	20	720	—	—
1862/28	20	710	—	—
1889/28	20	720	—	—
3036/28	20	700	—	—
4135/28	20	720	—	—
4180/28	20	700	—	—
33/29	20	690	—	—
1183/29	20	710	—	—
1044/27	25	720	—	—
2227/27	25	690	—	—
2890/27	25	720	—	—
3542/27	25	680	—	—
3794/27	25	700	—	—
920/28	25	720	—	—
1185/28	25	710	—	—
1499/28	25	710	—	—
1941/28	25	710	—	—
3466/28	25	700	—	—
4003/28	25	690	—	—
4197/28	25	720	—	—
4284/28	25	690	—	—
4154/28	25	710	—	—
167/29	25	710	—	—
172/29	25	710	—	—
514/29	25	720	—	—
522/29	25	670	—	—
789/29	25	700	—	—
863/29	25	720	—	—
879/29	25	720	—	—
923/29	25	720	—	—
1002/29	25	720	—	—
1011/29	25	720	—	—
1031/29	25	720	—	—
1087/29	25	710	—	—
1182/29	25	700	—	—
2557/27	30	720	—	—
3109/27	30	720	—	—
3425/27	30	700	—	—
3892/27	30	680	—	—
2225/28	30	670	—	—
3280/28	30	690	—	—
3465/28	30	680	—	—
36/29	30	700	—	—
89/29	30	680	—	—
150/29	30	690	—	—
257/29	30	710	—	—
593/29	30	710	—	—
625/29	30	710	—	—
677/29	30	690	—	—
927/29	30	700	—	—
957/29	30	700	—	—

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Case No.	Protein	NaCl	Cells	Organisms
979/29	30	690	—	—
3330/27	35	690	—	—
4312/28	35	650	L7	—
1217/29	35	670	—	—
3272/27	40	650	—	—
3310/27	40	700	—	—
522/28	40	700	—	—
1240/28	40	690	—	—
3660/28	40	710	—	—
203/29	40	720	L20	—
257/29	40	660	—	—
283/29	40	680	—	—
645/29	40	680	—	—
1057/29	40	640		Tubercle bacilli
1445/27	40	640		Tubercle bacilli
1064/27	40	640		Tubercle bacilli
3906/28	40	600	L180	Tubercle bacilli
3332/28	50	600	L250	Tubercle bacilli
1477/27	60			Tubercle bacilli
213/29	60	630	L250	Tubercle bacilli
957/29	60	640		Tubercle bacilli
1074/27	70	630	L100	Tubercle bacilli
1542/27	70	670		Tubercle bacilli
3083/28	70	660		Tubercle bacilli
3153/28	70	630	L100	Tubercle bacilli
2818/28	80	630	L150	Tubercle bacilli
3723/28	80	640		Tubercle bacilli
3912/28	80	630	L150	Tubercle bacilli
2775/28	90	630	L150	Tubercle bacilli
1086/29	90	610	L175	Tubercle bacilli
1101/29	90	610	L170	Tubercle bacilli
373/28	100	670		Tubercle bacilli
2778/28	100		L180	Tubercle bacilli
684/29	100	600	L150	Tubercle bacilli
1120/29	100	600		Tubercle bacilli
2228/27	120	620	L800	Tubercle bacilli
2238/28	120	600		Tubercle bacilli
701/29	150	620	L175	Tubercle bacilli
846/29	150	620	L200	Tubercle bacilli
4061/28	150	620	L150	Tubercle bacilli
830/29	300		Pus	Pneumococci
1261/29	300		Pus	Pneumococci
1077/27	350		Pus	Meningococci
99/29	350		Pus	Pneumococci
1304/29	350		Pus	Pneumococci
1062/27	480	620	Pus	Meningococci
1078/27	480	620	Pus	Meningococci
2718/28	500		Pus	Pneumococci
720/27	720	630	Pus	Meningococci

Note.—A dash means 'none found'; a blank space means 'not done.' L=Lymphocytes.

Figures for protein and NaCl represent mgrm. per 100 c.cm.

cigarette paper the size of a slide and with the aid of a pair of forceps, held in the right hand, lay over the surface of the coagulum, to which it will adhere if gentle pressure is made by means of a platinum loop held in the left hand. Transfer to the slide and blot dry with bold straight strokes. Carefully disengage the cigarette paper, when it will be found that the coagulum has adhered to the slide in its undisturbed condition. Dry in the incubator for two minutes and then fix by passing three times through the flame. Stain in the ordinary way.

By this method, tubercle bacilli have not once been missed in the last three years in a case of tuberculous meningitis in this hospital.

Conclusions.

(1) The estimation of protein is by far the most valuable single investigation that can be done on the cerebro-spinal fluid.

(2) An important modification (due to Mr. N. Smith) of the usual method of search for tubercle bacilli is described.