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Publication/Creation

London : Printed by Richard and John Edward Taylor, 1850.

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ON

THE COMPOSITION

OF THE

FÆCES OF MAN IN HEALTH

AND IN

DIABETES MELLITUS.

BY

JOHN PERCY, M.D., F.R.S.

[From the Chemical Gazette for March 15 and April 1, 1850.]

LONDON:
PRINTED BY RICHARD AND JOHN EDWARD TAYLOR,
RED LION COURT, FLEET STREET.
1850.

Part of the following paper was read to the Chemical Section of the British Association at Cambridge, 1845, and subsequently published in Dr. Day's translation of Simon's 'Animal Chemistry.' But as that work is not generally in the hands of chemists, I now present the entire paper in the 'Chemical Gazette.'

The analyses were made with particular reference to the pathology of Diabetes mellitus. To some it might appear useless to expend time in ultimate analyses of the solid egesta of man; but there are considerations, physiological as well as pathological, which render it desirable that such analyses should be made.

The patients from whom the fæces were obtained were under my own care; two of them were in the Queen's Hospital when I was physician to that institution. Two of the cases have appeared in the 'Medical Gazette;' but the third, upon which I have a very great number of observations, has not yet been published. Analyses of the fæces of man in health and under different conditions of diet, and of a patient affected with Icterus, will also be introduced.

Ultimate Analyses of the Fæces.

In these analyses chromate of lead was invariably used as the oxidizing body.

The desiccation of the fæces, preparatory to analysis, was effected at 212° F., or some degrees above. In the second analysis the matter employed was generally subjected to the desiccating process for a much longer time than in the first, so that the correctness of the amount of hydrogen might be satisfactorily tested.

1. *Of the Fæces in Health.*—The individual whose fæces were subjected to analysis was a young man, aged thirty, who had taken the ordinary diet of this country, and who appeared to be in the enjoyment of perfect health.

First Combustion.—7·41 grs. gave of HO 4·43 = H 6·64 per cent. Of CO^2 12·55 = C 46·18 per cent.

Second Combustion.—7·24 grs. gave of HO 4·44 = H 6·81 per cent. Of CO^2 12·28 = C 46·23 per cent.

Incineration.—50·13 grs. gave of ash 8·21 = 16·37 per cent.

Nitrogen.—Not determined.

Mean of the Two Combustions.

Carbon	46·20
Hydrogen	6·72
Nitrogen, Oxygen*	30·71
Ash	16·37
	100·00

* Sulphur is doubtless also present. When fæces are incinerated in a platinum crucible, the metal is somewhat attacked.

These results are very nearly the same as those obtained by Dr. Lyon Playfair at Giessen (Liebig's Anim. Chem., translated by Gregory, p. 285, 1842):—

Dr. Playfair's Analysis.

Carbon	45·24
Hydrogen	6·88
Nitrogen, Oxygen	34·73
Ashes	13·15
	100·00

These facts are worthy of attention, as they seem to show, that, under ordinary circumstances of health, the composition of the fæces is more uniform than we might *à priori* have inferred. The first analysis, it will be borne in mind, was of the fæces of a man in this country, and the second of the fæces of a soldier at Giessen.

2. *Of the Fæces of a Man undergoing the curious and rigorous Discipline of "Training" for Prize-fighting.*—Age, 22; height, 5 ft. 6 in.; weight, 8½ st. This individual, it will scarcely be doubted, must have been in the most perfect state of health. I wish to direct particular attention to his diet. He breakfasted at 9 A.M., and ate 1 lb. of mutton, weighed before cooking. He dined at 1 P.M., and ate the same quantity of mutton with the addition of about 2 oz. of bread. And again, at supper, at 8 P.M., he had the same quantity of mutton. At each meal he drank half a pint of ale, but no other liquid at any other time of the day. Nor did he eat any other vegetable matter whatever besides the small quantity of bread mentioned. He walked seventeen miles daily.

First Combustion.—5·35 grs. gave of HO 3·43 =H 7·12 per cent. Of CO^2 9·73 =C 49·60 per cent.

Second Combustion.—5·74 grs. gave of HO 3·62 =H 7·01 per cent. Of CO^2 10·52 =C 49·98 per cent.

The difference between these two combustions in respect to the carbon is greater than should be tolerated, but is not of much consequence in the present investigation, in which precise formulæ are not concerned.

Incineration.—31·42 grs. gave of ash 4·56 =14·51 per cent.

Mean of the Two Combustions.

Carbon	49·79
Hydrogen	7·06
Nitrogen, Oxygen	28·64
Ash	14·51
	100·00

I should remark, that after passing a current of dry air, in the usual apparatus, over these fæces during a considerable time, there still remained in the tube connected with the reservoir of water some clear and colourless liquid, which had a strong, peculiar and

offensive odour, and which powerfully reddened litmus. I continued to pass the air through the tube for a much longer time than usual, in order to remove the liquid, which at first I did not suspect to be more than water. Having since examined a specimen of pure butyric acid, I was immediately struck by the similarity of odour between it and the liquid mentioned above; and I am now disposed to believe that the liquid in question consisted of, or at least contained, butyric acid in large proportion. That acid has been discovered in the fæces by Dr. Ragsky of Vienna.

3. *Of the Fæces of a Boy*, Stubbs, *aged* 7 (*Diabetes*).—They were hard, and not of the natural consistence of health.

First Combustion.—5·44 grs. gave of HO 3·35 =H 6·83 per cent. Of CO^2 8·76 =C 43·94 per cent.

Second Combustion.—4·72 grs. gave of HO 3·01 =H 7·09 per cent. Of CO^2 7·58 =C 43·79 per cent.

Incineration.—30·76 grs. gave of ash 6·18 =20·09 per cent.

Mean of the Two Combustions.

Carbon	43·86
Hydrogen	6·96
Nitrogen, Oxygen	29·09
Ash	20·09
	100·00

The proportion of saline matter in this analysis is very large, and probably depended upon constipation.

4. *Of the Fæces of a man*, Flint, *aged* 48 (*Diabetes*), *while restricted to an Animal Diet.*—They were of moderate consistence. This analysis was made by my former pupil, Mr. Stallard, in my laboratory.

First Combustion.—8·22 grs. gave of HO 5·61 =H 7·58 per cent. Of CO^2 16·43 =C 54·51 per cent.

Second Combustion.—8·57 grs. gave of HO 5·84 =H 7·57 per cent.

Of CO^2 17·03 =C 54·20 per cent.

Nitrogen (determined by myself). Will's process was adopted. 6·29 grs. gave of metallic platinum 5·33 =N 12·01 per cent.

Incineration (*by* J. P.).—61·01 grs. gave of ash 5·71 =9·36 per cent.

(*By* Mr. Stallard).—9·35 grs. gave of ash 0·87 =9·34 per cent. 27·96 grs. gave of ash 2·57 =9·26 per cent.

Mean of the Two Combustions.

Carbon	54·35
Hydrogen	7·57
Nitrogen	12·01
Oxygen	16·71
Ash	9·36
	100·00

5. *Of the Fæces of* Flint, *while taking 3 oz. of Fat Bacon daily in addition to his usual Animal Diet.*—These fæces contained so large

an amount of fatty matter, that it was impossible to reduce them to powder *per se*. When heated gently, they became soft, pasty, and almost of the consistence of semi-melted fat. A proximate analysis of them will be subsequently inserted.

First Combustion.—5·06 grs. gave of HO 4·22 =H 9·22 per cent.
Of CO^2 11·20 =C 60·36 per cent.

Second Combustion.—6·28 grs. gave of HO 5·25 =H 9·28.
Of CO^2 13·89 =60·32 per cent.

Incineration.—55·93 grs. gave of ash 7·40 =13·23 per cent.

Mean of the Two Combustions.

Carbon	60·34
Hydrogen	9·25
Nitrogen, Oxygen	17·18
Ash	13·23
	100·00

6. *Of the Fæces of* Flint, *a few weeks afterwards, while restricted to Animal Diet of the Lean of Meat.*—As far as practicable all fat was removed.

First Combustion.—7·06 grs. gave of HO 5·05 =H 7·95 per cent.
Of CO^2 13·72 =C 53·00 per cent.

Second Combustion.—6·62 grs. gave of HO 4·77 =H 8·00 per cent.
Of CO^2 12·93 =C 53·27 per cent.

Incineration.—16·81 grs. gave of ash 2·96 =17·60 per cent.

Mean of the Two Combustions.

Carbon	53·09
Hydrogen	7·97
Nitrogen, Oxygen	21·34
Ash	17·60
	100·00

7. *Of the Fæces of a man*, Roberts, *aged* 37 (*Diabetes*).—With the exception of a small quantity of bread, his diet was exclusively animal.

First Combustion.—4·53 grs. gave of HO 3·07 =H 7·53 per cent.
Of CO^2 7·64 =C 45·99 per cent.

Second Combustion.—5·33 grs. gave of HO 3·67 =H 7·65 per cent.
Of CO^2 8·92 =C 45·64 per cent.

Incineration.—50·84 grs. gave of ash 10·77=21·18 per cent.

Mean of the Two Combustions.

Carbon	45·81
Hydrogen	7·59
Nitrogen, Oxygen	25·42
Ash	21·18
	100·00

8. *Of the Fæces of* Roberts, *while subsisting on a mixed Diet.*—At this time also he was greatly emaciated, in consequence probably of having been obliged to work, and not having been able to procure a due proportion of animal food.

First Combustion.—5·13 grs. gave of HO 3·36 =H 7·28 per cent.
Of CO^2 8·63 =C 45·88 per cent.

Second Combustion.—4·86 grs. gave of HO 3·18 =H 7·27 per cent.
Of CO^2 8·21 =C 46·07 per cent.

Incineration.—32·31 grs. gave of ash 7·14 =22·10 per cent.

Mean of the Two Combustions.

Carbon	45·97
Hydrogen	7·27
Nitrogen, Oxygen	24·66
Ash	22·10
	100·00

9. *Of the Fæces of a young Woman affected with Icterus in a mild form, and probably depending on functional derangement of the liver.*—They were brown, and not clay-coloured, as in severe jaundice.

First Combustion.—5·59 grs. gave of HO 3·66 =H 7·27 per cent.
Of CO^2 10·54 =C 51·42 per cent.

Second Combustion.—5·12 grs. gave of HO 3·37 =H 7·31 per cent.
Of CO^2 9·69 =C 51·61 per cent.

Incineration.—28·18 grs. gave of ash 3·41 =12·10 per cent.

Mean of the Two Combustions.

Carbon	51·51
Hydrogen	7·29
Nitrogen, Oxygen	29·10
Ash	12·10
	100·00

The following tables will show at a glance the relation in composition of the various specimens of fæces of which the analytical details have been recorded above.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Carbon	46·20	49·79	43·86	54·35	60·34	53·09	45·81	45·97	51·51
Hydrogen	6·72	7·06	6·96	7·57	9·25	7·97	7·59	7·27	7·29
Nitrogen, Oxygen	30·71	28·64	29·09	28·72	17·18	21·34	25·42	24·66	29·10
Ash	16·37	14·51	20·09	9·36	13·23	17·60	21·18	22·10	12·10
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

The succeeding table will exhibit clearly the precise relation in composition of these fæces, the per-centage of each being calculated exclusive of ash.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Carbon.....	55·24	58·24	54·88	59·96	69·54	64·43	58·11	59·01	58·60
Hydrogen...	8·03	8·25	8·71	8·35	10·66	9·67	9·62	9·33	8·29
Nitrogen, Oxygen	36·73	33·51	36·41	31·69	19·80	25·90	32·27	31·66	33·11
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Proximate Analysis of the Fæces in Health (No. 1. p. 2).—A portion of the same fæces as subjected to *ultimate* analysis was employed. By desiccation over the water-bath, a light brown residuum was obtained, of which 34·45 grs. were weighed for analysis.

1. *Matter soluble in Æther.*—The fæces were treated with æther (free from alcohol) until everything soluble in that menstruum was removed, and the æther at last came off quite colourless and without any fæcal odour. The æther was distilled off, and the residuum left *in vacuo* over sulphuric acid during several days; it weighed 4·12 grs.; it had precisely the appearance of fat, and was brownish-yellow.

2. *Matter soluble in Alcohol of spec. grav.* 830°.—The matter insoluble in æther was digested with successive portions of alcohol. The solution, which was clear and brown, was evaporated over the water-bath, and afterwards *in vacuo* over sulphuric acid, during several days. The residuum weighed 4·80, and left by incineration 0·48 of saline matter; a copious smoky flame was produced, and the odour of burnt horn was evolved.

3. *Matter soluble in Water.*—The matter insoluble in æther and alcohol was treated with successive portions of water at the ordinary temperature until the water ceased to acquire any perceptible colour. A clear deep brown solution was obtained, which by evaporation to dryness left a transparent, shining, deep brown matter, having an odour somewhat like that of extract of liquorice. After drying many hours in warm air, it weighed 4·76 grs., and by incineration gave of ash 0·76 grs. During incineration it frothed up much, like the residuum of diabetic urine, and emitted the odour of burnt horn.

4. *Fixed Saline Matter.*—50·13 grs. of dry fæces gave of ash 8·21. After washing with hot distilled water, 5·82 of insoluble ash remained. Soluble salts $=8{\cdot}21-5{\cdot}82=2{\cdot}39$.

Examination of Saline Matter soluble in Water.

a. The solution slowly restored the colour of red litmus-paper.

b. A just perceptible trace of effervescence by the addition of *acetic acid* to the concentrated solution (*carbonic acid*).

c. By addition of nitrate of silver, a curdy white precipitate, insoluble in nitric acid (*chlorine*).

d. By addition of chloride of barium, a white precipitate, insoluble in dilute nitric acid (*sulphuric acid*)

e. By addition of nitrate of silver to the aqueous solution of the saline residuum (3.), a copious lemon-yellow precipitate, completely redissolved by nitric acid (*phosphoric acid*).

f. By addition of bichloride of platinum, a precipitate slowly deposited (*potash*).

g. By testing the dry salt before the blowpipe *carefully* and *com-*

paratively, very distinct yellow flame, but purplish at the origin (*soda*).

h. By evaporating, *even slightly*, the solution became milky; and by continuing the evaporation further, a *white precipitate* was produced, which was instantly dissolved by *acetic acid* without the slightest effervescence; and by the addition of oxalate of ammonia to the acid solution, turbidity was occasioned. These facts would seem to indicate the presence of *sulphate of lime*.

Saline Matter insoluble in Water.

a. Moistened red litmus-paper placed upon the salt immediately became blue (*lime?*).

b. Added acetic acid, and evaporated to dryness; to dry residuum added a small quantity of water; filtered, and to filtrate added oxalate of ammonia; after a short time a slight precipitate appeared, sufficient merely to produce milkiness, not removed by acetic acid (*lime*, in minute quantity).

c. Digested insoluble saline matter with nitric acid at a gentle heat; remained undissolved a small quantity of gritty matter, which examined by a lens was seen to consist of minute, irregular and colourless grains, like *common sand* (*silica*).

d. Filtered solution (*c.*); filtrate not perfectly bright; copious white precipitate by addition of excess of ammonia, and, with the *exception of some light gray flocculi*, redissolved by excess of acetic acid.

e. To solution (*d.*), after addition of excess of acetic acid, added oxalate of ammonia; copious white precipitate immediately (*lime*).

f. To solution (*c.*) added hydrosulphate of ammonia; blackish-green flocculent precipitate. (From reactions (*d.*) and (*f.*), *phosphate of iron?*)

g. By addition of chloride of barium and dilute nitric acid to solution (*c.*), no precipitate (*no sulphuric acid*).

h. To solution (*e.*), after standing and filtration, added ammonia in excess; copious and characteristic crystalline precipitate of phosphate of magnesia and ammonia (*magnesia*).

Analysis.

Organic matter soluble in æther	11·95
Organic matter soluble in alcohol of 830°	10·74
Organic matter soluble in water	11·61
Organic matter insoluble in these menstrua	49·33
Fixed saline matter *soluble* in water	4·76
Fixed saline matter *insoluble* in water	11·61
	100·00

The whole of the error falls, as usual in analyses of this kind, upon the insoluble organic matter. By alcohol of 830°, 1·39 per cent. of saline matter was removed; and by water, 2·20 per cent., free from chlorine, and consisting chiefly, if not entirely, of alkaline phosphates. The sum of these is 3·59; but the proportion of soluble saline matter obtained from the ash of 50·13 of fæces was 4·76. Now 4·76—3·59 =1·17, which proves either an error of that amount, or that without

incineration the soluble saline matter could not be perfectly removed, or that the two portions of fæces used in the proximate analysis and for the determination of the ash respectively, were not exactly uniform in composition.

Examination and Proximate Analysis of Flint's *Fæces* (No. 4). —The fæces were passed early in the morning, every precaution having been taken to prevent the admixture of urine. Colour, dark brown; consistence, moderate. Desiccation was effected on a large flat dish in the hot-air chamber of the sand-bath.

1. *Examination with a view to the Detection of Sugar.*—200 grs. of the powder of the dried fæces were digested with alcohol of spec. grav. 832° at a little below the boiling-point. A dark brown solution was obtained, having an odour like that of fresh gall-stones. Thin whitish layers of apparently crystalline matter appeared on the surface on cooling. By evaporation over the steam-bath was left a dark brown liquid, which had the consistence of syrup, and became when cold hard like resinous matter. This was treated with hot water and filtered. The solution passed through very slowly, yet perfectly bright; it was clear, and had a dark brown colour. It was mixed with fresh yeast, and introduced into a graduated tube over mercury, which was left in a warm place till the following morning, when no gas was evolved. The precaution was taken to place by the side of the tube another tube, containing a portion of the same yeast mixed with water. In the last case only a very minute quantity of gas was disengaged. Now, to ascertain whether there might be present any substance derived from the fæces capable of retarding or preventing the action of yeast upon sugar, a minute fragment of cane-sugar was introduced through the mercury, and the apparatus was again put in a warm place. Fermentation speedily followed, as proved by the accumulation of gas at the top of the tube. Hence it may be concluded that sugar did not exist in these fæces.

2. *Examination in respect to Fatty Matter.*—200 grs. of the dried fæces were treated with a fluid ounce of boiling æther and filtered. Filtration proceeded slowly. By spontaneous evaporation, a light yellowish-green fatty matter was obtained, having a strong biliary odour, or at least the odour of gall-stones.

The residuum of the alcoholic extract insoluble in water (1.) was treated with warm æther. The ætherial solution was decanted and evaporated. The residuum was digested with a hot solution of potash, in order to dissolve out any resinous or fatty matter from cholesterine which might be present. By the action of the potash was obtained a tenacious mucus-like mass. This was washed with cold water, and then carefully pressed between linen in bibulous paper by the screw-press. Only a very small quantity of matter remained adherent to the linen, so that sufficient could not be detached for accurate examination. The piece of linen itself was then digested in hot æther, and the ætherial solution, which was colourless and exhaled a somewhat biliary odour, decanted into a glass capsule. By evaporation was left a white fat-like matter, which, examined carefully under the microscope, presented no trace of crystallization.

3. *Examination of the Ash.*—A portion of the fæces which had been well treated with alcohol was incinerated. The odour of burnt horn was evolved. The residuum was a mixture of white and red particles, and the intensity of the red colour excited some surprise. It was treated with water, which only partially dissolved it.

Aqueous Solution.

a. Immediately restored the colour of red litmus-paper.

b. No effervescence on the addition of hydrochloric acid (no *carbonic acid*).

c. Yellowish precipitate by addition of nitrate of silver, entirely redissolved by nitric acid (*phosphoric acid*).

d. As the extract which had been well treated by alcohol was employed for incineration, the chlorides must have been removed.

Solution by Nitric Acid of Matter insoluble in Water.—Precipitate with chloride of barium, partially redissolved by nitric acid (*sulphuric* and *phosphoric acids*).

The examination was not further proceeded with.

Re-examination of the fixed Saline Matter of these Fæces.—After again drying during several hours between 100° and 110° Cent., 61·01 grs. were weighed. As the fæces always emitted during the drying a strong odour, as the same quantity had been dried several times, and as some matter had evidently condensed upon the inner surface of the small copper drying-oven, it is to be expected that the per-centage of ash would be somewhat greater in this determination than in the preceding one. Accordingly it will be seen that there was a difference of excess, although very slight. By incineration fœtid gas was copiously evolved, and burned with a smoky flame, like that produced by the combustion of tallow; and at first some brownish oily matter condensed around the edge of the platinum crucible. The ash, which had a light brown colour, weighed 5·71 =9·36 per cent. Stallard obtained 9·26 and 9·35. The platinum crucible was slightly attacked. The ash was washed with hot water until the wash-water ceased to be affected by nitrate of silver. The salts *soluble* in water, as determined by loss, amounted to 2·59; the salts *insoluble* to 3·12; or, salts soluble in water, 45·35 per cent.; and insoluble, 54·65.

(*By* Stallard).—3·37 grs., washed with boiling water until wash-water ceased to be affected by nitrate of silver, gave of saline matter soluble in water, 1·51, of which alcohol of 830° spec. grav. removed 0·26; and of insoluble, 1·86. Or, salts soluble in water, 44·80 per cent.; and insoluble, 55·20. Of the former, 7·71 were soluble in alcohol of 830°, and 37·09 insoluble.

Examination of the Aqueous Solution of the Soluble Salts.

a. By reducing the volume of the solution by evaporation, a few white flocculi separated, which would probably have been inappreciable by the balance.

b. By addition of acetate of baryta, a very copious white precipitate was produced, which was in great measure redissolved by addition of a few drops of nitric acid. The usual analytical precautions having been observed, 0·31 of sulphate of baryta was obtained.

c. To solution (*b.*), after separation of sulphate of baryta, nitrate

of silver with nitric acid were added; 0·69 of chloride of silver was obtained.

Saline Matter insoluble in Water.

a. It was moistened with water, and then nitric acid was added. There was slight effervescence. It was digested, filtered, and washed with water containing nitric acid. The solution was evaporated to dryness, and heated to redness. Orange fumes were evolved. The residuum had a pale brown colour, and weighed 2·58. The insoluble matter left upon the filter, as determined by incineration, weighed 0·29. 2·58+0·29=2·87. But, 3·12 (the amount of insoluble saline matter given before) −2·87=0·25 difference.

b. The residuum (*a.*), obtained by evaporation of the acid solution and subsequent heating to bright redness, was broken up and treated with a small quantity of water; red litmus-paper was instantly turned blue by this solution.

c. It was digested with acetic acid, and evaporated to dryness at a gentle heat. This product was washed with boiling water on a very small filter, and the solution evaporated to dryness, during which the residuum was accidentally carbonized. It was then heated to redness, when the odour of a burning acetate was evolved. Finding that the carbon could not readily be removed by incineration, a few drops of nitric acid were added, which occasioned effervescence. The whole was evaporated to dryness, and again heated to redness, when there remained a perfectly white product. This was heated with sulphuric acid in excess, evaporated to dryness, and heated to redness. The residuum weighed 1·78 gr. It was treated with acetic acid, and to the filtered solution oxalate of ammonia was added, when a white precipitate was immediately produced.

d. To residuum (*c.*), insoluble in acetic acid, hydrochloric acid was added, which readily dissolved it, forming a yellowish solution, like dilute sesquichloride of iron. This solution was treated with excess of ammonia, which occasioned a copious white precipitate. This was redissolved by an excess of acetic acid, with the exception of some grayish flocculent matter, which on standing subsided. The whole was then boiled, but still this insoluble matter remained. The solution was filtered. When dry, the substance upon the filter had a pale brown tinge. It was dissolved in dilute nitric acid; ammonia added in excess to this solution precipitated gray flocculi, which became deep greenish-black by the addition of hydrosulphate of ammonia. Some of the acid solution was tested with chloride of barium, but no trace of sulphuric acid was found. It may be inferred that the flocculent matter insoluble in acetic acid was *phosphate of sesquioxide of iron.* A precipitate, having precisely the same appearance and giving similar reactions, was obtained by mixing dilute solutions of sesquichloride of iron and common phosphate of soda.

e. To the acetic acid solution (*d.*) oxalate of ammonia was added, which immediately produced a copious white precipitate (*lime*).

f. The solution (*e.*) was allowed to stand some time after addition of oxalate of ammonia, and then filtered. To the filtrate ammonia in excess was added, when the characteristic precipitate of phosphate of magnesia and ammonia shortly appeared. On the addition of

hydrosulphate of ammonia only the slightest brown tinge was produced.

Proximate Analysis of the same Specimen of Flint's *Fæces as used in the foregoing Experiments.*—After drying as before, 15·63 grs. were weighed.

1. *Matter soluble in pure Æther.*—A pale brown solution was obtained, having a strong feculent odour, somewhat resembling that of hot strong solution of common glue. At first the matter was simply macerated with cold æther in a stoppered bottle; the whole was frequently shaken, and the æther allowed each time before decanting the supernatant solution to remain in contact with the fæces many hours. This treatment was repeated five times with æther, and twice of the five times under slight pressure, until at last the æther came off having only a very slight odour and a just perceptible tint. Each time the ætherial solution was passed through a filter. The æther was evaporated, and the residuum exposed *in vacuo* to sulphuric acid during many hours. The evaporation of ætherial solutions of this kind requires considerable care to avoid loss by the solution escaping over the sides of the vessel. A minute quantity of fatty matter was so lost in this analysis. The residuum weighed 3·44.

Examination of this Residuum.—It was digested with a solution of potash during many hours on the sand-bath at a very gentle heat. A clear pale brown solution was obtained, with some colourless flocculent matter floating in it; it had only a feeble odour, much like that of caustic ley alone. Hydrochloric acid in excess was added, when copious, pale yellowish-gray, curdy flocculi separated; and again immediately the true biliary or fæcal odour was perceived, though it was not strong. The solution was filtered. The filtrate had only an extremely faint straw tinge, and did not evolve a *very distinct* fæcal odour. The residue on the filter was washed with a small quantity of cold water, the filter pressed slightly between bibulous paper; the pale yellowish-brown mass thus obtained was transferred to a capsule, and hot water poured upon it, when it immediately melted, and appeared on the surface of the water as a dark brown oil, exhaling only a feeble odour even while melted. A small quantity of this fat, heated in a test-tube over a spirit-lamp, evolved offensive products, apparently similar to those produced by fats in general when so treated. The filter containing the light flocculent matter, insoluble in solution of potash as above mentioned, was washed with water, the filter pressed between bibulous paper, and boiled with adherent matter in æther; the ætherial solution by spontaneous evaporation yielded a minute quantity of white matter, in which however under the microscope I was unable to detect any distinct appearance of crystallization.

2. *Matter soluble in Alcohol of* 820°.—Residue (1.), insoluble in æther, was digested several times with alcohol at a gentle heat. The solution at first had a deep brown colour. The treatment with alcohol was continued until the latter came off with the slightest perceptible colour. By evaporation a deep brown matter was obtained, exhaling a slightly fæcal or biliary odour. It was dried in the water-bath during many hours.

The residuum of organic matter, as determined by loss from incineration, weighed 1·74.

3. *Matter soluble in Water.*—I proceeded precisely as in the former analysis. A bright deep brown solution was obtained, which, by evaporation and subsequent drying during many hours, gave a deep brown brittle extract, weighing 1·88. The treatment with successive portions of water was continued until the water passed through the filter colourless. By incineration the extract evolved the odour of burnt horn, and gave of saline matter 0·54. The organic matter therefore is 1·88—0·54=1·34.

Analysis.

Organic matter soluble in æther		22·00
Organic matter soluble in alcohol		11·13
Organic matter soluble in water		8·57
Organic matter insoluble in these menstrua		48·95
Saline matter soluble in water, and containing—		
Chlorine	0·27	
Sulphuric acid	0·23	4·24
Phosphoric acid and Alkaline bases	3·74	
Saline matter insoluble in water, but soluble by the addition of nitric acid		4·64
Matter insoluble in nitric acid		0·47
		100·00

Examination of Flint's *Fæces in respect to Fatty Matter, while he was taking 3 oz. of Bacon daily.*—A portion of the same fæces as used in the ultimate analysis No. 5 was employed. 39·92 grs., treated with æther in the usual way, gave of fatty matter 20·58 =51·55 per cent. The residuum, after evaporation of the æther, was dried *in vacuo* over sulphuric acid. In this determination there was a slight *error of loss*, owing to the great difficulty in filtering the ætherial solution, which contained minute particles in suspension.

Examination of the child Stubbs' *Fæces, No. 3 of the table.*

Matter soluble in pure Æther.—I proceeded precisely as in the former analyses, continuing to treat with æther until it came off without the slightest colour or odour. 76·58 grs. gave of fatty matter 12·38=16·16 per cent. This fat seemed to consist of not less than two fatty bodies, one more liquid than the other at the ordinary temperature. I made three ultimate analyses of it, but the results varied considerably, and I was almost disposed to infer that the variation was in some measure owing to the want of uniformity of composition even in two or three portions taken consecutively from the same quantity, for on careful inspection it appeared to consist of irregular grains mixed with a brown oil. I give the results of the analysis in which I obtained the largest per-centage of carbon and hydrogen, as being probably the nearest approximation to the truth. Chromate of lead was used as the oxidizing body. 3·396 grs. gave of HO, 4·00=H 13·07 per cent.; of CO^2, 10·14 =C 81·42. If nitrogen were absent, the composition would be as follows:—

Carbon	81·42
Hydrogen	13·07
Oxygen	5·51
	100·00

This fat therefore in composition approximates to cholesterine, but much more nearly to a crystalline product obtained from the brain, and analysed by Dr. R. D. Thomson (Liebig, Tr. de Chim. Org., vol. iii. p. 318), whose analysis I insert for the sake of comparison :—

	Product of the brain, by Dr. Thomson.		Fat of the fæces, by J. P.
Carbon	81·9	81·51	81·42
Hydrogen	13·3	12·02	13·07
Oxygen	4·8	6·47	5·51
	100·0	100·00	100·00

Examination of Fixed Saline Matter of Stubbs' *Fæces.*—30·76 grs. of fæces gave of saline matter *soluble* in water, 0·74=2·41 per cent.; of *insoluble*, 5·44=17·68 per cent.

Saline Matter soluble in Water.

a. It slowly turned red litmus-paper blue.

b. By chloride of barium, a minute quantity of white precipitate, partially redissolved by nitric acid (*sulphuric and phosphoric acids*).

c. By nitrate of silver and nitric acid, slight milkiness. I was particularly struck with the small quantity of *chlorine* present.

d. By evaporation, small, distinct, prismatic crystals were obtained (*sulphate of lime?*).

e. By addition of bichloride of platinum to solution (*d.*) concentrated by evaporation, a tolerably abundant yellow granular precipitate (*potash*).

f. A little of the dry saline matter was tested before the blowpipe on platinum wire, with the precaution of making comparative trials with the wire alone and with phosphate of soda; but I did not satisfactorily detect soda in this instance. The pinkish tint at the origin of the flame, indicative of potash, was distinct, although I thought the end of the flame was slightly more yellow with the salt than with the wire alone.

g. By addition of nitrate of silver to the concentrated solution, instantly a curdy lemon-yellow precipitate (*phosphoric acid*).

h. A minute quantity of the white matter (*d.*) did not redissolve in water, but instantly dissolved by addition of acetic acid without effervescence; however, the quantity operated upon was very minute. By addition of oxalate of ammonia to the acid solution, instant turbidity, followed by a distinct precipitate.

Of the per-centage of Fat (*matter dissolved by pure æther*) *in the Organic Constituents of the Fæces of the Man in Health, of the child* Stubbs *and of* Flint, *or Numbers* 1, 3, 4 *and* 5 *respectively.*

No. 1.	14·28 per cent.
No. 3.	20·22 ...
No. 4.	24·27 ...

Concluding Observations.

The preceding investigation I admit to be very incomplete; but not having the intention of prosecuting the inquiry further, I have preferred publishing the results in their present state to withholding them altogether, as it is probable that some of them may not be uninteresting to chemists engaged in the study of animal chemistry. The nature and limits of the 'Chemical Gazette' forbid that I should enter upon any physiological or pathological discussion; so that in these concluding remarks I shall confine myself as much as possible to the strict chemistry of the subject.

1. As I have already stated, it is worthy of remark that the ultimate composition of the fæces would seem to be more uniform, even under different conditions of diet and exercise, than might have been anticipated. In proof of this I have alleged the close agreement between Dr. Playfair's analysis of the fæces of a soldier at Giessen and that which I have given of the fæces of a young man in this country. Besides, the ratio of the fixed saline matter of the fæces soluble in water to that which is insoluble in water, as given by Weber in H. Rose's paper "On the Inorganic Constituents of Organic Bodies" (Phil. Mag. vol. xxxv. p. 275), is nearly the same as that which I found. Thus, according to Weber, 100 parts contain of soluble matter 30·63, and of insoluble 69·37. The proportions which I have given in the proximate analysis of the fæces in health are 4·76 of soluble matter and 11·61 of insoluble, or 29·07 per cent. of the former and 70·93 of the latter.

2. *Of the Constituents of the Inorganic Matter of the Fæces in Health.*—The matter soluble in water contained carbonic acid, chlorine, sulphuric acid, tribasic phosphoric acid (*c*-modification, Rose), potash, soda and lime.

The matter insoluble in water contained phosphoric acid, lime, magnesia, iron, and silica as sand.

These results correspond, so far as they go, to those of Weber cited above.

3. *Of the presence of Sugar in the Fæces in Diabetes mellitus.*—M'Gregor states that sugar is "readily discoverable in the stools of diabetic patients;" but he appears to have founded that statement upon a single observation, and to have decided upon the presence of sugar from the gradual formation of crystals upon the surface of the fæces during spontaneous desiccation. He had taken the precaution of avoiding the presence of urine in the vessel which received the fæces. (Med. Gaz. vol. xx. p. 272.)

Now it is hardly necessary to remark, that this single observation is quite insufficient to establish the general fact of the presence of sugar in diabetic fæces; but possibly even in the particular instance mentioned the observation may not be altogether decisive; for it is not impossible that M'Gregor, unless he had availed himself of other sources of proof, may have mistaken the crystals of phosphate of magnesia and ammonia, which are known to occur in fæces, for those of grape-sugar. (*Vide* Simon's Anim. Chem., Day's Trans., vol. ii. p. 366; Donné, Cours de Microscope, p. 484; Berzelius, Tr. de Chim., vol. vii. p. 269. Paris, 1833.)

In the only instance in which I sought for sugar in diabetic fæces I failed to detect it. Against that result the objection may be urged that sugar may have been present in the fæces at the time of their evacuation, and have been subsequently destroyed, or otherwise changed, by the process of desiccation. However, it does not seem probable that such destruction or change should occur under the circumstances. I would not propose to infer from this single observation the general *negative* fact of the absence of sugar from diabetic fæces, any more than I would the general *positive* one of its presence in these fæces from the single instance of M'Gregor.

Simon searched for sugar in the fæces of a male diabetic patient, but without success. (Day's Trans., vol. ii. p. 377.)

From the preceding data, it may be concluded that the question of the *presence* or *non-existence* of sugar in diabetic fæces as a general fact remains undecided. Probably the truth will be found to be, that sugar may be present or not in the fæces in this disease according to circumstances. Thus, for example, if diarrhœa occur, and the urine be decreased in consequence, as I have known to be the case, it seems not unreasonable to suppose that some saccharine matter may be diverted from the kidneys, and pass off by the intestinal canal.

4. *Of the Composition of the Fæces in Diabetes mellitus.*—Simon has given a proximate analysis of the fæces of a male diabetic patient, whose daily ingesta consisted of 8 oz. of dry gluten bread, 11½ oz. dry meat, 2 oz. dry egg and 2 oz. cod liver oil. (Day's Trans., vol. ii. p. 377.) Now, while this analysis differs in some points from that which I have given, it agrees in one point, namely, the large proportion of fat, which amounted even to 34 per cent. In the case of Flint, it will be remembered the proportion of fat amounted to 59 per cent. of the organic matter, while he was taking about 3 oz. of fat bacon daily; at another time to 24 per cent.; and even in the case of the child Stubbs to 20 per cent.; while in the fæces of the healthy man it did not exceed 14 per cent. of the organic matter. If we take the proportion of hydrogen as a tolerably correct measure of the proportion of fatty matter, we shall find that the proportion of fatty matter is in every specimen of diabetic fæces, with the exception of No. 3, sensibly greater than in the fæces of health under very different circumstances of diet, and greater also than in No. 9, the fæces of the girl affected with jaundice. However, further observations are required to enable us to arrive at a satisfactory general conclusion on this subject.

Lehmann maintains that the "fæces of diabetic patients frequently yield a mere trace of nitrogen." (Note in Day's Trans., vol. ii. p. 377.) This is opposed to the results of Simon and myself. The odour evolved on incineration of diabetic fæces, so far as my observation has extended, has of itself uniformly afforded unequivocal proof that nitrogen is by no means deficient in these fæces. In one analysis the proportion of nitrogen amounted to 12 per cent.

With regard to the fixed saline matter of the fæces in Diabetes mellitus, a more extended and precise investigation is required to enable us to arrive at satisfactory conclusions upon the subject.