ON THE VARIATIONS OF THE
SULPHATES AND PHOSPHATES
EXCRETED IN
ACUTE CHOREA, DELIRIUM TREMENS,
AND
INFLAMMATION OF THE BRAIN.

BY
H. BENICE JONES, M.D., A.M. (CANTAB.), F.R.S., F.C.S.,
PHYSICIAN TO ST. GEORGE'S HOSPITAL.

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IN the Medico-Chirurgical Transactions for 1847, some cases are recorded of the variations of the quantity of phosphates excreted by the kidneys in delirium tremens, and in inflammation of the brain. I stated in conclusion, "that the excess of action, or the want of action of oxygen, may possibly ultimately be proved by the balance, not only to be traceable by its effect on the nervous tissue, but that other tissues may give a corresponding result; with this view, the variations of the sulphates in disease deserve the most careful investigation."

In the present communication, I purpose to relate the most remarkable cases I have met with of the variation of the sulphates in disease.

Generally, the variation of the sulphates and phosphates in the healthy urine of a person on mixed diet, taking moderate exercise, may be stated thus:—

The sulphates vary—

	Specific gravity.
After food, from 11·85 grs. of sulphate of baryta per 1000 grs. urine,	1033·9.
Before food, to 7·93 grs.	1026·5.

The phosphates vary—

	Specific gravity.
After food, from 7·22 grs. of phosphate of lime, per 1000 grs. urine,	1030·0.
Before food, to 7·96 grs.	1027·9.

(See 'Philosophical Transactions,' 1845 and 1849.)

Having determined the variations of the sulphates in the state of health, when different diets, and different amounts of exercise, and different medicines were taken, I proceeded to examine the variations of the sulphates in disease. At the same time, the total amount of alkaline and earthy phosphates was determined, partly in order to see whether the amount of sulphates and of phosphates bore any relation to one another, and partly to test the conclusions which were drawn in my previous paper, on the variations of the phosphates in disease.

The detail of 58 cases, in which 148 determinations of the amount of sulphates and phosphates were made, would be too long for this Society. But a few of the most interesting examples out of the most important classes into which the cases were divided, may possess some interest, and not be too tedious.

The cases were thus classified:—

1. Acute and chronic diseases, in which the muscular structures were chiefly affected.
2. Functional diseases of the brain, as delirium tremens and some other forms of delirium.
3. Acute inflammatory diseases of the nervous structures.
4. Chronic diseases of the nervous structures.
5. Acute diseases, in which neither the nervous nor the muscular structures were chiefly affected.
6. Chronic diseases, in which neither the muscular nor the nervous structures were chiefly affected.

The last three classes I shall not dwell on here, as they gave only negative results. The numbers obtained in the analyses will be found in the 'Philosophical Transactions' for 1850. In the first three classes respectively, cases of chorea, of delirium tremens, and of inflammation of the brain are included; and it is the variation of the sulphates and phos-

phates in these diseases, which I purpose to illustrate by the most marked cases which came under my notice.

First, then, on the amount of Sulphates and Phosphates in that disease in which the muscular structure is chiefly affected, namely, chorea. Chronic chorea gave me no marked results; but the following cases of acute chorea, that is, in which the muscular motions were so intense and so continuous that life was endangered, gave a most decided increase of the sulphates, without any increase in the phosphates of the urine.

CLASS I.

CASE 1.—Mary B—, æt. 19, Holland Ward; admitted March 8, 1848, having for the first time had rheumatic pains in the lower extremities for three days. The skin was hot; pulse 120, full and hard; tongue white; great thirst and loss of appetite; bowels confined. The right knee was swollen and very painful on pressure, but not red. The ankles were hot, red, and swollen, and very tender. There was a soft murmur heard with the first sound of the heart, and some pain in the epigastrium. Venesection ad ℥xij, Cal., gr. x; Opii, gr. ½; hac nocte; ht. Sennæ cras; ht. Ammoniz Citr., 4^{tis} horis.

9th. Passed a restless night. The pains becoming worse when she perspired in bed; ankles less swollen, but the elbows and wrists are now affected; pulse quiet; blood buffed and cupped; heart's action is increased, but no murmur is heard to-day.

10th. Had slight wandering and could not sleep at all. She lies very low in bed; has a slight cough; perspires very much; countenance is uneasy; so much pain in the joints that she cannot have the bed-clothes on her; bowels open; pulse quiet. Cal., gr. iij; Opii, gr. ½, ter die.

11th. Catamenia appeared this morning.

13th. There was pain in the region of the heart, and she was cupped to ℥x; the mouth was sore.

16th. There was pain in the left side; frequent cough; and pulse 120. She was bled to ℥xiv, and put again on fever diet; she had had beef-tea, a pint for two days.

17th. Blood buffed and cupped. The pains were relieved.

21st. Broth diet.—22d. Fish diet.—27th. Swellings, pain, and redness are gone. She sleeps well; tongue clean; bowels open; appetite good. Ordinary diet.

April 3d. Improving; slight pains occasionally.

8th. WAS ATTACKED WITH CHOREA this morning. Broth diet was ordered.

10th. Hydrarg. Chlor., gr. iij; statim et ter die; Ht. Sennæ cras mane. Heart's action very rapid.

11th. Ulcers on the side of the tongue, which have the appearance of aphthæ; valvular murmur very distinct towards the apex; motions very dark. Rep. Calomel, ht. Sennæ cras; ht. Nitri c. Vini Ant. Tart., ʒj, 6th horis.

12th. Has been very violent during the whole of the night. Hirudines viij; reg. pub. statim.

13th. More quiet this morning, but very violent during the night. Gums red; pulse 120. Valvular murmur towards the apex; has had no sleep; water caught this morning scanty, thick, gives a deposit of much reddish brown urate of ammonia, contained a minute quantity of albumen, and about four ounces in quantity, became very pink on the addition of ammonia. Specific gravity = 1032·3.

516·15 grs. boiled with Chlor. of Barium

and Nitric Acid, Sulphate of

Baryta = 12·95 = 25·09 grs. per 1000 urine.

After being re-treated with acid, and re-washed.

516·15 grs. precipitated by Chlor. of Calcium

and Ammonia. Total phosphates = 0·35 = 0·68 grs. per 1000 urine.

Some hours afterwards the same day about an ounce and half of water was again caught. It was thick, as before, from urate of ammonia. Specific gravity = 1035·2.

517·60 grs. boiled with Chloride of Barium

and Nitric Acid, Sulphate of

Baryta = 11·25 = 21·73 grs. per 1000 urine.

After being re-burnt and re-treated.

Ht. Sennæ statim. Adde sing. haust. Vini Colch., ʒx;
Liq. Potassæ, ʒxx.

14th. Has been very violent the whole of the night; had no sleep; ulceration on the tongue much increased; has been inclined to sleep during the morning; bowels well open. Bal. Calidum. Liq. Amm. Acet., 3vj; Amm. Sesqui-carb., gr. ij; Sp. æth. Nitr., 3j; ht. Piment. 3vj; 6th horis; ht. Morphia hac nocte.

15th. Has slept a good portion of the night, and seems disposed to continue to do so; is very quiet this morning. Did not have the bath, because she was so very violent. Skin very hot; bowels not open since yesterday; passes her water in bed; sweats very much; tongue very much loaded. Irregular spasmodic movements of the hands very much less. Rep. Mist. et ht. Sennæ si opus est.

16th. Was very restless and disturbed during the night; bowels not open; water passed this morning thick, chiefly from urate of ammonia, and contains a trace of albumen; she is much quieter than she was. Specific gravity = 1030.0.

515.00 grs. boiled with Chloride of Barium
and Nitric Acid, Sulphate of
Baryta = 3.75 = 7.28 grs. per 1000 urine.

515.00 grs. precipitated by Chloride of
Calcium and Ammonia. Total
Phosphates (not pink) . . . = 3.80 = 7.38 „

17th. Had morphia last night; had a very quiet night; bowels opened without the aperient; water passed this morning, paler colour, slight cloud of urate of ammonia, acid. Specific gravity = 1013.1.

506.55 grs. boiled with Chloride of Barium
and Nitric Acid, Sulphate of
Baryta = 1.30 = 2.56 grs. per 1000 urine.

506.55 grs. precipitated by Chloride of
Calcium and Ammonia. Total
Phosphates = 2.20 = 4.34 „

18th. Has passed a most excellent night; there was no necessity for a night draught; herpes about the lips. Perst. Hydr. c. Cretâ, gr. iij; Doveri pulv., gr. ij, bis in die.

19th. Passed a very quiet night. Perstet.

20th. Slept well during the night, and is much better

this morning. Gums red and sore; systolic sound is much softer; pulse 84. Rep. pulv. et mist.

22d. Gums affected with mercury; systolic murmur much softer; pulse 84. Fish diet.

24th. Ordinary diet. Ht. Sennæ alt. mane. Perst.

25th. Does not seem able to collect her thoughts; twitching of the hands and legs rather less.

26th. Ht. Ammonia Citr., 6th horis.

May 2d. Vini albi, ʒij quotidie. Rep. ht., ter die.

4th. Right knee and ankle very red, and swelled, and painful. Cal., gr. iv; Opii, gr. $\frac{1}{2}$, hac nocte; ht. Sennæ cras mane. Broth diet. Vini Ant., ʒxx; Vini Colch., ʒx; mist. Camph., ʒxj, ter die.

5th. Ankle and knee rather better. .

6th. Left ankle and knee rather swelled and painful. Ht. Colchici c. Opio, nocte maneque. Ht. Sennæ cras mane et pro re natâ.

7th. Much better this morning. The irregular spasmodic actions still continue, and she does not appear to have it in her power to express what she means.

8th. Ht. Colch. c. Opio, hac nocte. Ht. Salin. ex Ammonia, ter die.

9th. Continues to improve. Ordinary diet.

12th. Bowels not open; pains in the knees and ankles quite gone; the spasmodic movements of the hands and feet still continue without much change; she seems better able to collect her thoughts.

16th. Going into the country. Relieved.

The variations of the sulphates and phosphates may be tabulated thus:—

	Sulphate of Baryta per 1000 grs. urine.	Specific gravity.	Total Phosphates.
On the 5th day, after Sulphate of Magnesia.	25.09 grs.	. 1032.3	. 0.68 grs.
„ 5th day later	21.73 „	. 1035.2	
„ 8th day, quieter,	7.28 „	. 1030.0	. 7.34 „
„ 9th day	2.56 „	. 1013.1	. 4.70 „

In this case the Sulphate of Magnesia which was given interferes with the result, and renders it less conclusive than

it would otherwise have been. The diminution of the phosphates is very remarkable, and probably arose from the small quantity of food which could be taken.

CASE 2.—Charles G—, æt. 8, Hope Ward; admitted Nov. 16, 1849. Had scarlet fever three weeks previous to his admission. Was attacked by chorea three days ago; it is supposed, in consequence of cold, as he got out of bed in his night shirt without his shoes, and crept through a hedge into a field, where he was found in consequence of his cries. When brought home he had a rigor, and two days afterwards the chorea began. On admission he was not able to stand or to feed himself. He slept well; but the fits of motion came on always stronger at night than during the day. His face was flushed. He took two minims of Liq. Potassæ Arsenitis thrice daily, with aperients, and afterwards he took bark. In a week he improved; and about Christmas he was able to feed himself and to walk across the ward without help.

December 31st. This day very excited and very weak. He was ordered to omit the bark, and to take two teaspoonfuls of wine every four hours. From this day violent spasmodic action commenced, which hindered him from obtaining any sleep, and prevented him from taking but very little food.

January 2d. Can get very little sleep, is “continuously on the work in every muscle.” Able to swallow only a little arrowroot and wine.

3d. The bark was continued. His motions were very violent, altogether preventing all sleep. The face was very flushed.

4th. Strong muscular action continues. Obtains no sleep. Has been unable to speak for the last four days, from the involuntary motions of the tongue. He was this day ordered the sixth of a grain of tartarised antimony every six hours.

5th. Rather more quiet and has had a little sleep. Urine passed this morning at half-past ten, a.m., the first that could be obtained throughout this period of excitement, was of a light yellow colour. Gave a very large deposit

of urate of ammonia. Was acid to test-paper; gave with nitric acid immediate crystallisation of nitrate of urea. Specific gravity, 1030·6.

515·3 grs. precipitated by Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 5·80 = 11·25 grs. per 1000 urine.

515·3 grs. precipitated by Chloride of Calcium and Ammonia, Phosphate of Lime . . . = 1·70 = 3·29 „

6th. Has had a good night, and is much quieter. Tongue furred; pulse 84, weak; asked for his dinner. The urine passed at ten, a.m., was obtained; gave a large deposit of urate of ammonia. Specific gravity = 1031·8.

515·9 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 5·50 = 10·66 grs. per 1000 urine.

515·9 grs. precipitated by Chloride of Calcium and Ammonia, Phosphate of Lime . . . = 1·30 = 2·52 „

7th. Urine passed early this morning. Had the same appearance as yesterday. Specific gravity = 1031·2, gave crystals of nitrate of urea immediately on the addition of nitric acid.

515·6 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 5·75 = 11·15 grs. per 1000 urine.

515·6 grs. precipitated by Chloride of Calcium and Ammonia, Phosphate of Lime . . . = 1·31 = 2·54 „

9th. Urine passed this morning early, the involuntary motions being much less. Specific gravity = 1028·4; urine acid to test-paper; still gave a large precipitate of urate of ammonia.

514·2 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 3·80 = 7·39 grs. per 1000 urine.

514·2 grs. precipitated by Chloride of Calcium and Ammonia, Phosphate of Lime . . . = 1·80 = 3·50 „

10th. Pulse 84; much quieter; has taken his dinner of arrowroot; is still hardly able to protrude his tongue, in consequence of the involuntary motions; urine passed early this morning. Specific gravity = 1018·6; much clearer, more plentiful, and rather paler.

509·3 grs. boiled with Chloride of Barium and dilute Nitric Acid,
Sulphate of Baryta . . . = 2·00 = 3·92 grs. per 1000 urine.
509·3 grs. precipitated by Chloride of Calcium and Ammonia, Phosphate of Lime . . . = 0·80 = 1·57 „

14th. Has continued improving, becoming quieter each day; pulse 84; tongue slightly furred, and protruded more slowly and steadily. Has taken no solid animal food whatever; since the 6th of January, his food has been arrowroot, milk, and beef-tea. Has continued two ounces of wine daily. Urine passed this morning quite clear. Specific gravity = 1016·0.

508·0 grs. boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta . . . = 2·20 = 4·32 grs. per 1000 urine.
508·0 grs. precipitated by Chloride of Calcium and Ammonia, Phosphate of Lime . . . = 0·70 = 1·37 „

April 11th. Has been gradually improving up to this time. Urine passed this morning, acid; not of a deep colour. Specific gravity = 1030·6.

515·8 grs. boiled with Chloride of Barium and dilute Nitric Acid,
Sulphate of Baryta . . . = 4·20 = 8·01 grs. per 1000 urine.

He has for some time had full diet, and been able to take some exercise. His weight, about this time, was only 34lbs., and his height 4 feet 1 inch. He remained in the house until the end of May, when he went home; he became much more unsteady almost immediately after his return, and he was readmitted under my care on June 12th. He remained suffering from chronic chorea for some months; he went out, but

very slightly improved; all medicine was omitted; no further treatment was adopted, and he came to his Ward on January 21st, 1851, perfectly steady, and much stouter than when he left the house. He says that within a month after leaving the hospital, he got quite well, without taking any medicine; and since then he has grown stout. Can walk about quite steadily, face full and fat, and complexion ruddy.

The variations of the sulphates and phosphates may be arranged thus:—

	Sulphate of Baryta.	Urine.	Specific Gravity.	Total Phosphates.	Urine.
6th day, very violent	11.25 grs. per 1000		1030.6	3.29 grs. per 1000	
7th day "	10.66 "		1031.8	2.52 "	
8th day "	11.15 "		1031.2	2.54 "	
10th day, much quieter	7.39 "		1028.4	3.50 "	
11th day "	3.92 "		1018.6	1.57 "	
102d day "	8.01 "		1030.6		

When it is remembered that this patient was only eight years old, weighing, at this time, less than 34 lbs., and taking scarcely any food, the increase of sulphates is most remarkable. When the sulphates were most, then an excess of urea was always detectable. The phosphates were not increased, nor indeed (though the abstinence from food was excessive) are they remarkably diminished.

The comparison of the amount of sulphates on the 6th, 7th, and 8th days, when the disease was at its height, and on the 102d when the patient was convalescent and eating full diet, is worthy of remark.

CASE 3.—Elizabeth C—, æt. 23, servant, Queen's Ward; admitted March 27, 1850. Had slight chorea for a fortnight previous to her admission, and had been out of health during the winter. Particularly observed to be more irritable in her temper, and to have lost her sleep. No appearance of worms had been noticed in the motions. She was given ordinary diet, with an aperient of Calomel and Scammony, five drops of Liq. Potass. Arsenitis three times daily. She was not obliged to keep her bed.

31st. The nurse observed that she was strange in her

manner, and she went to bed in the afternoon because she felt ill. She vomited; and was much more unsteady than she had previously been.

April 1st. The catamenia appeared. She became very restless, and the face was much flushed; at night she was delirious. The bowels not having acted, she was ordered Pul. Cal. c. Jalap., ʒj, statim; ht. Sennæ, post horas tres.

2d. The symptoms remain the same. The urine passed late in the evening was of a reddish colour, contained a thick deposit of urate of ammonia; on the addition of caustic ammonia, the red colour of senna and alkali appeared. On the addition of nitric acid, an immediate crystallisation of nitrate of urea formed. There was also a trace of albumen. The urine was acid to test-paper; and very decidedly acid on the 6th. Specific gravity = 1036.0.

518.0 grs. boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta . . . = 10.30 = 19.88 grs. per 1000 urine.

Ice was applied to the head. Two pints of strong beef-tea, and a pint of milk, for her food. Liq. Opii Sedativi, ℥xv; Sp. Æth. Sulph., ʒss; ht. Piment., ʒxj, 6th horis; Ferri Sesquioxyd., ʒss, e. fæce sacchari 6th horis alternis; Enema Vesp. c. P. Jalapæ, ʒiij.

3d. Ol. Ricini, ʒss, statim. Enema commune cras cum ht. Sennæ, ʒj. Chorea very violent.

4th. Remains in the same state; catamenia still slightly present. Vini Rubri, ʒij, ter die; urine passed this morning very deep coloured; contained scarcely a trace of albumen; gave a very large precipitate of urate of ammonia; and on the addition of nitric acid, it gave an immediate crystallisation of nitrate of urea. Acid to test-paper. Specific gravity = 1033.8.

516.9 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 8.20 = 15.86 grs. per 1000 urine.

5th. Still continues delirious, and in violent motion, though the spasmodic action is less violent to-day. No

water had been passed from twelve o'clock midday yesterday, excepting a small quantity, which was passed involuntary under her. At twelve o'clock this day the water was drawn off, in quantity 32 ounces; deep coloured, gave a plentiful deposit of urate of ammonia. No trace of albumen. Acid. Specific gravity = 1028·4.

514·2 grs. boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta . . . = 7·10 = 13·80 grs. per 1000 urine.
 514·2 grs. precipitated by Chloride of Calcium and Ammonia, Total Phosphates . . . = 3·35 = 6·51 „

6th. Urine drawn off to-day at twelve o'clock. Not so deep coloured. No deposit of urate of ammonia. Did not give with nitric acid an immediate precipitate of nitrate of urea. Contained no albumen. Specific gravity = 1026·8.

513·4 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 4·80 = 9·36 grs. per 1000 urine.

7th. The last twenty-four hours she has become much quieter; but she bursts into fits of crying without any reason. Urine drawn off at twelve o'clock, about 19 ounces, not so deep coloured. Gave no deposit of urate of ammonia. Contained no albumen. Specific gravity = 1025·4.

512·7 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 3·10 = 6·08 grs. per 1000 urine.

8th. Urine passed by herself without the catheter, much paler colour. Tongue coated at the back. Skin perspiring much. Is lying nearly quiet; much exhausted, but free from spasmodic motions.

12th. Is gaining strength. Urine made last night, and early this morning. Acid; clear. Specific gravity = 1016·4.

508·2 grs. boiled with Chloride of Barium and dilute Nitric Acid, Sulphate of Baryta . . . = 2·40 = 4·72 grs. per 1000 urine.

17th. There is the slightest spasmodic action of the muscles.

21st. She went out steady. Able to walk well.

The variation of the salts may be seen in the following table:—

	Sulphate of Baryta.		Specific Gravity.	Total Phosphates.
3d day, very violent	19.88 grs. per 1000 urine.		1036.0	
5th day ,,	15.86 ,,		1033.8	
6th day ,,	13.80 ,,		1028.4	6.51 grs. per
7th day ,,	9.36 ,,		1026.8	1000 urine.
8th day, much quieter	6.08 ,,		1025.4	
13th day ,,	4.72 ,,		1016.4	

On the 3d day the amount of sulphates depended on the sulphate of magnesia, as well as on the violent action of the muscles. Nitrate of urea crystals formed immediately on the addition of nitric acid to the urine.

The 5th and 6th days, no salts were taken, and the increase of the sulphates was very decided. The urea was also in excess. The phosphates were not diminished. As the muscular action became quieter, the sulphates in the urine diminished.

Cases of acute chorea as severe as these are very uncommon. From the commencement of this investigation I have, as yet, seen but one other case; and in that, also, the urine immediately gave evidence of an excess of urea. To the eye the amount of Sulphates precipitated by chloride of barium, after boiling with hydrochloric acid, appeared to be in excess. But this mode of estimating the amount of Sulphates without the balance, is too uncertain to be trusted.

It is worthy of notice, how high the specific gravity of the urine is in the three cases related; this was not only owing to the amount of urea in solution, but still more to the amount of Sulphates. These salts increasing the specific gravity three times as much as an equal quantity of urea would do.

I pass on, secondly, to the amount of Sulphates and Phosphates in some functional diseases of the brain. The following four cases of delirium tremens I place in this class.

CLASS II.

CASE 1.—Jessie P—, æt. 39, Fuller Ward; a carpenter, and keeper of a beer-shop. Admitted March 29th, 1847.

Said to have had a fit three years ago; and last Christmas is said to have had another fit, which was thought to be apoplectic. On the 20th of this month he again felt the warning of a fit. For this he was bled to syncope, and the bleeding was repeated, but this treatment did not avert the fit; after the fit he was blistered and mercurialised. He then became delirious, but got some sleep at intervals, and remained in this state until Saturday the 27th. The delirium then became very violent indeed, and he has not slept since. When brought to the hospital, he struggled violently and talked incessantly, and there was constant and general tremor of the lips and hands. Though he was reported to be a sober man, yet, on inquiry, it turned out that he was much the contrary. 6 p.m., skin pale and clammy; pulse scarcely perceptible; right pupil very much dilated; left, very much contracted and not acting. Passed some urine in bed at 10 o'clock in the evening. Bowels not open. Emp. Canth. Nuchæ; Tr. Opii, 3ss; Sp. Ammonia Aromat., 3ss; Sp. Ætheris C., 3j; Aquæ Pimentæ, 3jss; statim. Rep. ht. sine Tr. Opii, 2^{dis} horis.

10th day, 30th. Has been very violent all night; has had no sleep; took four ounces of brandy during the night. Bowels not open at half-past 10, a.m. Enema statim.

2 p.m. Four ounces of water drawn off; acid, contained oxalate of lime, slightly albuminous, with some fibrinous casts. Specific gravity = 1024·74.

Re-treated.

512·37 grains of urine, precipitated by Chloride	Urine.
of Barium, and Acid; Sulphate of Baryta = 8·87 = 17·31 grs. per 1000	
512·50 grains, precipitated by Chl. Cal. and	
Ammonia, Phosphate of Lime. . . . = 0·45 = .87	„

The tongue was dry, and the teeth covered with black sordes.

Enema, Terebinth., statim. Rep. Vespere.

Sp. Ammoniae Arom., ʒss; ht. Nitri, ʒjss, 3^{tiis} horis. Hyd. Chlor., gr. iij, tertiis horis.

The pupil of the right eye has been much larger than the left for nearly twenty years. It is stated that he could see best with the left eye.

Died at half-past 9, p.m.

Examined at home by me, April 1st, half-past 4, p.m.

No signs of decomposition. Skull thick; brain not wet, firm; slight opacity under the arachnoid; ventricles of the brain not distended, contained a small quantity of clear fluid; choroid plexus of a purple colour; puncta of blood in the substance of the brain more than usual; base of the brain healthy; no clot or softening in any part could be found.

Right kidney healthy, with a speck of white deposit in the cortical structure; capsule readily removed.

Left kidney, capsule could, with great difficulty, be torn off in many places; the capsule split, so as to leave a layer adhering to the surface of the kidney. The surface was covered with cysts, some larger than a split pea, full of gummy, soft, solid matter; these extended in places deep into the cortical structure of the kidney, and in some places encroached on the pyramids. Some white spots were seen similar to that in the right kidney. There was but a small portion of this left kidney that was not studded with these cysts; but where they were absent, the kidney appeared healthy. The pelvis of neither kidney was injected. There was much fat around the pelvis of the left kidney.

The heart was large and flabby; the auricles dilated and containing coagula; the valves were all healthy, but there was much atheromatous and osseous deposit at the commencement of the aorta. There were no tubercles in the lungs. The other organs were not examined.

In the single analysis given in this case, the Sulphates are much increased, and the Phosphates are diminished.

CASE 2.—Richard W—, æt. 40, King's Ward; brewer. Admitted April 24th, 1849, half-past 4, p.m.

He works in a brewery; and has had two, if not three,

attacks of delirium tremens. The last attack was four months ago. The last but one, six months before that. States that he drinks about two pints and a half of ale per day, but no spirits. The present attack began three days ago, with loss of sleep, excessive talking, and delirium. He has had no sleep since the attack began. On admission he was in a state of delirium, busy and incessantly chattering; his whole body was in a constant tremor; he would not be still for an instant, but was otherwise perfectly obedient when spoken to. The face was rather pale, and he had no headache.

He was ordered Senna immediately. Tr. Opii, $\mathfrak{m}_{xx}$; Mist. Camphoræ, $\mathfrak{z}_{jss}$, 4th horis. Porter, one pint.

25th. Has had a sleepless night, talking so constantly that he kept the other patients awake. He has been exhausting himself all the morning, in efforts to disengage his feet from the straps in which they are fastened. Pulse 108, soft and compressible, occasionally intermitting. Tongue moist, covered with a yellowish creamy fur, very tremulous. He is bathed in a profuse perspiration; says he has no headache and no appetite. Since his admission to the present time, he has taken only a few mouthfuls of meat and a pint of porter. In his medicine he has taken about two drachms of laudanum. Urine passed early this morning, not very scanty. Specific gravity = 1037·8. Gave with heat and acid a slight coagulum of albumen; with cold nitric acid an immediate crystallisation of nitrate of urea. Quickly deposited crystals of triple phosphate in small quantity.

518·9 grains boiled with Chloride of Barium, and dilute Nitric Acid,
Sulphate of Baryta = 10·80 = 20·77 grs. per 1000 urine.
518·9 grains, with Hydrochloric Acid,
and then Chloride of Calcium
and Ammonia, Phosphate of
Lime = 1·15 = 2·14 „

Urine passed in the afternoon, 5 p.m., the same day. Acid to test-paper; gave a very large deposit of urate of ammonia; also a considerable deposit of albumen by heat and

acid; and an immediate precipitate of nitrate of urea.
Specific gravity = 1041·2.

520·6 grains boiled with Chloride of Barium, and dilute Nitric Acid,
Sulphate of Baryta = 19·10 = 36·69 grs. per 1000 urine.

520·6 grains, precipitated by Chloride of Calcium and Ammonia,
Phosphate of Lime = 3·10 = 5·95 „

1936·4 grains, precipitated by strong Acetic Acid after Urate of Ammonia was dissolved, Uric Acid = 2·35 = 1·21 „

10 p.m. He became much more delirious, noisy, and intractable. The perspiration pouring in large quantity from all parts of his body. Sp. Genevæ, 3ij.

26th, 1 p.m. No improvement. Pulse became weaker and more fluttering; brandy was given. At 5 p.m. he was sick; and soon after he died.

Examination April 27th, 1 p.m. There was a large number of vascular ramifications on the interior of the cranium. The arachnoid was rather opaque from subarachnoidean fluid in the meshes of the pia mater. The superficial veins of the hemispheres of the brain were much congested; the substance of the brain was more watery than natural, but firm, and the puncta vasculosa numerous. The ventricles were not dilated; the choroid plexuses were dark, and had two or three small-cysts. There was a small spot of extravasated blood along the posterior margin of the cerebellum under the arachnoid, dipping down into the sulci, but not into the substance of the cerebellum. In the posterior fossa of the cranium, at the point corresponding to the extravasated blood, was a fossa large enough to admit the extremity of the finger, but not extending through the whole thickness of the bone.

The posterior part of the left lung was congested; there were adhesions of old standing at the lower part of the right lung, and near its apex a small cretaceous tubercle; both lungs were crepitant throughout. The heart was covered with fat; the cavities were rather large, and the

valves perfectly healthy. There was no fluid in the pericardium; there were a few spots of atheroma at the commencement of the aorta.

The right lobe of the liver was adherent to the diaphragm; the whole substance of the liver was greenish, and of a pasty consistence; the gall-bladder was much distended with bile; the spleen was exceedingly small and healthy; the kidneys were congested; the Malpighian tufts being full of blood; on the surface of both kidneys were several small cysts, but the structure was otherwise healthy.

The bladder had exceedingly thin walls. Throughout the body the blood was perfectly fluid.

	Sulphate of Baryta.	Specific gravity.	Total Phosphates.
In this case on the 5th day	20·77 grs. per 1000 urine	1037·8	2·14.
" " 5th night	37·07	1041·2	5·95.
" " 6th, died.			

Some sulphate of magnesia had been taken on the day previous to that on which the water was examined, and, doubtless, this partly increased the sulphates to the enormous amount here stated. The urea was also in great excess whilst the phosphates were below the amount of health, though the specific gravity was unusually high.

CASE 3.—Robert B—, æt. 26, waiter, Fuller Ward. Admitted January 3d, 1850, at half-past 7 p.m. Always pale and sickly.¹ Was taken ill on the 23d of December, with sickness and loss of sleep. He had been poorly for a fortnight, so much so that soon after Christmas he gave up work: with rest and opiates he improved, and returned to his work for two or three days previous to his admission. In consequence of his excited state and his loss of sleep he came to the hospital. He was very violent until 11 p.m., when the strait-waistcoat

¹ This patient said that he was in the habit of drinking a quarter of a pint of gin, and three pints of beer daily. He had been in his situation for two years, and had taken more than his usual quantity at Christmas; that he never had any illness like this before. Had had rheumatic fever four years ago.

was put on. Sp. Æther Sulph. Comp., Sp. Ammoniaë Arom., aa 3j, Mist. Camph., ʒiiss; sextis horis. Opii, gr. ij; Ext. Gentianæ, gr. xv, ft. suppositorium, statim. At 12 p.m., Tr. Opii, ʒj statim.; 2 pints of porter and a mutton chop were ordered, after this he slept well until 4 a.m. Perspiring excessively on waking, he still talked much, but was not violent.

4th January, water passed at half-past 7 a.m. Thick from urate of ammonia. Deposit very pink coloured, filtered. Specific gravity = 1037·4. Acid.

518·7 grains boiled with Chloride of Barium, and dilute Nitric Acid, Sulphate of Baryta = 9·8 = 13·10 grs. per 1000 urine.
518·7 grains precipitated by Chloride of Calcium and Ammonia. Total phosphates = 5·10 = 9·83 „ „

Was much less excited during the day.

5th January, no more perspiration. Urine made before breakfast had the same appearance as yesterday; filtered. Specific gravity = 1034·6.

517·3 grains boiled with Chloride of Barium, and Nitric Acid, Sulphate of Baryta = 6·70 = 12·95 grs. per 1000 urine.
517·3 grains precipitated by Chloride of Calcium and Ammonia. Total phosphates = 4·60 = 8·89 „ „

He got up to dinner, having no symptoms.

11th January. He went out without any return of the delirium.

	Sulphate of Baryta.		Specific gravity.	Total Phosphates.
In this case on the 13th day	13·10 grs. per 1000 urine		1037·4	9·83.
„ „ 14th day	12·95	„	1034·6	8·89.
„ „ 20th, went out.				

Here also the sulphates are increased. The phosphates are also not diminished, probably, in consequence of the patient being able to eat. The amount of urea was not tested, but from the high specific gravity it is very probable that an excess of urea was present.

CASE 4.—Thomas J—, æt. 34, broker. Admitted April 23d, 1850, York Ward. His wife states, that for eight years he has been in the habit of living chiefly on drink, taking but one meal daily. For some weeks past he has at times been slightly delirious; on the evening of the 21st, he was first seen, when he was very delirious, and had had no sleep for the previous forty-eight hours. Tr. Opii was given, first in drachm, and afterwards in two drachm doses, and by the following morning he had taken ten drachms of laudanum, and two grains of acetate of morphia. He was, at this time, very violent, having spectral illusions, a very rapid and feeble pulse, and tremors of the tongue and limbs.

He was induced to inhale chloroform. He became very rigid and somewhat convulsed before he was insensible; but he was quite insensible by the time forty minims had been inhaled; a little more chloroform was given occasionally to keep him asleep, two drachms being inhaled in all. He slept for about three quarters of an hour, and was quiet when he awoke, but not free from delusion. He took two drachms of tincture of opium in the course of the night of the 22d, and was a little better on the morning of the 23d. Pulse stronger and less frequent, but still he was sleepless, and six doses of opium in pills of three grains each were given in the course of the day, without any apparent effect. He inhaled a drachm of chloroform at seven p.m., and slept for about an hour; but, on being left by his medical man, his attendants let him get up and go out into the street, when he became unmanageable and was brought to the hospital. For this account I am indebted to Dr. Snow. On admission he was given Sp. Ætheris, c. ʒj, Liq. Antim. Tart., ʒij, Mist. Camph., ʒix, 4th horis.

24th April, 10 a.m. He has not slept more than twenty minutes during the night, and only five minutes at a time. He is very quiet. The pulse is rapid and feeble. Twelve ounces of urine were passed last night.—2 p.m. He has been sleeping for about an hour and a half, and is again disposed to sleep. Twenty-two ounces of urine were passed this morning; deep coloured, clear, acid. Specific gravity=1027·5.

513·75 grains boiled with Chloride of
Barium, and dilute Nitric Acid,
Sulphate of Baryta = 9·10 = 17·71 grs. per 1000 urine.

On the addition of nitric acid to this urine, an immediate crystallisation of nitrate of urea occurred.

The Antimony was omitted, and he was ordered *ht. Morphiæ, ʒij, hac nocte.*

25th. He slept nearly all yesterday afternoon, until about 9 o'clock p.m., waking at intervals of about an hour and a half. He slept very little during the night, and not above five minutes at a time.

2 p.m. He has taken a mutton chop and a pint of porter. Pulse 80, very full. He starts often in his sleep.

He passed about twelve ounces of urine, deep coloured, acid, contained an excess of urea, but did not give immediate crystallisation. Specific gravity = 1025·4.

512·7 grains boiled with Chloride of
Barium, and dilute Nitric Acid,
Sulphate of Baryta = 6·40 = 12·48 grs. per 1000 urine.

Continue the medicine thrice daily, *ht. Morphiæ, ʒij, hac nocte.*

April 26th. He slept four or five hours yesterday afternoon, but had no sleep during the night. He occasionally fancies he sees objects before him, otherwise he is very quiet. *Ht. Morphiæ, ʒij, hac nocte et rep. post horas tres.*

27th. Slept four or five hours yesterday afternoon, but not more than two hours during the night. He has taken his chop and pint of porter each day. He is very quiet, but fancies he sees objects about him. *Tr. Opii, ʒss, Mist. Camph. ʒiss, vesp. et post horas tres rep.*

28th. Slept from 8 p.m. to 2 a.m. From this time he slept well, but for three weeks he required some opiate each night. He went out on the 21st of May, cured.

	Sulphate of Baryta.		Specific gravity.
In this case 6th day	17·71 grs. per 1000 urine	.	1027·5
" 7th day	12·48	"	1025·4
" 33d day,	went out.		

The urea was in great excess when the sulphates were most in this urine also, and as the sulphates diminished less urea was found.

The amount of sulphates and of phosphates obtained in other cases of delirium tremens is stated in the table in the 'Philosophical Transactions;' but to give all the details of the cases would extend this paper without adding to its value. The four cases which I have selected are sufficient to show the striking increase of the sulphates in delirium tremens.

I pass on, then, thirdly, to the amount of sulphates and phosphates in acute inflammatory affections of the nervous structures.

The four following cases of acute or subacute inflammation of the brain will give the variations of the sulphates and phosphates in this class of cases.

CLASS III.

CASE 1.—Philip B—, æt. 25, admitted November 24th, 1847.

On the 3d of November he was seen by the house surgeon, with a scalp wound, which had been made with a shovel on the left side of the head, near the vertex. There was great hæmorrhage, which was restrained by pressure, but he would not stay in the house.

On the 5th, he came with some fever, but without head symptoms, except pain, and from that time he followed his employment (he was a gentleman's servant) till the 21st of November, when he was attacked with severe headache and felt very ill. On the evening of the 23d, a severe rigor occurred, followed by much heat and sweating.

On admission on the 24th, his countenance was heavy; his articulation thick, and performed with some slight difficulty, and he could not walk unsupported. The right portio dura acted imperfectly; the tongue was somewhat drawn to the left side; the right arm numbed and almost powerless; he complained of slight headache. The pulse was 84, quick and regular. The tongue moist, and the skin cool. A scab about

two inches long remained from the wound, which appeared to have healed soundly, except in the centre, where a sinuous opening led down to exposed bone. A brisk purgative was immediately given, and repeated the 26th and 29th.

The day after his admission he was much better, and on the 29th all the symptoms had disappeared, excepting slight numbness of the arm. In the evening, however, he insisted on getting up, and it was some considerable time before he could be induced to go to bed; and the following morning there was a recurrence of all the symptoms of the 24th, with the superaddition of slight numbness of the right lower extremity, and pain in the left side of the head. But the pulse was still only 80, and the skin was cool.

December 1st. There was almost total paralysis of the right side.

2d. The paralysis is complete; the headache more severe; the countenance more dull and heavy; the articulation very thick and indistinct; and at half-past 1 p.m. he was trephined. The wound being enlarged crucially the pericranium was found to be readily separable from the bone, which, however, was only exposed in one spot. On the removal of a crown of bone by the trephine, some very fetid pus mixed with brain-like matter escaped, and two pieces more were therefore taken away by the instrument. The dura mater was then found to be separated for some distance, but healthy in appearance, except in one part, where there was a perforation, the size of the top of the thumb, round which it was sloughy. Out of this opening pus escaped from beneath the membrane. Perhaps, altogether, three ounces of matter were let out.

Water passed, before the operation, rather deep coloured. Gave a slight deposit of urate of ammonia and oxalate of lime. Specific gravity = 1018·7, acid reaction.

509·35 grains boiled with Chloride of
Barium and Nitric Acid, Sul-
phate of Baryta = 2·02 = 3·96 grs. per 1000 urine.
509·35 grains precipitated by Chloride
of Calcium and Ammonia, Phos-
phate of Lime = 2·62 = 5·14 ,, ,,

10 p.m. The headache had left him. He felt inclined to sleep, and the pulse was 108 and soft.

3d. He had a quiet night. The pulse fell to 88. The tongue was rather cleaner. The countenance perhaps improved. The other symptoms the same as before the operation. Water passed about 2 p.m., all that he had passed since half-past 1 the day before. Deeper colour, much more loaded with urate of ammonia. Specific gravity = 1027·26.

513·63 grains boiled with Chloride of
Barium, and Nitric Acid, Sul-
phate of Baryta = 5·77 = 11·23 grs. per 1000 urine.
513·63 grains precipitated by Chloride
of Calcium and Ammonia. Total
Phosphates = 5·72 = 11·13 „ „

4th. Water passed about 11 a.m., of much lighter colour. Gave no precipitate on standing. Acid to test-paper. Specific gravity = 1013·1.

506·55 grains boiled with Chloride of
Barium and Nitric Acid, Sul-
phate of Baryta = 1·47 = 2·91 grs. per 1000 urine.
506·55 grains precipitated by Chloride
of Calcium and Ammonia. Total
Phosphates : = 3·07 = 6·06 „ „

5th. He was lying in a state bordering on insensibility, and could scarcely speak. The eyes were half shut. The paralysed arm was contracted and stiff, and the thumb was drawn into the palm of the hand.

6th. Early this morning a rigor occurred. His motions were passed under him. The skin was warm and moist. The pulse 110, jerking. Tongue was furred. Pus was escaping freely from the wound. The dura mater was more sloughy, and the brain more prominent. It was stated that, during the afternoon, he became much less sensible, and that the jaws were so firmly fixed as to require some force to be used when it was necessary to open them.

Water passed at 11 a.m., gave a deposit of urate of ammonia and crystallised phosphate of lime, acid to test-paper. Specific gravity = 1027·0.

513.50 grains boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta	= 3.77 = 7.34	grs. per 1000 urine.
256.02 grains boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta	= 1.97 = 7.69	„ „
513.50 grains precipitated by Chloride of Calcium and Ammonia. Total Phosphates	= 5.52 = 10.75	„ „
513.30 grains precipitated by Chloride of Calcium and Ammonia. Total Phosphates	= 5.67 = 11.04	„ „

11 p.m. The face was noticed to be much swollen and red; and in this state he remained until between 3 and 4 a.m. on the 7th, when he died.

Post mortem examination 33½ hours after death. On removing the skull cap, no mischief was detected between the bone and the dura mater, but the exposed portion of dura mater presented a large opening through which the brain protruded; all the exposed portion was sloughy, and covered with lymph and most offensive discharge. On removing the dura mater, the convolutions of the brain appeared much flattened. On the right side, with this exception, there was nothing of any importance. On the left side there was a small, nearly circular, piece of the surface of the brain, which was prominent and sloughy, and which corresponded to the opening in the dura mater; through this latter projecting portion there was an opening leading into the substance of the brain, and communicating with a large foul abscess, which occupied a large space towards the posterior portion of the hemisphere, and extended to the upper wall of the left ventricle, into the cavity of which it had very nearly perforated. The walls of the abscess were perfectly distinct and firm. The substance of the brain surrounding the abscess was of a light lemon colour, and soft and pulpy in consistence. The greater portion of the left hemisphere not implicated in the abscess, was in this inflamed and altered condition, and on the outer side, where the mischief extended to the grey substance, the latter was entirely changed in character,

and had the same appearance as the other inflamed parts. The lateral ventricles were distended with thin serum. The septum lucidum was much softened and very readily lacerated. The base of the skull was natural.

There was some partial and firm adhesions of the pleura on both sides, chiefly at the upper part. Both cavities contained a quantity of blood mixed with serum. The upper portion of the lungs was crepitant, but the lower parts were highly congested and much compressed. The right lung was much collapsed when the chest was opened. There did not appear any injury of either lung. The other viscera were healthy.

The variations of the sulphates and phosphates may be thus given.

	Sulphate of Baryta.		Specific gravity.	Total Phosphates.	Urine.
12th day,	3·96 grs. per 1000 urine.	.	1018·7	5·14 grs. per 1000	
13th day,	11·23	„	1027·3	11·13	„
14th day,	2·91	„	1013·1	6·06	„
16th day,	7·34 }	„	1027·0	{ 10·75	„
	7·69 }	„		{ 11·04	„
16th night,	died				

The inflammation was not of the most intense character; but the increase of the sulphates and phosphates is apparent, and the corresponding variations of the two salts is very distinct.

CASE 2.—Emma F—, æt. 11, Crayle Ward. The mother says the child was strong, healthy, and very quick; has two more children quite healthy. Admitted March 22d, 1848. Has had pain at the top of the head for fourteen days, for which the head has been shaved; had some disease of the scalp; the mother states that she fell down stairs yesterday, since which she has been much worse. The tongue is furred; the pulse 130, sharp; the bowels open; the pupils large, but acting; she answers questions very readily; is unable to stand; the head is thrown back; there is no strabismus: fever diet.

Hirudines xij temporibus, Cal., gr. iij, statim, ht. sennæ, ℥jss, post horas tres. Hydr. Chlor., gr. ij, pulv. Opii, gr. ¼, ter die. Ht. Nitri; ℥jss, 6^{tis} horis. Glacies capiti.

23d. Skin hot and dry; pulse 108, small and rather sharp;

face swollen, looks heavy, and is very drowsy; motions greenish and lumpy; distinct pulsation in the carotids; has not been sick; water thick, scanty, and contains no albumen; that passed last night alkaline when I got it; a drop or two of hydrochloric acid was added, filtered. Specific gravity = 1030·0.

515·0 grains boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta. = 4·55 = 8·83 grs. per 1000 urine.

515·0 grains precipitated by Chloride of Calcium and Ammonia. Total phosphates = 4·85 = 9·41 „

Rep. Calomel, 6th horis. Rep. ht. Sennæ. Pint of milk.

24th. Water scanty; mouth rather sore; pupils dilated; still very drowsy and heavy; tongue rather brown. Rep. Pil. c. Opii, gr. $\frac{1}{8}$, vice $\frac{1}{4}$. Enema commune statim. P. c. glacie.

In the afternoon the opium was omitted. P. c. Hydr. Chlor., gr. ij, 6th horis. Emp. Lyttæ Nuchæ; Ung. Hydr. Ulceri. All the water that was passed from the previous night to 1 p.m. was about a pint, secreted after senna and salts had been taken; on long standing, it gave an excessive deposit of urate of ammonia. Acid. Specific gravity = 1029·0.

514·50 grains boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta. = 5·50 = 10·69 grs. per 1000 urine.

514·50 grains precipitated pink by Chloride of Calcium and Ammonia. Total Phosphates = 4·35 = 8·45 „

25th. Pulse 115, sharp and hard; pupils large and sluggish; breathing hurried; complains of pain in the chest. P. c. Pil. ter die.

26th. Mouth sore; takes more notice; bowels not open. P.

27th. The nurse says that she was delirious last night; complains of a good deal of pain in the head; pulse quick, skin hot. Ol. Ricini, ζ ss, statim; Pc. Pil. bis in die.

28th. Skin dry; pupils rather smaller; sees double; head not so much thrown back; bowels well open by the oil, and motions very copious; urine scanty. Rep. Oleum. P. c. ht.; Rep. Emp. Lyttæ, and Ung. Hydrarg.

29th. Pulse only 84; bowels freely open; sees double.

30th. Face more flushed; head more thrown back; pupils more dilated; pulse 84; seems to suffer most acute pain; complains chiefly of her back; bowels have not acted; water scanty, contains no albumen; acid. Specific gravity = 1029·8.

514·90 grains boiled with Chloride of

Barium and Nitric Acid, Sul-

phate of Baryta = 4·55 = 8·83 grs. per 1000 urine.

514·90 grains, precipitated by Chloride of Calcium and Ammonia.

Total phosphates = 5·25 = 10·19 „

Infri. Ung. Hydrarg. omni nocte. P. c. ht. 4th horis.
Enema commune hac vespere.

31st. Head still thrown back; is quite insensible; does not appear to see at all. Water passed under her. Insensibility came on last evening. Face flushed; pulse 60.

Pul. Jalap. c. ʒj, statim. P. c. unguento. Adde haustui Tr. Lyttæ m̄x. Water to be drawn off.

1st. Much better; sees perfectly; bowels were open four or five times, but the motions were passed under her; water much more plentiful, 18 ounces drawn off this morning; is quite sensible, and complains of a great deal of pain in the head; pupils not nearly so dilated, but frequently changing; pulse 80; head still thrown back; passed a very restless night. Rep. omnia.

2d. Quite insensible; takes no notice of anything; face flushed; squints very much, and the face is at times convulsed; is very restless, and calls out occasionally; pulse 86, very small; bowels have operated once, and a good deal of water has been passed under her; the skin is hot and dry; pupils are dilated, and she is evidently much lower.

3d. Still insensible; perspiring very freely; pupils very dilated, and squinting; not so much urine passed as yesterday; bowels not open; pulse 100; there is some difficulty in swallowing; water drawn off to-day, acid; contained some albumen, blood and pus globules. Specific gravity = 1031·4.

515·70 grains boiled with Chloride of

Barium and Nitric Acid, Sul-

phate of Baryta = 4·85 = 9·40 grs. per 1000 urine.

515·70 grains precipitated by Chloride of Calcium and Ammonia.

Total phosphates = 4·65 = 9·01 „

4th. Rather more sensible; pulse 150 running; lies perfectly quiet; skin perspiring; makes but little water; bowels not open; is sinking. Emp. Lyttæ amplum nuchæ. Pul. Jalap. c. statim. Vini Rubri, ʒij.

5th. Died at 5 o'clock this morning. Examined thirty-two hours after.

The body was well formed and rather thin. The vessels of the dura mater were gorged with blood. The convolutions of the brain were much flattened. The superficial vessels were much distended, and the subarachnoid cellular tissue on the superior surface of the brain contained a small quantity of very slightly opaque serum. The substance of the brain presented very many puncta of blood, and the cortical structure was dark in appearance. The lateral ventricles were distended with serum, which contained some flocculi of lymph, making it slightly turbid. The septum was softer than natural, and jelly like, but not tattered. In the subarachnoid cellular tissue at the base of the brain, there was a much larger quantity of semi-transparent lymph effused. The structure of the cerebellum was somewhat softer than the cerebrum, but this might have resulted since death.

In the upper part of the right lung, there was a small patch of scrofulous matter, with the deposit of several small miliary tubercles in its neighbourhood; other small semi-transparent tubercles were found thinly scattered over the other portions of the lung. In the left lung there were also a few miliary tubercles; the lower lobe was inflamed and hepatised at its lower part, and greatly congested. The heart was healthy. The kidneys were healthy in structure, but the mucous membrane of the pelvis was slightly congested in both. The mucous membrane of the bladder was congested, perhaps slightly inflamed.

In this case.	Sulphate of Baryta.	Specific Gravity.	Total Phosphates.
15th day	8·83 grs. per 1000 urine	1030·0	9·41
16th „	10·69 „	1029·0	8·45
22d „	8·83 „	1029·8	10·19
26th „	9·46 „	1031·4	9·01

28th, died.

In this case also, the corresponding increase of the sulphates and phosphates is remarkable, considering the age of the patient. The post-mortem examination leaves no doubt whatever as to the nature of the disease.

CASE 3.—Henry P—, æt. 23, York Ward, accustomed to drink freely. Admitted May 16, 1849; having been an out-patient for hæmoptysis. Complains of pains all over the body and limbs, with constant tremor, which he has had for ten days; sleeps badly; no appetite; feels very weak; is covered with profuse perspiration; tongue rough, has been much furred; pulse feeble; has occasional attacks of dyspnœa; bowels rather confined; has much headache; petechiæ over the body. Milk diet and beef tea. Salines, blue pill, and castor oil.

17th. He says he has attacks of shivering four or five times a day, afterwards he perspires; bowels have been open this morning; pulse 72, soft; slept well last night.

18th. He is in a constant perspiration; skin hot; hands trembling; slept well last night; tongue coated and moist; no headache; starts up from his sleep frequently in the night; he is occasionally slightly delirious, and says that he sometimes fancies two persons are walking along the ward when there is only one.

19th. Feels extremely weak; tongue tremulous, moist, and creamy, furred at the base; he perspires less than he did; pulse 72, soft, intermitting; he sleeps in short, light dosings, very frequently both day and night; still occasionally he is slightly delirious; bowels not open; no appetite; urine very dark.

20th. Has been very delirious and noisy all night, having no sleep. To-day he has a dull, heavy, vacant look; he answers questions, but not readily; he does what he is told to do; left eyelid closed; pupils neither dilated nor contracted; no strabismus; face not flushed; complains of great pain across the forehead; tongue is protruded towards the left side; the left arm is paralysed, lying by his side; so also appears to be the left leg; the right arm is in constant tremor, and

moved about unsteadily without any apparent object; urine passed early this morning, deep coloured, alkaline. Specific gravity=1031·6.

515·8 grs. boiled with Chloride of Barium
and dilute Nitric acid, Sulphate
of Baryta = 5·10 = 9·88 grs. per 1000 urine.
515·8 grs. precipitated by Chloride of
Calcium and Ammonia. Total
phosphates = 4·40 = 8·72 „ „

Late at night about 32 ounces were drawn off; acid; contained phosphate of lime crystals. Very deep coloured, contained some few blood globules, probably from the catheter. Specific gravity 1032·2. On the 22d, torulæ were very evident, but no trace of sugar could be found.

516·1 grs. boiled with Chloride of Barium
and dilute Nitric acid, Sulphate
of Baryta = 5·20 = 10·07 grs. per 1000 urine.
516·1 grs. precipitated by Chloride of
Calcium and Ammonia. Total
phosphates = 4·60 = 8·91 „ „

Enema commune statim; Emp. Lytt. nuchæ, Radatur caput; Glacies capiti. Calomel gr. ij; Opii gr. $\frac{1}{4}$ 6th horis; ht. Nitri, ʒiiss, 6th horis.

21st. Rather less pain across the forehead. He was very noisy and delirious all yesterday and last night; he is now quiet, speaking only occasionally; still answers questions, but with less readiness; still does some things which he is told to do; paralysis of the left side of the body the same as yesterday; he speaks with the right side of the mouth (as also he did yesterday); the right hand still moves about and is in constant tremor; the eyes are both turned towards the right side; tongue rather red at the tip, furred at the base; skin hot and dry; no contraction or dilatation of the pupils; eyes bloodshot and suffused; pulse variable, 11 a.m., 84; 1 p.m., 144, soft; bowels were open yesterday after the injection, not to-day. On examination of the chest, want of breathing was found at the apex of the right lung. Twenty-four ounces of urine were drawn off early this morning, acid, specific gravity=1016·4, contained more blood-globules.

508·2 grs. boiled with Chloride of Barium and dilute Nitric acid, Sulphate of Baryta	= 3·40 = 6·69 grs. per 1000 urine.
508·2 grs. precipitated by Chloride of Calcium and Ammonia. Total phosphates	= 2·40 = 4·74 „ „

Later in the evening about 18 ounces of urine were drawn off, acid. Specific gravity = 1018·2.

509·1 grs. boiled with Chloride of Barium and dilute Nitric acid, Sulphate of Baryta	= 4·20 = 8·25 grs. per 1000 urine.
509·1 grs. precipitated by Chloride of Calcium and Ammonia. Total phosphates	= 2·90 = 5·69 „ „

Enema commune statim P. c. Pil., 4^{tis} horis, c. Pulv. Opii, gr. $\frac{1}{8}$. At 9, when the urine was drawn off, he became comatose; pupils dilated.

22d. He continued comatose throughout the night, and died at $\frac{1}{4}$ before 11 a.m.

Examined May 23d, 1 p.m.

The dura mater was very vascular, and the Pacchionian glands larger than natural. The arachnoid was slightly opaque, and the superficial veins enormously distended. The substance of the brain was tolerably firm; not wet; very vascular. The lateral ventricles were dilated with clear fluid. At the base of the brain in the posterior subarachnoidean space there were slight traces of opacity, apparently from lymph. Two or three small tubercles were found in the cineritious substance of the posterior part of the right lobe of the cerebellum.

Both lungs were adherent to the parietes of the thorax. There was cretaceous deposit in the bronchial glands. The lungs were crepitant, but congested; at the posterior part of the left, was a large patch of pulmonary apoplexy; in both there were a few tubercles, particularly in the apex of the left. Heart quite healthy, containing no coagulum.

Liver healthy for the greater part. At the upper part of the right lobe was a large cyst, with a dense wall, containing thick, whitish, cheesy-looking matter, also some gelatinous substance.

Both kidneys were congested, smooth on the surface; a few tubercles were found in each.

Bladder was much distended with urine. We have, then, on the—

	Sulphate of Baryta.		Specific Gravity.	Total Phosphates.
15th day .	9.88 grs. per 1000 urine	.	1031.6	. 8.72
„ night .	10.07 „	.	1032.2	. 8.91
16th day .	6.69 „	.	1016.4	. 4.72
„ night .	8.25 „	.	1018.2	. 5.69

17th day, died. The increase of the sulphates and phosphates is not so marked as in the previous case; but the specific gravity being considered, it is evidently present.

CASE IV.—George M—, æt. 22, under-butler, York Ward. Admitted October 16, 1848. The man who came with him said that he was taken ill on the 13th with pain in the head. On the 14th he was worse, and had leeches applied to the head; on the 15th he became delirious, and the next day was sent to the hospital. Mr. Keate made inquiry for me, and the history of this man's illness appeared to be true. He had had no cough previous to the headache, and had been out with the carriage one day before it began.

Water passed on the evening of the 16th; scarcely acid to test-paper. On standing twenty-four hours, contained some granules and tufts of phosphate of lime, and some phosphate of ammonia and magnesia. It was clear when passed. Specific gravity = 1027.85, neutral.

514.20 grains, boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta = 4.30 = 8.55 grs. per 1000 urine.

514.20 grains, precipitated by Chloride of Calcium and Ammonia. Total phosphates = 3.70 = 7.19 „

2000 grains of urine with Hydrochloric Acid, Uric Acid = 2.95 = 1.47 „

Ht. Potasse Citr. 6th horis; ht. Rhei mane.

Oct. 17. Is very delirious; face flushed; tongue moist and furred; conjunctivæ suffused; head hot; pulse 100; skin hot and dry. Hirudines viij, temporibus.

P. c. ht. c. Vini Ant. Pot. Tart., $\text{m} \times \text{l}$; Cal., gr. iv, hac nocte. Emp. Canth. ampl.

18th. Has been very delirious all night; constantly talking; lies on his back; passes his stools and his water in bed; pulse 96; face still much flushed, and head hot. Urine drawn off this evening. Specific gravity = 1026.1; gave a deposit of phosphate of ammonia and magnesia in twenty-four hours; about half a pint, neutral.

513.20 grains, boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta	= 4.01 = 7.81 grs. per 1000 urine.
513.20 grains, precipitated by Chloride of Calcium and Ammonia. Total phosphates	= 3.30 = 6.43 „
2054.2 grains, with Hydrochloric Acid; Uric Acid	= 1.55 = 0.75 „

C. Cruent. temporibus ad. $\text{z} \text{ viij}$; Perst. Vespere Calomel gr. iij, hac nocte, et post horas iv.

19th. Face less flushed, and skin less hot; low muttering, with convulsive movements of the hands; eyelids nearly closed; pupils insensible, not dilated, or but slightly so; bowels open; pulse 96. The catheter could not be introduced, but the water was passed freely under him.

Enema commune statim. Calomel, gr. viij vespere.

20th. Lies quite still, and moans sometimes; face pale, cooler, with a slight perspiration; eyelids more open; eyes fixed; pupils insensible; slight strabismus; skin hot; pulse 140, sharp; tongue cooled; and much occasional hiccough. Water drawn off at 2 p.m., 16 z , quickly gave a deposit of urate of ammonia, highly acid, and remained so on the 25th. Specific gravity = 1031.4.

515.70 grains, boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta	= 6.00 = 11.63 grs. per 1000 urine.
515.70 grains, precipitated by Chloride of Calcium and Ammonia. Total phosphates	= 4.80 = 9.30 „
2062.40 grains, with Hydrochloric Acid. Uric Acid	= 1.65 = 0.80 „

Rep. Enema vespere Glacies Capiti subinde. Hyd. c. cretâ, grs. v, 6th horis.

21st. Gradually sinking; urine drawn off late; very thick from urate of ammonia, filtered. Specific gravity = 1026·2. Twenty-six ounces of urine.

513·10 grains, boiled with Chloride of Barium and Nitric Acid, Sulphate of Baryta	= 5·20=10·13 grs. per 1000 urine.
513·10 grains, precipitated by Chloride of Calcium and Ammonia. Total phosphates	= 4·10= 7·99 „

He died in the night.

Examined 27 hours after. Body in good condition.

The vessels of the dura mater were congested, and the large veins of the pia mater; there were about the usual number of puncta vasculosa; no increased depth in the colour of the grey matter; there was a slight amount of sub-arachnoid fluid on the convex surface of the hemispheres; no effusion of lymph or pus anywhere; the lateral ventricles contained a small quantity of serous fluid, which was perhaps a little turbid; the septum lucidum and fornix were but little, if at all, softened; the blood-vessels ramifying in the superficial structure of one of the thalami optici had undergone a peculiar alteration, which appeared to consist in the deposit of an opaque white matter in their coats; the matter consisted of oily molecules, sometimes very distinct, and resembled, on the whole, some varieties of scrofulous deposit; the large vessels at the base were not observed to have undergone any morbid change; the substance of the brain was everywhere healthy, so far as the eye could judge, but very wet.

The left pleura was healthy; there were some old adhesions on the right side; both lungs contained numerous miliary tubercles, which were most advanced towards the apex of the left lung; there was no vomica; the left lung, at its posterior part, was excessively congested, so much so that a piece of it sank in water; it did not, however, seem to be truly hepatised; the right lung was similarly affected to a much less

degree; the pericardium contained an ounce of serous fluid; the heart was healthy; the aorta healthy, and its coats not stained; liver healthy; kidneys contained numerous small tubercles, but were otherwise healthy; spleen rather enlarged.

The deposit in the blood-vessels of the brain appears to have been similar to that found by Dr. Hughes Bennett in cases of inflammation of the brain.

We have, then, in this case :—

	Sulphate of Baryta.		Specific Gravity.		Total Phosphates.
4th day ...	8.55	grs. per 1000 urine	...	1027.8	... 7.10
6th „ ...	7.81	„ „	...	1026.1	... 6.43
8th „ ...	11.63	„ „	...	1031.4	... 9.30
9th „ ...	10.13	„ „	...	1026.2	... 7.99
9th night, died.					

There is, therefore, a very decided increase in the sulphates and phosphates, and the corresponding increase and diminution of the two salts is again apparent.

The four cases, though not so marked as those which I have recorded in my previous paper in the 'Medico-Chirurgical Transactions' for 1847, are confirmatory of the statements made, that in inflammation of the brain the phosphates are increased. From these cases it is probable that the sulphates are also increased in the same disease.

Conclusion.

These, then, are the most remarkable examples which have occurred to me, of the increase of the sulphates in disease.

The phenomenon common to acute chorea and to intense delirium tremens, is increased and unceasing muscular action; the result of which is, an increase of the sulphates and of the urea in the urine; just as in health they would be increased if continued exercise was taken.

In my former paper I stated, that in delirium tremens, when no food was taken, the phosphates were diminished; and I attributed this to the diminished action of oxygen on the nervous structure. How far I was correct in my conclusion, further experiments must determine; but as in this

paper I have shown that the phosphates were diminished in acute chorea, when no food could be taken, it must be admitted, that abstinence from food in itself lessens the phosphates, more than from my former experiments appeared to be the case. Still, however great the abstinence from food in chorea may be, the amount of phosphates in that disease, or in any other, was never found to be so low as in the cases of delirium tremens, recorded in my previous paper.

Cases of excess of urea in the urine possess some interest, in consequence of the opinion of Dr. Prout, that the excretion of an excess of urea, constituted a disease analogous to diabetes. The cases I have now detailed, of excess of urea in chorea and delirium tremens, point to the fact, that the increase is a consequence of the changes taking place in the muscles, and that the amount of urea does not constitute the disease, but is a result of the changes which are taking place within. The muscles are highly complex organic compounds, in which sulphur exists in an unoxidised state; and the muscular action is accompanied, if not caused, by an action of oxygen, which, among other results, gives rise to the formation of urea and sulphuric acid, the amount of oxidation being proportioned to the intensity of the muscular action.

In my former paper, I also stated, that in cases of increased action of the brain, an increased formation of phosphoric acid results from an increased oxidising action taking place in the nervous structures. The cases which I have now related, of the variation of the sulphates and phosphates confirm the fact, that in inflammation of the brain, the phosphates are considerably increased, and they lead to the belief that in the same cases, the sulphates also are above the average amount. When it is remembered that the amount of sulphur in the albumen of the brain, is probably not very different from the amount of phosphorus in the cerebral fatty matter, the simultaneous and corresponding increase of the phosphates and sulphates in inflammation of the brain, is seen to depend on the same oxidising action which takes place at one time, on all the elements of the

nervous structure, at another time, on all the elements of the muscular structure, according as an increased action of the brain or of the muscles takes place.

I cannot quit this subject without again repeating, that these experiments are preliminary; they show the action of the inspired oxygen within the human body, in a few striking cases. They are slight demonstrations of the far more extensive results which may be obtained, by taking into the account the quantity of phosphates and sulphates which are thrown out of the kidneys in twenty-four hours. But in such experiments, unless the greatest care is taken in determining the exact quantity of urine secreted in twenty-four hours precisely, the results will lead to error, and not to truth.