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XX. On a new fat acid in the butter of nutmegs

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at Cramlington, is sufficiently obvious: it appears by the accounts given, that it was necessary for the water to be saturated to such a degree as to have a deposit formed on the side of the boiler; that a high temperature is requisite as the machine is a high-pressure one; that the electricity increases with the deposit, and that it varies with the temperature.

This phænomenon only appearing when there is a saline coat deposited, and its tension increasing with the thickness of the layer, it will serve to make known the degree of internal incrustation and the sudden variations of temperature.

XX. *On a new Fat Acid in the Butter of Nutmegs.* By
LYON PLAYFAIR, *Ph. D.**

THE butter of nutmegs has been the subject of several examinations; for the best account of its properties, however, we are indebted to Schrader. This chemist has shown that it is a compound of three oils, two of them being solid, the other volatile and liquid. He has also examined the proportional quantities of these, and described the methods by which they might be separated from one another.

Lecanu† observed that this butter possessed different properties from other vegetable fats, and approached more nearly in character to those of animals. He remarked likewise its partial solubility in æther, which had formerly been pointed out by Schrader as a distinguishing mark.

Pelouze and Boudet‡ described a method by which *margarine* could be procured in a state of purity, and mentioned that the same *margarine* existed in the butter of nutmegs; but they have given no experiments in proof of this, nor did they state analyses of the products obtained.

None of the chemists now mentioned have published the numerical results of their examinations. Hence it was uncertain whether the acid existing in the butter of nutmegs was really *margaric acid*, or some other acid resembling it in properties. It was interesting to ascertain the exact composition of this *margarine*, and for this purpose the following examination was undertaken.

When the butter of nutmegs is digested with alcohol of the common strength, it is decomposed; the alcohol dissolves a coloured fat, acquires a wine-red colour; and yields by

* Communicated by the Author; having been read before the British Association at the late meeting at Glasgow.

† *Journal de Pharmacie*, t. xx. p. 339.

‡ *Annales de Chimie et de Physique*, t. lxi. p. 47.

evaporation a red, soft, semi-fluid fat of an agreeable odour of the nutmeg. Part of the butter remains undissolved; a small portion of it does dissolve, but is again precipitated upon cooling. When the alcohol is very strong, the butter dissolves in four times its weight (Schrader).

The fat, which remains undissolved, is very impure, and, even after several digestions, still retains the odour of the butter. It must therefore be subjected to strong pressure within folds of bibulous paper, first by treating it with alcohol, and afterwards with æther, and renewing the pressure after each treatment. The solution in æther must be filtered whilst hot, in order to get rid of the impurities. When the fat has attained a constant melting point of 31° C., it may be considered pure.

Care must be taken in the selection of the butter, for that sold in commerce under the name of "butter of nutmegs," sometimes consists of animal fat boiled with powdered nutmeg, and coloured with saffras. The specimen may be relied on as pretty pure, if it dissolves in four times its weight of strong boiling alcohol, or half that quantity of æther.

The fat obtained as described above is oxide of glyceril in combination with a fat acid, which, as far as I am aware, has never hitherto been described. It has a beautiful white silky appearance. From this property (which is shared also by the acid derived from it) I propose to call it *Sericine* (from the Latin word *serica*), as I am desirous at present to give it no name exclusively applying to its origin; for researches now in progress of being made by another, appear to show that it is not confined to this butter, but also exists in others.

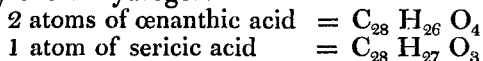
Sericic Acid.—The acid to which this name is applied, may be obtained by the saponification of *sericine*. The soap must be washed with cold water, in order to free it from the alkali employed in its saponification. It is now to be dissolved in boiling water, and muriatic acid added until the liquid possesses an acid reaction. The sericic acid now separates as a colourless oil, which solidifies to a crystalline fat on cooling. It must be washed with water, in order to free it from muriatic acid, and then repeatedly melted in fresh portions of pure distilled water.

Thus obtained, it possesses a snow-white colour and crystalline appearance. It is very soluble in hot alcohol, from which it is partly deposited in small crystals on cooling; the remainder may be obtained by further evaporation. In hot æther it dissolves in considerable quantity, but separates almost entirely on cooling. When allowed to crystallize slowly from alcohol by spontaneous evaporation, it is semi-transpa-

rent and highly crystalline. Its melting point is between $48\frac{1}{2}^{\circ}$ and 49° C.

The atomic weight of the anhydrous acid obtained by the analysis of the salt of silver, is 2733.27; the mean of two analyses of the salt of barytes gave the atomic weight 2732.54. The formula of the anhydrous acid deduced from the analyses of its salts is $C_{28}H_{27}O_3$.

The formula for œnanthic acid is $C_{14}H_{13}O_2$; sericic acid may, therefore, be considered to have the same composition as œnanthic acid, in which one equivalent of oxygen is replaced by one of hydrogen.



It may be compared, in this respect, to benzoic acid and the hydruret of benzule.

The anhydrous acid has not been procured in an isolated state; the acid procured by the decomposition of sericate of potash by muriatic acid, is the hydrate, and contains one atom of water. The following are the results of the analyses of this hydrate.

i. 0.351 gramme of substance, burned with oxide of copper, gave 0.389 gramme water, and 0.941 gramme carbonic acid.

ii. 0.309 gramme of substance gave 0.342 water, and 0.829 carbonic acid.

iii. 0.412 gramme of substance, burned with chromate of lead, gave 1.101 carbonic acid, and 0.454 water.

iv. 0.250 gramme of substance gave 0.670 carbonic acid, and 0.276 water.

v. 0.278 gramme of substance gave 0.744 carbonic acid, and 0.309 water.

	I.	II.	III.	IV.	v.*
Carbon ...	74.12	74.06	73.89	74.10	74.00
Hydrogen	12.31	12.29	12.24	12.26	12.02
Oxygen ...	13.57	13.65	13.87	13.64	13.98

These numbers approach closely to the formula $C_{28}H_{28}O_4$.

Atoms. In 100 parts.

28 Carbon	2140.18	74.06
28 Hydrogen...	349.42	12.09
4 Oxygen	400.00	13.85

2889.60 100.00

* The analyses Nos. i. ii. iv. were made upon sericic acid repeatedly crystallized from alcohol; iv. was kindly executed by Mr. Miller, assistant to Professor Daniell; iii. v. were made upon the acid obtained by decomposing sericate of soda with muriatic acid, with precautions formerly described.

The formula for the anhydrous acid is $C_{28}H_{27}O_3$; hence the formula for the hydrate is $C_{28}H_{27}O_3 + HO$.

There are several points besides its composition, which distinguish this hydrate from that of margaric acid, for which it has hitherto been mistaken. Its melting point is very different from that of margaric acid, and it is soluble in almost every proportion in hot alcohol. The soaps which it forms with potash or soda dissolve with greater facility than the corresponding soaps of margaric acid; they are also more crystalline in their appearance. Sericic acid does not appear capable of forming two classes of salts with the alkalis, that is, its salts are always neutral, and the soaps may be treated with water without passing into supersalts; a character possessed neither by stearic nor margaric acid.

The solution of sericic acid in alcohol strongly reddens litmus paper. When it is boiled with nitric acid diluted with half its weight of water, a violent action ensues, and peroxide of nitrogen is evolved in considerable quantity. The products of the decomposition appear to be soluble in water, for the acid remaining after the action had ceased was found unchanged; at least the salts of barytes and silver made from it possessed a composition precisely similar to that of the original acid; the melting point also remained the same. The subject was not more nearly examined.

Sericine.—The process for obtaining this substance has been described at the commencement of the paper; it is the solid part of the butter of nutmegs, and has been described by M.M. Pelouze and Boudet as *margarine* (margarate of the oxide of glyceril).

Sericine is a very beautiful fat (when crystallized from æther), having a snow-white colour, and silky lustre. It is soluble, in all proportions, in hot æther; but the greater part crystallizes on cooling: in water it is quite insoluble. It is not easily saponified by caustic alkaline ley of the common strength, a property which distinguishes it from *margarine*; but it is easily converted into a beautiful white soap, by melting it with hydrate of potash and a very small quantity of water.

For the purpose of determining with what base sericic acid is combined in sericine, the following process was adopted. A quantity of sericine was boiled for several days with basic acetate of lead. An insoluble salt of lead was thus formed with the acid: the base must, therefore, have been separated. A stream of hydrosulphuric acid was now passed through the liquid filtered from the salt, until all the lead was precipitated. Hence the liquid could now only contain the base with which

the acid had been combined, together with acetic and hydro-sulphuric acids. During the evaporation of the liquid, the two latter were expelled, and a thick straw-coloured liquor of a syrupy consistence and sweet taste remained, which possessed all the common characters of the oxide of glyceril.

The following are the results of the analyses of sericine.

I. 0·3045 gramme of substance yielded 0·344 gramme of water, and 0·832 gramme carbonic acid.

II. 0·406 gramme of substance yielded 0·452 gramme of water, and 1·104 gramme of carbonic acid.

III. 0·310 gramme of substance yielded 0·341 gramme of water, and 0·847 gramme of carbonic acid.

	I.	II.	III.
Carbon	75·55	75·19	75·55
Hydrogen ...	12·18	12·36	12·22
Oxygen	12·27	12·45	12·23
	100·00	100·00	100·00

Lecanu has endeavoured to show that stearin (the stearate of the oxide of glyceril) is composed of two atoms of stearic acid, and one atom of a peculiar oxide of glyceril represented by the formula $C_6 H_6 O_4$. But Pelouze has proved that the common oxide of glyceril should be represented by the formula $C_6 H_7 O_5$. Meyer, in his researches upon elaidic acid, has also shown that Lecanu's formula for glyceril is correct in some combinations of the fat acids; although it may reasonably be questioned whether it possesses this composition in stearin; for Liebig has shown it to possess the formula $2 St + Gy O + 2 HO$. Liebig does not deny that other oxides of glyceril may exist besides that expressed by the formula $C_6 H_7 O_5$; on the contrary, he suggests that there may be several, which may unite with one, two, or three atoms of anhydrous acid, just as there are acids which unite with one, two, or three atoms of a base. But very little is known regarding the nature of glyceril.

Sericine may be an example of such a combination, containing an oxide of glyceril, $C_6 H_5 O_3$, capable of uniting with four atoms of an anhydrous fat acid. These different glycerins would be formed by the removal of one or two atoms of water from the common oxide of glyceril. The hydrogen shown by the analysis is a little too high to countenance this idea; but this may be partly accounted for by the æther with which it is prepared, and which adheres to it with much obstinacy. The formula would be $4 (C_{23} H_{27} O_3) + (C_6 H_5 O_3)$.

	Atoms.		By calculation.
Carbon	118	9019.33	75.65
Hydrogen ...	226	1285.37	11.82
Oxygen	15	1500.00	12.53
		11804.70	100.00

Sericate of the Oxide of Ethyle.—This compound may be formed by sending a stream of muriatic acid gas through a concentrated alcoholic solution of sericic acid. The solution must be kept boiling, in order to ensure the complete decomposition of the chloride of ethyle by the fat acid. After some time, sericic æther collects upon the surface of the alcohol as a colourless oil, which may be purified by simple agitation with distilled water. The agitation with water must be continued until no further smell of muriatic æther can be perceived. It may be rendered still purer, by digesting it with a solution of carbonate of soda, in order to remove any excess of sericic acid; but in this case a considerable portion of the æther is lost. If the stream of muriatic acid be continued sufficiently long, such a precaution is unnecessary. The æther cannot be purified by distillation, as part of it, in this case, appears to be decomposed.

When sericic æther is obtained in the manner now described, it is an oily transparent fluid at common temperatures, destitute both of colour and smell; but when the muriatic æther has not been carefully removed, it possesses a pale straw-yellow colour, and a faint odour. It is lighter than water, having a specific gravity of 0.8641. It may be obtained in beautiful white crystals, by surrounding the liquid with a freezing mixture.

Sericic æther is insoluble in water, but soluble both in alcohol and æther: when boiled for a considerable time with an alcoholic solution of caustic potash, it is decomposed. The following are the results of its analysis, which was performed in the same way as that of other liquid bodies of small volatility.

I. 0.243 gramme of substance, burned with oxide of copper, yielded 0.653 gramme carbonic acid, and 0.273 gramme water.

II. 0.199 gramme of substance, burned with oxide of copper, yielded 0.535 gramme carbonic acid, and 0.221 gramme water.

	I.	II.	Atoms.	By calculation.
Carbon ..	74.30	74.34	60 = 458.61	74.75
Hydrogen	12.48	12.34	60 = 748.77	12.20
Oxygen...	13.22	13.32	8 = 800.00	13.05
	100.00	100.00	6134.87	100.00

Prof. Redtenbacher has shown* that stearic æther is a compound of stearate of the oxide of ethyle with the hydrate of stearic acid, and represented by the formula $2 \text{ St Ae O} + 3 \text{ HO}$. As stearic acid is a bibasic acid, four atoms of base are combined with two of acid. Sericic æther is a body of an analogous composition, and forms a true double salt—sericate of oxide of ethyle and sericate of water. Its formula therefore, is $(\text{Se} + \text{Ae O}) + (\text{Se} + \text{H O})$.

Two atoms of sericic acid ... = $\text{C}_{56}, \text{H}_{54}, \text{O}_6$.

One atom of oxide of ethyle = $\text{C}_4, \text{H}_5, \text{O}_1$.

One atom of water = H_1, O_1 .

Sericate of the oxide of ethyle = $\text{C}_{60}, \text{H}_{60}, \text{O}_8$.

The formation of sericic æther may be easily explained; the muriatic æther, formed by passing muriatic acid gas through a solution of sericic acid in alcohol, is decomposed by the fat acid; sericic æther is thus produced, and attaches itself to an equivalent of the undecomposed hydrate.

Sericate of Barytes.—This salt may be prepared from sericate of potash, by adding an alcoholic solution of the latter to a pure salt of barytes. A bulky white precipitate is thus obtained, which must be thrown on a filter, and well washed. It is slightly soluble both in water and in alcohol; in the former it possesses nearly the same degree of solubility as gypsum.

I. 0·797 gramme of the salt left, after ignition, 0·266 gramme carbonate of barytes; and 0·858 gramme, burned with chromate of lead, yielded 0·691 gramme water, and 1·702 gramme carbonic acid.

II. 0·481 gramme of the salt left, after ignition, 0·161 gramme carbonate of barytes; and 0·319 gramme, burned with oxide of copper, yielded 0·257 gramme water, and 0·634 gramme carbonic acid.

	I.	II.	Atoms.	By calculation.	
Carbon ...	56·91	57·09	28	2140·18	57·32
Hydrogen	8·94	8·95	27	336·94	9·02
Oxygen...	8·26	8·09	3	300·00	8·04
Barytes...	25·89	25·97	1	956·88	25·62
	<hr/>	<hr/>		<hr/>	<hr/>
	100·00	100·00		3734·00	100·00

The absolute quantity of carbon obtained in the analysis was under that stated: in the first 54·85 is the quantity shown by the analysis, but 2·06 per cent. must be added for the carbonic acid retained by 25·89 of barytes, as carbonate of ba-

* *Annalen der Chemie und Pharmacie*, xxxv. 1.

rytes. In the second also 54.95 is expressed by the analysis, but 2.14 being added for the carbon retained by 25.97 barytes, gives the number stated above.

The mean of the two analyses makes the quantity of barytes contained in the salt 25.93 per cent.: the quantity found by calculation is 25.62.

Sericate of Silver.—This salt may be prepared by double decomposition in the same manner as sericate of barytes.

When it is newly precipitated, it is a bulky white powder, which speedily acquires a lilac colour by exposure to light. To avoid this it must be washed in the dark. It is insoluble in water, but very soluble in a solution of caustic ammonia, from which it may be obtained, by spontaneous evaporation, in large transparent colourless crystals. It melts upon the application of heat, but at the same time undergoes decomposition.

I. 0.361 gramme of substance, burned with oxide of copper, gave 0.267 water, and 0.646 carbonic acid.

II. 0.340 gramme of substance, burned with oxide of copper, gave 0.610 carbonic acid, and 0.243 water.

III. 0.553 gramme of substance, burned with oxide of copper, gave 0.992 carbonic acid, and 0.4015 water.

0.704 gramme of salt left, after ignition, 0.277 metallic silver.

	I.	II.	III.
Carbon	49.48	49.61	49.60
Hydrogen	8.03	7.94	8.06
Oxygen	7.82	7.78	7.67
Oxide of silver	34.67	34.67	34.67
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	100.00	100.00	100.00

If we suppose the salt to be composed like that of barytes of one atom of seric acid and one atom of oxide of silver, then the numbers given below should represent the analysis.

		By calculation.
28 Carbon	2140.18	50.61
27 Hydrogen	336.94	7.94
3 Oxygen	300.00	7.13
1 Oxide of silver	1451.61	34.32
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	4228.73	100.00

The difference between the carbon found by analysis and calculation is very considerable, but the close correspondence between the hydrogen and the oxide of silver leave little doubt that the formula is the same as that of the salt of barytes. At the same time it is proper to mention that the close correspond-

ence between the analyses themselves, which were executed on salts prepared at different times, and with scrupulous attention to their purity, lead us to question whether some other formula should not be adopted for it. Salts of silver are generally anhydrous, but this does not always appear to be the case; for Crasso has lately described* a salt of silver which contains water. Sericate of silver may be an example of a similar compound, corresponding to Johnston's sulphate of lime, in which two atoms of salt are united with one atom of water. This is merely brought forward as a conjecture, want of material having prevented my making any further experiments on this subject. The calculated result, however, agrees pretty closely with the analysis.

	By calculation.	
56 Carbon	4280·36	49·94
55 Hydrogen.....	686·37	8·00
7 Oxygen.....	700·00	8·19
2 Oxide of silver	2903·22	33·87
	8569·95	100·00

Hence the formula would be $2 \text{ Se Ag O} + \text{H O}$.

Sericate of Potash.—This compound may be prepared by melting pure carbonate of potash and sericic acid with a small quantity of water. The mixture must then be gently heated, in order to effect the complete saponification of the acid, and afterwards evaporated to dryness on the water-bath. The residue is now to be digested with absolute alcohol, which dissolves the sericate of potash, but leaves the carbonate of potash undissolved.

Sericate of potash is very soluble both in hot and cold alcohol and water. When it is dissolved in a hot solution of alcohol, it is partly deposited on cooling in the form of beautiful white crystalline scales. It is insoluble in æther.

We possess no data for determining how we should estimate the carbonic acid in the analysis of a salt of potash formed by an organic acid. Liebig states, in his treatise on Organic Analysis, that the potash remains after the combustion as a carbonate; and consequently that an atom of carbon should be added to the result of our analysis. But experiments made on this subject by Prof. Redtenbacher, Dr. Varrentrapp and myself, show that this cannot be relied on, when the salt is burned with oxide of copper. Dr. Varrentrapp mixed the carbonates of potash and soda with oxide of copper, and exposed them to the action of heat in a common tube of com-

* Liebig's *Annalen*, Band xxxiv. 1. 79.

bustion. As the result of his experiments, he ascertained that a quantity of carbonic acid always passed into the apparatus, containing potash. This gain was generally about one-third of the potash employed, two-thirds still remaining in combination with the alkali. By subtracting this from the weight of the carbonic acid obtained in the experiment, and calculating the potash as a neutral carbonate, we cannot be far from the truth. This has been done by Redtenbacher * in his researches upon stearic acid, and is the only one at present which can be adopted.

I. 0.354 gramme of substance gave 0.324 water, and 0.797 carbonic acid.

II. 0.324 gramme of substance gave 0.296 water, and 0.727 carbonic acid.

0.404 gramme gave 0.130 sulphate of potash.

The first is equal to 62.25 per cent., the second 62.04 per cent. carbonic acid; but on the supposition that the potash remains after the combustion, as a carbonate, then 2.25 per cent. of carbon must have remained with it. Only two-thirds of this, however, should be added to the carbon actually procured in the analysis; hence the result is as follows:

	I.	II.	Atoms.			
Carbon ...	63.75	63.54	28	2140.18	...	63.56
Hydrogen	10.16	10.15	27	336.94	...	10.00
Oxygen...	8.70	8.92	3	300.00	...	8.92
Potash ...	17.39	17.39	1	589.91	...	17.52
	<hr/>	<hr/>		<hr/>		<hr/>
	100.00	100.00		3367.03		100.00

The formula of the salt is $\text{Se} + \text{K O}$. Before sericate of potash is subjected to analysis, it must be repeatedly dissolved in water and evaporated to dryness, for the alcohol employed in its preparation adheres to it with so much tenacity that it cannot be expelled, unless this process is adopted.

Sericate of Soda.—This salt may be prepared in the same manner as the last. It is soluble in water and alcohol, but insoluble in æther. For the reasons already stated under “sericate of potash,” the salt of soda was not analysed, as its analysis could lead to no satisfactory results.

Sericate of Lead.—This salt was obtained by digesting sericine for several days with basic acetate of lead ($\text{Ac} + 6 \text{PbO}$). It is a dense white powder, insoluble in water, and insoluble or very slightly soluble in alcohol. After digesting for a considerable time, the salt must be thrown on a filter, and washed very carefully with water. The lead was estimated

* *Annalen der Chemie und Pharmacie*, xxxv. 1.

by igniting the salt, ascertaining the weight of the lead, and oxide of lead, which remained; washing the mixture with weak acetic acid by decantation, and calculating the loss as oxide of lead.

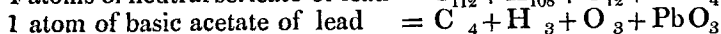
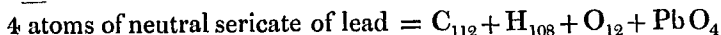
It has been shown* that both benzoate and margarate of lead contain acetic acid in chemical combination, and not as a mere accidental constituent arising from imperfect washing. Hence it was necessary to ascertain whether or not sericate of lead contained this acid. For this purpose a few grains of the salt were moistened with alcohol and sulphuric acid, and subjected to distillation. Acetic æther passed over and was easily recognized by its well-known properties. The quantity of acetic acid contained in the salt, appeared to be very small.

0·985 gramme of salt left, after ignition, 0·421 gramme of lead and oxide of lead; of this 0·55 gramme was oxide of lead, and 0·366 gramme metallic lead: both together are equal to 45·58 per cent. of oxide of lead.

0·456 gramme, burned with oxide of copper, gave 0·684 gramme carbonic acid, and 0·273 gramme water.

		Atoms.		By calculation.
Carbon	41·48	116	8866·46	41·21
Hydrogen . . .	6·65	111	1385·22	6·48
Oxygen	6·29	15	1500·00	6·94
Oxide of lead	45·58	7	9761·50	45·58
	100·00		21513·18	100·00

We have already seen that sericine contained four atoms of sericic acid, and one atom of oxide of glyceril. In the sericate of lead made from sericine, the oxide of glyceril appears to be displaced by one atom of basic acetate of lead ($\text{Ac} + 3 \text{Pb O}$).



The formula would therefore be $4 (\text{C}_{28} \text{H}_{27} \text{O}_3 + \text{Pb O}) + (\text{C}_4 \text{H}_3 \text{O}_3 + \text{Pb O}_3)$.

Another salt of sericic acid and oxide of lead may be obtained by adding acetate of lead to a solution of sericate of potash. But from the great disposition of oxide of lead to form basic salts, a mixture of salts appears, in this case, to be

* *Annalen der Chemie und Pharmacie*, xxxv. 1.

formed; at least the results of the analysis of a salt thus obtained showed no definite composition*.

Before concluding this paper it may be interesting to mention a few facts connected with the butter of nutmegs. It has been already stated, that when this butter is digested with alcohol of the common strength, a soft fat of a red colour is dissolved: when this fat is distilled with a large quantity of water, a colourless oil passes over. This has an agreeable pungent odour, and is probably the same as that described by John and others.

But if this red fat be subjected to dry distillation, several interesting compounds are formed, which, however, have not been examined more closely. The same oil passes over as that obtained by distillation with water, but as the heat increases it is accompanied by a white crystalline fat, which after being purified presents the characters of paraffin. A black matter like humus remains in the retort, and may be easily saponified by continued digestion with caustic potash; when the soap thus formed is dissolved in water, and decomposed by muriatic acid, a mixture of fat acids is separated. By dissolving this in weak alcohol, and allowing it to evaporate, a black fat exactly similar in appearance to humus is deposited. Upon further evaporation a white fat is likewise separated, which may be purified by repeated solutions in alcohol, and digestion with animal charcoal. The black fat is soluble in alcohol and æther; with the latter it forms a solution of a syrupy consistence. This solubility in æther shows that it is not humic acid. The colour of the acid does not appear to be merely accidental; but the examination of these substances was not proceeded with, for being products of decomposition and not at all crystalline, there were no means of ascertaining when they were sufficiently pure for analysis.

St. Andrews, Oct. 28, 1840.

XXI. *Abstract of recent Researches on the Constitution of the fatty Substances, made by MM. REDTENBACHER, VARENTRAPP, MAYER and BROMEIS†.*

FROM the original analyses of Chevreul, the composition of hydrated stearic acid appeared to be

Carbon	77·42	}	100.
Hydrogen	12·43		
Oxygen	10·15		

* Sericate of copper may be obtained by double decomposition; it is of a green colour, insoluble in water, and contains water in chemical combination; the sericates of zinc, lime, cobalt, &c. may be procured in a similar manner, but their examination was quite unnecessary.

† From the *Annalen der Pharmacie*, July, August, and September, 1840. *Phil. Mag.* S. 3. Vol. 18. No. 115. Feb. 1841. I