slight increase in the tonus which was still low at the end of a 3½-hr. period. Fig. 2 is a typical record showing the decrease in the tonus of the cardiac sphincter in patient who was being treated for cardiospasm by means of hyperpyrexia.

Summary. Kymographic tracings are shown which clearly indicate that hyperpyrexia causes relaxation of the common bile duct sphincter and of the cardiac sphincter in the human.

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Bisulfite Binding Substances (B.B.S.) in the Blood and Cerebrospinal Fluid.*

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(Introduced by N. Jolliffe.)

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The bisulfite binding substances (total aldehydes and ketones) have been the subject of much recent investigation, and their relationship to Vitamin B_1 deficiency has been both confirmed[1] and denied.[2]

The present study of B.B.S. in the blood and cerebrospinal fluid was undertaken in order (1) to compare the levels of bisulfite binding substances in the blood and cerebrospinal fluid, (2) to study the level of bisulfite binding substances in the blood and cerebrospinal fluid in various neuropsychiatric disorders, (3) to determine the relationship of any increase in these carbonyl compounds (B.B.S.) to clinical evidences of Vitamin B_1 deficiency.

Method. Blood and spinal fluid were taken from patients fasting and at rest and delivered into bottles containing dried potassium oxalate. In almost every case, duplicate samples were analyzed without

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1 Sherman, W. C., and Elvehjem, C. H., *Am. J. Physiol.*, 1936, **117**, 142; Sherman, W. C., and Elvehjem, C. H., *J. Nutrition*, 1936, **12**, 321; Thompson, R. H. S., and Johnson, R. E., *Biochem. J.*, 1935, **29**, 694; Johnson, R. E., *Biochem. J.*, 1936, **30**, 31; Platt, B. S., and Lu, G. G., *Proc. Phys. Soc. Third Gen. Congress Chinese Med. Assn.*, 1935; Wilson, H. E. C., and Ghosh, B. C., *Indian Med. Gaz.*, 1937, **72**, 47.

2 Wilkins, R. W., Taylor, F. H. L., and Weiss, S., PROC. SOC. EXP. BIOL. AND MED., 1937, **35**, 584; Jong, S., *Arch. Neerland Phys.*, 1936, **21**, 465.

delay. The following modification of the method of Clift and Cook[3] was used.

Ten ml of oxalated blood (or spinal fluid) is precipitated immediately with 40 ml of 10% trichloracetic acid, allowed to stand for 30 minutes and then filtered. Thirty ml of the blood filtrate and 40 ml of the spinal fluid filtrate are adjusted to pH 2 by the addition of 10% NaOH. To this mixture is added 1 ml of molar sodium bisulfite solution and the sample allowed to stand for 15 minutes. Five drops of a freshly prepared 1% starch solution are then added and the excess bisulfite titrated against N/10 iodine solution. The end point is adjusted with N/200 iodine and N/200 sodium thiosulfate solutions and fixed to a one-drop iodine excess. The bound bisulfite is now released by supersaturation with dry sodium bicarbonate salt and the released bisulfite then titrated immediately with an excess of N/200 I_2 solution. This excess is readjusted by titration with N/200 thiosulfate. The rapid addition of I_2 prevents the volatilization and loss of liberated bisulfite. Throughout the titration procedure, the flask is rotated in a medium of cracked ice. A reagent blank is titrated on each occasion.

Calculation. The amount of N/200 I_2 corresponding to the liberated bisulfite is equivalent to the total I_2 minus the thiosulfate. The value of the blank is then deducted from this figure. This difference is then multiplied by 3.67 for the blood sample and 2.75 for the spinal fluid sample. The result obtained equals the total B.B.S. expressed as mg of pyruvic acid per 100 cc.

Results. A comparison of blood and cerebrospinal fluid was obtained on 126 patients with various neuropsychiatric disorders. Wilkins and his coworkers,[1] using a similar technic, reported the normal range for blood as 3.66-5.75 mg %, with an average of 4.74 mg per 100 ml. Platt and Lu,[1] working in the Orient, had previously reported as normal 2.22-4.82 mg %. Since our own control cases (50) fall within the range set up by Wilkins and his coworkers, it was decided to use 5.75 mg % as the upper limit of normal. For purposes of analysis, our cases are divided into 4 groups dependent upon the blood level. Those patients with blood levels above 5.75 mg % were considered abnormally high. (Table I.)

Of these cases 105 had normal ranges for B.B.S. in the blood (2.00-5.72). Their spinal fluid figures ranged from 0.42-3.07 with an average of 1.64 mg %. Only 5 cases were in the range of 0.42-1.00 mg % and most of the cases above 2.25 were inebriates with definite indications of disturbances in vitamin and carbohydrate

3 Clift, F. P., and Cook, R. P., *Biochem. J.*, 1932, **26**, 1788.

TABLE I.

Group	Blood range B.B.S. in mg %	Cerebrospinal fluid range B.B.S. in mg %	C.S.F./Blood, avg %	Standard deviation	No. of cases
I	5.93-13.5 (Avg 7.59)	1.02-8.68 (Avg 3.73)	49%	± 6	21
II.	5.03-5.72 (Avg 5.34)	1.32-2.67 (Avg 2.02)	46%	± 5	8
III.	3.70-4.98 (Avg 4.26)	1.01-3.07 (Avg 1.81)	37%	± 3	51
IV.	2.00-3.63 (Avg 3.13)	0.42-2.36 (Avg 1.37)	44%	± 4	46
				Total	126

metabolism. Children apparently had somewhat lower figures in blood and cerebrospinal fluid than adults, but the results were well within the normal range.

The material presented consists of 126 cases from the wards at the Psychiatric Division of Bellevue Hospital. B.B.S. levels were determined in the blood and cerebrospinal fluid. They formed the following diagnostically labelled groups:

Group		No. of cases
I.	Inebriates	10
II.	Inebriates with paraldehyde therapy	10
III.	Delirium tremens	7
IV.	Alcoholic hallucinosis	4
V.	Wernicke's syndrome	4
VI.	Korsakoff syndrome	2
VII.	Central nervous system syphilis	12
VIII.	Schizophrenia—all types	25
IX.	Manic-depressive psychosis	4
X.	Miscellaneous psychoses and neuroses	11
XI.	Miscellaneous medical conditions	7
XII.	Behavior and conduct disturbances in children	30†

Our results indicated the following: 1. The normal range of B.B.S. in the spinal fluid is 0.42-3.07 mg %. The average for 106 cases with blood below 5.75 is 1.64 mg % with a standard deviation of ±0.06, 91 fell within a range of 1.00-2.25 mg %, which is usually 35-60% of the amount found in a simultaneous blood sample.

2. The B.B.S. may or may not be elevated in cases of clinical Vitamin B_1 deficiency (peripheral neuropathy, beri-beri—possibly Korsakoff and Wernicke's syndromes) but this is also true for conditions in which there is no clinical evidence of Vitamin B_1 deficiency. Eight cases of peripheral neuropathy in inebriates were studied. This syndrome in inebriates is the result of Vitamin B_1

† Of the total 126 cases, 8 cases had peripheral neuropathy as a complicating syndrome (3 in Group 1, 3 in Group III, and 2 in Group V).

deficiency.[4] Four cases showed an elevated B.B.S. in the blood or cerebrospinal fluid or both, and the other 4 had normal figures. These variations obtained in both acute and chronic cases. Hence the B.B.S. in blood and cerebrospinal fluid cannot be used as an indication of Vitamin B_1 deficiency.

3. A comparatively large group of psychiatric disorders including alcoholic psychoses, schizophrenia, manic-depressive psychoses, miscellaneous psychoses, and behavior and conduct disorders in children were studied. No constant deviation from the normal was found.

4. Paraldehyde causes an elevation of B.B.S. in the blood and cerebrospinal fluid for 24 hours. The drug itself does not bind bisulfite, but our experiments show that the method employed (precipitation with trichloracetic acid) causes a partial hydrolysis of paraldehyde to acetyldehyde, which latter binds bisulfite. Furthermore, patients given paraldehyde, drams 2, by mouth or rectum showed a marked rise in blood and spinal fluid B.B.S. for at least 24 hours. The effect of sodium amytal is under investigation.

5. Our unpublished observations indicate that the B.B.S. is not an accurate measure of the pyruvic acid levels in the blood or cerebrospinal fluid. Several cases of peripheral neuropathy in inebriates were observed with elevated pyruvic acid levels in the body fluids, and a normal total B.B.S.

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Potassium as a Toxic Factor in Intestinal Obstruction.

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A satisfactory explanation of the cause of death in intestinal obstruction is not apparent at the present time. Many hypotheses have been advanced[1-4] and of these the view that potassium is a toxic

[4] Jolliffe, N., and Colbert, C. N., *J. A. M. A.*, 1936, **107**, 642.

[1] Gamble, J. L., and Ross, S. G., *J. Clin. Invest.*, 1925, **1**, 403.

[2] Hartwell, J. A., and Houget, J. P., *J. Am. Med. Assn.*, 1912, **59**, 82.

[3] Knight, G. C., and Slome, D., *Brit. J. Surg.*, 1936, **23**, 820.

[4] Gatch, W. D., and Culbertson, C. G., *Ann. Surg.*, 1935, **102**, 619; Whipple, G. H., Stone, H. B., and Bernheim, B. M., *J. Exp. Med.*, 1913, **17**, 307; Dragstedt, L. R., Dragstedt, C. A., McClintock, J. T., and Chase, C. S., *J. Exp. Med.*, 1919, **30**, 109.