I.

A KEG OF "BOG-BUTTER" FROM SKYE AND ITS CONTENTS.

BY PROFESSOR JAMES RITCHIE, M.A., D.Sc., F.S.A.Scot.

Read May 9, 1932.

THE CUSTOM OF BURYING BUTTER.

The practice of burying butter and fat in the earth, partly to preserve it against future need and partly to "mellow" its flavour, is at once an old custom and a modern usage. In Scotland several discoveries of such a kind have been made in peat-bogs, but here the custom has been commemorated neither in contemporaneous written records nor in tradition and must be regarded as ancient, as indeed the description of the Skye example will show. Ireland has yielded many similar discoveries, for "bog-butter is one of the commonest 'finds' in Irish bogs" according to Macalister (1928, p. 192). There, however, although the custom probably extended to times as remote, it was continued and was prevalent as late as the seventeenth century, when the allotted span of burial to produce the desired flavour was said to be seven years; and a sample found at Tirnakill Bay, Co. Galway, and contained in a wooden vessel on which was scratched the date 1789 (Arup, 1932, p. 300) carries the practice almost to the end of the eighteenth century.

In these cases the material is stated, as a rule, to have been butter, but body fat was sometimes treated in the same way. In his *Description of the Faroe Islands*, written in 1670, Debes tells how tallow, obtained principally from sheep, was rendered, cast into large pieces, and buried in moist earth "to keep it, it growing the better the longer it is kept" (Dr John Sterpin's translation in 1676).

The practice must have been well known in northern lands in past centuries, for, in addition to the countries mentioned above, it has been described from Iceland and Finland. But the burying of butter extended far beyond these lands, as is shown by examples mentioned below, from Fez in Morocco and Hunza in Kashmir. In a letter to *The Times*, dated 18th May 1932, the late Mr J. H. Stevenson wrote: "When I was in Tetuan, in 1899, Mr Bewick, the British Vice-Consul, told me that an underground hoard of ancient butter had been found, not long before, at Fez. The Sultan, understanding that the store was in condition to be considered a delicacy, confiscated it as treasure trove. The stuff was then discovered to have been buried too long to be eaten at all. He therefore sent it to Tetuan with orders to the Captain of the Market to allow no

butter to be exposed for sale there until the hoard was sold. Tetuan then witnessed the unusual spectacle of an alliance of Moslems, Christians, and Jews to buy up the Sultan's butter and clear the way for the marketing of their own, which they did."

Of the persistence of the custom to the present day an example from Kashmir was given by Lord Conway of Allington in a letter to *The Times* (14th May 1932), following upon the description in that newspaper of the Skye discovery. "In the year 1892, shortly after the Nile campaign, a small British Expeditionary Force occupied Hunza, and I believe I was the first traveller to visit that remote little principality after it came within the area of British Administration. Our people, when they occupied the little castellated town Baltit, found that one of the great luxuries reserved for the Rajah was ancient butter. I heard a good deal about it, but I never actually saw anything. I was informed that the Rajah every year laid down one or more big pots full of butter. I understood that these pots were dated. The older the butter the greater the luxury. These pots of butter, I believe, were buried in the ground at some recognised spot. From time to time the oldest pots were excavated and their contents were regarded as a delicacy. I believe I rightly remember that the colour of the old butter was black, and that our people consumed some of it with relish. Thus bog butter, found in Ireland or in Skye, perhaps carries on some ancient and widely spread tradition."

The present record, therefore, falls into line with an old and widespread economy, which originated when the preservation of fresh food was an intractable problem and palatable flavourings were scarce. The people of Faroe set great store upon their buried hoards of tallow because "the longer it is kept being so much the better, and forreign pyrates having little desire to rob it from them. It may, therefore, not unreasonably be termed a hidden treasure which rust does not consume, nor thieves steal away" (Debes, English translation, 1676).

DISCOVERY OF THE SKYE BOG-BUTTER.

During the peat-cutting season in the late spring of 1931 there was found in a peat-bog on the south of the main road, about 1 mile east of the inn at Kilmaluag, at the north end of Skye, a wooden barrel or keg full of the material known as bog-butter. The discoverer of this obviously ancient interment, Mr Hugh Mackay of Balmacquien, appreciating its interest, communicated with Mr Seton Gordon, from whom I received a fragment of the "butter" for identification; and this led to the ultimate arrival in Aberdeen, where I was then teaching, of the keg and its contents just as they had been resurrected.

The keg when found embedded in the solid peat bank was tilted a

little sideways, as *if* lack of lateral support had resulted in uneven settling upon the peat bed. Since the large keg found at Morvern in Argyllshire in 1879 and now in the National Museum of Antiquities was also found in a slanting position, the suggestion is that the kegs were not buried in a hole dug in solid peat, but were merely sunk in a water-filled peat-hole, which permitted a tilting of the mass as it settled upon the bottom. The point is of some interest because, if the barrel was simply deposited in a natural peat-hole, the peat layers lying over the barrel must have been formed since the barrel was placed there.

In a deep peat-bog from which peats have long been cut for fuel, it is almost impossible to be certain about the distance of a buried object from the original surface; for the bog is denuded in a series of "banks," so that the top layers may have been removed generations before cutting begins in the mid or lower layers. But as regards the present find this is certain, that in 1931 the top of the barrel lay rather more than 18 inches below the present surface at that place, and that Mr Mackay himself, in former years, had removed peat to a depth of more than 4 feet from the same place. So that the top of the barrel lay some 6 feet below the older surface, although even that may not have been the original surface of the deposit.

CONDITION OF KEG AND ATTEMPTS AT PRESERVATION.

Before I describe the keg and its contents, a note about its condition and the attempts which were made to preserve it may serve as a warning and at the same time an aid in dealing with future discoveries of the same kind.

Both the wood and the fatty mass it contained were saturated with water, the wood to such a degree that in places it could be rubbed into its constituent fibres with the fingers, while even the surfaces which looked most solid and fresh could be scooped out by the finger-nail as if the wood were thoroughly rotten. The contents were also so impregnated with water that when the mass was squeezed or simply cut, drops of water collected upon the surface.

It was realised that the preservation of an object in such condition would not be easy, and an attempt was made to dry it very gradually, so that the contents would support the barrel. The wood, however, drew in as the water left it, and the contents became rather powdery on the surface and increased in bulk, so that the disruption of the barrel was threatened. As it split longitudinally along old cracks, the opportunity was taken, by separating the two halves, to remove the entire contents (no easy matter) and allow the barrel to dry alone. Difficulties still arose, in spite of the addition of glycerine to prevent too rapid and thorough drying, from a tendency of the wood to become seriously warped. To

correct this tendency and preserve a semblance to the original shape, a cooper, Mr Gordon, who took a keen interest and share in the work, girded the keg with two iron hoops. These were, of course, no part of the original structure.

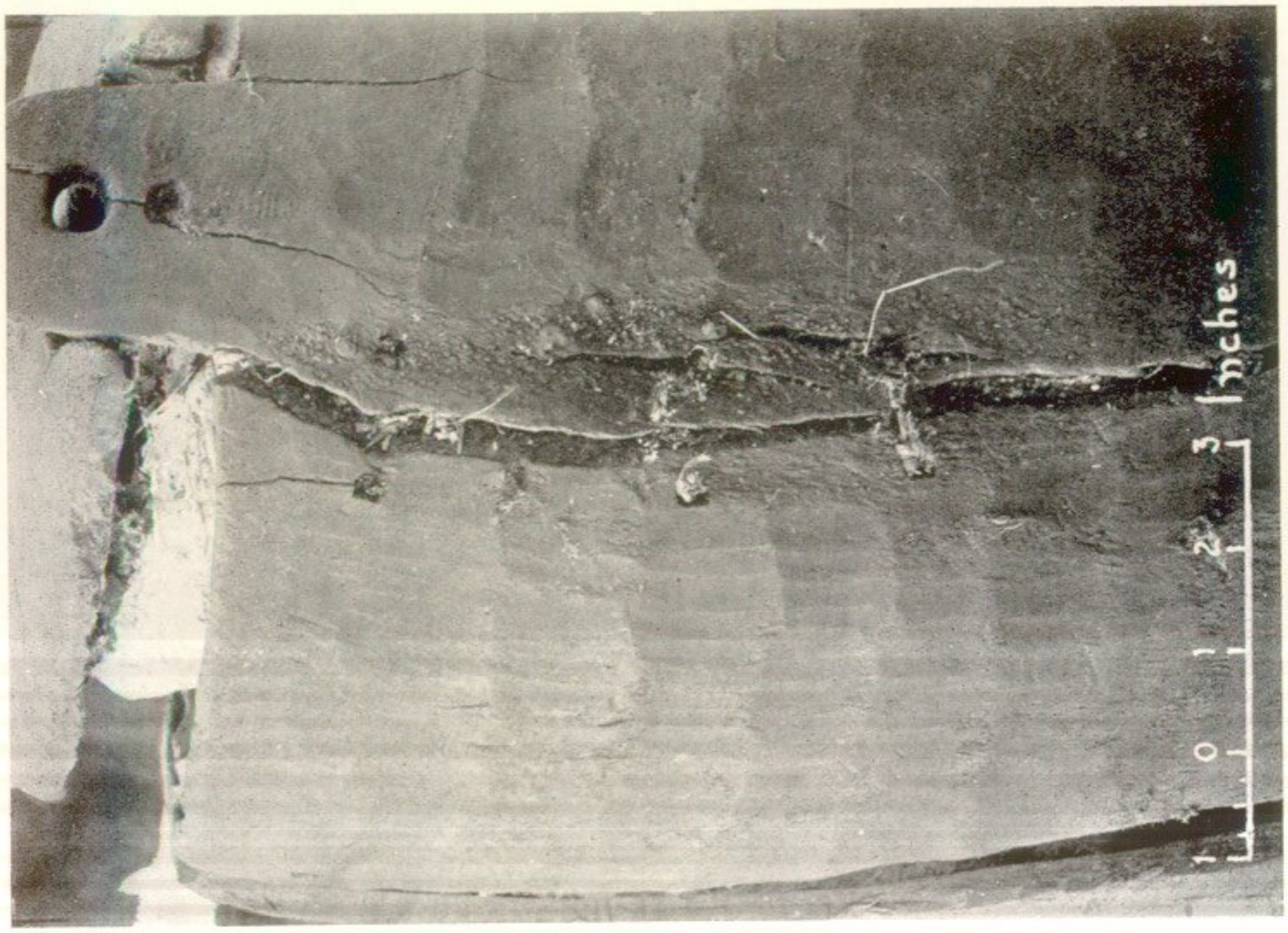
THE KEG AND ITS WORKMANSHIP.

The keg and its associated structures are in three pieces—the body of the barrel itself hewn from a solid piece of wood, a circular lid and a wooden bottom, both also carved from the solid, the latter, although not found at the uncovering of the keg, being discovered in the same place during the peat-cutting of the following year, 1932. The timber from which these objects have been carved is not easily recognisable, but a microscopical examination, made by Dr Laing of the Forestry Department of Aberdeen University, showed that all are of birch.

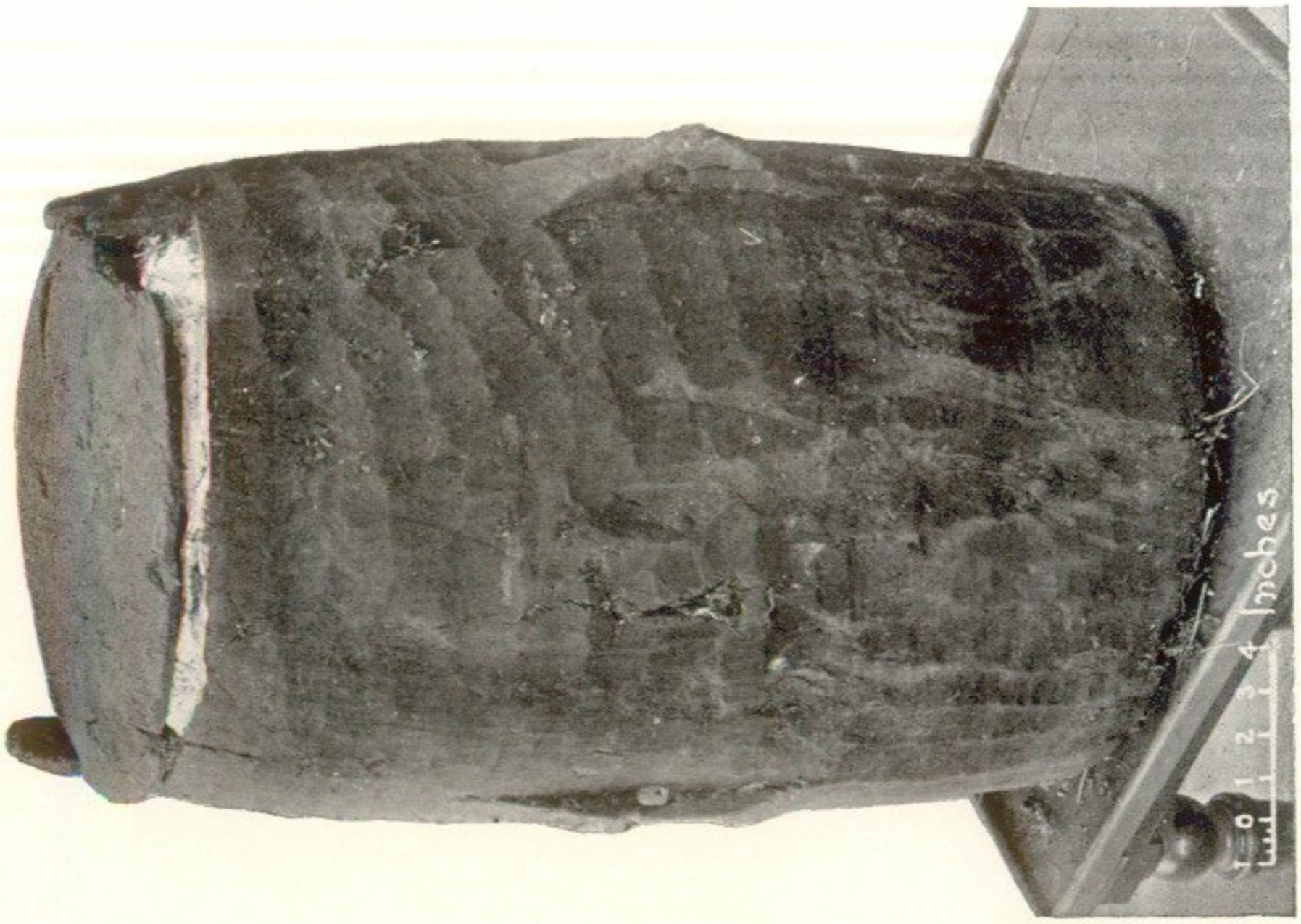
The body of the keg is a skilful piece of handiwork (see PL I, 1). It stood 21 inches high from base to upper edge, and varied in circumference from 43 inches at the top to 45 inches at the widest portion, measured through the holes in the side lugs. It was not quite round; the slightly oval outline in plan may have been due to warping in the bog, but it seemed rather as if the craftsman had been making the most of the natural shape of the tree-trunk from which the keg was carved.

The skill of the work was shown particularly in the uniform thickness of the walls; they were generally from $\frac{3}{8}$ to $\frac{7}{15}$ of an inch thick and seldom reached half an inch; the top edge was slightly bevelled away to a thinness of $\frac{1}{4}$ inch. The method of the workman is shown in the accompanying reproductions of photographs (PL I, 1 and 2, and PL II). The tool employed on the outside seems to have been an adze with a cutting face of about $1\frac{1}{4}$ inches, and it was used on most of the surface in a direction travelling round the girth, but at the base in a vertical direction. Inside the keg a smaller tool, with a cutting face of about $\frac{1}{2}$ inch, was used.

Of excrescences upon the body of the keg there were two pairs, both carved from the solid wood from which the body was made (PL I, 1). At exactly opposite sides of the upper edge were two projecting lugs, $2\frac{3}{4}$ inches high, each perforated by a large upper and smaller under hole. The larger holes may have been used for a rope to aid in lowering the keg into the bog and raising it; the smaller for the insertion of either a supple stick or some pliable fastening to keep the lid in place. The second pair of lugs, originally very strong, but much rubbed away on the surface, projected from the wall of the keg a little above its middle. Instead of being placed on diametrically opposite sides of the keg they stood considerably closer together, the distance separating them being $14\frac{3}{4}$ inches, where a half circumference measured $22\frac{1}{2}$ inches. Each was perforated by a compara-



2. Upper part of keg, showing projecting mass of "butter," the characteristic tool work upon the timber, one of top lugs, and a crack which had been held together by thongs of hide.



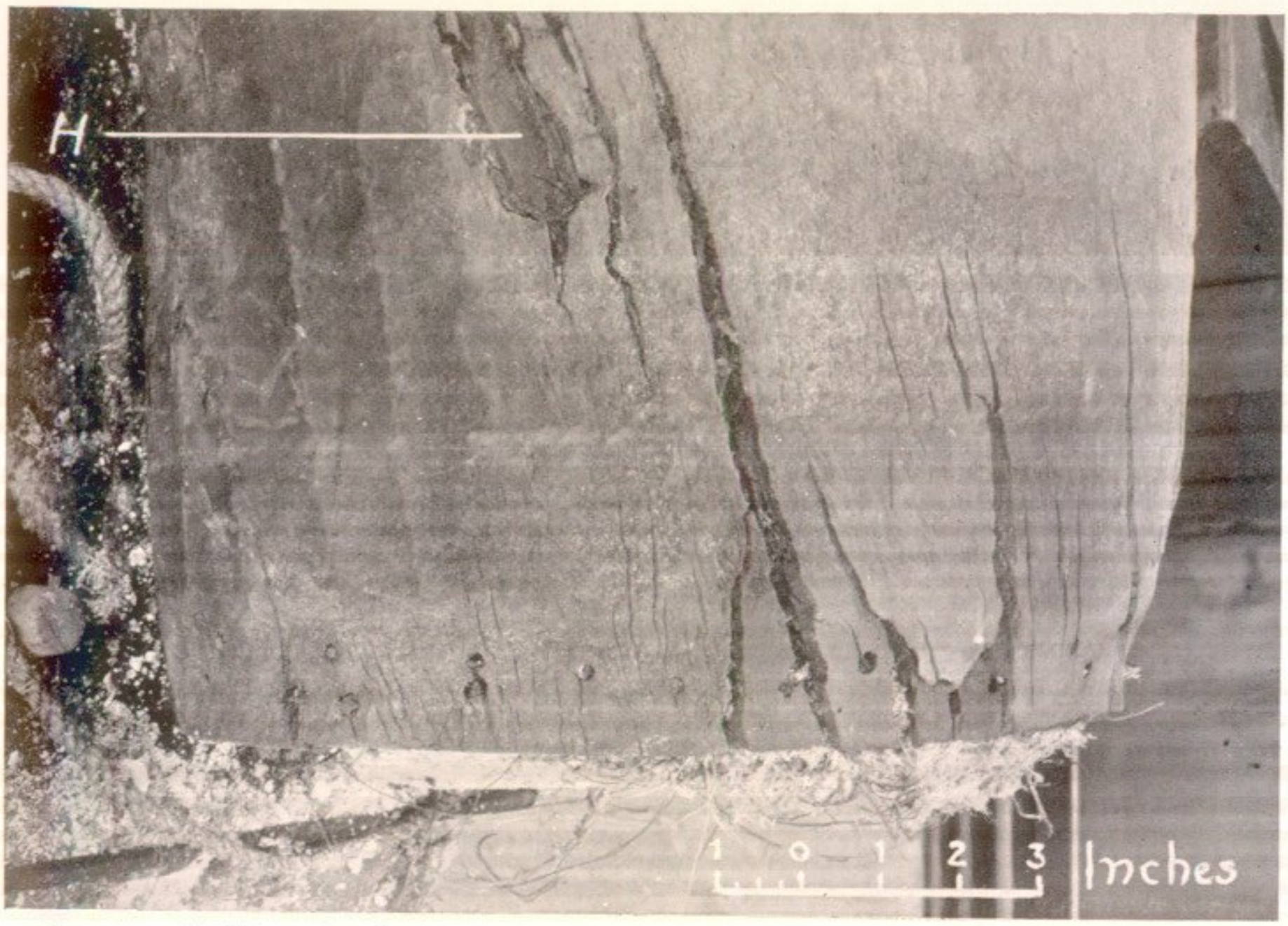
1. Birch keg containing "bog-butter" from Kilmaluag, Skye.

James Ritchie.

[*To face page 8.*

Upper surface of lid of keg, showing method of carving, and in centre probable identification mark.

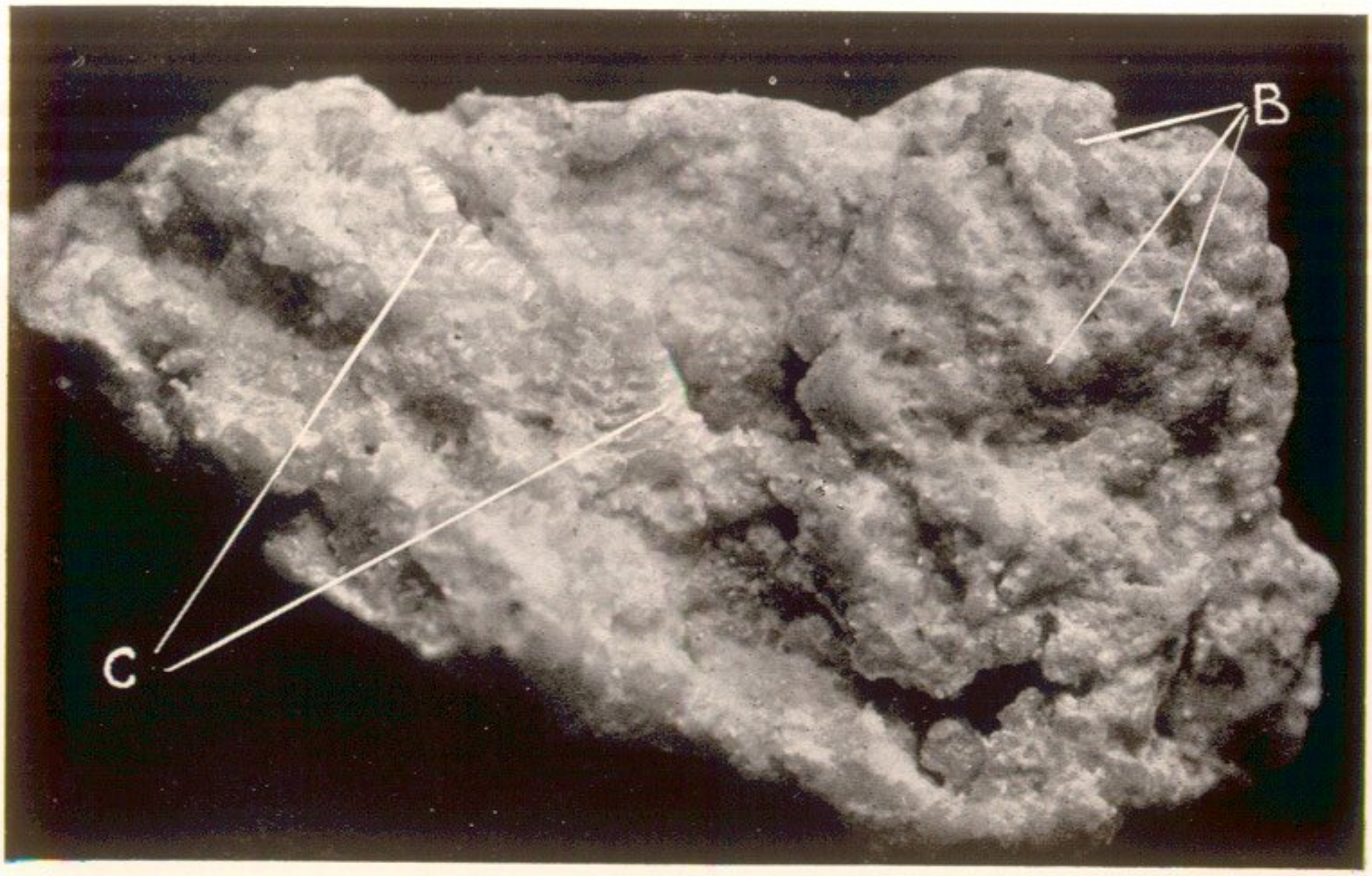
James Ritchie.



Lower part of keg, showing two series of holes by which successive bottoms were attached by thongs of hide, and hole stopped on inside by thin carved slip of wood (H). The pale band at the bottom of the keg shows the part overlapped by the rim of the bottom piece.

James Ritchie.

1. Butter keg from Kyleakin, Skye, in National Museum of Antiquities of Scotland.



2. Magnified fragment of "butter" from the margin of the Kilmaluag mass, showing translucent spheres (B), and an alteration product in the form of minute scaly crystals (C). Magnified 6 diameters.

James Ritchie.

tively small oval hole, and the suggestion I make is that these lugs and their holes were used to allow the passage of a rope by which the keg could be strapped to the back of a man or a pack-pony.

The circular lid was dressed by an adze-like implement worked in a spiral direction from centre to circumference (Pl. II). It was slightly convex on the outside, concave inside, beautifully graded from a thickness of f of an inch at the middle to $\frac{1}{2}$ inch at the margins. The lid completely covered the top of the keg and the slightly projecting contents; it was prevented from slipping sideways by means of two broad rectangular marginal notches which fitted about the lugs. On the outside centre of the lid rough incisions in form somewhat like ⧺ suggest an identification mark.

The bottom of the barrel was also carved from solid wood, a circular base surrounded by a wooden rampart or flange, the top margin of which was bevelled away to a fine edge. The lower edge of the body of the keg stood within the flange of the base, and the bottom was attached by thongs of leather or hide, of which a few fragments remained, and which passed through holes in the flange and corresponding holes in the body of the keg (Pl. III). Round the bottom margin of the keg itself were two series of such holes, roughly $1\frac{1}{4}$ and $\frac{5}{8}$ inch from the edge, the presence of which I shall explain later. The arrangement of the bottom of the keg was similar to that figured in the paper describing the Morvern butter-keg, discovered in Glen Gell, Argyllshire, in 1879, and indeed the two kegs were very similar in general appearance (see *Proc. Soc. Ant. Scot.*, 1882, vol. xvi, p. 220).

It is noticeable that the holes in the wood have not been drilled, but have been burned through sometimes with a round, sometimes with a rectangular implement.

THE "BUTTER" MASS.

When the keg was freshly taken from the bog and its contents were removed, they were of a bleached white colour and of a cheesy consistency, cutting easily and cleanly with a knife. At this time the butter mass seemed to be saturated with water, for whenever a smooth cut surface was exposed, beads of moisture collected thickly upon it. On drying, the mass lost almost entirely its soft cheesy texture, became hard and firm with a tendency to become powdery on the surface when rubbed, and had something of the soapy feeling of talc. Its smell reminded one of rancid butter or sour milk, and it tasted like rancid butter, with a slightly acrid flavour succeeded by a persistent feeling of "acidity" after it had been swallowed. The dry weight of the mass was about 35 lbs.

The mass was cut through the centre in a vertical direction to discover whether it showed any internal structure. From an examination of the

fresh surfaces thus exposed I concluded that the material had not been run into the keg in a liquid or semi-liquid form, for there were no indications of successive level layers, such as would have been present had melted fat been run in from the top. On the other hand, irregular lines of translucent spots throughout the material, the directions of slight cracks and the seeming junctions of different masses, suggest that the keg had been filled by the successive addition of rather small quantities of the material, each of which was firmly packed against the earlier contents. That is to say, the packing suggests the storage of butter rather than of melted body-fat or tallow. Microscopic examination revealed that while the mass was generally amorphous, there were areas in which inclusions of small translucent yellow spheres seemed to indicate a state approaching that of the original material, and other areas near the surface where crystallization in the form of flattened scaly crystals had taken place (Pl. IV, 2).

Through the services of Messrs. Ogston and Tennant of Aberdeen I received a chemical analysis of the "butter" made in the research laboratory of Messrs. Leverhulme. The report is as follows: "We have examined the sample of fat which was sent by Professor J.' Ritchie and find that it consists of a mixture of 55·4 per cent. fatty matter and 44·3 per cent. material which was volatile at 100° C. The characteristics of the fatty matter separated from the fat by extraction with methyl ether are as follows:—

Iodine value	17·8
Acid value	183·8
Saponification value	203·4
Melting-point	43·7° C.
Titre of fatty acids	45·5° C.
Oxy-acids per cent.	1·73
Reichert-Meissl value (soluble volatile fatty acid)	0·5
Polenske value (insoluble volatile fatty acid)	0·7
Mineral matter per cent.	0·027"

"It was concluded from the above figures that the fatty portion consisted of approximately 90 per cent. free fatty acids and 10 per cent. esters, probably glycerides. The fatty material, apart from its high content of free fatty acids, is evidently very different from butter fat. First, its iodine value is low and its melting-point high, and secondly, there is only the smallest indication of volatile acids as shown by the small Reichert-Meissl and Polenske values.

"According to calculations made from the saponification equivalent and the iodine value, it would appear that the acids are made up of about one-third C_{16} acids and two-thirds C_{18} acids.

"The analytical evidence therefore gives no indication that the origin of the material was butter fat. It is possible, however, that during the

course of many years, decomposition may have proceeded to such an extent that the lower molecular weight acids which are characteristic of butter fat have become removed as water-soluble and/or volatile constituents and the unsaturated acids have been oxidised and changed partly into saturated acids. If this were the case the present composition of the fat as judged by iodine value and saponification value would permit of it having been formed from butter fat. At the same time it must be remembered that tallow might, in the course of storage, give rise to a fat of similar composition.

"In connection with the gradual transformation of fat on long storage, it is perhaps worth while mentioning that a sample of fat removed from a vase in one of the Egyptian tombs was found by us to consist almost entirely of palmitic acid.

"Examination of the fat sample, as received, does not give any definite evidence regarding the origin of the material. The fat and the water are well emulsified and are not readily separated by heating. The aqueous portion after separation of the fat by methyl ether extraction shows only a small acidity corresponding to not more than 0·02 per cent. butyric acid and contains 0·26 per cent. non-fatty solids, both figures being expressed on the fat emulsion. The aqueous portion contains no salt and the amount of mineral matter present in it is extremely small. It is concluded, therefore, that the data which we have been able to obtain on the aqueous portion of the material is not sufficient to throw any definite light upon the origin of the fat."

Since this analysis left undecided the nature of the material placed in the keg, a further test was made by Dr D. J. Bell, then in the Biochemistry Department of the University of Aberdeen. He reports: "We have done amino-nitrogen estimations on the 'bog-butter' and find the content to be 3·6 per cent. of total weight (as NH_3). The material does not give the tests for protein, but contains traces of ammonium-salts. The nitrogen probably originates in infiltrated material from the bog.

"As regards the origin of the material: the virtual absence of NH_2N does not, of course, preclude the initial presence of cheesy matter, as the protein may have been removed by the action of ferments in the marsh-water.

"The large preponderance of high fatty acids (C_{16} and C_{18}) would, on the face of things, at once point to somatic fat and not milk fat as the origin of the material, although one must always consider the occurrence of the synthesis of long chains from short ones, under the conditions of storage."

It is clear from these analyses that whatever the substance may have been which was placed in the keg, it has now no longer the characteristics of either butter or animal fat. Time and perhaps the peculiar peaty

surroundings have brought about extensive chemical changes which have destroyed its original nature. Two explanations of these have been suggested. W. Ivison Macadam in 1882 (p. 222) suggested that "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 milk, succinic and lactic acids being formed, after which the fermentation would yield a proportion of butyric acid. 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."

On the other hand, P. S. Arup in 1932 (p. 301), in describing two buried masses from Co. Leitrim and Co. Tyrone, the analyses of which closely resemble that of the Kilmaluag material, attributed some of the changes to the chemical effects of the action of living organisms—bacteria and moulds. "Fat hydrolysis in butter may be accomplished by two distinct groups of organisms, *i.e.* moulds belonging to the *Oidium*, *Penicillium* or *Cladosporium* orders, or by certain water bacteria, notably *B. fluorescens liquefaciens* or *B. prodigiosus*. The moulds consume part of the free fatty acids thus produced, notably the lower members, while the bacteria are eventually destroyed by the acids they liberate." He attributes the disappearance of soluble fatty acids to the fat-hydrolysing bacteria and the solvent action of percolating water; the insoluble volatile acids, which were solid and powdery, to the oxidation of the unsaturated acids; and the low iodine values to chemical oxidation of the unsaturated fatty acids, as apart from the action of micro-organisms.

A distinction between butter and animal or body fat lies in the high content of soluble volatile fatty acid in the former, Reichert-Meissl value 25·0, as against 0·8 in animal fat. But such content would dissolve out in material immersed for centuries in watery surroundings, so that the low present value (represented by the Reichert-Meissl value of 0·5) might equally well represent the end product in butter or animal fat.

Indeed, although Macadam (1882, pp. 212 *et seq.*) describes differences between bog-butter and animal fat (adipocere), chemical analyses seem to give no certain clue as to whether we are dealing with an altered butter or an altered body fat.

Since the results of the chemical analyses were indecisive about the original nature of the fat, further examination of the material was made for any indication of its origin. Several fibres contained in the substance were extracted and examined. Some of these were indeterminate vegetable fibres, the rest were mammalian hairs, and since these might be significant they were examined in detail.

VARIETIES OP HAIR FOUND IN BOG-BUTTER.

In addition to the hairs obtained in the material described in this paper, hairs were examined from two other masses of a similar nature

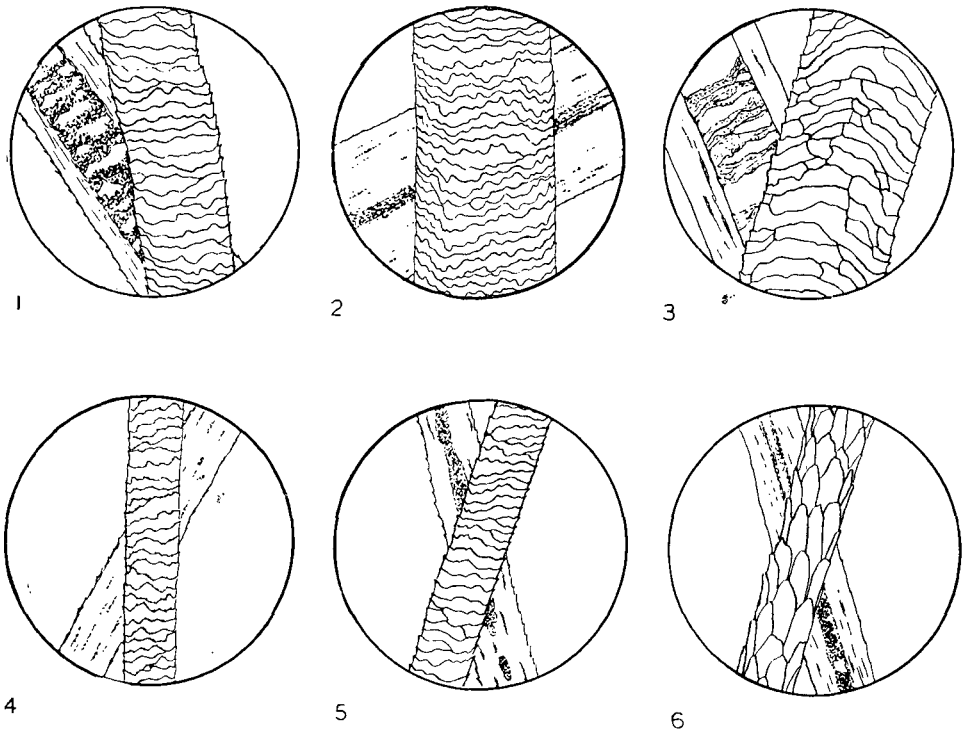


Fig. 1. Varieties of Hair from Bog-Butter. In each figure the upper drawing shows the cuticular scale pattern on the surface, the lower drawing the appearance in median optical section.

1. Cattle hair, strongly medullated, Kilmaluag, Portree, Skye.
2. Cattle hair, with small medulla, Plockton, Loch Carron.
3. Horse hair, Kilmaluag, Skye.
4. Human hair, non-medullated and blond, Kilmaluag, Skye.
5. Human hair, partly medullated and auburn, Kilmaluag, Skye.
6. Dog hair, North Yell.

All the figures are magnified about 150 diameters, except 3, the magnification of which is about 250 diameters.

preserved in the National Museum of Antiquities, one found in a keg at Plockton, Loch Carron, in 1887 (ME. 174), the other a mass of "adipocere" from a bog in Ross-shire, 1849 (ME. 171), as well as from "butter" found in a large oval dish of wood buried in a moss at Cunnister, North Yell, Shetland, and purchased in 1888 (ME. 222). In each of these hairs were rare inclusions.

Of most frequent occurrence in the small collection were hairs of cattle,

present in each of the masses except that from North Yell. They represent two forms, both with large and fairly regular cuticular scales, having fine wavy scale margins (see fig. 1, 1 and 2). In one form, varying from 80 to 96 μ in diameter, the medulla was large (50 μ) and contained much pigment (fig. 1, 1), while in the other larger form with a diameter of 112 to 132 μ the medulla was narrow (20 to 24 μ) and strongly pigmented although pigment granules were also scattered in streaks throughout the cortex (fig. 1, 2). Both hairs must have been of a deep red colour, and comparison shows that the second type agrees in every way with a hair taken from the flank of a one-year-old Highland ox.

Next in frequency occur human hairs, which were present in the masses from Skye and North Yell. These are finer in texture, 32 to 52 μ in diameter, have broad cuticular scales, in one case finely toothed on the margin, and have the medulla absent (fig. 1, 4) or discontinuous (fig. 1, 5). Pigment granules are arranged in short longitudinal lines in the cortex and are present in the medulla. The medullated hair was auburn in colour, the other blond, and both types were present in the Skye sample; the North Yell hair was blond.

A single deeply coloured hair, 72 μ in diameter, from Kilmaluag, Portree, Skye (fig. 1, 3) has cuticular scales with smooth edges forming large rather rectangular cells, and a large medulla varying from a discontinuous cylinder, $\frac{1}{4}$ of the diameter of the hair shaft, near the tip, to a well-defined continuous cylinder, $\frac{1}{3}$ of the diameter of the shaft, at the base, and these are characteristic structures of horse's hair (see Lochte, 1938. p. 241, and fig. 91, *a* and 6).

The only other animal represented in these collections is the dog. The surface pattern of a hair from North Yell is distinctive (fig. 1, 6). The scales are longer than broad and form an imbricated design. The hair itself is 54 μ in diameter, its well-marked medulla 8 μ; it is typical of one of the several hair-patterns found in domestic dogs (see Lochte, 1938, p. 182, and figs.).

The examination of the hairs brings out some interesting points. I had been keeping in view the possibility that the fat might be somatic fat or tallow of sheep, such as was preserved in the Faroe Islands, or even of seals, since the latter was frequently stored for food and light in winter. The absence of wool fibres and the hair of seals rules out these possibilities.

The solitary hairs of dog and horse may be regarded as accidental inclusions, which suggest the domestic atmosphere of a farmyard, in keeping with the relics of blonde and auburn dairymaids.

On the other hand, hairs of cattle were present in three of the four samples which were examined, although in none were they common. Macadam records the presence of "cow hairs" in samples of bog-butter

which he analysed at different times: in three samples from different places in Scotland, including those from North Yell and Plockton (1889, p. 434), and in nine samples, of which two were Scottish, six Irish, and one from an unknown locality. Of the Irish samples two contained many cow hairs, and in the undetermined sample they were "abundant, partly coal black outside" (1882, pp. 206, 207). There is no indication that the hairs were specifically identified by Macadam, and Dr Joseph Anderson's "perceptible admixture of cow hairs" in a sample of bog-butter he examined from Kyleakin, Skye, was probably also a cursory determination (1885, p. 310).

Nevertheless our investigations bear out these identifications and we have Macadam's statement that the presence of cow-hairs is characteristic of bog-butter, as contrasted with adipocere or somatic fat from which hairs are absent (1882, p. 217). In the same place Macadam notes, as I also found, that the colour of these cow hairs was always red, and since comparison showed them to be identical in colour and structure with the coat of Highland cattle, it is likely that the cattle associated with bog-butter belonged to a primitive breed, related to the "kyloes."

Macadam suggests that the presence of the hairs is "most likely due to the milk having been churned in a skin," in which case they would bear no essential relationship to the material within the churn, but the greater probability is that they were chance inclusions made during milking, and that they, therefore, are direct indications that the material is a cow-product, probably butter.

Apart from such evidences, testimony and tradition in Ireland and other countries lend their weight in favour of the presumption that the material originally buried was butter.

CONSIDERATIONS BEARING UPON THE AGE OF THE SKYE BUTTER-KEG.

A find of bog-butter in Ireland carries the date of the custom there down to the eighteenth century (see p. 5), and to a late period when the kegs were made of staves, according to a statement referred to by Macadam (1882, p. 219). But how far back the custom extended in Ireland is uncertain and, as I have mentioned, there are no records to indicate when it was in force in Scotland.

Three lines of enquiry may throw light upon the date of the Skye bog-butter or any similar discovery: (1) the keg itself, and particularly its material and handiwork; (2) its position in the layers of the peat-bog; and (3) associated relics or analogy with similar finds with which relics were associated.

To follow these lines of enquiry: (1) *The Keg.*—This is remarkable in construction, the bottom being a separate structure within the rampart-like

rim of which the lower edge of the keg was placed, and then the two were laced together with thongs of hide. No nail of copper or iron and no peg of wood was used. Yet obviously the keg was fashioned by an edged tool of metal, and the holes were burned out by metal rods. The latter is a slow process and suggests that the craftsman had no satisfactory drilling tool of metal. Skilful, therefore, though the craftsmanship of the keg undoubtedly is, it is of a simple and primitive nature, and reveals a lack of appliances and facilities, all of which point to its creation at a fairly remote period.

(2) *Relation to Layers of Peat-Bog.*—The Skye bog-butter under consideration was found at a depth of approximately 6 feet from the old surface of the peat, and the greater number of Scottish discoveries have occurred at what must be regarded as a considerable depth from the surface. For example, the Morvern keg from Argyllshire was found 4½ feet below the surface (Macadam, 1882, p. 221); the Farr, Sutherland, mass of butter, encased in wicker-work at 3 feet (p. 223); the oval wooden vessel from Cunnister, North Yell, at 3 feet (Macadam, 1889, p. 433); the Keith mass in a ba.rk case at 15 feet (p. 433); the Plockton, Loch Carron, keg at 4 feet (p. 434); the Kyleakin, Skye, keg at 7½ feet (Anderson, 1885, p. 311). It must be assumed that these are minimum depths, for peat-cutting is an ancient industry, and some of the surfaces from which these measurements were made may have been denuded of several feet of deposit in earlier times.

Further, if we are right in thinking that the butter-kegs were not buried in a hole dug for the purpose in the peat, but were lowered into a peat-pool (see p. 7), and Macalister also refers to "the practice of sinking butter in bog-holes" (1928, p. 192), then the important conclusion follows that the layers of peat directly above the keg must have been formed after the deposition of the keg itself. Clearly, then, the depth at which the kegs, in particular those from Kilmaluag and Kyleakin, both in Skye, were found indicates a long period of peat formation; but the rate of formation of peat differs so much with the climate, soil and exposure that depth alone gives no satisfactory answer to the time question.

During recent years Dr L. von Post, State Geologist of the Geological Survey of Sweden, has developed a method, adopted by his students and by workers in this and other countries, of analysing and recording the comparative numbers of pollen-grains which the microscope reveals in the deposits of peat-bogs. The numbers of pollen grains in any layer are taken to indicate the frequency of the trees to which they belonged in the neighbourhood of the bog during the period when the layer was forming. And a comparative study of successive layers may show differences in quantities of pollen which indicate that certain trees were increasing in number while others decreased. The Value of the evidence thus gained

is that it shows changes of climate which must have been general over the whole country, and so enables the layers of a peat deposit in one district to be brought into relationship with those of a deposit elsewhere.

Mr Mackay, the discoverer of the Kilmaluag keg, kindly obtained for me two samples of the peat in which it was found, one taken from below the position of the keg and one from above. The former would presumably indicate the local conditions before the butter was placed in the bog, the latter would show the conditions a short time after the deposition.

These samples have been analysed by Dr Ian M. Robertson, formerly of the Macaulay Institute for Soil Research and now a member of the staff of the Edinburgh and East of Scotland College of Agriculture. The sample from below the butter-keg was a *sphagnum*-heather peat, partially decomposed, the index of humifaction in von Post's notation being H_{6-7}, where H_1 is undecomposed peat and H_{10} is very highly decomposed. Pollen grains were present in the following proportions, roughly indicated as percentages of the total :—

Birch (*Betula*)	72
Alder (*Alnus*)	16
Hazel (*Corylus*)	10
Pine (*Pinus*)	9
Oak (*Quercus*)	3

Heather was abundant, and grasses were represented, as also were the shells of the fresh-water protozoon, *Amphitrema*.

The sample taken from above the keg was a *grass peat*, very little decomposed, the index of humifaction being H_4. Its pollen grains were in the proportions:—

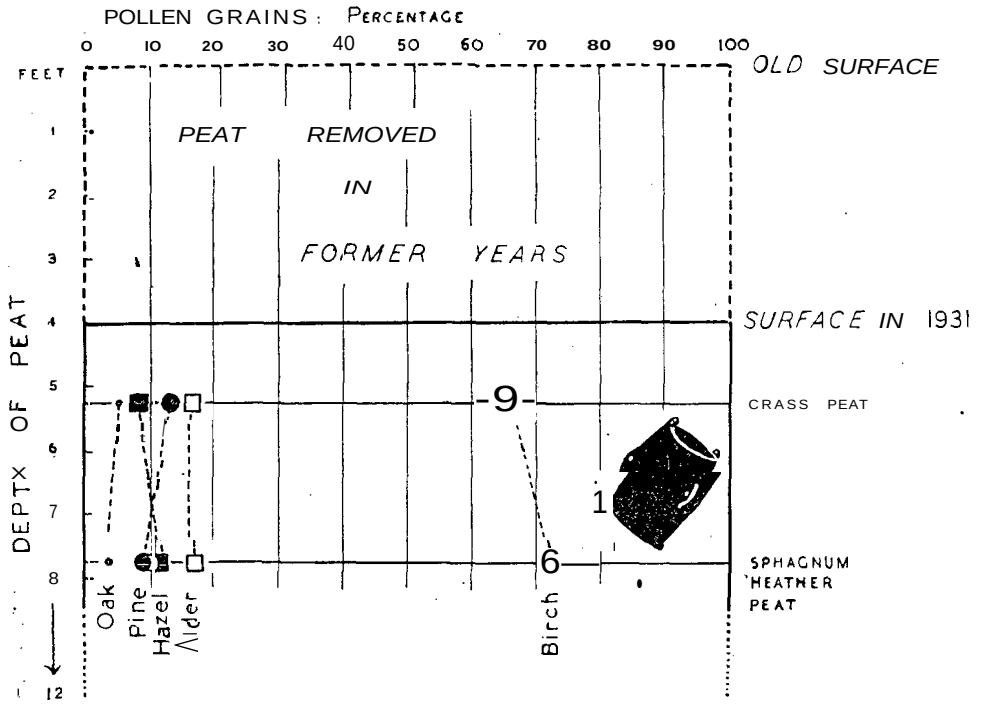
Birch	66
Alder	16
Pine	13
Hazel	8
Oak	5

Grass, rushes, and heather were all very abundant, and the fresh-water protozoa, *Amphitrema*, *Assulina*, and *Arcella* were present. The results of the analyses are shown graphically in fig. 2. What deductions may be drawn from them?

In the first place, the keg was embedded in peat layers which reveal that when they were formed woods or thickets were growing in the neighbourhood in which birch was the dominant tree, accompanied by a small proportion of alder, hazel, and pine and a sprinkling of oak, although the small amount of pine pollen may have been transported a great distance

by wind. No tree of any kind grows near the place now, and Mr Mackay tells me that no trees have existed there in the memory of the oldest inhabitant. Moreover, such a type of vegetation is scarcely represented in Skye at the present day.

In the second place, although there is no significant difference in the pollen frequencies of the various trees in the layers above and below the



Pig. 2. Diagram illustrating the position of the keg in relation to recent and former surface of peat deposit, and pollen-grain content of peat below and above the keg.

keg, there is a significant difference between the layers. Thus the bottom sample is a *sphagnum*-heather moss rather more than semi-decayed, while the upper sample is a slightly decayed grass peat, which resembles closely the present undecomposed grass peats so common in the islands. The difference indicates a considerably more recent deposition of the upper layer.

In the third place, alder invaded the islands, according to the evidence of pollen grains, at a period much later than it appeared on the Scottish mainland, as is shown by a comparison of the pollen diagrams in Erdtman's paper dealing with Scottish mainland peat deposits (1928, pp. 170 *et seq.)* and in his paper dealing with the Scottish Isles (1924, pp. 465 *et seq.*). He

says in the latter (p. 494) that "in Sjaelland and Sweden the first alder-pollen appears in late boreal strata (about 6000 years B.C.), and it probably is the same in Scotland," that is on the mainland. The indication is, therefore, that, generally speaking, the appearance of alder on the Scottish islands was considerably later than that date, and, further, that its presence on Skye, where in the few deposits investigated alder pollen makes a characteristic sudden and late appearance (Erdtman, 1924, p. 467), marked a still more recent period.

Now in the layer *below* the keg alder pollen has attained a place only second to birch in frequency, and therefore we must assume that long before the burial of the keg the tree was already well established; and, as we have shown, the upper layer is considerably later than the lower one.

Finally, the grouping of the pollen-grain percentages of the different trees in our samples falls into line with that in the higher strata of the peat-bog N.W. of Portree investigated by Erdtman (1924, p. 467), and although the resemblance is not conclusive, it suggests an origin not earlier than late sub-boreal or early sub-Atlantic times.

The pollen analysis of the peat cannot give a definite answer regarding the age of this keg, but the cumulative evidence, of the accretion of five or six feet of peat and of the presence and the particular character of woodland in the neighbourhood of a place now treeless, of the keg itself carved from a substantial birch-tree more than 15 inches in diameter (although the possibility that the wood was not native but was imported for the purpose must be kept in mind [1]), points to a period more remote than the sixteenth or seventeenth centuries, to which such finds have usually been attributed, and suggests rather some time in the early historical or late prehistoric periods.

The above discussion is based upon the supposition that the peat found immediately above the butter-keg was formed after the keg had been lowered into a bog-pool. The position of the keg when found supports this supposition, but there are two other possibilities either of which would make the reading of the pollen content in the upper layer valueless as a time indicator. The first is that the keg may have been buried in a hole dug in the solid peat for its reception. This, I think, is unlikely because an essential for the exclusion of air is close contact throughout between the keg and its surroundings. Such contact would be perfect in a water-filled bog-hole, it would be almost impossible in a hole dug in solid peat. If a simple method of placing in a bog-hole could attain the necessary result, is it likely that the laborious method of burying and resurrecting from a pit would be used?

[1] This possibility seems to me to be somewhat remote, for the discovery in Scotland of other butter masses wrapped in skin and in constructions of wicker-work suggests that a birch trunk need not have been used and would not have been used unless it was easily obtained.

The second possibility is that the keg, having been placed in a bog-hole, sank into deeper and older layers of the peat. Against this possibility must be reckoned the fact that the owner intended to recover his keg, which, as I shall show, was of great value to him; and on that account he would avoid a soft peat-hag where he might lose it, and would select a pool on the firm bottom of which the keg could rest in comparative stability.

It may be noted that either of these possibilities would probably leave recognisable traces in the peat immediately above the keg, where the layers instead of being continuous with the surrounding layers, as in the case of deposition in a bog-hole, would be broken and disturbed. Observation of such disturbances could only be made on the spot and at the time of discovery, and in the present case the finder is emphatic that there was no appearance of former disturbance, and in his opinion the peat grew after the keg was deposited.

(3) *Indication of Age from Archæological Associations.*—It is unfortunate that the discoveries of bog-butter in Scotland have generally been recorded with little information about their associations in the peat, and that in only one case is there a record of a contemporaneous relic which might give a clue to the date of burial. That also is a Skye record. Along with several kegs or small barrels of butter found under a depth of about 7½ feet of peat in a moss at Kyleakin, Skye (PL IV, 1), there was present and said to be in close juxtaposition a bronze cauldron, semi-globular in form, 18 inches in diameter and 12 inches high (J. Anderson, 1885, p. 311, fig. 1). Its date is unknown, but Dr. Anderson regarded it as having several points of correspondence with two similar cauldrons found about 1837 on sub-soil below peat near Cockburnspath, Berwickshire. These contained a miscellaneous collection of iron implements and bronze objects, including the bowl of a Roman patella, and the nature of the collection made it evident to Dr. Anderson that it belonged to "a time subsequent to the Christian era, and probably after the period of the Roman colonisation of the south of Scotland." The indication of the worn, dilapidated and much-patched cauldron is that it was older than the collection of tools it contained. If it corresponds with the Kyleakin specimen, and if this was contemporaneous with the butter-kegs, then they must be attributed to the early centuries of the Christian era. But Dr. Anderson's description of one of the Kyleakin butter-kegs suggests that it is less primitive than the Kilmaluag specimen, for in the former the top and bottom were "inserted in ledges prepared to receive them," whereas in the latter the bottom was a rough external piece laced on to the keg by thongs.

I have examined the Kyleakin keg, which is preserved in the National Museum of Antiquities (ME 167), and am indebted to the Director, Mr. A. J. H. Edwards, for the photograph here reproduced (PL IV, 1). While at the lower end as shown in the photograph, a piece of wood was

apparently inserted and held in place by internal ledges in the wall of the keg,[1] at the other end a stout rim, formed by a deep external incision round the wall, indicates that this end was closed by a covering of skin or hide tied in position, and not by a wooden structure as Dr. Anderson suggested. The Kyleakin keg possessed side lugs carved from the solid wood of the body of the keg and perforated by circular burned holes, as in the Kilmaluag specimen, and the appearance and smell of the butter content of the two are similar.

The Kilmaluag keg may therefore be still earlier than that from Kyleakin, and this dating, about the opening of the Christian era, is in general agreement with the evidence from the peat deposit.

Although no definite age has been assigned to the earlier examples of bog-butter from Ireland, the recent tendency there has been to regard the practice as of far greater antiquity than was at first supposed. And Mr. L. S. Gógan, of the National Museum of Ireland, relying upon pyrographic decorations on the containing vessels, determines some of them as dating approximately from the eleventh to fourteenth centuries (see f.n. in Arup, 1932, p. 300).

THE USE OF THE BUTTER-KEG.

The keg itself bears evidence of the value in which it was held by its owners. It has been treated with great care, a possession which, in spite of the long periods of immersion to which it was subjected, had to be conserved for use over and over again. This keg had been used in the bog on previous occasions, for the drying of its saturated timber, while it was in the house after an earlier resurrection from the bog, had caused shrinkage and the development of a huge crack from the top rim. Too precious to be rejected on this account, the keg was repaired by the lashing together of the split wood by means of hide thongs passing through holes burned in the timber (see Pl. I, 2).

A second accident happened to it on this or another occasion, for, again while it was in the house, mice had gnawed through the wooden wall to reach the butter, leaving the marks of their incisor-teeth upon the sides of the hole. The hole, nearly three inches long by an inch broad, would have allowed the butter to escape when next the keg was filled. The owner therefore carved a thin oval slip of wood, $4\frac{3}{4}$ inches long by $1\frac{1}{2}$ inches broad, which was slipped over the hole on the inside of the keg while the butter was being packed, so that, without other support, the butter held it in place (see Pl. III, H). It fell away from this position when I removed the butter.

Finally, evidence of repeated use is given by two series of holes around

[1] The wooden hoop shown securing this end is not part of the original structure but, like the bands of wire, has been added to keep the keg in shape.

the base of the keg for the attachment of the separate bottom-piece. These are of two distinct sizes, bored by different tools, are at different levels, and some are so close together that they could not have been used on the same occasion. The indications are that the keg was used until the first bottom became so dilapidated that it had to be replaced by a new one, through the rampart of which and the base of the keg holes were bored simultaneously.

Of the history of the butter-keg and its contents after its disposal in the peat-hole nothing is known, but a shrewd conjecture may be made. It is unlikely that the owner of so treasured a possession, or his family, would forget the spot where it lay and whence he meant to retrieve it. It may have sunk beyond his ability to recover it, but he must have considered and done his best to avoid that possibility when he selected the site. The chances are that the vagaries of war or of tribal feud left it ownerless, to be eventually overgrown and imbedded in the accumulation of peat, until after many centuries a modern peat-cutter revealed again its resting-place.

The Skye keg from Kilmaluag here described has been given by me to the Regional Museum of the Town Council of Aberdeen.

PAPERS REFERRED TO *IN* TEXT.

ANDERSON, JOSEPH, 1885. "Notice of a Bronze Cauldron found with several small kegs of butter in a moss near Kyleakin, in Skye; with notes of other cauldrons of Bronze found in Scotland." *Proc. Soc. Ant. Scot.*, vol. vii. pp. 309-315.

ARUP, P. S., 1932. "Analyses of Two Samples of Irish 'Bog Butter.'" *The Analyst*, vol. Mi. 1932, pp. 300-302.

ERDTMAN, *G.*, 1924. "Studies in the Micropalæontology of Postglacial Deposits in Northern Scotland and the Scotch Isles, with especial reference to the history of the woodlands." *Journ. Linn. Soc., Botany*, vol. xlvi. pp. 449-504.

ERDTMAN, G., 1928. "Studies in the Postarctic History of the Forests of Northwestern Europe. 1. Investigations in the British Isles." *Geolog. Fören. Stockholm Förhand.*, pp. 123-192.

LOCHTE, TH., 1938. *Atlas der Menschlichen und Tierschen Haare.* Leipzig.

MACADAM, W. IVISON, 1882. "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 Gel], Morvern, Argyllshire, and now in the Museum." *Proc. Soc. Ant. Scot.*, vol. xvi. pp. 204-223.

MACADAM, W. IVISON, 1889. "Notes on the Analyses of Additional Samples of Bog-Butter found in different parts of Scotland." *Proc. Soc. Ant. Scot.*, vol. xxiii. pp. 433-434.

MACALISTER, R. A. S., 1928. *The Archæology of Ireland.*