On the Chemical Composition of Butyrellite (Dana).

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IN DANA'S *System of Mineralogy*, 5th Edition, 1883, page 747, the following description of this substance is given:—"Crystallisable in needles; butter-like in consistence; colour, white; melting point of impure native material, 47°, Brazier; but of material after solution in alcohol, 51°, Luck; 52°-52°·7, Brazier; easily soluble in alcohol or ether."

"Comp. $C_{32} H_{64} O_4$, Brazier = Carbon 75·0, hydrogen 12·5, oxygen 12·5 = 100, and like palmitic acid in ratio. The following are Williamson's analyses:—Nos. 1, 2, were the uncrystallised butyrite; 3, that obtained by combination with potash (with which it forms a kind of soap) and a separation afterwards with acid:—

	C.	H.	O.
1. Uncrystallised	73·78	12·50	13·72 = 100
2. ,, ...	73·89	12·37	13·74 = 100
3. From Potash solution ...	75·05	12·56	12·39 = 100

Obs.—From the peat bogs of Ireland."

The only other notice of the substance with which I shall deal is one which occurs in Vol. XIX. of the *Proceedings of the Manchester Literary and Philosophical Society*, and is contained in a paper written by Mr. John Plant, F.G.S., &c. entitled *Bog Butter (Butyrellite) from Co. Galway, Ireland.* In this paper the author calls the substance a "mineral resin," and on page 70 says, "By the aid of scientific analysis, the substance called bog butter can be shown to be a perfectly natural production, arising from the decomposition of the vegetable matters growing the peat or bog," and "it is affirmed that the butter is sometimes found in small wooden kegs in bogs along the coast."

Following the advice of the last named author, I have submitted several samples of the bog butter to rigid chemical analysis, with the following results.

The samples collected for the investigation were ten in number, and were obtained as stated below.

No. 1.—From Antiquarian Museum, Edinburgh; found *in a keg* in Glen Gell, Morvern, Argyllshire.

No. 2.—From Co. Galway; collection of John Plant, Esq., F.G.S., and sample referred to in his paper.

No. 3.—Locality unknown; from a "Mether" in the Museum of Science and Art, Edinburgh.

No. 4.—Locality unknown; from the Museum of the Royal Irish Academy, Dublin.

No. 5.—Broora Bog, County Derry, Ireland (1830); from the Belfast Academy Museum.

No. 6.—County Down, Ireland; from the Belfast Academy Museum.

No. 7.—Bog near Stranoant House, Co. Antrim, Ireland; from the Belfast Academy Museum.

No. 8.—Kerry, Ireland; author's collection.

No. 9.—Locality unknown; from Mayne collection, Museum of Science and Art, Edinburgh.

No. 10.—Moss of Strathmore, Parish of Farr, Sutherlandshire, Scotland; Duke of Sutherland's collection, Golspie.

Sample 1 was a white solid, friable and greasy to the touch, with a cheese-like smell. Somewhat darkened on exposed surface. On the application of a heat of 100° C. (212° F.) the material melted readily to a clear yellow liquid, with floating solid particles very readily soluble in ether, and yielded, after evaporation at ordinary temperatures, a hard, slightly yellow mass, which on heating became a clear liquid with a yellow shade of colour. Fusing point 42°·2 C.; the ash of the original substance contained phosphoric acid.

Sample 2 was a white friable solid, somewhat greasy to the touch and with an odour resembling cheese. On heating, the material melted quickly to a clear yellow liquid with floating solid particles. Ether readily dissolved the sample, and on evaporation a hard yellow solid was obtained. Fusing point 47°·2 C.

Sample 3.—White, slightly friable, greasy, cheese-like smell. Heat readily melted the substance to clear yellow liquid with floating solid particles. Ether solution on evaporation gave a rich yellow solid. Fusing point 36°·1 C.

Sample 4.—White and very friable, greasy, cheese-like smell. Melted on application of heat to a clear slightly yellow liquid. Ether gave a hard white solid. Fusing point 47°·2 C.

Sample 5.—Strong yellow colour, very slightly friable, cuts with knife, greasy, cheese-like smell. Heat readily melted the sample to a rich yellow oil with few floating particles. Ether gave a yellow hard mass. Fusing point 46°·1 C.

Sample 6.—White and very greasy, could be moulded in fingers, butter-like smell. Melted to a clear slightly yellow liquid with floating solid particles. Ether gave a rich yellow and hard mass. Fusing point 37°·6 C.

Sample 7.—Rich yellow colour, very slightly friable, greasy, butter-like smell. On heating, yielded a clear rich yellow oil with floating solid portions. Ether gave a hard solid with rich yellow colour. Fusing point 36°·1 C.

Sample 8.—White, very friable, slightly yellow, greasy, butter-like smell. Melts very readily to a clear very slightly yellow liquid with floating solid particles. Ether gave a hard almost white substance. Fusing point 46°·6 C.

Sample 9 was a white, slightly yellow, greasy solid, with an odour resembling butter. Very friable. Melted readily to a clear slightly yellow liquid with floating solid particles. Purification by means of ether gave a hard almost white solid, melting at 46°·6 C.

Sample 10 was a white friable solid, with a cheese-like smell. Readily melted to a clear slightly yellow liquid. After solution in ether the resulting solid was white with a slight yellow tinge, and melted at 46° C.

The preliminary qualitative examination disclosed the presence of (1) fat, fatty acids, or material soluble in ether; (2) of a portion insoluble in ether but of an organic nature; (3) of a sugar, giving all the tests for the variety present in ordinary milk; and (4) of a residual ash, which in all cases contained a proportion of phosphoric acid.

The results of the quantitative analyses of the above constituents will be found on Table A., whilst the ultimate analyses of the samples will be found on Table B. and can readily be compared with the published analyses as given in Dana's *Mineralogy* and abstracted on Table C.

TABLE A.—ANALYSES OF SAMPLES OF BUTYRELLITE.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.
Water	2·322	0·528	1·043	0·303	0·788	3·587	0·947	2·562	1·369	0·918
Portion soluble in Ether	97·252	98·943	96·308	98·813	95·468	91·517	97·194	93·955	97·260	98·452
Organic matter, insoluble in Ether	0·379	0·469	2·287	0·828	3·677	4·556	1·847	3·385	1·233	0·532
Ash or Mineral matter	0·047	0·058	0·361	0·055	0·065	0·334	0·011	0·096	0·137	0·084
	100·000	99.998	99·999	99·999	99·998	99·994	99·999	99·998	99·999	99·990

TABLE B.—ULTIMATE ANALYSES OF BUTYRELLITE.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.
Carbon	73·86	73·55	74·21	75·13	73·37	73·72	75·48	73·55	75·12	74·56
Hydrogen ...	12·48	12·33	12.52	12·56	12·14	12·88	12·25	12·74	12·31	12·68
Oxygen	13·66	14·12	13·27	12·31	14·49	13·40	12·27	13·71	12·57	12·76
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

TABLE C.—ULTIMATE ANALYSES OF BUTYRELLITE.

	Williamson.		*Brazier.*	*Greg and Lettsom.*	
	No. 1.	No. 2.		No. 1.	No. 2.
Carbon	73·78	73·89	75·0	73·33	75·65
Hydrogen ...	12·50	12·37	12·5	12·46	12·35
Oxygen	13·72	13·74	12·5	13·71	12·00
	100·00	100·00	100·0	99·50	100·00
Melting point	50°C.		47°C.	51°·1 C.	

TABLE A.—The following examination was made on the results of the purification by ether:—

1.—The ether solution was evaporated spontaneously, and afterwards heated on the water bath till a constant weight was established. The material was then treated with caustic soda and boiled. Salt was added to the mixture, and the separated curd removed and treated, after washing in small quantities of cold water, with sulphuric acid. The material so separated was allowed to stand until a firm cake was formed, which was then removed, and was found to consist of acids in all ways resembling those in ordinary butter. The liquid, after saponification with soda, was evaporated to almost dryness, and separated from the salt, which crystallised out. On exposure to heat the material evolved the odour of Acrolein, one of the products of the decomposition of glycerine by heat.

These experiments prove that the portion of the Butyrellite soluble in ether corresponded in all respects to the body obtained under like conditions from ordinary butter.

2.—The organic portion insoluble in ether was found to be to a slight extent soluble in water, and the solution on concentration gave faint but distinct evidence of the presence of *milk sugar* in very small proportions.

The portion left after treatment with water contained nitrogen, and gave when burned the peculiar "feathery" odour of burning cheese. *These tests are taken as indicating coesin similar to that found in milk.*

3.—The ash or mineral portion, as already stated, contained phosphoric acid in traces.

Taking all the above results into consideration, I am decidedly of opinion that Butyrellite has no claim to be called a "mineral," or to appear in text-books of mineralogy. The fact that a large number of the samples of this substance were found, and still exist in barrels, and can be seen by any one who takes the trouble to visit the Museum of Antiquaries of Scotland, Edinburgh; or the Dublin Museum, or the Belfast Museum; that samples have been found wrapped in cloth or bearing the marks of woven cloth and covered with rushes or other plant fibre; that the substance is only found in peat bogs (noted for their powers of arresting decomposition); and lastly, that tradition speaks of the butter-dyke or butter-safe being dug in bogs, all point to the material being of veritable animal origin, and having nothing in common with the mineral kingdom.

But outside of all this mass of evidence, chemical, circumstantial, and traditional, the butter—for butter it is—has its own story to tell. One and all of the samples on being broken across, or still better when treated with ether, yield to the observer a number of *hairs*, which on being examined

under the microscope can be readily identified as resembling in all respects *cow's hair*, and in one case at least the very same bog has furnished not only *bog butter* but *heads of oxen*—these heads having still attached to them hairs exactly corresponding to those imbedded in the butter.

As to how these kegs and masses of butter found their way into the positions from which they are now obtained we cannot here discuss; it is sufficient for our purpose to show that the material is not of mineral or even of resin origin, but of undoubted animal derivation. The material should therefore be erased from mineral lists.