

## II.

ON THE RESULTS OF A CHEMICAL INVESTIGATION INTO THE COMPOSITION OF THE "BOG BUTTERS," AND OF "ADIPOCERE" AND THE "MINERAL RESINS;" WITH NOTICE OF A CASK OF BOG BUTTER FOUND IN GLEN GELL, MORVERN, ARGYLLSHIRE, AND NOW IN THE MUSEUM. BY W. IVISON MACADAM, F.C.S., F.I.C., LECTURER ON CHEMISTRY AND ANALYTICAL CHEMIST, EDINBURGH.

When asked in June last to undertake the analysis of the Butter contained in the keg lately added to the Museum, the matter seemed so simple that the results were promised for an early meeting. Within a month, however, I received a copy of vol. xix. of the *Proceedings of the Manchester Literary and Philosophical Society*, in which a paper appears by the veteran geologist, John Plant, F.G.S., &c., of the Salford Borough Royal Museum, and entitled "Bog Butter (Butrellite) from Co. Galway, Ireland." In that paper Mr. Plant throws doubt upon the genuineness of the material, and terms it a "Mineral Resin;" and further (page 70, par. 2) 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 forming the peat or bog," and in the first paragraph "it is affirmed that the butter is sometimes found in small wooden kegs in bogs along the coast."

This paper put the matter in an entirely new light, for instead of a body recognised to be a fat or butter, you had a substance of questionable origin.

In carrying out the inquiry, I have not confined myself to reputed samples of "Bog Butter," but have considered "Adipocere," and to a limited extent certain "Mineral Resins." This has been done for comparison, and so as to enable those interested to deduce results for themselves.

The samples analysed were—

1. "*Bog Butter*," from the keg found at Glen Gell, Morvern, Argyllshire, and now in the Museum of this Society.

2. *Butrellite* or *Bog Butter*, received from John Plant, Esq., Salford Borough Museum.
3. *Bog Butter*, from a mether in the Museum of Science and Arts, Edinburgh.
4. *Bog Butter*, from the Museum of the Royal Irish Academy, Dublin.
5. *Bog Butter* No. 1, from the Belfast Museum.
6. *Bog Butter* No. 2, from the Belfast Museum.<sup>1</sup>
7. *Bog Butter*, from the Belfast Museum.
8. "*Kerry Butter*, 350 years old," from a private collection in Edinburgh.
9. *Adipocere*, from the Hunterian Museum, University of Glasgow.<sup>2</sup>
10. *Adipocere*, from a private collection in Edinburgh.<sup>3</sup>
11. *Adipocere*, from the Museum of the Society of Antiquaries of Scotland.
12. "*White substance*," from Peat Bog, Aberdeenshire.
13. *Fichtelite*, from the private collection of John Plant, Esq., F.G.S., Salford.
14. *Butrellite*, from the "Main" Collection, Museum of Science and Arts, Edinburgh.
16. *Butrellite*, from the mineral collection, Museum of Science and Arts Edinburgh.
17. A sample of ordinary *Fresh Butter*.
18. *Fat* received from the Rev. J. M. Joass, LL.D., Golspie.

The chemical part of the paper is divided into, first, the consideration of the composition of the "Bog Butters;" and secondly, of the "Mineral Resins" and "Adipocere;" after which the whole results are compared with one another.

The analysis of the samples was carried out proximately and ultimately, and the results are given under these sub-sections.

PROXIMATE ANALYSIS.—The substances determined were water, oils and volatile acids, curd of animal origin, and saline or mineral matters.

<sup>1</sup> This butter was exposed to the atmosphere in a cellar with the door open for more than twenty years.

<sup>2</sup> Said to be part of the fat of a pony discovered in an old pit working at Airdrie.

<sup>3</sup> Said to be derived from the body of a pig.

## ANALYSES OF SAMPLES OF BOG BUTTER (W. IVISON MACADAM).

No. of Sample.	No. 1.	No. 2.	No. 3.	No. 4.
Locality where found,	Glen Gell, Morvern, Argyshire	County Galway	...	...
Country where found,	Scotland	Ireland	Scotland	Ireland
Museum now placed in,	Society of Antiquaries, Scotland	Salford	Science and Art, Edinburgh	Royal Irish Academy, Dublin
Water,	2.322	0.528	1.043	0.803
Fat and fatty and volatile acids,	97.252	98.943	96.308	98.813
Matter soluble in ether,	0.379	0.469	2.287	0.828
Insoluble curd,	0.047	0.058	0.361	0.055
Ash or mineral matter,	100.000	100.038	99.999	99.999
Appearance of sample,	White solid, friable, greasy, cheese smell, darkened on surface	White friable solid, somewhat greasy, cheese smell	White solid, slightly friable, greasy, cheese smell	White very friable solid, greasy, cheese smell
Cow hairs,	Present	Present	Present	Present
Application of heat (100° C.) to sample,	Melts readily to clear yellow liquid with floating curd	Melts easily, giving yellow clear liquid, with curd	Readily melts to clear yellow liquid, with curd	Melts to clear slightly yellow liquid, with floating curd
Appearance of solid after purification by ether and <i>not heated</i> ,	Hard, slightly yellow	Hard, slightly yellow	Rich yellow solid	Hard white solid
Appearance of heated solid after purification by ether,	Clear, slightly yellow	Clear, slightly yellow	Clear rich yellow	Clear white, very slight yellow tinge
Fusing point of purified fat,	42.2° C.	47.2° C.	36.1° C.	47.2° C.
Phosphoric acid in ash,	Present	Present	Present	Present

## ANALYSES OF SAMPLES OF BOG BUTTER (W. IVISON MACADAM).

No. of Sample.	No. 5.	No. 6.	No. 7.	No. 8.	No. 14.
Locality where found, . . .	Broova Bog	...	Bog near Stranocant House	...	...
Country where found, . . .	County Derry (1830), Ireland	County Down, Ireland	Co. Antrim, Ireland	Kerry, Ireland	Not known
Museum now placed in, . . .	Belfast Academy	Belfast Academy	Belfast Academy	Private Collection	Science and Art, Edinburgh, "Main Collection"
Water, . . .	0.788	3.587	0.947	2.562	1.869
Fat and fatty and volatile acids, . . .	95.468	91.517	97.194	98.955	97.260
Matter soluble in ether, . . .	3.677	4.556	1.847	3.385	1.233
Insoluble curd, . . .	0.065	0.334	0.011	0.096	0.137
Ash or mineral matter, . . .	99.998	99.998	99.999	99.998	99.999
Appearance of sample, . . .	Strong yellow colour, cuts with knife, slightly friable and greasy, cheese smell	White, butter smell and greasy, partly moulded by fingers	Rich yellow colour, very slightly friable, cuts with knife, butter smell and greasy	White, slightly yellow, greasy, with butter smell, and very friable	White, brittle, solid, butter smell
Cow hairs, . . .	Many present	Many present	Present	Present	Abundant, partly coal-black outside
Application of heat (100°C.) to sample, . . .	Readily melts to clear rich yellow oil, with some curd	Melts to clear, slightly yellow liquid, with curd	Melts to clear, very rich yellow oil, with curd	Very readily melts to clear, slightly yellow liquid, with curd	Melts very readily to oil, with curd
Appearance of solid after purification by ether, <i>not heated</i> , . . .	Yellow and hard	Rich yellow, hard	Rich yellow, hard	Hard white, slightly yellow	Yellow white, hard
Appearance of heated solid after purification by ether, fusing points of purified fat, . . .	Yellow oil	Rich yellow oil	Very rich yellow oil	Clear, slightly yellow oil	Yellow oil
Phosphoric acid in ash, . . .	46°-1 C. Present.	37°-6 C. Present	36°-1 C. Present	46°-6 C. Present	45°-5 C. Present

## No. 18.

*Moss of Strathmore, Parish of Farr, Sutherland, Scotland.  
Duke of Sutherland's Museum, Dunrobin.*

Water, . . . . .	0.918
Fat and fatty and volatile acids, matter soluble in } ether, . . . . . }	98.452
Casein, milk, sugar, &c., . . . . .	0.536
Ash or mineral matter, . . . . .	0.084
	<hr/> 99.990

Appearance of sample, . . . . .	White friable solid, cheese smell.
Cow hairs, . . . . .	Present.
Application of heat (100° C.) to sample, . . . . .	{ Melts readily to a clear slightly yellow liquid, with floating curd.
Appearance of solid after purification by } ether, and <i>not</i> heated, . . . . . }	Hard yellow solid.
Appearance of solid heated after purifica- } tion by ether, . . . . . }	Clear, slightly yellow.
Fusing point of purified fat, . . . . .	46° C.
Phosphoric acid in ash, . . . . .	Present.

## No. 17.

*Fresh Butter—Mid-Lothian.*

Water, . . . . .	9.514
Fat and fatty and volatile acids, matter soluble in } ether, . . . . . }	87.518
Casein, milk, sugar, &c., . . . . .	1.286
Ash or mineral matter, . . . . .	1.682
	<hr/> 100.000

Appearance of sample, . . . . .	Strong yellow colour.
Cow hairs, . . . . .	None.
Application of heat (100° C.) to sample, . . . . .	Melts readily to deep yellow liquid.
Appearance of solid after purification by } ether, and <i>not</i> heated, . . . . . }	Deep yellow.
Appearance of solid heated after purifica- } tion by ether, . . . . . }	Deep yellow oil.

From these results it is seen that the fatty substances and volatile acids, in other words, the portion soluble in ether, ranges from 91.517 per cent. up to 98.943 per cent., and that the variation is due to the more

or less large amount of curd present in the sample, the proportion of which may be as low as 0·379 per cent. or as high as 4·556 per cent., in special cases. The curd consists of casein similar in all respects to that substance as found in ordinary cow's milk. It is in an insoluble state, and when heated yields the vapours of the substances formed by the decomposition of casein under like conditions. The mineral matter is in all cases extremely small, being in one sample only 0·011 per cent., whilst the highest figure obtained from the bog butters was 0·361 per cent. The colour of the samples, as received, was from a pale white to a deep rich yellow, and these were intensified by purification of the material from its ethereal solution. The *fusing point* was variable, being in two of the samples as low as 36°·1 cent. and rising to 47°·2 cent. These figures were obtained from the purified material. The *ash* or mineral matter contained in all cases a proportion of phosphoric acid. The butters are *soluble* in alcohol and ether, but insoluble in water. The application of *heat* (100°C) causes immediate liquefaction of the substance, which then yields an oily-looking liquid with the floating particles of curd. A *higher temperature* gives (using the purified sample) the peculiar odour of acrolein,  $\left. \begin{matrix} \text{C}_3\text{H}_3\text{O} \\ \text{H} \end{matrix} \right\} \text{O}$ , a body derived from glycerine,  $\left. \begin{matrix} \text{C}_3\text{H}_5 \\ \text{H}_3 \end{matrix} \right\} \text{O}_3$ , by the action of heat.

*Ordinary fats and oils*, including butter, are built up chemically of glycerine in combination with certain fatty acids, and are known as glycerides. These fatty acids are three in number, stearic acid,  $\left. \begin{matrix} \text{C}_{18}\text{H}_{35}\text{O} \\ \text{H} \end{matrix} \right\} \text{O}$ , palmitic acid,  $\left. \begin{matrix} \text{C}_{16}\text{H}_{33}\text{O} \\ \text{H} \end{matrix} \right\} \text{O}$ , and oleic acid,  $\left. \begin{matrix} \text{C}_{18}\text{H}_{33}\text{O} \\ \text{H} \end{matrix} \right\} \text{O}$ , the first two of these acids belonging to the acetic or  $\text{C}_n\text{H}_{2n}\text{O}_2$  series, and the latter to the acrylic or  $\text{C}_n\text{H}_{2n-2}\text{O}_2$  series. They are all monatomic, and therefore when in combination with glycerine, which is triatomic, require to be present in three proportions. The glycerides are stearin,  $\left( \left. \begin{matrix} \text{C}_3\text{H}_5 \\ \text{C}_{18}\text{H}_{35}\text{O} \\ \text{O} \end{matrix} \right\} \right)_3 \text{O}_3$ , palmitin,  $\left( \left. \begin{matrix} \text{C}_3\text{H}_5 \\ \text{C}_{16}\text{H}_{31}\text{O} \\ \text{O} \end{matrix} \right\} \right)_3 \text{O}_3$ , and olein,  $\left( \left. \begin{matrix} \text{C}_3\text{H}_5 \\ \text{C}_{18}\text{H}_{31}\text{O} \\ \text{O} \end{matrix} \right\} \right)_3 \text{O}_3$ . The stearin is most largely present in solid fats,

whilst olein is found in greatest quantity in the semi-solid butters and permanently liquid oils. These glycerides, when treated with a caustic alkali (potassic or sodic hydrate), give on boiling soaps, which are formed by the alkali combining with the fatty acids to form stearate, palmitate or oleate of potash or soda, whilst the glycerine is set free. On treating the *bog butters* with a caustic alkali, a soap is readily obtained, and on the addition of dibrydic sulphate (oil of vitriol), this is decomposed with the liberation of the free fatty acids. From these facts then (1) that acrolein is obtained on the application of heat, showing the presence of glycerine, and (2) that a soap is formed on the addition of an alkaline solution, which can be decomposed, giving the fatty acids, recognisable by their special tests, we have evidence that the bog butters are of veritable animal origin.

We now pass on to the consideration of the "Mineral Resins" under the influence of similar conditions and reagents to those employed with the bog butters. The special resin to which we devote our attention, as representing the class, is one obtained between the annual layers in the wood of pine logs which have been embedded in bogs, and is known as *Fichtelite*. Until lately this resin was unknown except in Germany, but has been discovered within the last few months, by Mr. John Plant, F.G.S., of Salford, in some wood uncovered in a moss at Handford, Cheshire, and I am indebted to that gentleman for my sample. The material occurs in pearly white crystalline scales. Treated with ether, 91.916 per cent. dissolves, giving a solution which on evaporation yields a pure white sticky mass. The application of a temperature of 104°4 C. causes fusion, with the odour of ordinary resin, and after cooling gives a resinous sticky mass, which on standing becomes vitreous and like ordinary resin in appearance. This purified resin is insoluble in water, but dissolves readily in hot alcohol, yielding a solution which, on cooling, deposits crystals of sylvic acid, retaining, however, a proportion in solution. The *Fichtelite* is undoubtedly derived from the resin of the wood. The application of a high temperature yields all the products derived from ordinary resin under similar circumstances, and *no* acrolein. The material insoluble in ether consists principally of ligneous matter, whilst the ash

of the resin contains no phosphoric acid. An alkali solution gives on boiling a soap, from which oil of vitriol liberates a resinous mass free from oil. These results cannot be compared with the bog butters.

## ANALYSES OF FICHELITE (W. IVISON MACADAM).

"SPECIMEN OF FICHELITE, under Semi-Fossil Pine Bark, buried in a Moss at Handforth, Cheshire, Collection of J. Plant, Salford."

No. of Sample.	No. 13.
Water, . . . . .	4.651
Soluble in ether, . . . . .	91.916
Insoluble in ether, . . . . .	3.100
Ash or mineral matter, . . . . .	0.332
	<u>99.999</u>
Appearance of sample, . . . . .	Soft pearly white scales, crystalline
Hairs, . . . . .	None
Application of heat (100° C.) to sample, . . . . .	Melts slowly in part, portion insoluble
Appearance of solid after purification by ether— <i>not heated</i>	Pure white, sticky
Appearance of heated solid after purification by ether,	Sticky resinous mass, with resinous odour
Fusing point of purified substance, . . . . .	104° C.
Phosphoric acid in ash, . . . . .	None

I am indebted to Mr. W. Hamilton Bell of Edinburgh, for a sample of a white substance from the moss of Dinnet, Aberdeenshire.<sup>1</sup> It is a grey-white, porous, very light, fibrous mass, which with ether yields a solution of green colour. Further examination proved it to be chlorophyl, thus giving very strong evidence of the vegetable origin of the substance. The portion insoluble in ether consists of 25.29 per cent. of cellulose and ligneous matter, and of 66.551 per cent. of an ash of purely mineral matter, and composed of the flinty skeletons of diatoms, and showing a trace of phosphoric acid. The application of a high temperature gives rise to charring, with a peat odour and no acrolein.

<sup>1</sup> See Edinburgh Geological Society's *Transactions*, vol. iv. part 2 (1882).



ANALYSIS OF "WHITE DEPOSIT FROM PEAT," FOUND IN DINNET MOSS,  
ABERDEENSHIRE (W. IVISON MACADAM).

Water, . . . . .	7.450
Soluble in ether, . . . . .	1.708
Insoluble in ether, . . . . .	25.290
Ash of mineral matter, . . . . .	65.551
	99.999
Appearance of sample, . . . . .	Grey, tough, fibrous solid, cuts like peat, very light and open
Application of heat (100°) to sample, . . . . .	No change
Appearance of material soluble in ether, . . . . .	Bright green colour (chlorophyll)
Application of heat to sample, . . . . .	Burns with peat smell — no acrolein
Phosphoric acid in ash, . . . . .	Present

We have now by chemical analysis proved that bog butter is of true animal origin, and bears very little resemblance to the "mineral resins," or to the white substance found in peat.

It is necessary to consider the animal fats more fully, and to draw a distinction between the butters and the fats. The fats when buried in contact with moisture are gradually changed into a material known as "*adipocere*" (*adeps*, fat, and *cerax*, wax), and this name is frequently also given to specimens of bog butter. The substance "*adipocere*" was first described by Fourcroy of Paris. The material in this case was of human origin, and obtained from bodies in the Cimetière des Innocents. A large number of coffins had been placed on the top of each other, and on being disturbed after some twenty or thirty years, the contents were found to have been turned into a hard white substance, enclosing the bones, which were brittle and easily broken. The surface of the *adipocere* showed beautifully the markings of the linen in which the bodies had been wrapped. Fourcroy states, that from his analysis the material consisted of margarate (a mixture of palmitic and stearic acids), of ammonia, potash, and calcium.

Ebert (*Deut. Chem. Ges. Ber.*, viii. page 775) states that *adipocere* is a mixture of fatty acids, and contains no glycerine, which substance is

replaced by potassium as potassic palmitate,  $C_{16}H_{31}O \left. \begin{array}{c} K \\ \hline \end{array} \right\} O$ , with a small quantity of potassic margarate,  $C_{17}H_{33}O \left. \begin{array}{c} K \\ \hline \end{array} \right\} O$  (melting at  $59^\circ$ ), and some oxymargaric acid as a potash salt,  $C_{17}H_{33}O_2 \left. \begin{array}{c} K \\ \hline \end{array} \right\} O$  (melting at  $80^\circ$ ). Further, he says, no oleic acid is present, and that on the addition of potassic hydrate and heating, ammonia is given off as gas. The samples examined by Ebert contained 6 per cent. of insoluble residue, consisting of tissues, and were soluble in alcohol and ether, but insoluble in water.

Frequent mention is made of the substance in Australian treatises; sheep drowned in the creeks being found next wet season as a mass of adipocere, and in Ireland the College of Surgeon's Museum contains the body of a woman entirely changed into adipocere.

I have made analyses of four samples. In three of these the portion soluble in ether is over 98 per cent. of the whole substance, and in the remaining sample is only 70 per cent. It must be noticed, however, that the latter sample was very impure containing a large amount of fibrin (23.724 per cent.), and also a very considerable proportion of earthy impurity (3.675 per cent.) obtained by the material whilst buried in the earth. Two of the samples have so small an amount of mineral matter that it could not be properly determined. Phosphoric acid was found in the ash. The substance is usually very brittle and crystalline, excepting when the proportion of fibrin present is so large as to render it impossible to cause a fracture. The application of a temperature of  $100^\circ C.$  readily melts the substance, giving a clear, almost colourless solution, with the odour of stearic acid (composite candle odour), and, if fibrin is present, floating solid particles. After purification with ether, the substance is very hard and crystalline, and, if coloured, has a very slight yellow tinge. This purified body fuses at a temperature between  $46^\circ$  and  $48^\circ C.$ , again passing into the crystalline state on cooling. Alcohol and ether act as solvents, the material being insoluble in water. Caustic alkalies boiled with the fat give off ammonia with the formation of soaps, which are afterwards decomposed by sulphuric acid, the resulting fatty acid being

## ANALYSES OF SAMPLES OF "ADIPOCERE" (W. IVISON MACADAM).

No. of Sample.	No. 9.	No. 10.	No. 11.	No. 16.
Locality where found	Airdrie?	Edinburgh	Not known	Not known
Country where found,	Scotland	Scotland	Not known	Not known
Museum where placed in,	Hunterian Museum, Glasgow	Private Collection	Society of Antiquaries, Scotland, Edinburgh	Museum of Science and Art, Edinburgh—"But- rellite" Mineral Col- lection
Water,	0-372	2-362	0-441	1-512
Fat and fatty and volatile acids, matter soluble in ether,	99-627	70-288	99-211	98-319
Insoluble tissue,	...	23-724	0-347	0-101
Ash or mineral matter,	...	3-675	...	0-067
	99-999	99-999	99-999	99-997
Appearance of sample,	Very hard, crystalline, candle-looking	Very white	White, brittle, partly crystalline	White brittle, solid
Cow hairs,	None	None	None	None
Application of heat (100° C.) to sample,	Very readily melts to clear liquid, with stearic (candle) smell —no curd	Very readily melts, much skin	Readily fuses to yellow liquid	Fuses at once to clear white, very slightly yellow liquid — no curd—small stearic
Appearance of solid after puri- fication by ether— <i>not heated</i> ,	Hard, white, crystalline,	Yellow, brown, hard	Hard, white, crystalline	White, slightly yellow
Appearance of heated solid after purification by ether,	Clear white, very slightly yellow	Clear yellow, brown	Clear, slightly yellow	Slightly yellow oil
Fusing point of purified fat,	47°6 C.	46°6 C.	46° C.	...
Phosphoric acid in ash,	...	Present	...	Present



The "adipocere" gives from 66·4 per cent. to 69·3 per cent. of carbon, from 15·5 to 16·4 per cent. of hydrogen, and from 15·1 to 17·5 per cent. of oxygen.

ULTIMATE ANALYSES OF "ADIPOCERE" (*Purified*) (W. IVISON MACADAM).

Sample No.	No. 9.	No. 10.	No. 11.	No. 16.
Museum now placed in, {	Hunterian, Glasgow.	Private Collection.	Antiquaries, Edinburgh.	Science and Art, Edinburgh.
Carbon, . . . . .	67·120	66·436	69·351	68·562
Hydrogen, . . . . .	16·474	15·943	15·526	16·214
Oxygen, . . . . .	16·406	17·542	15·123	15·224
	<u>100·000</u>	<u>100·000</u>	<u>100·000</u>	<u>100·000</u>

The Fichtelite and white substance from peat were also analysed ultimately, with the results stated below; and also appended is the analysis by Johnson of a resin called Guyagnillite, which shows much resemblance to bog butter in the amount of carbon and oxygen present.

ULTIMATE ANALYSES.

FICHELITE.		GUYAGNILLITE.	
No. of Sample.	No. 13.		
Observer, . . . . . (Bromeis)	(W. Ivison Macadam)	(Johnson)	
Carbon, . . . . . 89·30	Carbon . . . . . 81·501	Carbon . . . . . 76·67	
Hydrogen, . . . . . 10·70	Hydrogen . . . . . 8·913	Hydrogen . . . . . 8·17	
	Oxygen . . . . . 9·586	Oxygen . . . . . 15·16	
	<u>100·00</u>	<u>100·000</u>	<u>100·00</u>

ULTIMATE ANALYSES OF WHITE SUBSTANCE FROM PEAT (W. IVISON MACADAM).

Carbon, . . . . .	14·087
Hydrogen, . . . . .	5·534
Oxygen, . . . . .	7·427
Mineral matter, . . . . .	65·551
Water, . . . . .	7·450
	<u>99·999</u>

These ultimate analyses are not suitable to base any decided opinion upon, for they only give the total amount of each ingredient present, and tell nothing whatever of the manner of combination. It is quite possible to have two bodies of very opposite properties with the same ultimate analysis, and thus, whilst aiding in deductions, they must not be relied upon as sole evidence.

During the analyses of the bog butters casein was regularly found. The adipocere is always crystalline; the bog butters, so far as I have seen, are always amorphous; whilst the fatty acids present in bog butter are mostly oleic, with small proportions of stearic and palmitic acids, in adipocere the stearic is large, and the palmitic and oleic acids small. A very ready and easy method of determining between the bog butters and adipocere is to melt a portion of the substance over hot water, and carefully look for the hairs, which are invariably present in bog butters, but never have been seen by me in adipocere. These hairs are generally readily noticed in the samples without any special preparation, being found at all the fractures, but may be separated for the microscope, most easily, by ether, which dissolves the fatty and volatile acids, leaving the curd and hairs as a residue. So far as I have seen, the colour of these hairs is always red. They are most likely due to the milk having been churned in a skin. This process is a very old one; it was regularly practised by the Arabs and Indians centuries ago, and is still a common practice with the former. These hairs are mentioned in old Irish writings. In the *Ulster Journal* (vol. vii.), a quotation from the Irish *Hudibras* is given, and is as follows:—

“Great heaps of thick three-corned bread,  
And *hairy* butter van did lead.”

And in the notice of a barrel found at Ableyleix, it is stated that the sample contained “red cow hairs,” and that in the same bog the heads of several of the Irish long-faced breed of cattle had been found.

The earliest specimen of bog butter seems to be one mentioned in the *Mechanics Magazine* of September 1824, where it is said that “mineral

tallow" was found in Finland in the year 1726. In 1817 a mass of twenty-three pounds weight was obtained in the Galtee Mountains, Ireland. And in 1820 (*Edinburgh Phil. Jour.*, vol. xi.), the first Scottish specimen is mentioned in a sample of "mountain tallow" found on the shores of Loch Fyne. In 1826 a tub of butter was obtained at Balinsloe, Ireland, and is noticed in the Royal Dublin Society's *Transactions* for that session, and in the same year Professor E. Davy gave the analysis of the sample. In the Royal Irish Academy there are said to be three or four samples of the butter, and I am obliged to Mr. Danagh of the Belfast Museum, for the following list of samples contained in that Museum :—

- No. 1. Found in Booeva Bog, Co. Derry, 1830.
- „ 2. From a bog in Co. Down.
- „ 3. From bog near Stransant House, Co. Antrim, and contained in a *methers*.
- „ 4. From Co. Antrim, also found in a *methers*.
- „ 5. From Ballynahinch Bog, Co. Down, found in 1844.

Dr. John Alexander Smith (*Proc. Soc. Antiq. Scot.*, vol. iii. p. 105) mentions a keg, wrapped in a skin, found in October 1857, in a moss, near the Point of Sleat, Skye.

Mr. W. Jolly, F.S.A. Scot., in the *Transactions* of this Society (*Proc. Soc. Antiq. Scot.*, vol. ii. N. S., p. 47), says, as an evidence of the site of old Poolewe market, "Moulds of some fatty substance, either butter or tallow." Mr Mackintosh, Poolewe, to whom I was referred by Mr. Jolly, says that whilst unfortunately he cannot obtain samples, that an old man of about seventy years of age tells of two finds, one being from the same bog as some bronze instruments, first in the possession of Sir Kenneth Mackenzie, and now in this Museum, and the second in a hollow at the foot of the hill on which the bog lies.

There is also a *methers* of butter in the Museum of Science and Art, Edinburgh, and two samples of "butrellite."

These samples of butter are usually found in barrels or kegs, but

occasionally are enclosed in pieces of cloth, whilst the Poolewe samples were rolled in the outer bark of trees; rushes have been known to be used as a covering. Mr. James O'Lavery, in the *Ulster Journal* (vol. vii.), says: "I have in my collection a lump of butter, found rolled up in some sort of coarse cloth, at a depth of 12 feet in the bog of Gortgole, Co. Antrim, which still retains visibly impressed upon it the marks of the hands of the ancient dame who pressed it into its present shape."

The barrels are usually hollowed out of a single piece of wood, with an end cut out from another piece of wood, and having a rim cut round it into which the barrel fits. The top is made in a similar manner. In the *Ulster Journal* (vol. vii.), a vessel, described as a *churn*, is figured, the lid in this case being oval. The height is 14 inches, circumference 46 inches. It was found at Ahoghill, Co. Antrim. The same plate shows a *pail*, made of one piece, height 10 inches, circumference 30 inches, and found at Ballyboland Bog. A third figure represents a firkin of butter found in the Townlands of Coolnamans, Co. Derry, and also cut out of a single piece, with the top and bottom fitting with grooves to the sides. It is 14 inches high, and 45 in circumference. Mr. M. H. Close, of the Royal Irish Academy, informs me that kegs are occasionally found made of staves, but unfortunately he does not give any instance of such, or state where they are to be seen. Such vessels must be comparatively modern.

The Museum of Science and Art, Edinburgh, contains a *mether*, which is probably unique. The upper part of this *mether* is round, and measuring across  $6\frac{1}{4}$  inches at one part, and  $5\frac{3}{4}$  inches at another point. The bore is round. The upper part is  $5\frac{1}{2}$  inches deep, and two small wooden projections are on one side, and were most likely the points of attachment for a handle. The lower half of this keg is shaped square, and gradually tapers inside and outside to the centre. There is no bottom to the vessel, and it has never had a wooden one, but instead has a piece of the rough skin stretched across it. I obtained portions of this skin, and recognised readily the structure of the substance when placed below the microscope. Portions of hair remain attached at parts, and the colour is similar to those found in the butter.



The keg of butter (fig. 1) lately added to this Museum is undoubtedly the largest ever described, and so much above any previous measurements

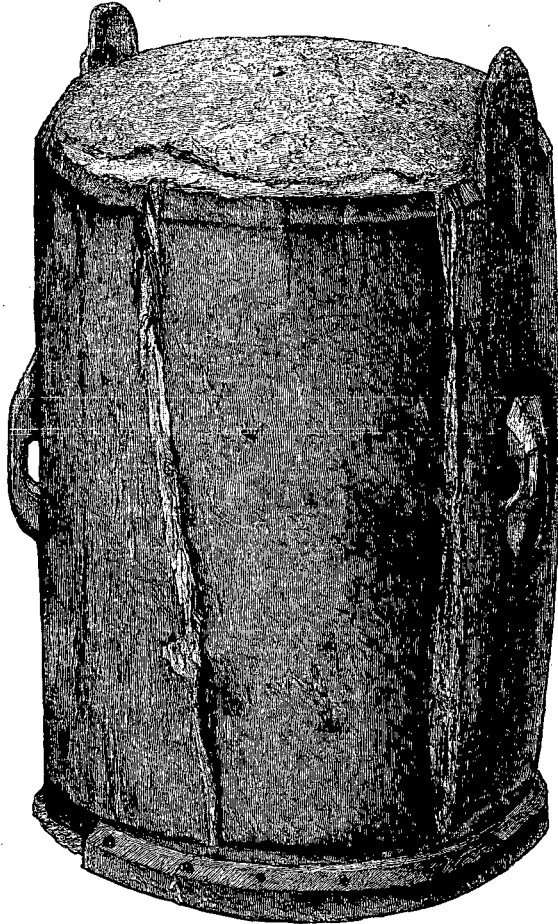


Fig. 1.—Keg of Butter found in a moss at Morvern (24 inches high).

given, that there can be little doubt it is the largest ever found. The keg was obtained on the 14th of May 1879, by Mr. James Palmer, manager,

Beach, Morvern, Argyllshire. It was discovered whilst digging peats at the north end of Glen Gell, close to where the Avon Water rises. The keg was found at a depth of  $4\frac{1}{2}$  feet from the surface of the moss, and lay in a slanting position. The body of the barrel is 24 inches high, with a diameter of  $16\frac{1}{2}$  inches, and is hollowed out of a single piece of wood, which has thus a total height of  $28\frac{1}{2}$  inches, two "lugs," 4 inches high, being left one on each side of the cask. The end fits on with a groove, and

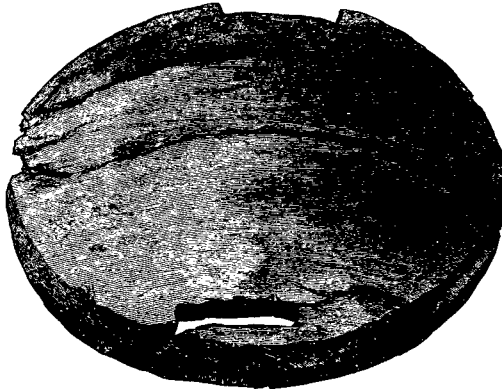


Fig. 2.—Top or Cover of Keg, found at Morvern.

the top (fig. 2), which is partly hollowed into a basin shape, in a similar manner. The wood of the keg is in excellent condition, but is cracking somewhat as it gradually dries.

Many suggestions have been given as to how these samples of butter found their way into the positions in which they are invariably obtained, namely, in peat bogs; whilst it is probable that accident may be the only cause, yet one suggestion that may have some foundation is, that the butter, being somewhat strong tasted from the rank herbage eaten by the cattle, was buried in these bogs much in the same way as sea-fowl are buried now-a-days, to rid them of the aroma. One other reason suggests itself to me, namely, that as no salt was used, the butters were buried to preserve them in a fit condition for food. These two latter views receive confirma-

tion to some extent by old writings on the subject. The *Irish Hudibras* says:—

“ Butter to eat with their hog  
Was seven years buried in a bog.”

Looking at the subject from a chemical point of view, the preservation of the butter might be accounted for by considering that, when first buried, the material would tend to pass into the lactic fermentation, being aided by the casein of the milk, succinic,  $\left. \begin{matrix} C_4H_4O_2 \\ H_2 \end{matrix} \right\} O_2$ , and lactic,  $\left. \begin{matrix} C_3H_5O_2 \\ H \end{matrix} \right\} O$ , acids being formed, after which the butyric fermentation would yield a proportion of butyric acid,  $\left. \begin{matrix} C_4H_7O \\ H \end{matrix} \right\} O$ . When this process had proceeded a certain length the casein would be rendered insoluble by the free acid present, when the action would cease, the butter remaining for an indefinite period without further change. The glycerine, although partly decomposed, is not decreased very largely in any of the samples, but at the same time, they are all acid, and yield butyric ether,  $\left. \begin{matrix} C_2H_5 \\ C_4H_7O \end{matrix} \right\} O$ , when treated with alcohol and sulphuric acid. In Classin and Pobelson's *Travels in Ireland*, it is stated that the poor people in winter eat sour butter which contains no salt, and which in time becomes acid, but after that can be preserved for over twenty years; and further that, when the sour butter is too old, it loses its acidity and weight, dries up and acquires a rancid taste. Debe, in his description of the Faroe Islands, written in 1670 A.D., speaks of a certain “Rue tallow,” and says, “The tallow, principally obtained from sheep, was cut in pieces and allowed to rot awhile; it was then rendered, and cast into large pieces, which they dig and put in moist earth to keep it, it growing the better the longer it is kept, and, when it is old and is cut, it tasteth like old cheese. The most able peasants have ever much endeavoured to bring together a great quantity of that tallow, so that a countryman had sometimes in the tallow dyke [that is, a place in the earth where it is kept] above one hundred loads, and this hath always been looked upon as the greatest riches of Faroe, for when sheep die, such tallow is very necessary in the land, the longer it

is kept being so much the better; and foreign pyrates having little desire to rob it from them."<sup>1</sup> From the small quantity of curd present, it is possible that the milk may have been heated to aid the separation of the cream, a process which is regularly carried out by savage or semi-savage tribes to the present day, and would greatly aid the keeping qualities of the material by rendering the casein insoluble. That the process was somewhat different from that now used is probable, as it is stated that those Arabs who have adopted the English method of churning, cannot get their butter to keep so well as that made by the old method.

This paper would not be complete without a notice of the latest find. This sample was obtained last autumn (1881) by peat-cutters, in the moss of Strathmore, parish of Farr, Sutherlandshire. The Rev. Dr. Joass of Golspie, to whom I am indebted for the information and also for the sample analysed (No. 18), tells me that it was found under 3 feet of peat, and was, he believes, incased in wickerwork, which, however, unfortunately fell to pieces on drying. The case was lined with birch-bark, the fibrous side being next the creel. The mass was in the form of a cylinder, 8 inches in diameter and about 9 inches high. Some of the birch-bark adheres to the fat, and seems to have been used as a long strip coiled horizontally inside the little creel or basket. It has been deposited in the Duke of Sutherland's Museum, Dunrobin.

I here beg to record my thanks to the following gentlemen, who have aided me with samples and references, without which the paper could not have been nearly so complete:—

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<sup>1</sup> *Royal Irish Academy Transactions*, vol. vi. 372.