XIX. *On the Immediate Principles of Human Excrements in the Healthy State.*

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Communicated by H. Bence Jones, *M.D., F.R.S.*

Received February 23,—Read March 12, 1857.

In June 1854 I had the honour of communicating to the Royal Society an account of some investigations I had undertaken respecting the composition of the excrements of man and animals; since that time I have continued my researches on human excrements, and obtained further results which form the subject of the present paper. I have been most ably seconded in this work by my assistant, Mr. Frederick Dupré, Ph.D., and have derived much valuable aid from his thorough knowledge of chemical and physical science.

The method of investigation employed in this instance is similar to that which had been adopted on the former occasion; alcohol and ether were again the principal means employed for conducting the analysis, chemical decompositions being thereby avoided and the constituents of excrements consequently obtained under the form of *Immediate Principles.* It will also be observed that in this case, for the purpose of extracting excretine, the alcoholic solution of excrements was in many instances not mixed with milk of lime, which simplified materially the operations and increased the interest of the investigation.

The results obtained are as follows:—

1. *Margarate of lime*, *phosphate of lime*, and *margarate of magnesia* were discovered to be three immediate principles of human evacuations.

2. I found a new and simple method for obtaining excretine, and its chemical formula has been established.

3. The fact that vegetable food increases the presence of margaric acid in excrements has been confirmed.

4. The existence of a comparatively large quantity of *cholesterine* in the spleen, which I had mentioned as probable, has been confirmed [*].

When healthy human evacuations are exhausted with boiling alcohol an extract is obtained, which, on cooling, leaves a deposit. This deposit was examined as follows:— The dark alcoholic solution being decanted, the residue was thrown upon a filter and washed thoroughly, first with cold and then with boiling alcohol. The boiling alcoholic solution, on cooling, yielded more or less of a peculiar substance, in the form of a light granular precipitate, which has been alluded to in my previous communication. The

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[*] I introduce here this result, having alluded to the subject in my previous communication.

substance insoluble in boiling alcohol and remaining on the filter was now submitted to examination; the original alcoholic extract having filtered nearly quite clear through the calico, it was evident that this deposit could consist but in small quantity of insoluble substances, which might have found their way through the meshes of the cloth. The deposit, removed from the filter into a capsule, was boiled with a solution of caustic potash, when the greatest part of it dissolved; an attempt to filter the fluid having failed, I decomposed the alkaline solution with hydrochloric acid, which induced the formation of a precipitate. The precipitate, collected on a filter, was washed with water until the washings ceased to exhibit an acid reaction and induce a cloudiness in a solution of nitrate of silver. Boiling alcohol and ether dissolved the substance on the filter, it crystallized on cooling from its solution in alcohol, and by spontaneous evaporation from its solution in ether; by means of repeated crystallizations in a mixture of alcohol and ether, the substance in question was obtained perfectly colourless and pure. When heated on a platina spatula, it fused and then burnt with a flame; a carbonaceous residue was left, which, on the further application of heat, disappeared completely, leaving no ashes on the spatula. When viewed with the microscope, the crystals had the peculiar stellate structure of margaric acid; the substance, when fused and allowed to cool, assumed a crystallized nature; it was found to fuse at 60° Centigrade. The above characters are those of *margaric acid*[*], so that this fatty acid is constantly present in healthy human evacuations[†].

It was now of much importance to ascertain in which form the margaric acid found in the above circumstances existed as a constituent of human fæces, or in other words, to determine the Immediate Principle containing the fatty acid in question; but previous to entering on this subject, I beg to relate an experiment instituted for the purpose of detecting the best method to be employed to prepare the alcoholic extract of excrements. It was noticed that the quantity of the deposit yielded by the extract, on cooling, varied according to the manipulations adopted to prepare the solution; consequently a healthy and fresh evacuation was triturated in a mortar, in order that every part of it should be equally moistened, and the mass was divided into three quantities, weighing each 60 grammes. Each portion was boiled four times successively with two ounces of alcohol; the first part being treated with alcohol in an open tin capsule and strained through a clean laboratory towel, the second being boiled in a long-necked flask and strained through the same towel, and the third being treated in a similar flask and strained through muslin folded in two. The fluid passed very freely through the muslin, and there appeared to be a greater deposit on cooling in the alcoholic extract of the third portion than in that of the two others; about two hours afterwards the alcoholic extracts were filtered separately through filtering-paper, and a clear dark-coloured solu-

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[*] Notwithstanding the fusing-point and crystalline structure of this fatty acid, it might have been mixed with a small proportion of stearic acid and traces of oleic acid. Stearic and margaric acid have the same chemical properties.

[†] I had shown in my previous communication that margaric acid was occasionally present in fæces.

tion was thus obtained. The residue left on the three filters, after being washed with cold alcohol and subsequently removed to capsules with the platina knife, was boiled in alcohol, the fluid being afterwards rapidly strained through calico. On cooling, a very small quantity of deposit occurred in the solutions No. 1 and No. 2; solution No. 3 yielded rather more: the fluids were subsequently evaporated to dryness and the residue boiled in a little alcohol, when, on cooling, an increase of the deposit occurred; No. 3 yielded decidedly more than No. 1 and No. 2. Having proceeded so far with the experiment, it was necessary to examine the part of the original deposit insoluble in boiling alcohol. The three quantities were boiled separately in a solution of caustic potash till they were nearly dissolved, and then an excess of hydrochloric acid was added. There occurred immediately an abundant precipitate; when the fluid had become cold, the precipitate was collected on a filter and thoroughly washed with water. Each filter being dried, first by a temperature not exceeding 55° C., then under the air-pump, over sulphuric acid, they were next treated separately with ether until no more was dissolved; by spontaneous evaporation the ethereal solution deposited a crystalline substance*, which was washed with water, again collected on a filter, and dissolved in ether; the operation being repeated a third time for No. 1, No. 2, and No. 3, the solutions were finally evaporated to dryness, and each residue was dried and weighed: in the three cases the substance was colourless, or nearly so.

The weight of the fatty acid was in

No. 1	0·047 gramme.
No. 2	0·056 „
No. 3	0·083 „

From these experiments I conclude that the amount of margaric acid derived from the original deposit varies according to the mode of manipulation, and that the maximum quantity is obtained by preparing the alcoholic extract in a glass flask, and straining it through muslin; in which case little of the alcohol is lost by evaporation, and the fluid has not time to cool previously to its being strained.

It is evident that the fatty acid contained in the deposit yielded by the alcoholic extract of excrements on cooling, did not occur therein as a free substance, for if in the free state, it must have been dissolved by the boiling alcohol and ether washings. For the purpose of determining with which substance it was combined, the acid filtrate from the deposit, after it had been decomposed by potash and hydrochloric acid, was submitted to a qualitative and quantitative analysis; the ashes from the burnt deposit were also analysed. The inorganic substances present were found to be *phosphoric acid* and *lime*, and in such a proportion, as will be seen from the result of the quantitative analysis, that there was more lime than required to combine with the phosphoric acid, the excess of this substance being just in the proportion necessary to convert the

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* In that operation the ethereal solution was exposed to the air long enough to ensure the crystallization of the whole of the fatty acid.

margaric acid into a neutral margarate of lime. The quantitative analysis of the deposit was effected by boiling it with potash, and decomposing the soap by means of hydrochloric acid, for the purpose of precipitating the margaric acid. The whole being thrown on a filter, the precipitate was washed until the washings had ceased to exhibit an acid reaction and produce a cloudiness in a solution of nitrate of silver; the fatty acid was dried on filtering-paper, and finally dissolved in ether; the ethereal extract being evaporated to dryness in a weighed beaker, the weight of the residue could be easily ascertained. The phosphoric acid and lime were determined in the filtrate from the margaric acid precipitate, the phosphoric acid with perchloride of iron and sulphate of magnesia, and the lime with oxalic acid. The following Table shows the result of the analysis, together with the quantity of margaric acid necessary to combine with the amount of lime, exceeding that which could possibly have been combined originally with the phosphoric acid: these numbers were obtained by calculation, according to the formula for the neutral margarates,—

$$C_{34}H_{33}O_3+MO.$$

	Found.			Calculated.
	Lime.	Phosphoric acid.	Margaric acid.	Margaric acid.
1.	0·0021	0·015	0·083	0·074
2.	0·040	0·031	0·230	0·112
3.	0·058	0·042*	0·205	0·196
4.	0·031	0·023*	0·100	0·102

These results show that the lime, phosphoric acid and margaric acid found in the deposit under examination, existed as phosphate of lime and margarate of lime, and consequently assumed this form in excrements[†].

From the difficulty of extracting fatty acids perfectly pure and colourless, without experiencing more or less loss of substance, when they are mixed up with animal colouring-matters and other impurities, it is next to impossible to obtain mathematically exact results in such analysis. In analyses No. 1 and No. 3, the quantities of margaric acid found were slightly above the proportion determined by calculation, which resulted from the presence of impurities; these could not have been removed without the loss of more or less of the acid. In analysis No. 2 the margaric acid was highly coloured and impure, which accounts for its proportion being considerably above what it ought to have been. In analysis No. 4, the margaric acid obtained being comparatively pure, the result was very conclusive.

The alcoholic extract of excrements filtered from the deposit just described, four or

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[*] In analyses 3 and 4, the quantity of phosphoric acid was obtained by calculation.

[†] It is very remarkable that these salts should have dissolved in the boiling alcoholic extract of fæces, and lost their property of dissolving in boiling alcohol, after having been collected on a filter; which circumstance is probably owing to the acid reaction of the alcoholic extract. The same observation applies to the margarate of magnesia.

five hours after the extract had been prepared, yielded a dark-coloured fluid. When this solution was allowed to stand undisturbed in a flask for twenty-four hours, another substance subsided and collected at the bottom of the flask; a cold night favouring in a remarkable degree the formation of this second deposit. After decanting the clear fluid and filtering the residue, a nearly white and amorphous substance remained on the filter; boiling alcohol and ether removed from it every trace of colouring matter or other impurities, the deposit being insoluble in these fluids. A sample of the substance being burnt on the platina knife, it ignited, charred, and finally left a residue of white ashes, whilst in the case of the first deposit it was found impossible, even with the blowpipe, to obtain the ashes otherwise than dark coloured. The inorganic residue submitted to analysis, proved to consist entirely of *magnesia*[*]: in order to determine the nature of the organic substance, combined with magnesia, the compound was boiled with potash, when after a short time it dissolved, leaving in the fluid but a light precipitate; the addition of hydrochloric acid to the mixture induced the separation of a white solid substance, which floated on the liquid; this substance was collected on a filter, thoroughly washed with water, and then dissolved in a little boiling alcohol, when on cooling it solidified, assuming the crystallized form peculiar to margaric acid; its fusing-point was found to be 56° C., and on cooling, the fused mass again crystallized; in short, there could be no doubt that this substance was *margaric acid*; the deposit under examination being nearly colourless, I had no difficulty in obtaining the fatty acid in a perfectly white and pure condition. Though a qualitative analysis of the deposit showed that it contained no other substance than margaric acid and magnesia, still it was important to determine if they were present in such proportion as to form the neutral margarate of magnesia,—

$$C_{34}H_{33}O_3+MgO.$$

For this purpose, a sample of the deposit, purified by repeated washings with boiling alcohol and ether, was dried in the water-bath until it ceased to lose weight; it was then ascertained to weigh 0·088 gramme; after it had been burnt in a platina capsule, the weight of ashes left amounted to 0·007; the result of the analysis may be given as follows:—

On 0·088 gramme.

	Found.	Calculated according to formula.
Margaric acid	0·081	0·081
Magnesia	0·007	0·007
	0·088	0·088

which shows that the compound can be no other than *margarate of magnesia.*

In my previous communication I stated that I had noticed an increase of margaric

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[*] The carbonate of magnesia resulting from the incineration of a compound of this substance with an organic acid, had been decomposed by the blowpipe flame, with the evolution of carbonic acid.

acid in fæces after a vegetable diet, a fact previously ascertained by LEHMAN from microscopical examination. It was now important to determine, by actual experiment, whether a purely vegetable diet would, according to my former method of investigation, determine the presence of an excess of margaric acid in the precipitate obtained by mixing the alcoholic extract of fæces with milk of lime. I consequently submitted myself to a vegetable diet, consisting of bread, potatoes, water-cresses, salad, other green vegetables, wine, beer and tea; vegetable soup was prepared for me without meat, gravy, or butter; I avoided milk, eggs, &c. Having confined myself exclusively to this vegetable diet for four days, I examined the second evacuation passed since the beginning of the experiment; the lime precipitate in the clear alcohol extract was collected on a filter, and dissolved in hydrochloric acid; not only did the substance insoluble in hydrochloric acid yield margaric acid, but it contained at least two or three times as much of this substance as I had ever obtained by the method in question. I was prevented from continuing the investigation from its injurious effects upon my health, but this experiment sufficed to show the influence of a vegetable diet upon excrements.

I now beg to give an account of some further investigations into the nature and composition of the substance which I proposed to call *Excretine.*

This constituent of human fæces I first obtained by adding milk of lime to the alcoholic extract of fæces, collecting on a filter the precipitate thus obtained, and subsequently treating it with ether, when the solution yielded by spontaneous evaporation very impure crystals of excretine, which were purified by repeated crystallizations. This method unfortunately yielded so small a quantity of the substance in question that I failed to collect enough to determine its chemical composition; it was therefore found necessary to postpone this investigation. Until the month of December 1855, my endeavours to extract excretine by a more satisfactory process had failed, when on coming to my laboratory one morning after a very cold night, on which occasion the temperature of the atmosphere had fallen several degrees under the freezing-point, I observed that an alcoholic extract of fæces prepared the day before, and left in an open beaker, had lost its fluid nature and assumed a thick or gelatinous consistence; a sample of the mass submitted to the microscope was discovered to be full of slender silky crystals, which proved by further examination to consist of excretine; the thick nature of the fluid was owing entirely to the presence of these crystals. It became therefore evident that the easiest way of extracting the Immediate Principle in question was by reducing the temperature of the alcoholic extract of fæces; and I took advantage of the cold nights of last winter to prepare a quantity of this interesting substance*.

The first crop of crystals being collected on a filter, the alcoholic filtrate yielded a second quantity on the same day or next morning; in very cold weather sometimes even

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* Having failed to obtain excretine by means of artificial cold, I could not prepare enough of it last winter to complete its analysis; the cold weather of this season has lasted such a short time that it was necessary to adopt a modification of the first method; and thus I was compelled to delay communicating my results, for which circumstance I beg to offer my sincere apologies.

a third crop of excretine could be obtained; but as soon as the thermometer rose above the freezing-point, the alcoholic extract ceased to deposit crystals, and those which had formed were rapidly dissolved. It was also observed that the crystallization occurred more rapidly when the alcoholic solution was left in an open vessel; which is accounted for by the circumstance that the evaporation of the alcohol increased the proportion of water in the alcoholic fluid, and consequently the excretine acquired a favourable condition for assuming the solid form; the cold temperature moreover reduced its solubility in alcohol, and it was therefore induced to crystallize. The amount of crystallized excretine was apparently proportional to the intensity of the cold. Each crop of crystals was collected upon the same filter, and allowed afterwards to become comparatively dry by exposure to air in the funnel. The filter was next washed with ether or boiling alcohol, which dissolved out the whole of the crystals, and the solution by standing for a night yielded an abundant crop of nearly pure excretine; more or less of the impurities which had precipitated with the excretine were left on the filter, being insoluble in ether or in boiling alcohol. For the purpose of obtaining excretine in a perfectly pure and colourless condition, the impure substance resulting from the spontaneous evaporation of the ether solution, or from the exposure of the alcoholic extract to cold, was separated from its mother-liquor (the latter being decanted), then washed in a capsule with a little cold alcohol, which dissolved the colouring matter and a very small proportion of excretine; the cold coloured alcohol was decanted, and after repeating this operation four or five times, and collecting the washings, the excretine was dissolved in a little hot alcohol; on cooling, it was obtained colourless and beautifully crystallized; if the crystals were not yet pure, the above operation was repeated. The washings yielded another crop of crystals, which were purified by the same process; and the operation was repeated on the successive series of washings until the coloured alcoholic solution contained but very little excretine; by this method much less of the substance was lost than by repeated crystallizations in ether, and drying the impure crystals on filtering-paper.

In order to submit this new substance to analysis, it was necessary to prepare it on a large scale, and the cold weather not lasting long enough for the purpose of allowing me to extract it in sufficient quantity, I was obliged to adopt the following method, which is a modification of that described in my first paper. The clear alcoholic extract of eight or nine evacuations was mixed with lime-water and then filtered. I washed the precipitate with water, and then dried it perfectly on a water-bath; this substance being transferred to a flask, was now agitated with a mixture of alcohol and ether, and filtered after having stood for some hours. The residue left on the filter was washed with ether, dried in the open air, or in a retort (with the view of recovering the alcohol and ether), and again treated with a mixture of alcohol and ether. The solutions were but little coloured, and after twenty-four hours yielded a beautiful crop of excretine. The mother-liquor, separated by filtration or decantation, deposited some hours afterwards a second crop of crystals. The substance was purified by repeated solutions in alcohol and ether, subsequently filtered, if necessary, through animal charcoal. This method is attended with no difficulty, and enabled me to obtain at once from nine evacuations, as much as 0·815, or not quite one gramme of excretine; its only objection is the expense resulting from the unavoidable use of large quantities of alcohol and ether. It is very troublesome, and I may say next to impossible, to wash the lime precipitate to such an extent as to remove from it every trace of excretine, and consequently the above number must be far short of the real proportion of the substance contained in nine evacuations: I am at present engaged with investigations respecting this subject.

Among the properties of excretine there is one on which I shall add a few words, as it appears to me possessed of especial interest. This immediate principle of human fæces is not subject to spontaneous decomposition, even when freely exposed to the atmosphere, and its presence can be detected in excrements long after they have been voided, a property which might be serviceable in a medico-legal point of view. Moreover, although I have not yet been able to find out a test for the purpose of showing the presence of excretine in complex mixtures, still the method for obtaining it, which consists in the addition of milk of lime to the alcoholic extracts of fæces, will suffice to show the presence of very minute quantities of this organic substance even in mixtures of the most complex description. Thus I had no difficulty in obtaining a sample of pure excretine from the contents of my laboratory water-closet, consisting of fæces, urine, paper, dust and other filth. Between two or three gallons of the above nearly fluid mixture were evaporated to dryness in a water-bath, and the dry residue was exhausted with boiling alcohol in the usual way. A small quantity of excretine was deposited in the alcoholic extract on cooling; but on adding lime-water to the solution, collecting upon a filter the precipitate thus induced, drying it and washing it with ether, a comparatively large amount of excretine was obtained.

Having prepared a sufficient quantity of colourless and pure excretine, partly by the action of cold upon the alcoholic extract of fæces, and partly by the other method, this immediate principle was submitted to chemical analysis. The qualitative examination confirmed the existence of sulphur in excretine, and consequently in the combustions it was necessary to interpose a tube full of peroxide of lead between the chloride-of-calcium tube and the potash apparatus. The presence of nitrogen in excretine was very carefully looked for by burning the substance with potassium and testing the fumes evolved when a sample of the crystals was heated with lime in a test-tube. I repeated these experiments several times with Dr. DUPRÉ, but failed to obtain indications of the slightest traces of nitrogen; it is therefore obvious that excretine contains no nitrogen*. The absence of water of crystallization was determined by fusing in the water-bath a weighed quantity of the crystallized substance, and then weighing it again, when it was not found to have lost any weight; the experiment was repeated twice with the same

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* In my first communication I stated that nitrogen was present in excretine; this error resulted from having but a small quantity of substance to operate upon, which, moreover, might possibly not have been perfectly pure.

result. Excretine burnt with carbonate of potash and nitrate of potash, yielded no phosphorus.

The quantitative analysis was first attempted by combustions with oxide of copper, but it was soon found out that from the large proportion of carbon present, it was necessary to employ a more powerful oxidizing compound, and consequently the formula was obtained from combustions with chromate of lead. The proportion of sulphur was determined in the usual way, by burning the substance with carbonate of baryta and nitrate of potash.

I. 0·145 gramme of crystallized excretine yielded,—

Sulphate of Baryta	0·032,	
corresponding to Sulphur . .	0·004; or in 100 parts of excretine .	2·758

II. 0·107 gramme of crystallized excretine yielded,—

Sulphate of Baryta	0·027,	
corresponding to Sulphur . .	0·003; or in 100 parts of excretine .	2·803
Average per-centage		2·780

The combustions with oxide of copper yielded,—

I. For 0·071 gramme of excretine,

					For 100 parts.
Carbonic acid .	0·211	Carbon . .	0·057	Carbon . .	80·281
Water . . .	0·087	Hydrogen .	0·009	Hydrogen .	12·676

II. For 0·1115 gramme of excretine,

					For 100 parts.
Carbonic acid .	0·318	Carbon . .	0·0898	Carbon . .	79·81
Water . . .	0·121	Hydrogen .	0·0134	Hydrogen . .	12·01

In these analyses* the carbon was not far from correct, as the gaseous products (sulphurous and sulphuric acid) formed at the expense of the sulphur of excretine had made up for the loss depending on the incomplete combustion of the substance; that the excretine was not perfectly burnt is shown by the amount of hydrogen obtained, which is too low.

The combustions with chromate of lead yielded,—

I. For 0·1458 gramme of crystallized excretine,

					For 100 parts.
Carbonic acid .	0·430	Carbon . .	0·117	Carbon . .	80·412
Water . . .	0·182	Hydrogen .	0·020	Hydrogen .	13·746

II. For 0·1355 gramme of crystallized excretine,

					For 100 parts.
Carbonic acid .	0·400	Carbon . .	0·109	Carbon . .	80·442
Water . . .	0·167	Hydrogen .	0·018	Hydrogen .	13·284

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* In the analysis with oxide of copper the tube containing peroxide of lead had not been used.

Consequently these analyses yielded, for 100 parts of excretine,

	I.	II.	Average result.
Carbon	80·412	80·442	80·427
Hydrogen	13·746	13·284	13·515
Sulphur	2·780	2·780	2·780
Oxygen	3·062	3·494	3·278

No substance having been found as yet to combine with excretine, its atomic composition was calculated from the assumption that one equivalent contained one equivalent of sulphur, and the following formula was obtained:—

78 equivalents of Carbon	468
78 equivalents of Hydrogen . . .	78
1 equivalent of Sulphur	16
2 equivalents of Oxygen	16
Atomic weight of Excretine . . .	578

	Found.	Calculated.
Carbon	80·427	80·969
Hydrogen	13·515	13·495
Sulphur	2·780	2·768
Oxygen	3·278	2·768
	100·000	100·000

It is now evident that excretine differs widely from cholesterine, though it should appear at first sight closely allied to it.

Most of the properties of excretine have been described in my former communication: I am at present engaged with investigations respecting this subject, more especially for the purpose of establishing the physiological relations of the substance in question. To the present paper is annexed a Plate, XXIII., showing the various forms which excretine may assume; when viewed by transmitted light, the tufts of crystals exhibit a most beautiful silky appearance, more especially if obtained perfectly colourless. It is easy to prepare large-sized crystals by dissolving in alcohol a specimen of dry excretine; the presence of water prevents the formation of the sharply defined prisms. It is impossible to separate the whole of the colouring matter from excretine when extracted by the lime method, unless its solution be filtered several times through animal charcoal; the solution in alcohol appears to be discoloured by charcoal more readily than that in ether. I hope to be soon able to communicate some further details respecting the crystallography of this substance.

In my former communication the existence of cholesterine in the spleen was reported as probable*: I have now convinced myself that this gland contains the substance in question. The subject being one of very great importance in a physiological point of

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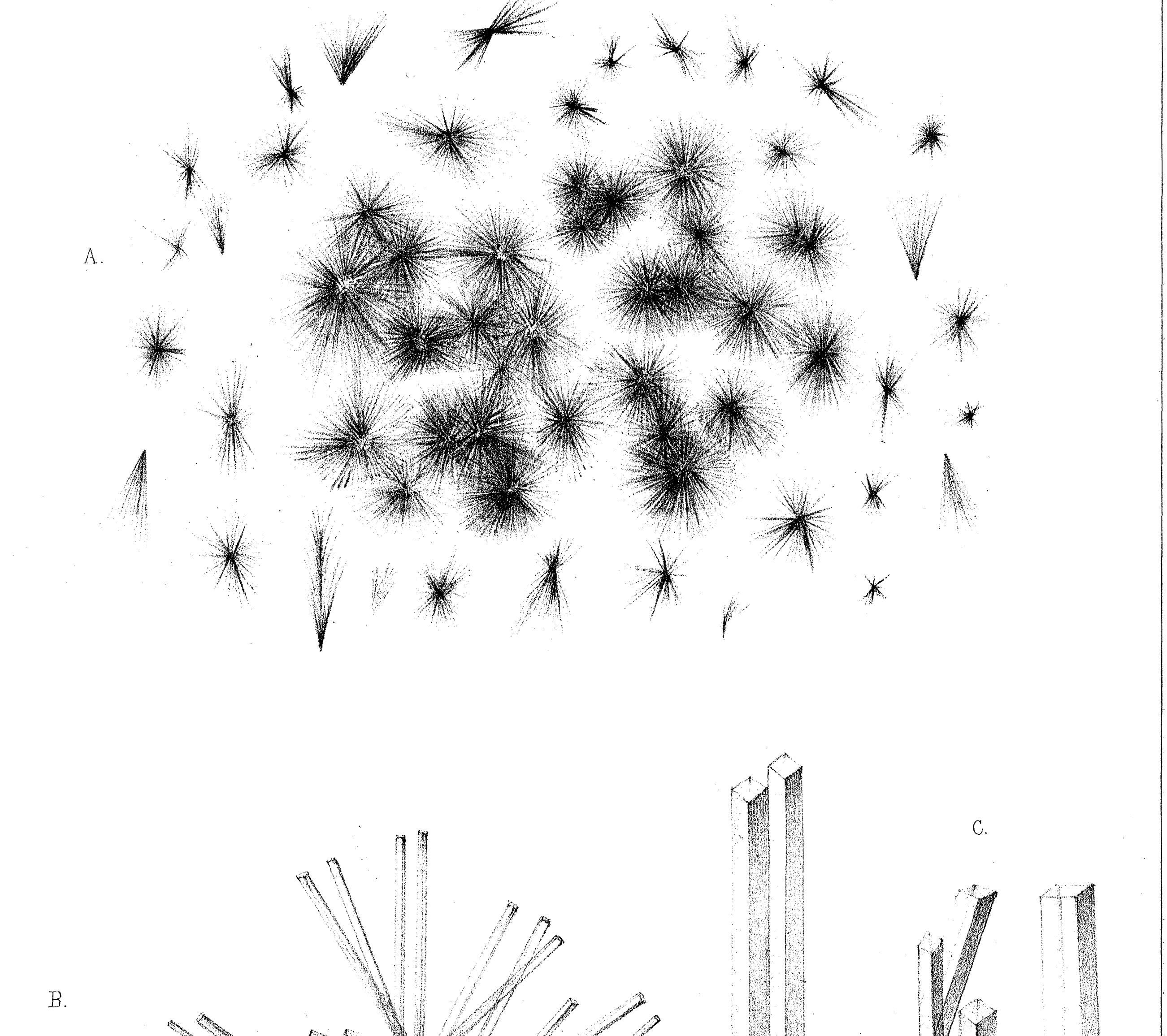
* This observation occurred accidentally whilst I was examining the spleen to discover whether it contained excretine.

view, the investigation was resumed, and another sample of the substance prepared; it crystallized readily, assuming the characteristic tabular form of cholesterine; the crystals were soluble in ether and hot alcohol, being again deposited by the alcoholic solution when cold. When boiled in a strong solution of potash, this substance did not dissolve; but the alkaline fluid being filtered, and the filter washed with boiling alcohol, the crystals again appeared in the liquid on cooling. Burnt in contact with potassium and then treated with a proto- and per-salt of iron and hydrochloric acid, no blue colour was obtained, consequently nitrogen was absent; when burnt with soda-lime, the fumes evolved did not produce a blue stain on red test-paper, confirming the above result. Its fusing-point was 139° Cent. There can be now no doubt but that the spleen always contains a comparatively large quantity of cholesterine, which is evidently independent from that which might exist in the blood retained by this organ after death. Is it that the spleen secretes cholesterine? This can only be determined by actual experiment; but it is very remarkable that a part of the blood which enters the liver should come directly from an organ containing large quantities of a substance which is known to enter into the composition of the bile.

Description of the Plate.

PLATE XXIII.

This Plate shows the microscopical appearance of excretine; the crystals are seen to consist of acicular four-sided prisms, grouped usually in round masses, the needles radiating from the centre to the periphery.



W. G. Searson, del ad nat. *J. Basire, lith.*

A.—GROUPS OF CRYSTALS OF EXCRETINE SEEN WITH THE NAKED EYE.
B. & C.—GROUPS OF CRYSTALS OF EXCRETINE SEEN UNDER DIFFERENT MAGNIFYING POWERS.