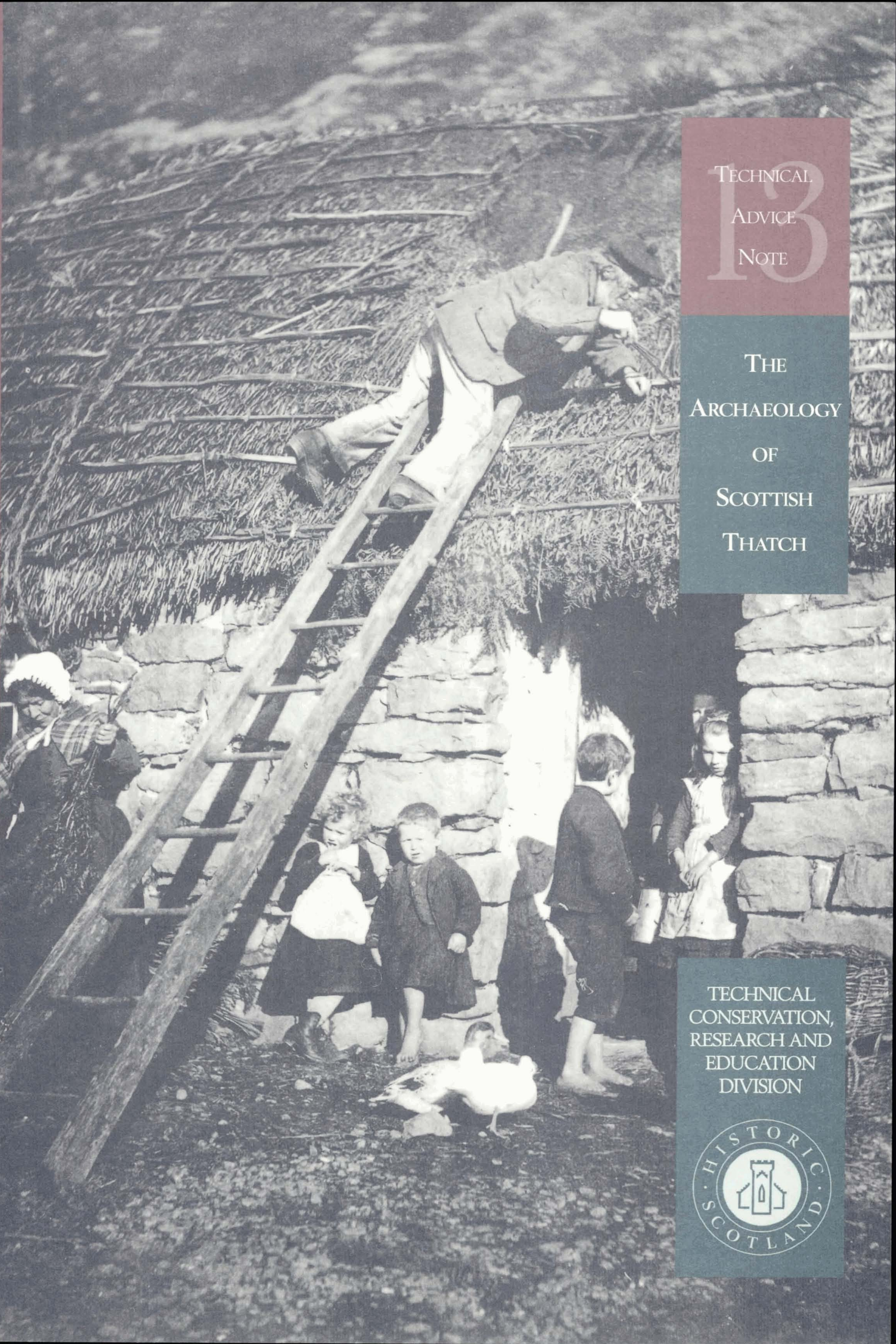

Technical Advice Note 13

The Archaeology of Scottish Thatch

Technical Conservation, Research and Education Division

Historic Scotland

TAN 13

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TECHNICAL

ADVICE

NOTE

THE ARCHAEOLOGY OF SCOTTISH THATCH

by

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ABSTRACT

This Technical Advice Note presents the case for detailed study of thatching methods and materials from Scotland using, as examples, the analysis of a number of thatched roofs from contrasting areas across the country. The discussion of the potential for study has highlighted several areas of academic research where old thatch provides valuable information that would be difficult to recover from other lines of investigation. Experience gained through the worked examples has been used to outline a proposed methodology for future study.

The examples presented here have uncovered details regarding the materials and methods used for thatching, the selection of materials, their source and how the roofs were maintained, thereby providing an accurate picture of many practical aspects of what is very clearly a rapidly disappearing craft. A wide variety of materials have been identified as the main thatching materials including heather, bracken, cereal straw and rushes reflecting local environments, economic circumstances and strong regional traditions. Details of sub-surface structures and less obtrusive but nevertheless important components have also been identified and added to the understanding of how these roofs functioned.

The materials used for the construction of the roofs together with other plants, invertebrates and mineral components inadvertently collected with them, all add to the overall picture. The majority of these components must have derived from the local environment and therefore inform us about the conditions around the settlements at the time of collection. The different elements within the roof can therefore be used as evidence for land management, crop husbandry techniques, vegetation cover, exploitation of wild resources and agricultural development.

Thatching is certain to have been the main method of roofing in Scotland before the advent of slate and tile but little evidence for its use has been identified in archaeological deposits. To some extent this is because archaeologists have not recognised the signals that might be expected from decaying thatch. A detailed study of the type undertaken here therefore enables the production of interpretative frameworks that will allow archaeobotanical and other archaeological techniques to more easily recognise the characteristics of early thatch.

A methodology for the recording of these roofs is suggested which consists of a combination of recording in the field and the removal of intact portions of the roof for detailed dismantling in the laboratory. A number of different lines of investigation including botanical, pedological and entomological analyses are recommended.

An unusual needle thatch from Orkney with diagonal as well as standard simmens. (National Museums of Scotland C12181).

CONTENTS

FOREWORD

This Technical Advice Note (TAN) is the fourth publication in the wider series to deal with Scottish Traditional Building topics. It has been prepared to compliment TAN 4 "Thatch and Thatching Techniques, A Guide to Conserving Scottish Thatching Traditions", published in 1996. That volume gave the historical background to thatching and outlined the technical advantages and disadvantages of the various Scottish thatching techniques that have been used. It also described surviving thatches, whilst noting the decline of associated traditional skills in the face of techniques introduced from elsewhere.

This publication starts to redress that imbalance through exploring the value and methodology of archaeological recording and analytical techniques, and their relevance to the thatching industry in Scotland. As with other TANs, it cannot be prescriptive, and it should not be used as a source from which to take a definitive specification. Rather, its value lies in the development methodology based on case studies. This brings a new dimension to the study and understanding of thatch roof construction.

Although this approach has been adopted with the archaeological profession in mind, its value should not be underestimated for other professional groups involved in the repair, maintenance and reconstruction of Scottish Traditional thatched buildings. However, given the general validity of the approach, and the high quality of supporting illustrations the recommended methodology will also have a much wider, international, application.

Historic Scotland is indebted to Timothy Holden of Headland Archaeology Ltd, and to the other contributors, for the detailed work that has been involved in producing this TAN.

Its release greatly adds to the value of advice currently available and should do much to ensure the continuing survival of the wider variety of Scottish thatch and thatching techniques that still exist, albeit under threat.

Ingval Maxwell
Director, TCRE
January 1998

A needle thatch from Faray, Orkney. Note the Orkney flagstone at the eaves and the rooflight over the window. (National Museums of Scotland C8332).

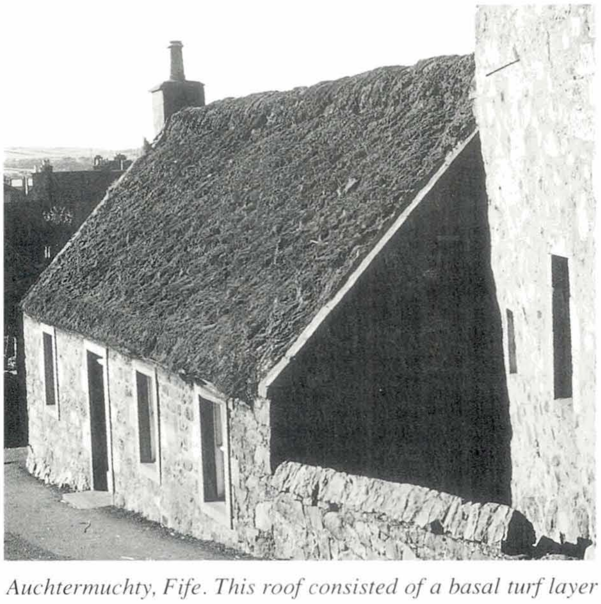
1 INTRODUCTION

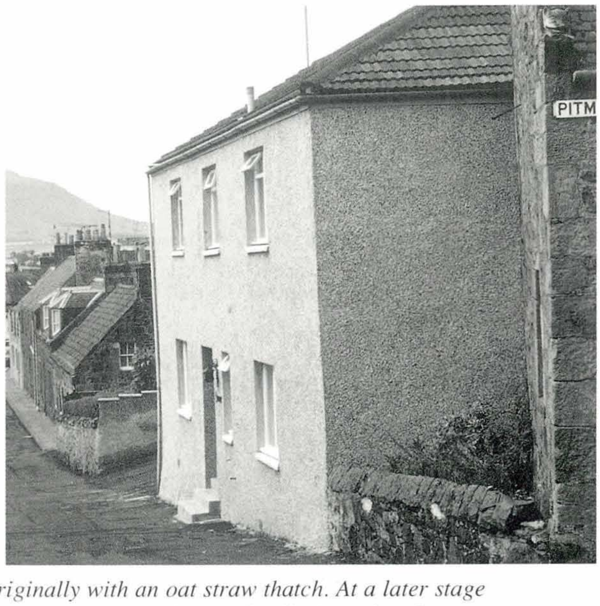
1.1 The present situation

Walker *et al* (1996) have already discussed the position of thatched houses within the existing legislative framework with respect to buildings of special architectural or historic interest (ie. Listed Building legislation). The majority of the surviving examples are, however, not listed and many are not even known about, being concealed under later sheet materials such as corrugated iron or asbestos. The following points illustrate the position of these within existing planning legislation and highlight some of the problems regarding the conservation of the better examples or, the recording of those that are beyond the scope of the existing maintenance or repair schemes.

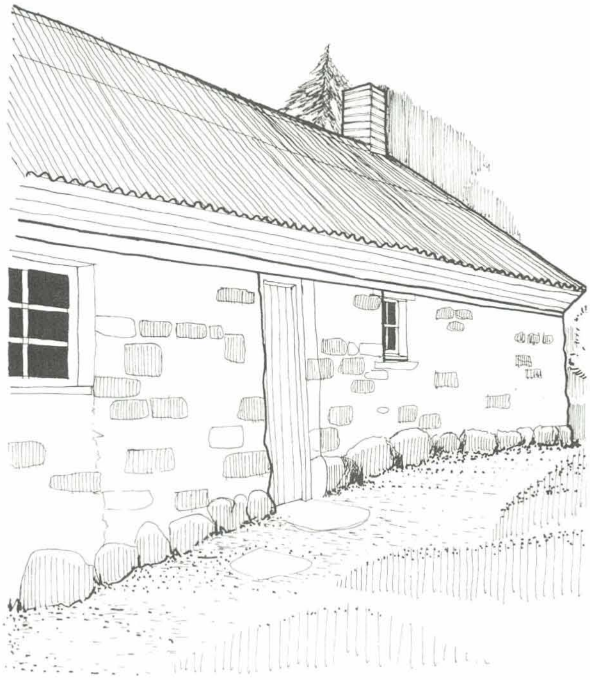
- Most examples are neither Listed Buildings nor Scheduled Monuments so do not, as a matter of course, fall within the terms of the legislation administered by Historic Scotland.
- Surviving examples are unlikely to appear in either the National Monuments Record of Scotland (NMR) or council Sites and Monuments Record (SMR). Although surveys of vernacular buildings exist for some parts of Scotland, knowledge regarding most areas largely depends upon local knowledge and interested groups.
- Examples of thatch on agricultural buildings that have been covered by later sheet materials are unlikely to be identified during the planning process. Planning consent may not even be required to remove or replace these roofs in some cases.
- Many of the roofs are in a ruinous state and deteriorating through natural agencies rather than development. Recording of such roofs before they disappear is therefore unlikely to be required by local planning authorities.
- Many of the known examples, including those referred to in the enclosed report, are not expected to survive long into the next millenium.
- Depending on the condition of a thatched house it may be regarded as either an historic building or as an ancient monument. The transition phase between these two states, when the building may be deserted but with some part of the roof surviving, is the point at which it is most urgently in need of detailed recording and it is at this point that they seem to be least protected.

It would appear that these rapidly disappearing resources presently have little protection through the





Auchtermuchty, Fife. This roof consisted of a basal turf layer originally with an oat straw thatch. At a later stage short layers of reed were driven through the oat straw. The ridge was capped with a mudwall mix and turf. Before (1974) and after (1980) renovation (B.W.)



Thatch boxed-in under corrugated iron. Red Roofs, Liff, Angus (B.W.)

planning process. This situation is actively being addressed by Historic Scotland.

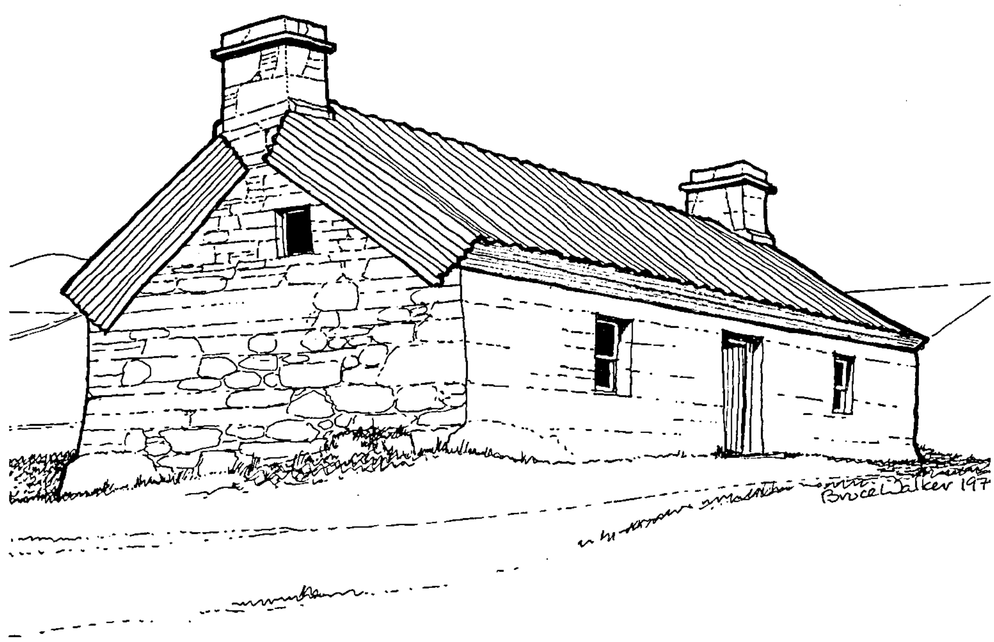
1.2 The scope of this Advice Note

This Technical Advice Note is designed to complement the existing publication by Walker *et al* (1996) and will discuss the value and methodology of applying archaeological recording and analytical techniques to the study of thatch and thatching. From the outset it was clear that, given the wide variety of thatching materials used in Scotland and the various circumstances of the buildings (for example dilapidated or complete, under later sheet materials or exposed), it would be impossible to provide a definitive formula for their sampling and analysis. The methodology outlined below does, however, bring together the experience gained to date in highlighting some of the benefits and pitfalls offered by the basic approach.

Samples from seven different thatched buildings were selected in order to develop a methodology. These included thatches from a variety of locations which were constructed using a variety of different techniques and materials:

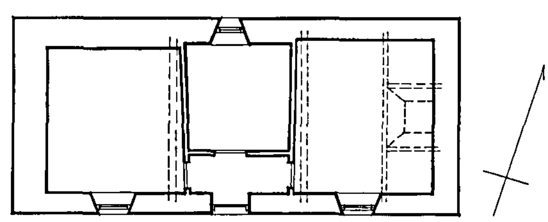
- Jock's Croft, Lochearnhead, Stirling - a thatch of bracken with alternating layers of drawn oat over turf.

Thatch is often preserved under corrugated iron or other sheet materials. In this case the thatch was of reed. Murroes, Angus. (B.W.)

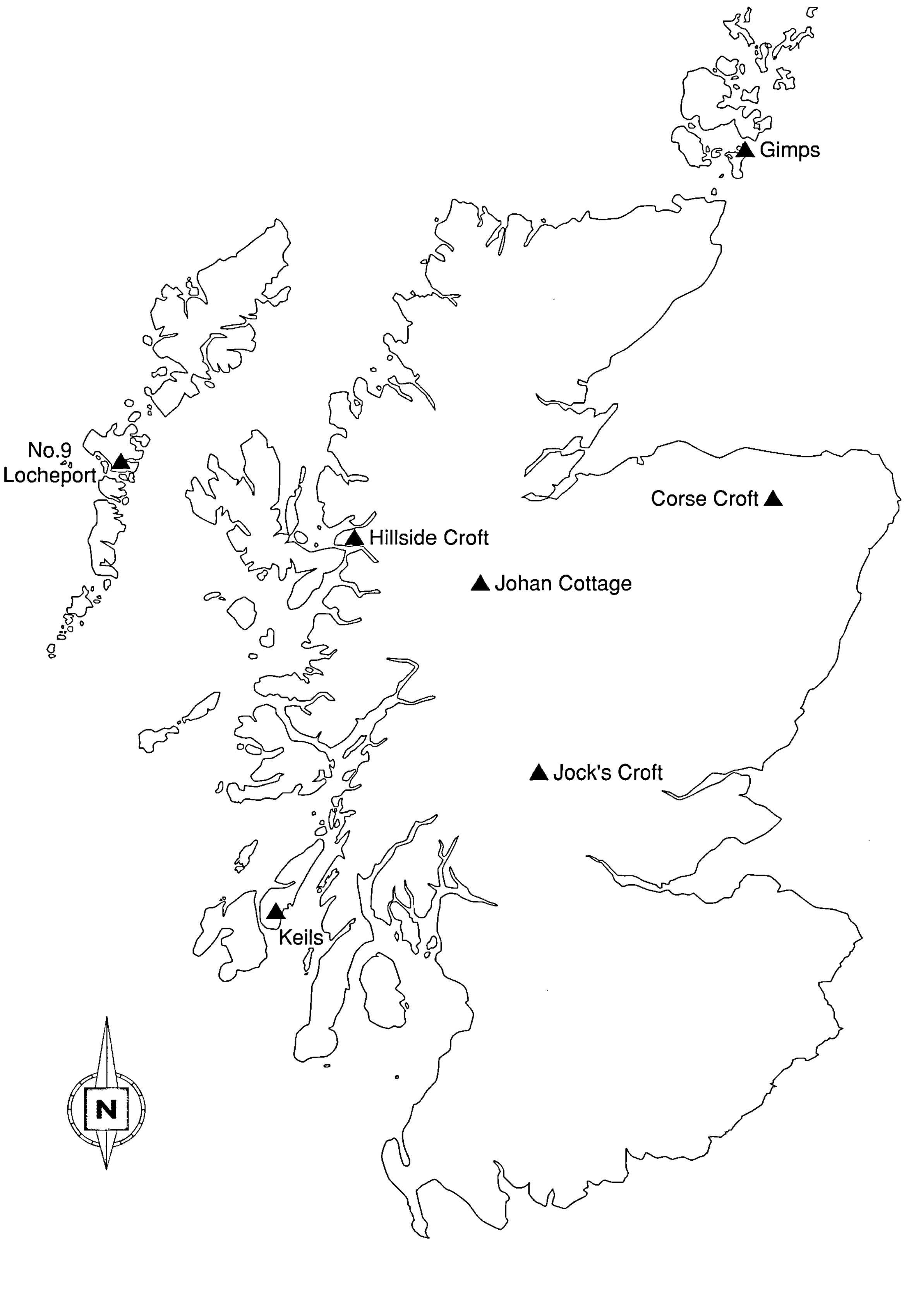


- No. 9 Locheport, Sidinish, North Uist - a heather thatch with bracken bedding layers and with earlier coats of cereal and marram grass over turf.
- Keils, Jura - a rush thatch with occasional layers of cereal straw over turf.
- Gimps, South Ronaldsay - a needle thatch with underlying straw *simmens* and numerous successive layers of cereal straw.
- Corse Croft, Huntly, Aberdeenshire - a cereal straw and clay thatch with broom at the ridge and eaves.
- Johan Cottage, Fort Augustus, Highland - a heather thatch over turf with turf and applied sediments over the ridge.
- Hillside Croft, Sheildaig, Strathcarron - a thatch made of coarse heather with no sub-strata.

The construction of the thatch from each building was recorded as much as possible *in situ* and samples were taken for later analysis in the laboratory. The dismantling of the thatch was undertaken using archaeological principles of stratigraphic excavation, i.e. by the removal of different strata in the reverse order to that used in their initial construction. In this way it was possible to gain a better understanding of how the thatches were constructed and the materials used. It also enabled collection of uncontaminated samples for later detailed analysis.



Thatch under corrugated iron. Drumdewan Cottage, Perthshire. (B.W.)



Location of the worked examples discussed in the text.

2 THE POTENTIAL FOR INVESTIGATING OLD THATCH

2.1 The thatched roof

The construction of a thatched roof involved numerous decisions and different tasks; suitable thatching material had to be selected, collected and prepared, and finally assembled on the roof. Once constructed, it had to be maintained and frequently repaired. The dismantling of a thatched roof in controlled circumstances can provide a good insight into the techniques and materials used.

2.1.1 Construction

In some cases the thatching was undertaken by specialist thatchers (eg. Souness 1991), but in many parts of Scotland the materials used required regular repair and maintenance and both the house and the corn and hay stacks were thatched by the owners or tenants themselves. This was primarily the case with the less durable materials such as cereal straw or rushes, which needed annual attention. By carefully dismantling the thatch it is possible to identify the structure of the material or combinations of materials used for the main bulk of the thatch. At Jock's Croft for example the presence of alternating layers of drawn oat straw within the bracken thatch was previously unrecorded. Where preservation allows, the methods of applying the thatching coats, the fixing techniques and the special precautions taken at vulnerable parts of the roof such as the apex, eaves, skews and around the smoke-hole or lum are also recognisable.

2.1.2 Selection of construction material

The choice of material used in a thatch reflects the function of a building, the preferences of the thatcher and the availability of preferred materials. The heather thatches from Sheildaig were formed of long, old heather which must have led to a relatively open roof structure possibly only suitable for temporary accommodation or an animal byre. It was in all probability constructed by the user of the building. By contrast the heather used at No. 9 Locheport was shorter and younger and in conjunction with the underlying layers of bracken probably provided a more

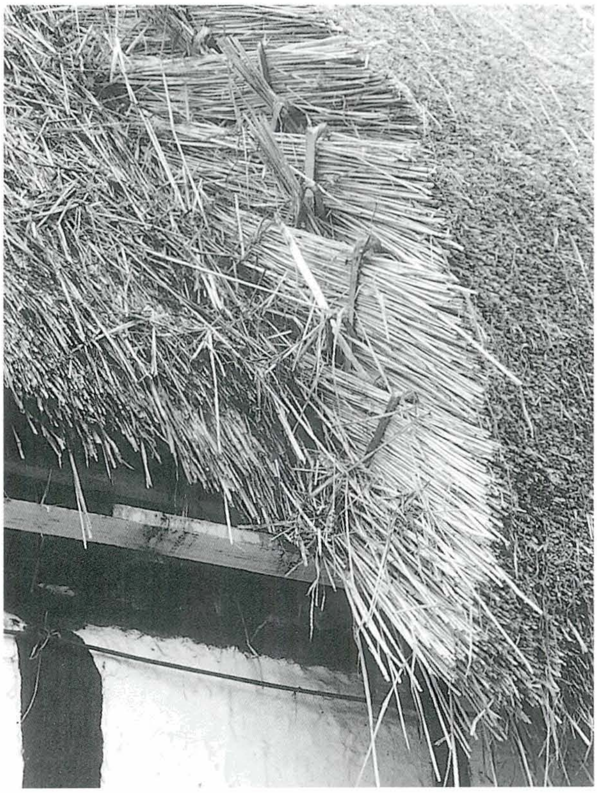
A cottage, New Galloway, Dumfries and Galloway. The dark colour and coarse texture suggest this might be a broom thatch. Note the rolled skews, roped chimney heads and scob and wand fixings at the ridge. (G.W.W. Aberdeen University Library E1509)

A Skye crofters' home. A thatch of cereal straw, bent or rush, roped and weighted with stones. (G.W.W. Aberdeen University Library C7409)

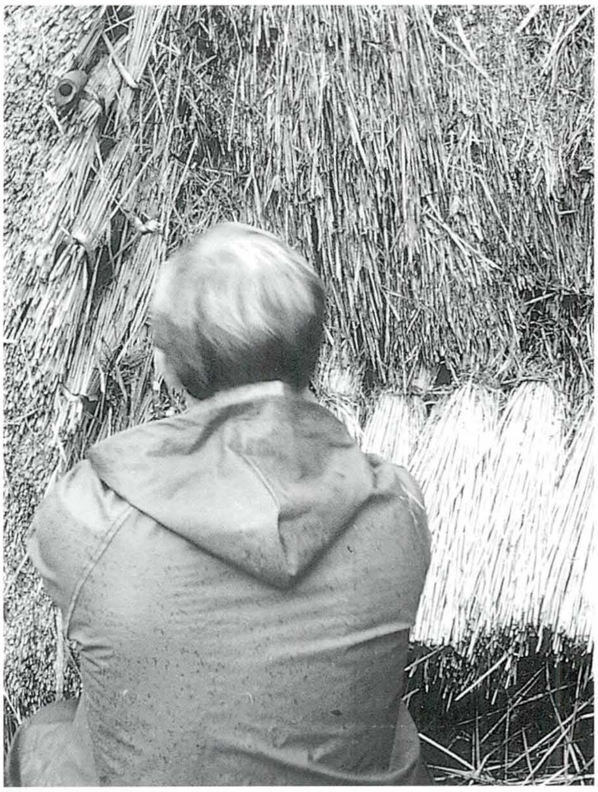
Cottages at Brodick Castle, Arran. The dark colour of the roofs suggests these are of heather fixed with either twine or chicken wire weighted with stones and timber laths. They have rolled skews fixed with wand and scob. (G.W.W. Aberdeen University Library B0595)

Two Highland cottages, at Luss, Loch Lomond. Different thatching techniques are shown on adjacent buildings. The house on the left is probably a bracken thatch, the horizontal lines being formed by the blackened basal parts of the stipe exposed on the surface. Close to the apex wand and scob have been used as a fixing. The house on the right is in a much poorer condition and appears to have a coarse material such as bracken close to the skews but other parts of the roof look more like cereal straw. (G.W.W. Aberdeen University Library F4310)

Michael Bruce's Cottage, Kinnesswood, Loch Leven. Probably one of the earliest reed thatches in the area. The reed would have been stitched to the roof and the gable capped with turf. This commonly used roofing style superseded earlier cereal thatches in many east coast towns. Most have now been replacing with pantiles (G.W.W. Aberdeen University Library F5351)



A wheat reed technique, Warwickshire. (B.W.)



A stob thatching technique, Warwickshire. (B.W.)

weather-proof covering. In some locations this type of structure may have been constructed by a specialised thatcher such as the one described by Souness (1991).

In some cases it is evident that methods and materials changed throughout the life of the roof and the techniques used in the earlier periods may not have been observed by any living thatchers. It is evident that environmental or economic situations changed during the life of various roofs and the materials used were altered as a consequence. At both Keils and No. 9 Locheport, for example, the earliest functional roof was probably one of turf which was later topped by a cereal thatch. Circumstances changed and subsequent layers were composed of rushes and heather respectively until their abandonment. Detailed analysis therefore allows not only for accurate identification of the materials used but also provides a record of these changes.

The choice of materials for a thatch must often represent a compromise between the desired and the available materials. Examination of thatches shows that thatchers could be very particular in their choices as illustrated by the type of heather used in the thatches studied for this report.

2.1.3 How the materials were prepared

A detailed analysis enables us to comment upon the methods and possible season of collection and upon the preparatory processes. Two of the buildings studied contained bracken as an element in the roof. At Jock's Croft this consisted of the whole upper part of the plant and also the blackened stipe indicating that it must have been pulled from the ground. By contrast, the bracken used at No. 9 Locheport was shorter and more typical of that found on the Western Isles. It had been cut at the base of the stem with a sharp implement such as a sickle or scythe. In these two cases the bracken performed very different functions within the roof: the first, as the main body of a single thatching, and the second, a thin bedding layer within a much more complicated and evolving thatch.

The presence of cereal straw within the thatch offers a significant record of the crops cultivated and how these have changed throughout the life of the roof. It is also evident that the same basic material was prepared very differently according to circumstances. At Jock's Croft a thin bed of cleaned and drawn oat straw had been used to improve the water shedding characteristics of the bracken. Evidence for field weeds in this case was negligible. This is in contrast to the cereal layers within the thatches at Gimps, Keils and No. 9 Locheport where, apart from threshing, little or no preparation had been undertaken and a reasonably full suite of cereal weeds, together with the crop itself, had been piled on to a roof of very different structure.

Some methods of thatching involved the application of clays, dung or organic muds (Fenton & Walker 1981). The clay used at Corse Croft had been mixed with locally available limestone to form a hard impermeable layer while thin section analysis of one of the earliest layers from Gimps suggested that peat or dung had been smeared on to the roof.

Turves are present under many Scottish thatched roofs. The size, shape and cross-section profile of these provide a good indication of the tools used to cut them. The large squared turves from No. 9 Locheport were probably cut by spade. They contrast markedly with the scalloped turves from Jock's Croft and Johan Cottage which had probably been cut using a specialised cutting implement such as the *flauchter* which produces a characteristic convex undersurface to the turf. The evidence from Jock's Croft and No. 9 Locheport also highlights the fact that the vegetation had been heavily grazed or mown from the turves before they were cut. The heather from turves from Johan Cottage had been burnt not long before cutting.

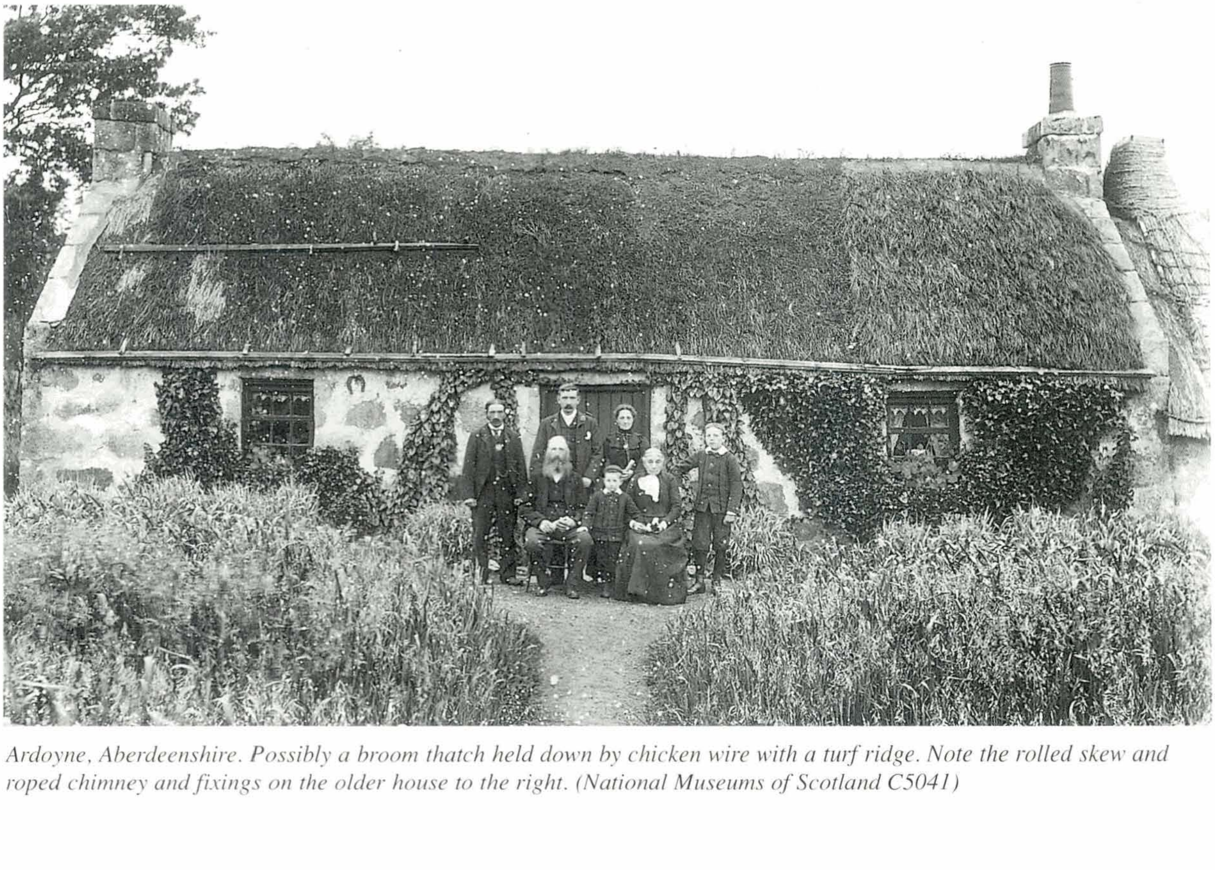
2.1.4 Sources of materials

Detailed identifications of the botanical element within the roof can lead to the sourcing of materials used. Walker (pers. comm.) notes that wheat straw, a crop that cannot normally be grown on the Hebrides, has, in the past, been imported into the Uists for the sole purpose of thatching during a period when locally available straw was scarce. In such circumstances the exotic nature of materials is clear; however, more subtle indicators can also be used. At No. 9 Locheport it was the characteristic weed flora associated with the crop which led to the conclusion that the cereals used in the earliest phases of the roof derived from the sandy western coast of the island. According to the owner of the house the original occupants were moved to Sidinish from the west coast. The use of cereals and marram grass in the earliest thatch may therefore stem from a period when they had access to resources on the other side of the island.

In buildings with a turf element the *in situ* vegetation and pedological structure can be used to identify the source of the turves. It was for example clear that the turves from Keils had been removed from the surface of a peaty soil. This supports local custom that they were taken from the surface of strips of land about to be opened for peat cutting (Sandy Buie, Knockrome pers. comm.). By contrast the samples from Jock's Croft had been cut from an area of heath vegetation over a thin, gritty, acid soil.

2.1.5 Life-span and repair

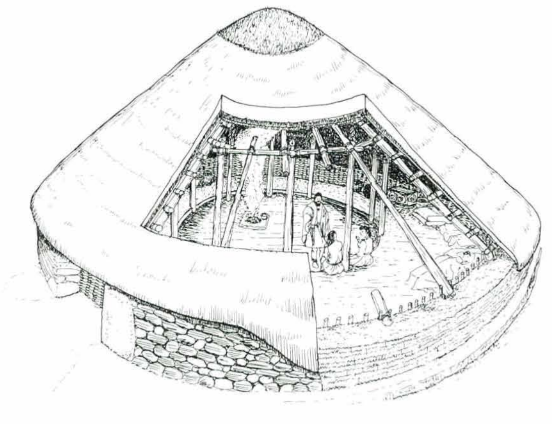
The durability of different classes of thatching material varies considerably and techniques have been developed to cope with this. Different sources of evidence are available regarding the duration of a particular roof although, as with other forms of archaeological analysis, truncation of layers by the removal of upper strata can frustrate matters. On a roof such as the one from No. 9 Locheport, layers that were once exposed at the surface can be identified by the presence of highly eroded heather surfaces within the thatch. The presence of heather ropes also indicate earlier surface layers but, as Walker (pers. comm.)



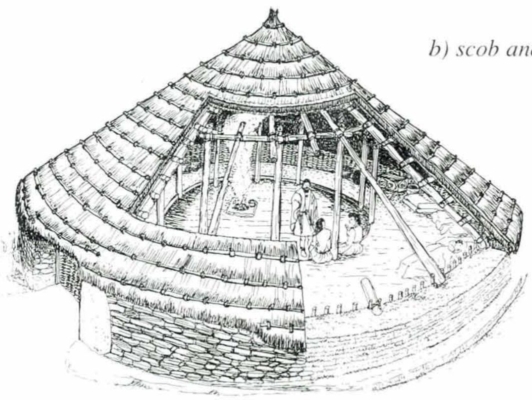
Ardoyne, Aberdeenshire. Possibly a broom thatch held down by chicken wire with a turf ridge. Note the rolled skew and roped chimney and fixings on the older house to the right. (National Museums of Scotland C5041)

*The following drawings are based upon an original reconstruction by C Unwin of a round-house excavated at Lairg. They show some of the thatching techniques that would have been possible using just one interpretation of the buildings superstructure. Other structural interpretations altering the pitch of the roof for example, would also have had a significant effect on the character of the building and the thatching techniques which could have been used. Roofs **a** and **e** would be typical of a sheltered location, **f-h** – exposed locations, **d** – coastal, **b** and **c** intermediate between sheltered and exposed. (B.W.)*

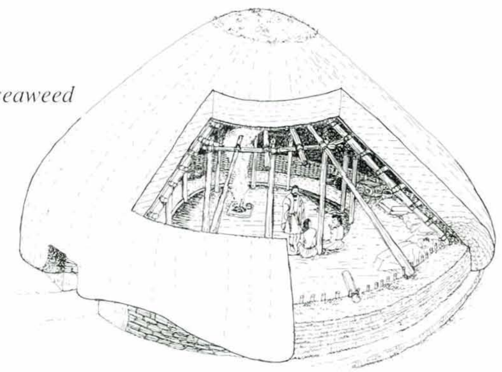
a) secret fixing with turf at the apex (eg stob thatch or clay fixing)



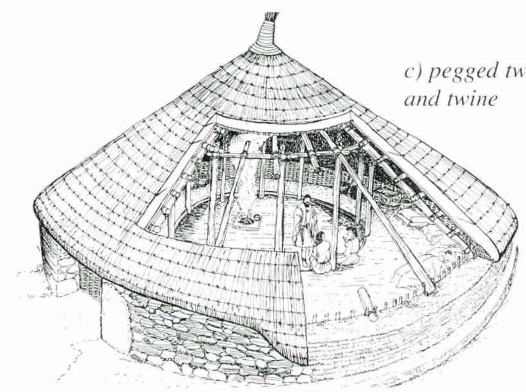
b) scob and wand



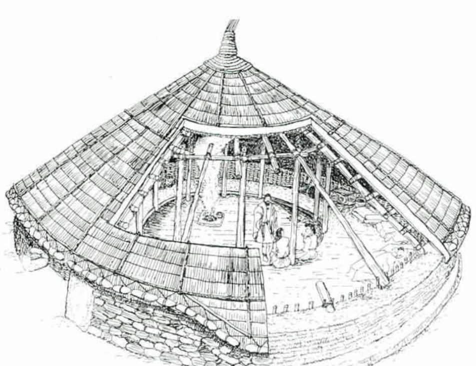
d) seaweed



c) pegged twine/scob and twine

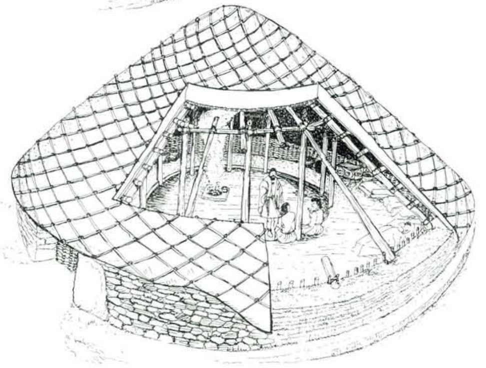


e) layered thatch

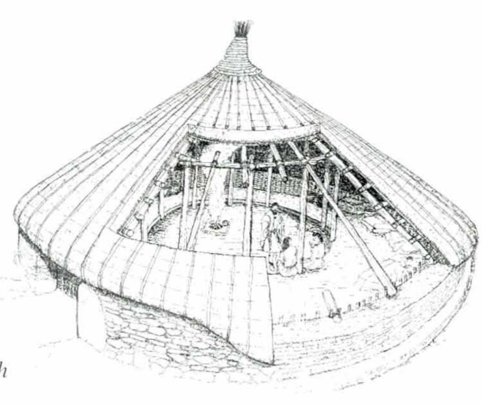


f-h) different styles of roping

f



g



h

points out, good ropes can be re-used with only the older ones being left *in situ*. Using these criteria at least five re-thatchings of the roof can be suggested at No. 9 Locheport. Given that the house was probably built in the later half of the 19th century this would certainly support assertions that such roofs can last as long as twenty years (Souness 1991). Independent dating evidence would be valuable in determining the time span represented by successive re-thatchings.

Gimps and Keils represent a very different form of thatching and re-thatching with frequent additions of roofing material, rushes and cereal straw respectively. These materials rapidly compact and decay *in situ* and, over the years, produce a dense organic felt. Within such a structure individual layers cannot easily be distinguished so it is impossible to determine how many episodes are represented. This is complicated by the fact that a vegetation cover rapidly builds up on the surface and where this occurs a proportion of the upper thatch is generally removed before the addition of a new surface coat. The rate of accumulation of material on such a thatch is difficult to ascertain but at Gimps certain markers can be recognised and thereby provide some sort of chronological framework. The basal layers at Gimps contain black oats and bere, the upper ones common oats and two rowed barley. According to the owner this transition occurred just after the Second World War, enabling us to use this as a chronological marker. The recovery of a dated crisp packet 5 cm below the surface also provides an indication of the depth of thatch that had accumulated since 1973.

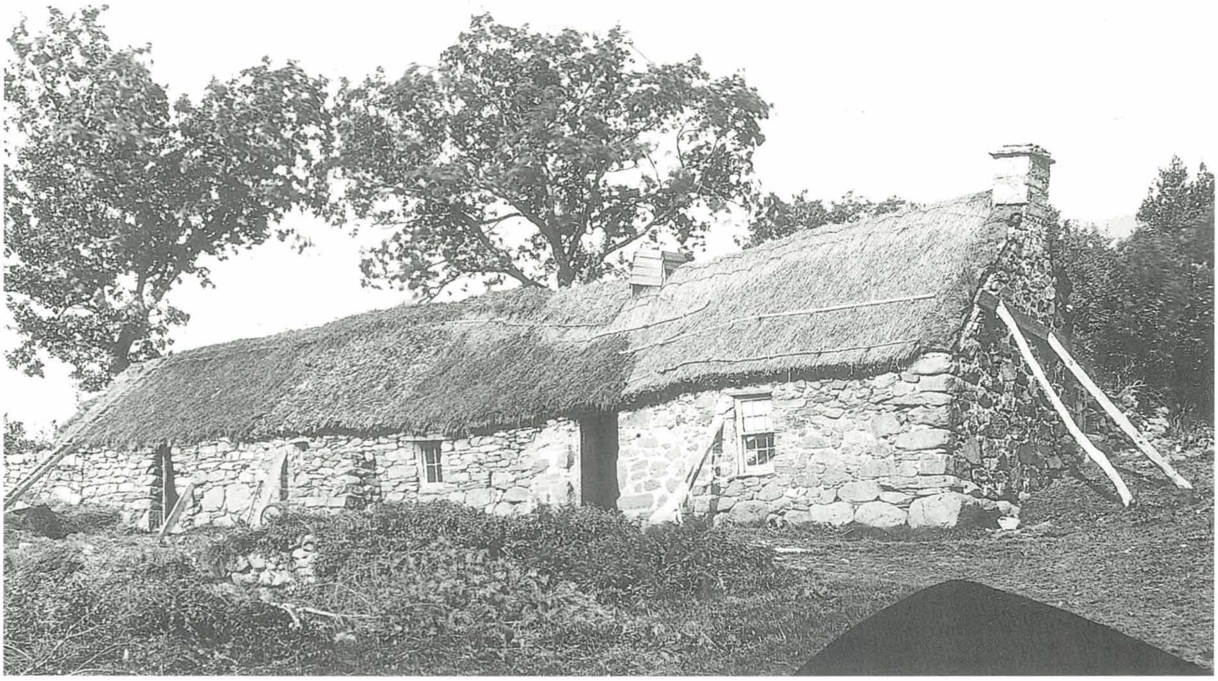
Repairs to the roofs must have been commonplace and evidence for this frequently remains. Repairs to the apex at Gimps were identified by better than average preservation of the straw there. The best evidence, however, was provided by the recovery of bundles of straw probably representing *tippets* or *grips* that had been pushed into the bracken thatch at Jock's Croft as a form of repair.

2.2 Historical information

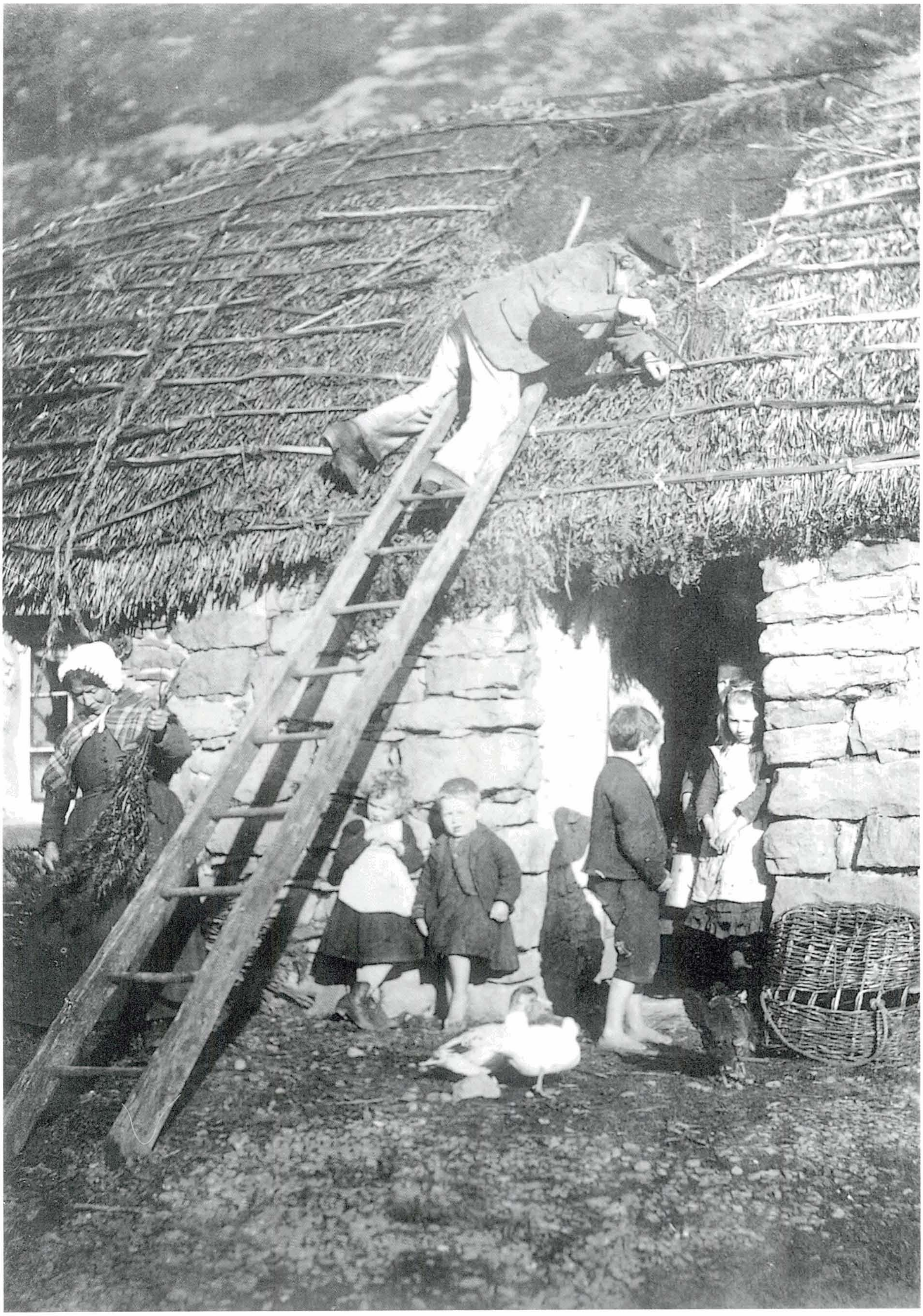
2.2.1 Agricultural development

Many of the thatching methods described by Walker *et al* (1996) use cereal straw as one of the main thatching materials. Barley, bere, oats, rye and wheat were all used for this purpose. In some cases it was the practice to replace the straw every year, the old thatch being used as a form of fertilizer (Fenton 1976). In others, regular additions of fresh straw to the surface with little disturbance to the sub-surface layers resulted in the accumulation of many years worth of well-stratified cereals. These were frequently accompanied by the remains of the weeds that grew alongside them.

It is likely that some of the material recovered will have originated before the agricultural improvement of the last two hundred years. Even the most recent thatches will still derive from a period before the regular use of chemical pesticides and herbicides, highly automated harvesting and processing techniques and the use of improved crop varieties. The crops and their associated weeds will therefore provide



Mrs Ferguson's Inn, Bridge of Turk, Perthshire. These buildings show cereal or rush thatches in different states of repair. Scobed timber wands have been used to fix parts of the roof and stitched timber wands as fixings at the apex. (G.W.W. Aberdeen University Library F2883)



Ullapool, Wester Ross c1880. A thatcher is making repairs to a bracken thatch using a stitching technique. Most of the roof is however, held in position by scobs and timber wands. (Edinburgh Central Library)

Annie Shaw's Castle, Nairn. This building has been repaired many times. Broom would appear to have been used to fix the roof. (G.W.W. Aberdeen University Library C1184)

an excellent opportunity to investigate the regional development of crops and changing field ecology. The following are seen as important potential benefits:

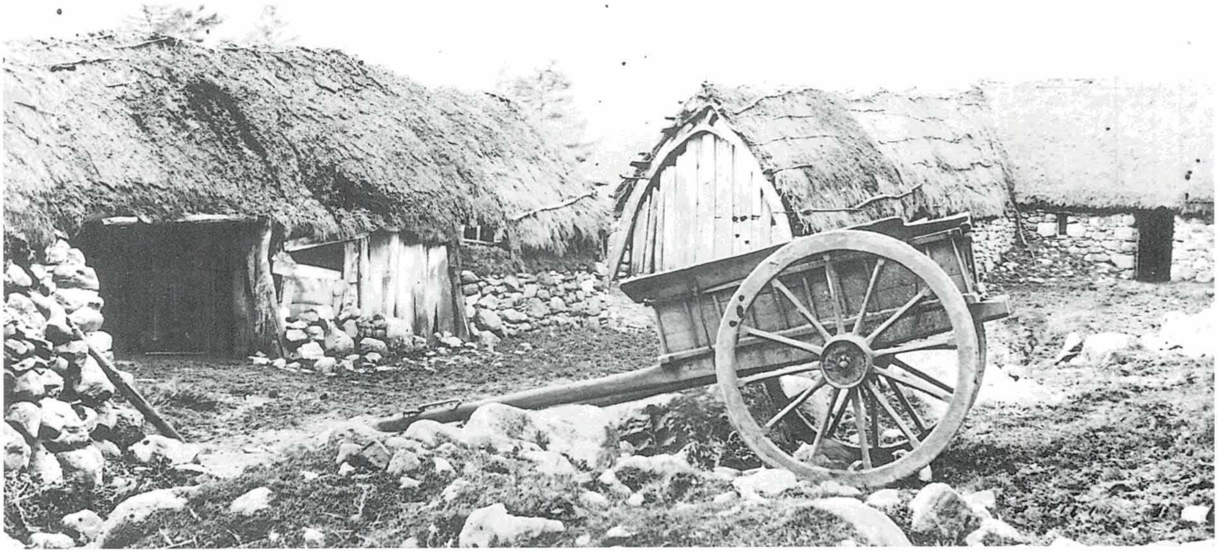
- It will be possible to determine the varieties of crops used. Most of these are no longer cultivated but modern comparative material for their identification may be held by some of the larger agricultural agencies. Some varieties may have been deliberately grown for the properties of their straw while others will certainly reflect the regional environment.
- The methods of harvesting and processing used will be reflected in the condition of the crop. For example, whether the crops were uprooted or cut should be easily detected by the presence of culm bases and roots. Whether they were cut high or low on the stalk, threshed by flail, lashed or threshed by machine will all be reflected in the condition of the culm and the weed species present.
- The crop weeds enable inferences to be drawn regarding the type of land on which the crops were grown. For example it might be possible to determine how fertile the soil was, how acidic/alkaline, how well drained it was, whether it had been weeded or whether it was from the infield or the outfield.

The ability of the thatching material to answer these types of questions will depend on the techniques used in the preparation of the different materials. In some cases straw was evidently drawn, or at least cleaned of most leafy material, prior to use. This seems to have been the case with the sub-surface straw layers from Jock's Croft. Very little leafy material was present and most traces of the crop weeds had been removed. The crop had been threshed prior to use, as most of the florets and the grain they enclosed, were missing. In this case therefore the ability to comment upon the ecology of the fields is negligible. However, it may be possible to identify the variety of oats grown, thereby providing useful information on the local economy.

Other thatching styles, particularly the random cereal thatching, seen throughout Gimps and from the basal layers from Keils and No. 9 Locheport, offer more potential for this type of work. Much less rigorous cleaning of the straw is evident from these samples and this has resulted in a much more complete picture of the field ecology.

The best evidence for crop processing methods would be expected from the chaff element of the crop. In England, John Letts' project on thatched houses has found that sometimes this chaffy material can be used as basal layers in cereal thatches. This has not yet been observed from Scotland but remains a possibility and would be of considerable value if recovered.

Corstorphine, Midlothian c1900. A cereal or reed thatch on a well-built two storey building. The horizontal lines across the roof are formed by raip and scob fixing. (National Museums of Scotland)



A Highland Steading, Kinlochewe, Wester Ross. A range of thatch types are shown. On the right the main farm house uses a method of secret fixing, the range to its left is secured using timber wands. The cart shed to the left of the photograph may have a deteriorating cereal or rush thatch although there are indications that turves or clay may be exposed at the surface. (G.W.W. Aberdeen University Library 0748)

2.2.2 Economy and resource availability

The materials used in the thatches will largely reflect the resources available and the nature of the local economy. The following points are of importance:

- Aspects of status and the original function of the various buildings can be reflected in the materials used. Out-houses, barns, kilns and byres are frequently roofed in different materials from those used for dwellings.
- Detailed analysis of the thatch can identify the importation of materials by, for example, the identification of the ecological preferences of the weed species present. This will allow some comment on the local availability and the relative value of certain thatching resources.
- It should be possible to identify the different classes of land that were being exploited for thatching materials. The turves used in the

"Gathering in the Reeds" by David Farquharson (1840-1907). The Carse of Gowrie 1873.

construction of the walls and the basal layers of the roof, for example, can provide good information regarding land accessibility and maintenance of soil quality.

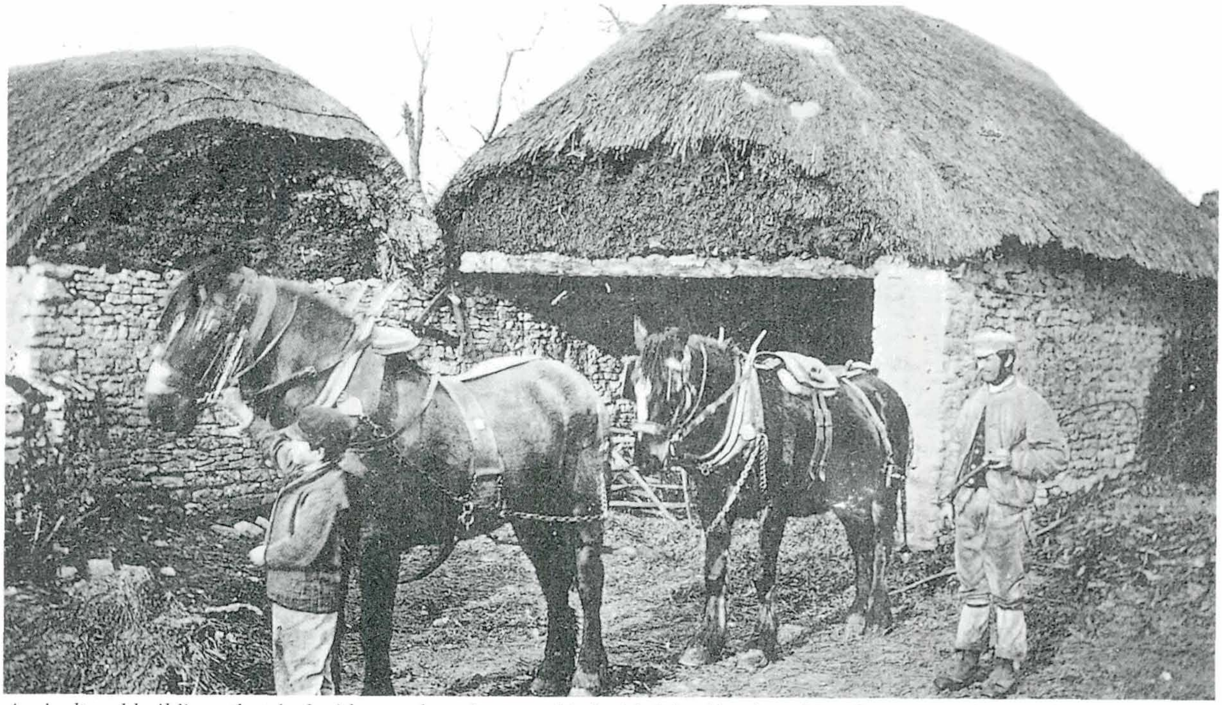
- The age and condition of the materials used will enable one to determine the season in which collection was undertaken. This should, to some extent, reflect the work scheduling priorities of the occupants, revealing possible differences between people relying on fishing or other specialist occupations and those concerned solely with agriculture for example.

2.2.3 Land-use patterns

The majority of the roofing materials will have derived from the surrounding countryside and therefore provide an indication of the categories of land utilised and of the management practices that had been employed. The use of the heather, for example, indicates the exploitation of areas of acid heath, whereas its maturity and growth form offer an indication of how often the land was cropped and whether it was grazed or burnt. Some of the best evidence for this survives in the surface layers and structure of any turves used in construction. These varied considerably in the samples examined. The large rectangular spade-cut turves at No. 9 Locheport represented only the surface organic horizons of a soil profile. The accumulated organic matter was dominated by moss stems and the *in situ* vegetation was rich in mosses with some grass and sedge. The turves were not, however, from the top of a peat soil, because bracken rhizomes were also present, indicating that the soil was reasonably well drained. The combination of plants in the No. 9 Locheport turves suggests an area of poor or declining pasture. At Jock's Croft, the turves came from an area of acid heath with heather and bilberry and abundant *Polytrichum* moss. They had a shallow organic litter layer which overlay a mineral subsoil with very poor soil profile development. This indicates recent truncation of the soil, a conclusion that accords with the immature state of the heather and bilberry plants. The implication is that this area had been cut for turves on a number of occasions in the past and therefore was habitually used for this purpose.

2.3 Interpretative models for archaeology

Evidence for the nature of roofing material from archaeological excavation is slim indeed but there are a few examples from Scotland. From a post-medieval drying kiln and loading area from the site of Kebister, Shetland, archaeologists were able to identify a number of fragmentary turves and one complete one during excavation. These were thought likely to have been derived from turf used in roofing. The botanical element of these turves was investigated in detail by Dickson (forthcoming), and, having characterised their composition, she was able to suggest that many of the other sediments on the site were also derived from structural turf. The turves had been stripped from vegetation layers ranging from grassy heath to rich fen, exploiting shallow soils on a gravelly base. From a number of contexts the same constituent species were recovered in a carbonised form, leading to the identification of burnt turf, resulting from either a conflagration or from the deliberate burning of turf as fuel. There was no direct evidence for a surface covering to the roof turves, if one had ever existed. It was considered unlikely, given the conditions of survival, that any such debris would have remained intact. A second example comes from an Iron Age



Agricultural buildings thatched with cereals and part-gabled with fale, Aberdeenshire. Several patches of what appears to be clay on the surface could indicate repairs or exposed areas of a clay fixing. The building on the left is roped. (B.W. collection)

context at Howe, Orkney. Here Dickson (1994) was able to identify a 10 cm thick layer of cereal straw, which was thought likely to have been the remains of a cereal thatch on the basis of its stratigraphic location and composition.

Beyond Scotland one further example is worthy of note. During the excavation of a Viking settlement at Toftanes, Leirvíc, on the Faroes (Hansen 1988), a total of over 100 m of cord made of juniper branches was recovered. One of the cords was tied round what was interpreted as a roof stone. In all probability the cord and the stone represent the remains of rope used in the construction of a thatched roof. A construction similar to that from No. 9 Locheport, North Uist might be suggested in which ropes (heather in this case) would have been anchored by stones hanging from the eaves to secure thatch. In cases such as Toftanes where preservation of archaeological deposits was excellent, detailed analysis of soil and other samples might be expected to reveal other elements of the roof such as the main body of the thatch, a turf sub-stratum.

Until relatively recently thatch would have represented one of the most common methods of roofing throughout Britain yet, as the above examples show, good quality evidence is rarely forthcoming from archaeological situations. Where appropriate methods of recovery are employed during excavation, plant remains, insects, other invertebrates and pollen are frequently recovered. Sediments which are unlikely to be naturally derived are also encountered. The interpretation of these archaeological remains is severely constrained by a lack of suitable, region-specific, interpretative models. It is likely that many of these archaeological deposits may have derived from roofing material. If this is the case any characteristic signature is presently being overlooked. For example, at Buiston Crannog, Ayrshire, large quantities of well-preserved organic debris were recovered (Holden 1996). Much of this could have been potential roofing material although our inability to distinguish the distinctive signatures of accumulated floor deposits or roofing material tempered any detailed interpretation. In view of problems such as this a detailed study of existing thatches therefore holds the following benefits for archaeology:

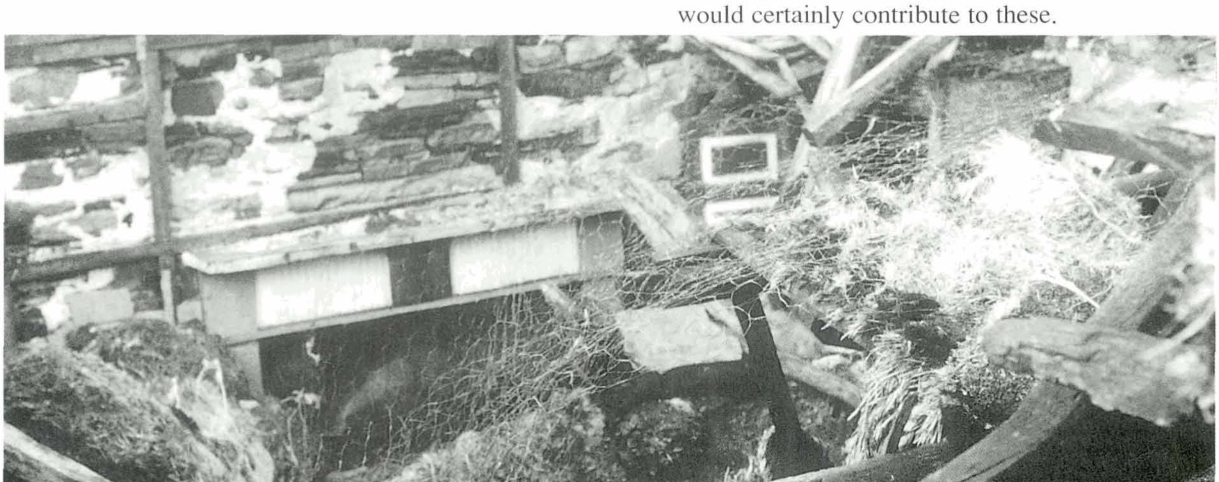
- It will provide a detailed list of potential materials and methods used for thatching in different parts of Scotland. This will offer archaeologists a much more informed insight into methods and materials that may have been used in the past and the nature of regional diversity. More reliable, regionally specific archaeological interpretation and reconstruction will be possible, taking into account the resources and technology available at different times in the past. This will benefit not only academic archaeological interpretation but would also enable more accurate popular presentation of the data.
- Analysis of thatch will enable detailed characterisation of the various botanical, zoological and sedimentological signatures of the different types of thatches and their fixings. The

more resistant of these elements, such as the insects, dense plant parts (preserved by charring or waterlogging) or soil microstructure from turf elements might be expected to survive archaeologically. These could be used to reconstruct elements of the thatching practices that produced them. There is a considerable quantity of ethnographic and ethnohistorical work from Scotland relating to crops and the field environment but little of this has been undertaken with archaeological problems in mind. They do not, as a consequence address the subject in sufficient detail, with a focus on taphonomy and disposal of waste, to allow accurate interpretation of the archaeological record. The samples recovered from cereal thatches will enable such work to be undertaken and appropriate archaeological models produced.

- It is evident that over a number of years a functional thatch will develop its own characteristic flora and fauna. This will undoubtedly be linked with the materials used, how often the building is re-thatched and maintained and the uses to which the building was put. A soot-impregnated heather thatch might, for example, harbour very different insect species from a regularly replaced cereal thatch. The bracken thatch from Jock's Croft was quick to develop a living surface vegetation once the metal roof was stripped off. It is possible therefore that some taxa might only become associated with a roof once it has been abandoned. The presence of such species archaeologically might enable the condition of a building at the point of destruction to be determined.

- When used in conjunction with ethnographic data it may be possible to highlight some of the variables that combine to determine which thatching practices were employed in different places at different times. For example, it is possible that a shortage of straw for fodder might precipitate the use of bracken or heather thatch. Conversely the potential for year-round grazing on the coast could enable people to use cereal straw as their preferred material. Aspects of status and the function of buildings might also be reflected in the materials used. Better understanding of what prompted these different courses of action in the recent past will enable a more in-depth interpretation of the archaeological evidence.

- Within the thatch other aspects of traditional life such as crop husbandry, may be inadvertently incorporated in the form of the weed seeds, insects and surviving vegetation on turves, for example. These have largely been explored in section 2.2 above because they primarily inform us about conditions at the time when these buildings were constructed or last thatched. However, the detailed analysis undertaken here enables us to predict what evidence of traditional practice we might expect to find archaeologically. This type of approach, using ethnographic models to interpret the composition of archaeological plant assemblages, was pioneered very successfully by Hillman (1981, 1984) and later Jones (1984) and few interpretations of traditional crop processing in Europe and the Middle East fail to use these or subsequent models as the basis for a discussion of the results. There is, however, an urgent requirement for more regionally specific models of this type and an analysis of thatching materials would certainly contribute to these.



Up to 1m of organic material can accumulate after the collapse of the roof. (Gimps, Orkney 1996 see section 6.4)

Balnald Cottages, Fortingall, Perthshire. Re-thatching with reeds. (Dundee Courier)

3 CONSTRUCTION AND MATERIALS

3.1 Introduction

Walker *et al* (1996) have summarised many of the techniques used in the construction of Scottish thatched roofs. They have also highlighted the diversity of materials used under different circumstances and in different parts of the country. Several different elements of the roof are discussed:

- Basal or sub-stratum layers
- Main thatching materials
- Fixings
- External features

These elements are able to provide complementary information about the building and its surroundings and should, wherever possible, be recorded to an appropriate level of detail.

3.1.1 Basal or sub-stratum layers

The basal layers provide the support for the overlying thatch and derive from a number of different sources. They include heaped vegetable material used as stuffing/levelling layers and supportive structures such as timber, brushwood, turf, wattle and *simmens* (straw rope).

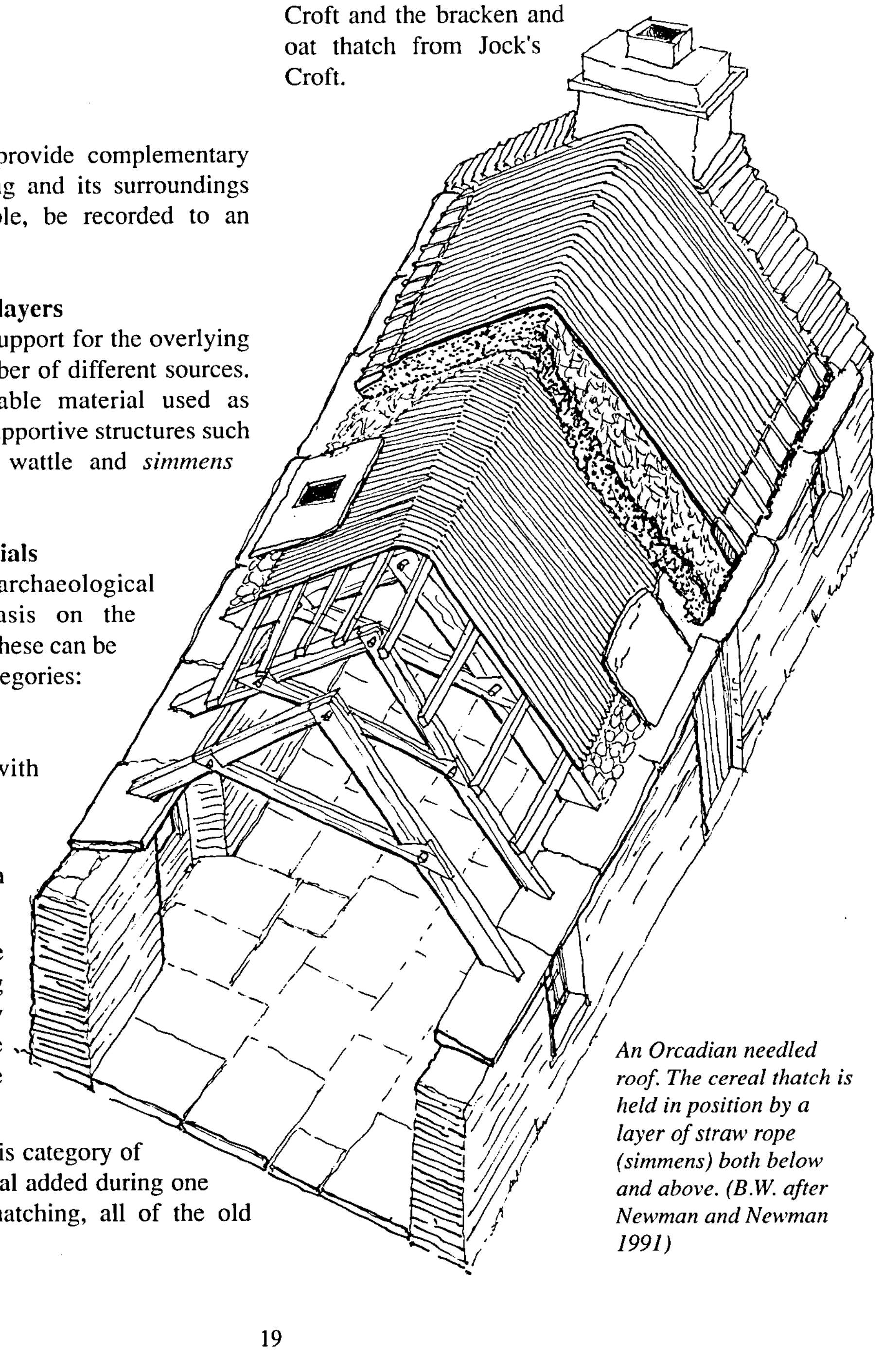
3.1.2 Main thatching materials

For the purposes of this archaeological discussion, with its emphasis on the stratigraphy of the structures, these can be divided into three different categories:

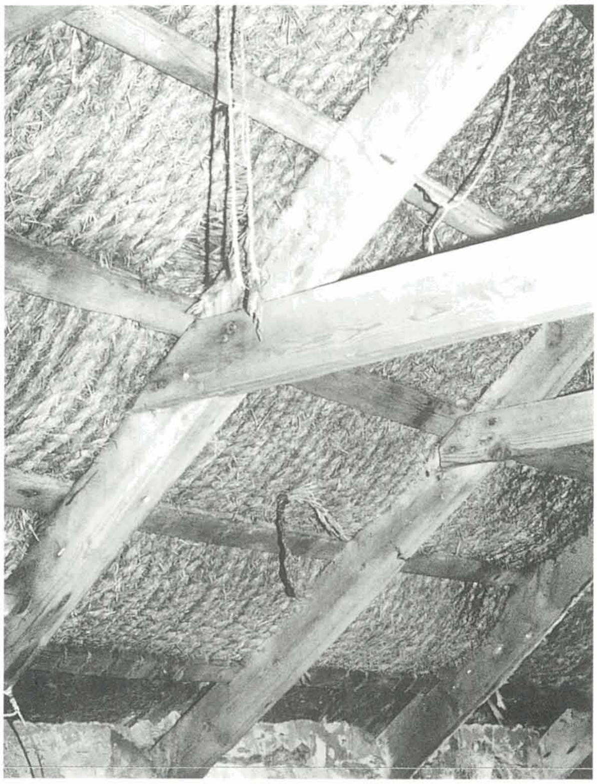
- single episode structures
- cumulative structures with regular, often annual, resurfacing
- cumulative structures with periodic resurfacing

These categories will require different methods of recording and sampling as part of any stratigraphic analysis and are therefore discussed in some detail below.

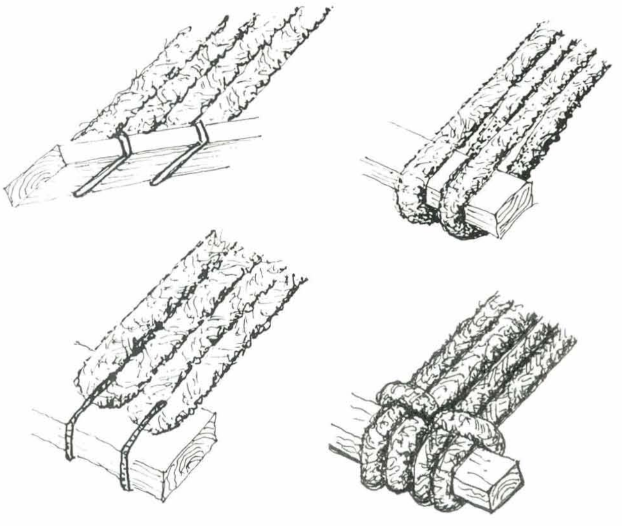
Single episode structures - This category of roof consists largely of material added during one thatching event. During re-thatching, all of the old material is removed, with the probable exception of supporting timber work and substrata, usually turf. A completely new thatch is then added to the surface. These roofs provide little information regarding temporal changes in techniques and materials but reveal important details regarding construction that are frequently obscured in the more complex thatched structures (below). Examples of such roofs are the clay and straw thatch from Corse Croft and the bracken and oat thatch from Jock's Croft.



An Orcadian needled roof. The cereal thatch is held in position by a layer of straw rope (simmens) both below and above. (B.W. after Newman and Newman 1991)



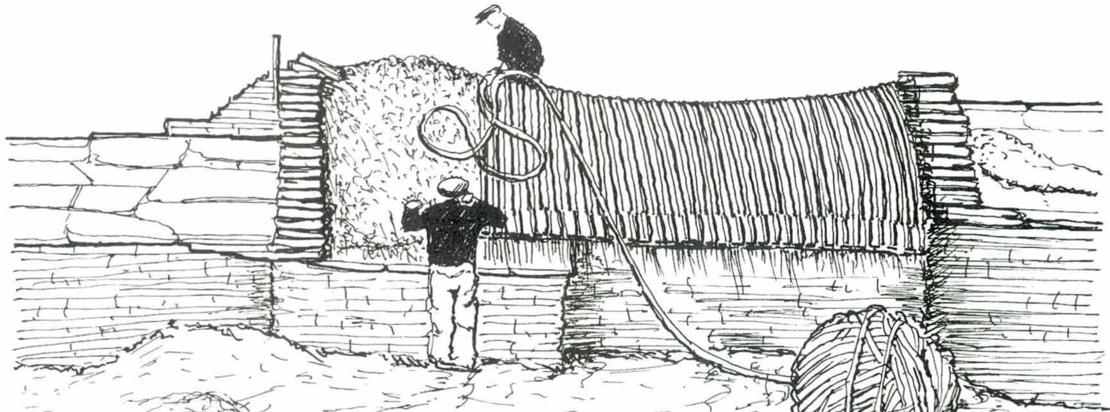
Gears, Orkney 1996. A needle thatched roof from the inside.



Patterns of fixing ropes on needled thatch roofs. (B.W. after Newman and Newman)

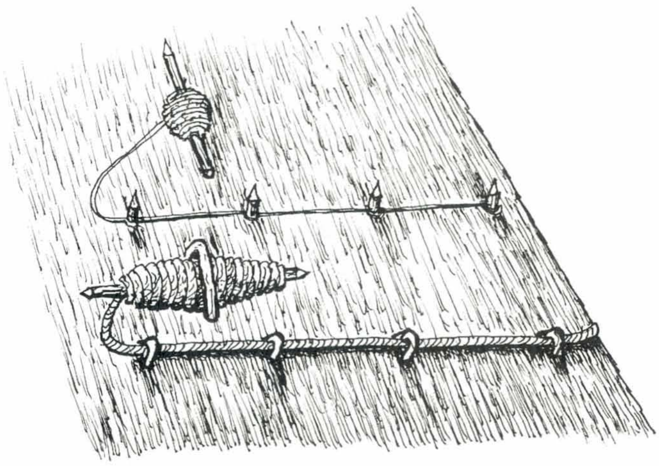
Cumulative structures with regular, often annual, resurfacing - These roofs generally consist of thick mats of thatch which frequently show no obvious stratification that can be related to particular thatching events. Over a number of years the lower layers become crushed and distorted. Even straw ropes included within the thatch are likely to be unrecognisable after a number of years. Such roofs are frequently formed where annual or biannual resurfacing is undertaken using materials such as rush or straw. In some cases, particularly where a living vegetation has been able to take a hold, layers of degraded surface material may be removed before resurfacing. However, the general trend is towards increased quantities of material on the roof. These mats of material can occur with both directional thatch as at Keils where rushes were used or with random thatches such as at Gimps where cereal straw had been used.

Cumulative structures with periodic resurfacing - In these roofs re-thatching occurs at intervals of as long as twenty years at which point additional layers of material, sometimes the same, and sometimes different, are added to the surface. Considerable depths of material can build up as with the 60 cm of heather bracken and other material that accumulated over the years on the roof of No. 9 Locheport. Areas exposed at the surface become eroded and bleached. Where the



Roping an Orcadian needle thatch roof with simmens. Large balls of straw rope were made over the winter for re-thatching in the spring. (B.W. from a photograph of the National Museums of Scotland)

Two different methods of fixing with raip and scob. (B.W. after Stowe 1954)



thatching methods involve the application of new layers with minimal disturbance to old coats these features, together with the presence of ropes or other fixings within the matrix, help to identify earlier surface layers. More complex stratigraphy would, however, be envisaged where re-thatching involves the pushing of new material into the existing thatch. This would occur where techniques such as stob thatching (eg. Walker *et al* 1996) or tucking (eg. Souness 1986) were used.

3.1.3 Fixings

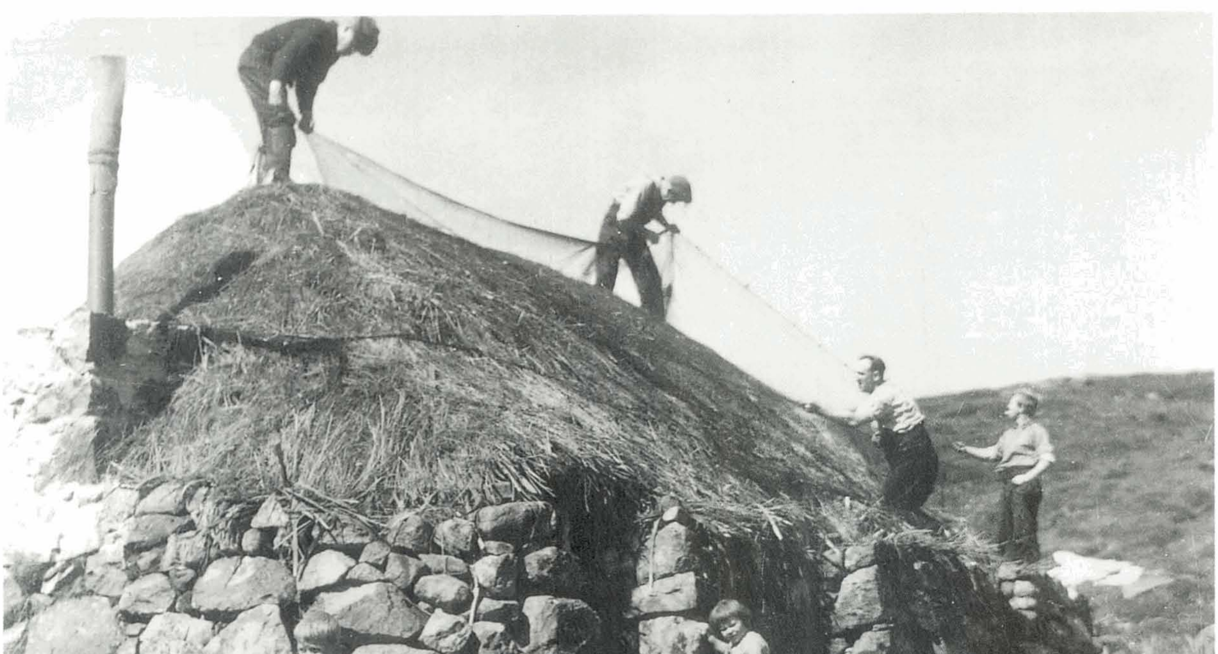
A wide variety of both concealed and visible methods of fixing are used to secure the various thatching materials to the roof. They have been discussed in detail by Walker *et al* (1996) who highlight the variety of materials that can be used. These include, turf, clay, wooden pegs, twine/rope, netting, wire, timber or metal stays and wooden staples.

3.1.4 External features

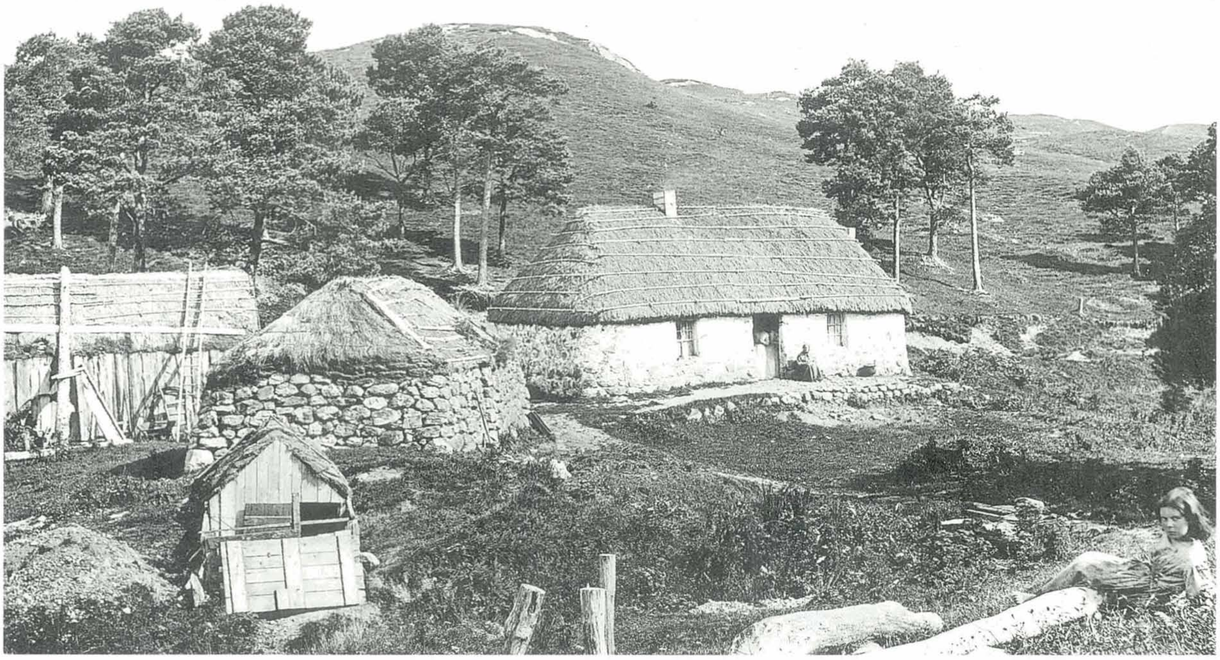
These include more potential sources of information regarding the building. Specific materials are, for example, used in the construction of smoke-holes, lums or flues or to strengthen vulnerable parts of the roof such as, at the eaves, skews and the ridge and also around doors and windows.

3.2 Supporting timber and other wooden elements

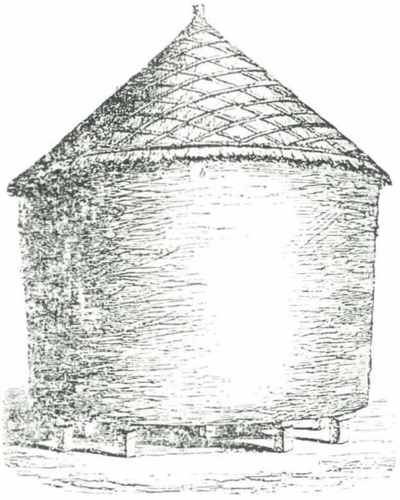
The wooden element in the roof can illuminate various aspects of the site economy, local environment and resource exploitation. In many cases large timbers are salvaged from earlier buildings, ships or other structures. On the coast, driftwood is a major source of materials. By identifying the species present it may prove possible to source the timber. In this way imported timber can be identified and in some cases local cultivation of non-indigenous species suggested. This is of particular importance in earlier buildings which might provide data relating to the 18th century development of softwood timber plantations.



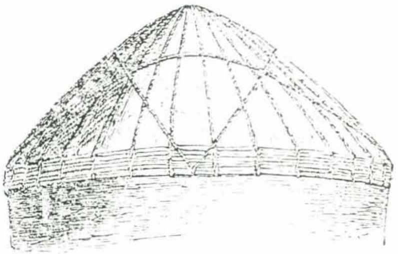
Netting and roping a thatch of cereal or bent on the Uists. (National Museums of Scotland C7684)

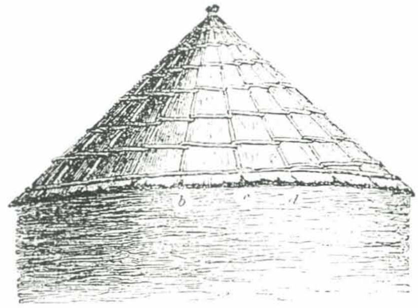


Highland cottage, Lochaber. Wooden stays used for fixing. The building on the left shows the presence of turf under the main thatching material. (G.W.W. Aberdeen University Library F4247)



Three different styles of roping used on corn stacks (Stephens 1855). These could equally have been used on round-houses.





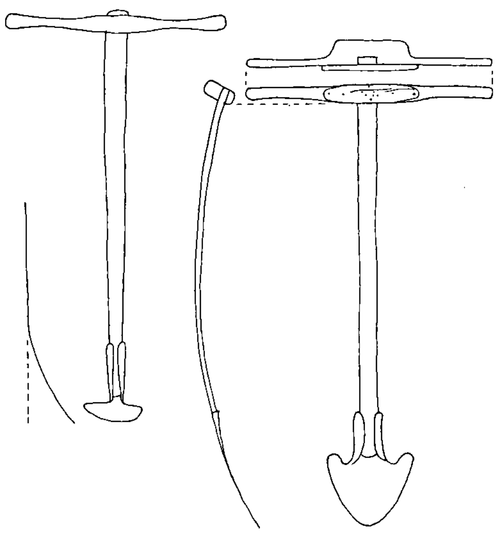
The timbers might also provide a useful source of dating evidence for certain buildings through tree ring dating (dendrochronology). However, the widespread practice of re-using larger timbers makes this technique of limited value in many cases.

Identification of the smaller diameter wood used in brushwood layers, in wattle panels or as fixings can be undertaken and provides useful information regarding local availability of species and how they were used in thatching. Issues relating to the management of these resources can also be identified. For example, whether they were collected from the wild or from coppiced plantations might be highlighted by the characteristics of the wood used.

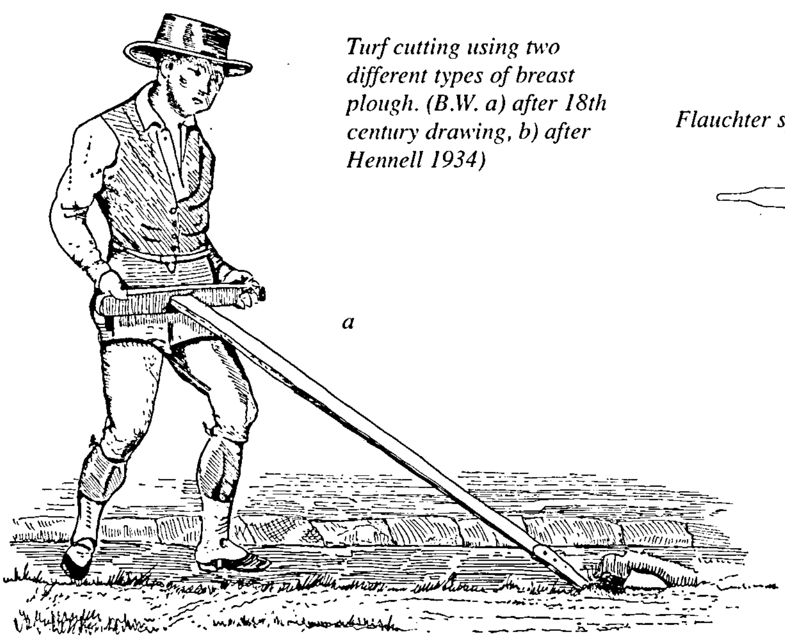
3.3 Turf

The use of turf in roofs and its associated terminology has been discussed by Walker *et al* (1996). It is commonly used as a basal layer underneath other roofing materials, as the sole roofing material and to provide a protective coat at the ridge. Where used on its own it is usually laid vegetation side up so that it provides something of a living turf structure or 'natural mat'. This technique is most frequently used on temporary structures such as sheilings or out-houses. On more substantial buildings Walker & McGregor (1996, 21) indicate tramped peat may be used between the turf layers to improve the weather-proofing. Where turves are used as a basal layer they are more often positioned vegetation side down under which circumstances the vegetation becomes soot-blackened and often survives in good condition.

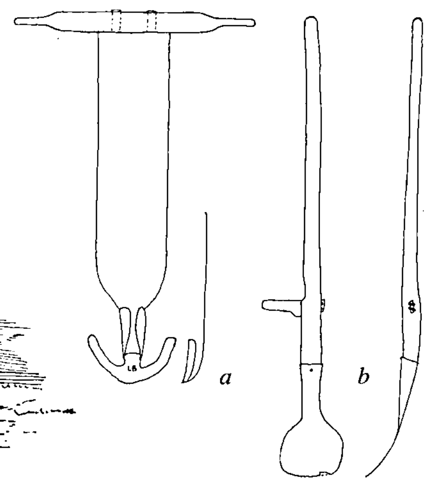
The turves can be cut from different categories of land according to preference and availability. From the test cases presented below it can be seen that some turves, notably those from No. 9 Locheport and Keils, had been cut from a peaty topsoil. This ties in nicely with observations from Jura (Sandy Buie pers. comm.) where such turves would have been taken from the surface of new peat cuttings. In other samples, such as those from Johan Cottage, the turves had been taken from areas of coarse grassland and burned heath. These were likely to have derived from areas of outfield land around the settlement and offers some indication of the management regimes practiced.



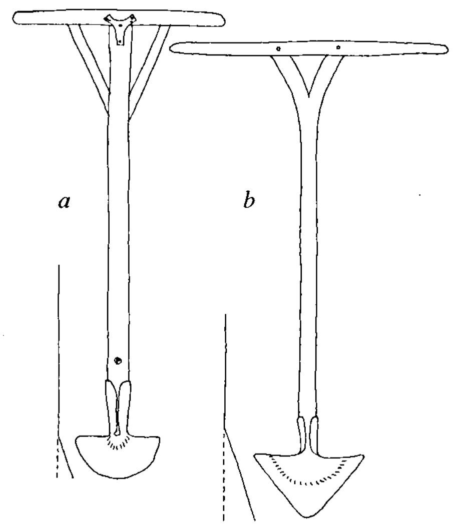
Flauchter spades with straight shafts. (after Fenton 1970)



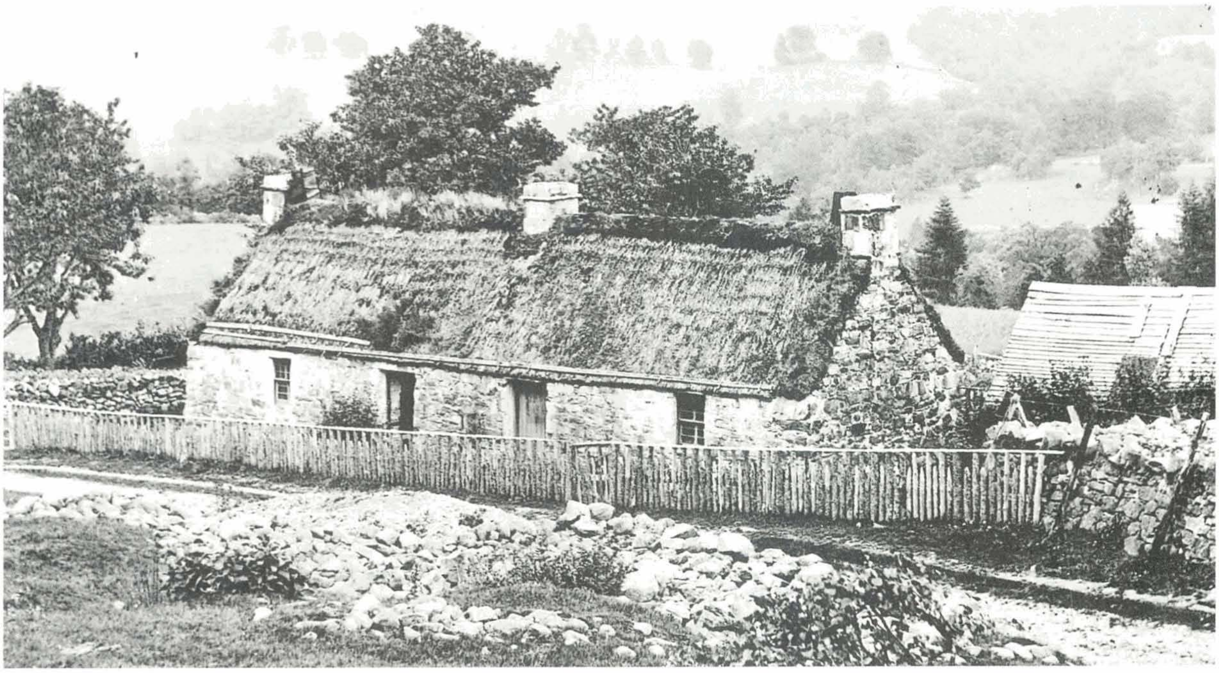
Turf cutting using two different types of breast plough. (B.W. a) after 18th century drawing, b) after Hennell 1934)



a) Flauchter spade, Shetland. b) moor spade, Orkney. (after Fenton 1970)



Flauchter spade a) strutted shaft, b) forked shaft. (after Fenton 1970)



Pitlochry, Perthshire. Possible bracken thatch with turf ridge and skews. The eaves are secured with crook and caber fixings. Note also the false chimney heads with timber lums against them. (G.W.W. Aberdeen University Library)

The bull's house on a Muckle Row croft, Orkney. Roof turves retained with wooden pins –1962. (Orkney Library)

Cereal thatch over turf – Duncan Matherson, Luib, Skye. (B.W.)

Evidence for complete stripping of areas is also apparent. From Jock's Croft the lack of a developed A horizon indicates repeated cutting of turves from the same area over a number of years.

The turves can be cut in a number of ways but the most common is with a flaughter spade. This implement has many regional forms (eg. Fenton 1970) but commonly possesses a broad blade and wide cross-piece at the top of the shaft which is used to push the tool into and through the turf. A flat-bladed flauchter spade removes turves of even thickness while the more commonly used dish-shaped flauchter removes a tapered turf. The different profiles produced can be used to determine which implement had been used to cut them. From Jock's Croft, the convex profile of the turves clearly indicated the use of a dish-shaped flauchter. Other tools can also be used for cutting turves. Fenton (1970) for example, illustrates a number of turf cutters/moor spades from Orkney and Shetland that might also be expected to produce distinctively shaped turves in the archaeological record. In some parts of the Highlands in more recent times Grant (1961, 118) suggests that the flauchter has been replaced by the ordinary spade for removing the turf from peat cuttings. Turves cut in this way are likely to have been used at Keils and No. 9 Locheport.

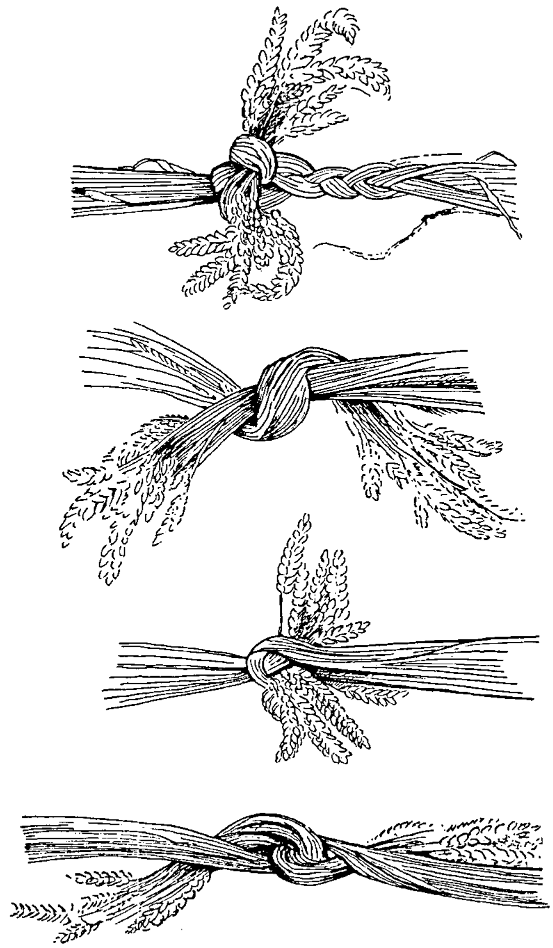
Overlapping basal turves, Luib, Skye. (B.W.)

Turves can be positioned on the roof in a number of different ways and those with tapered edges make it easy to interleave adjacent turves producing a more or less level surface. The direction of the prevailing winds can also have an influence of the way turves are laid. At No. 9 Locheport, for example, a herring-bone pattern was produced by laying turves with their straight edges at 45° to the horizontal. This was done so that the overlaps would prevent water from being blown between the turves by strong westerly winds (John MacDonald pers. comm.). In some areas the turf could be cut into a long length and carried to the roof as a roll to be applied in a continuous strip running from eaves to eaves (Walker *et al* 1996, 25).

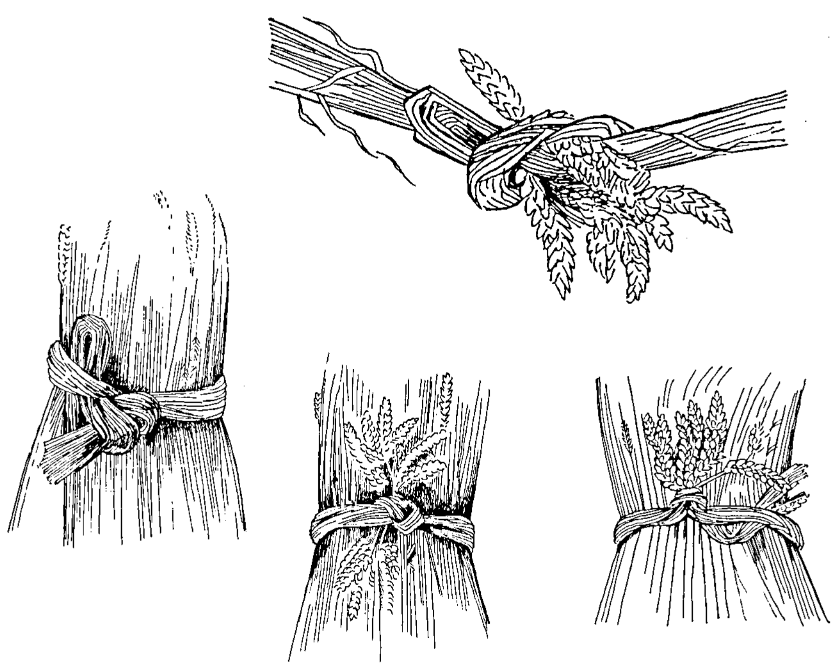
3.4 Cultivated plants

In many parts of Scotland cereal straw was an important thatching material but other cultivated plant material such as flax, potato shaws and beanstalks were also occasionally used (eg. Walker *et al* 1996). Well-preserved examples of whole crop plants provide evidence of agricultural development that is unobtainable by any other means. It is surprising how little is known regarding early crop varieties before the advent of modern seed banks. In many cases general descriptions of the plants are available but few examples of whole plants exist. Even in the extensive collections of modern seed testing stations, pre-improvment strains, including landraces adapted to the diverse environments found across Scotland, are very poorly represented. The height, colour and other features of the crops would have imparted a very distinctive character to the pre-improvement landscape. A knowledge of yields in different parts of the country might also be revealed in the number and size of grains per plant.

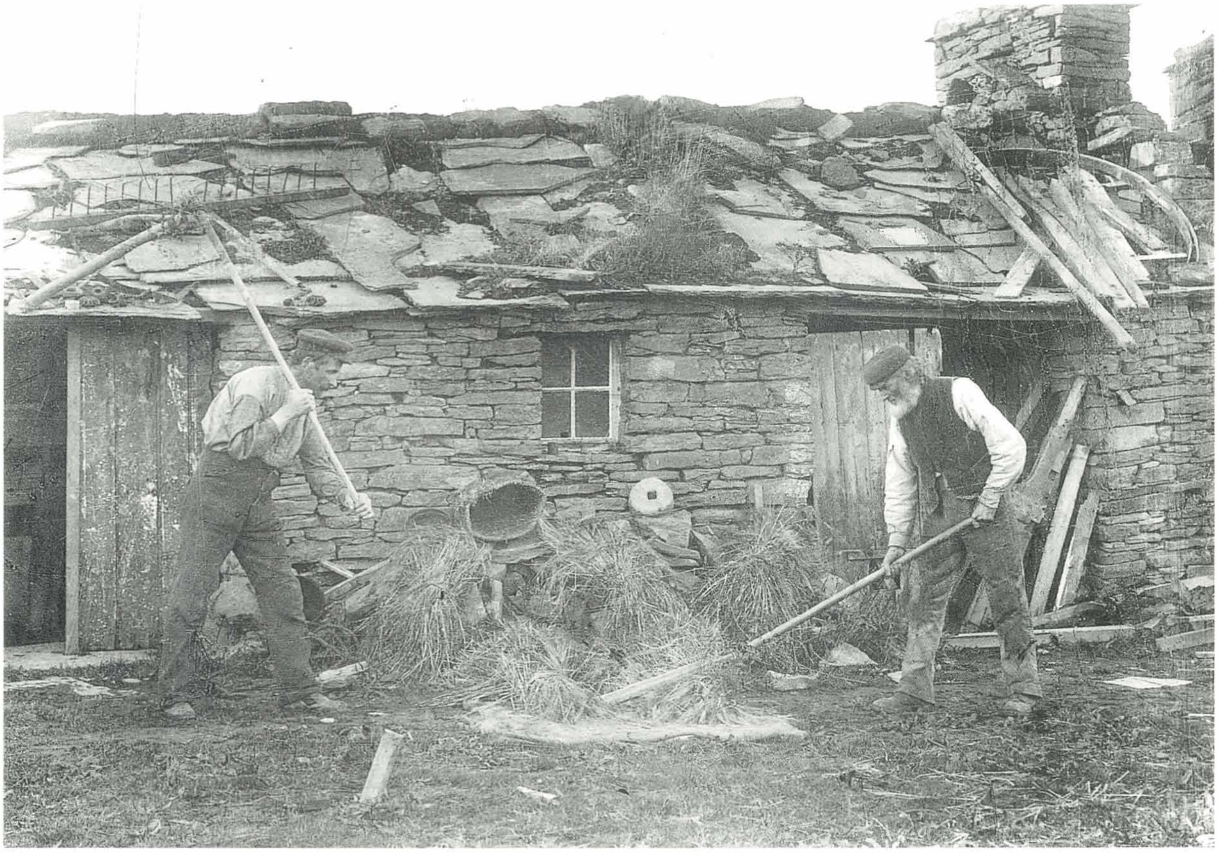
Changes in the economy can also be highlighted in certain types of thatched roof. For example, at Gimps it was possible to record the use of the black oat and bere barley in the early part of the roof and identify the points where these were replaced by the common oat and two row barley. These changes were a result of improved agricultural techniques, the use of machinery, artificial fertilisers, herbicides and insecticides and improved varieties of cereals. All of these might be recognised by detailed study of the straw from thatch.



Flax (Linum usitatissimum). (B.W.)



Examples of regional variants of sheaf knots which could become incorporated in a thatched roof. (B.W. after Hennell 1934)



Flail threshing in Orkney. (Orkney Library, Tom Kent Collection 1386)

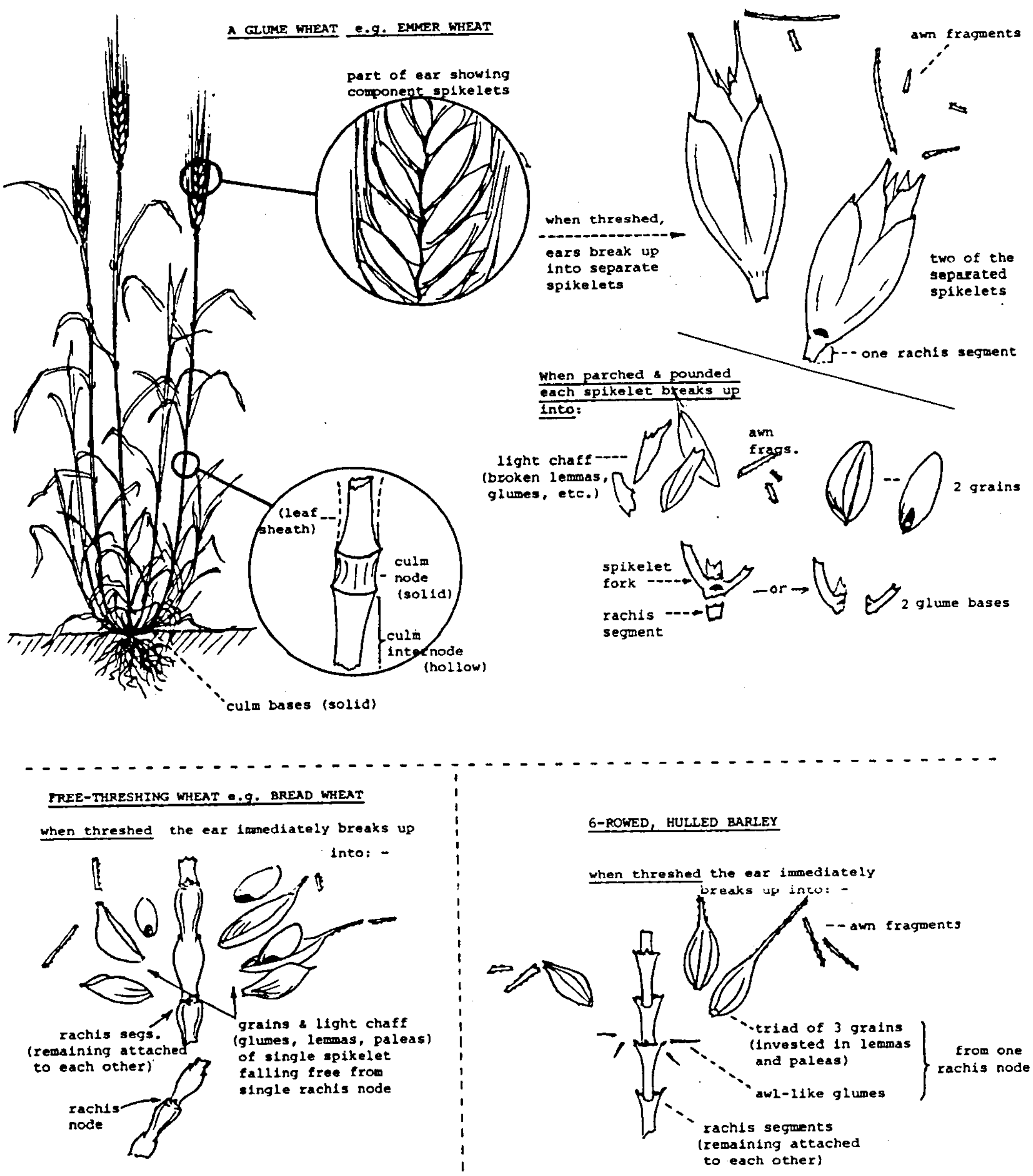
The methods of harvesting and preparing cereals might also be recognised from the condition of the straw. Fenton (1978, 337, 358) records the practice of plucking (pulling from the ground) in order to obtain maximum lengths of straw and the use of lashing rather than flailing in order not to damage straw that was to be used in thatching. The presence of unbroken straw, absence of cut stems and surviving fragments of the basal parts of the stem for example, would enable these techniques to be identified. The use of machines for threshing or whether the straw had been drawn (as at Jock's Croft) as part of the preparation procedure might also be apparent.

In some cases whole sheaves were put on to the roof ready for thatching. In these cases the bands used to tie them sometimes became incorporated into the thatch (Walker pers. comm.). The knots used to tie these were often distinctive and specific to individuals or particular regions so, where present, provide further cultural information.

Intermixed with the crops themselves are remains of the field weeds that would have grown alongside and been harvested with them. These weeds are characteristic of the field ecology and would vary in different fields according to the underlying geology and agricultural regime practiced. Undrained fields would have a different flora from drained ones in the same area and the machair would have a very different flora from that of fields on the acidic soils further inland. As demonstrated at No. 9 Locheport, this can be used to identify the importation of thatching materials from one region to another. The identification of the weeds, particularly through their seeds, therefore offers the possibility of providing relevant information regarding the agricultural economy of a site.

Busta, Fair Isle. A wooden frame made specifically for lashing corn. (B.W.)

Reaping corn. (Stephens 1855)



The main components of different species of cereal. (after Hillman 1981)

The weed flora of Scotland has developed through time with many exotic species having been incorporated and other native species becoming extinct. Different agricultural practices have encouraged certain weed species at the expense of others and their presence or absence can be used to identify when and how these changes took place. The development of the present weed flora and the history of these changes held within thatching materials is of considerable botanical interest.

3.5 Wild resources

A wide variety of wild resources are used in Scottish thatch construction and are discussed in more detail in Walker *et al* (1996). These include:-

Native grasses (eg Couch grass - *Agropyron repens*, Marram - *Ammophila arenaria*)

Reed (*Phragmites communis*)

Rush (*Juncus* spp.)

Iris (*Iris pseudacorus*)

Sedges (*Carex* spp. - particularly *C. pendula*)

Bracken (*Pteridium aquilinum*)

Dock (*Rumex* spp. especially *R. viridis* and *R. sanguineus*)

Heather (*Calluna vulgaris*)

Juniper (*Juniperus communis*)

Broom (*Sarothamnus scoparius*)

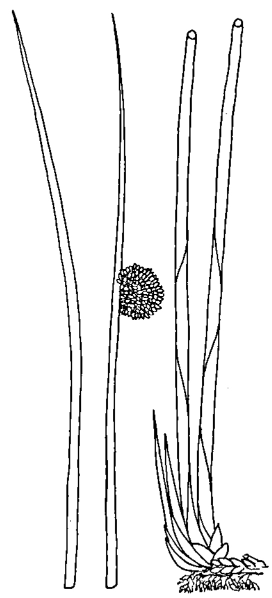
Seaweed (Various species)

Eel-grass (*Zostera* spp.)

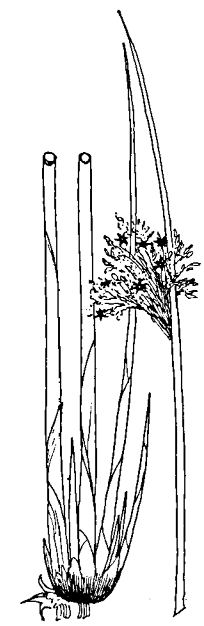
The majority of these will have been locally available. The sources of the materials will depend on the local ecology and land management practices and will therefore provide information regarding these. Some of the resources would have been managed either specifically for thatch or for other purposes and detailed study of the remains from thatched roofs can inform us about this. Even without any deliberate management repeated harvesting would tend to alter the plant population of an area. Marram grass is a good example of this as it grows more thickly when regularly cut than otherwise. The age structure of different elements can be of importance in determining how it was managed and the size of the plant will give an indication of this. Souness (1991) describes the best type of heather for thatching as being long (up to 4 feet), straight, unbranched and often to be found growing on steep north-facing slopes.

Something can be deduced of the method of harvesting used. The presence of roots or other underground organs imply uprooting as observed with the bracken from Jock's Croft and the heather from Johan Cottage. The cut stems of bracken from No. 9 Locheport, on the other hand, indicated that this had been cut by sickle or scythe.

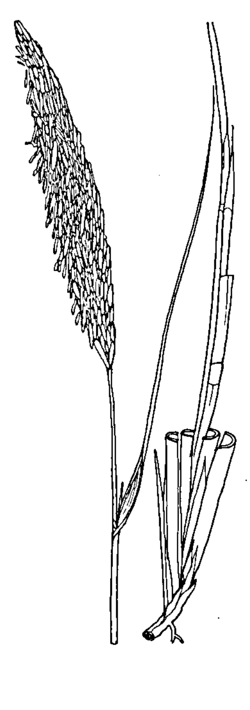
The condition of the material can also provide information regarding the methods of preparation used. At Jock's Croft it was clear that the bracken had been applied without the stripping of the leafy material. This differs from other examples where the foliage is removed before use.



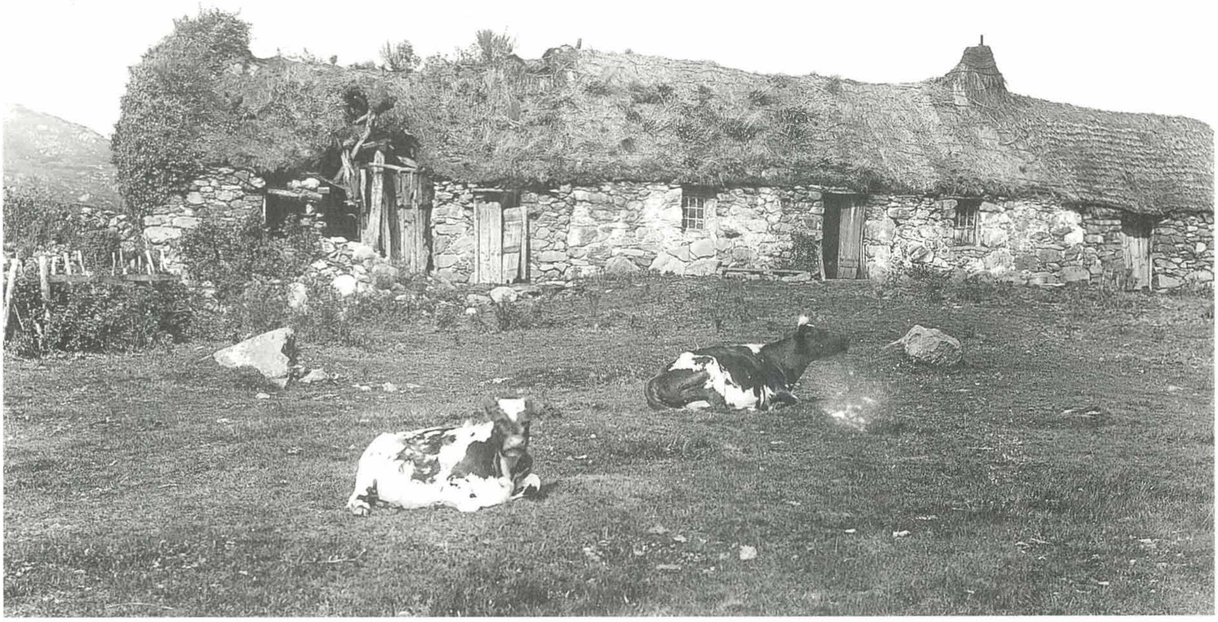
Compact rush (Juncus conglomeratus).



Soft rush (Juncus effusus). (B.W.)



Marram grass or bent (Ammophila arenaria). (B.W.)



A Highland cottage, Aberfoyle. Un-maintained roofs rapidly begin to aquire a flora and fauna of their own. The buildings to the left of the photograph appear to have a cereal thatch secured by wand and scob. The building on the right probably has a bracken thatch. (G.W.W. Aberdeen University Library C2961)

3.6 Inclusions

Once completed a thatched roof will immediately begin to accumulate its own flora and fauna, which, if unchecked, will eventually lead to its destruction. It is, however, important to be able to identify these elements from an archaeological viewpoint a) because some might be characteristic of different types of roofs and therefore help to identify the presence of roofing materials archaeologically and b) the presence of certain taxa may provide a good index of the condition of the roof and could, under certain conditions of preservation, be used on archaeological sites to identify the condition of a roof at the time of its collapse.

An unmaintained roof very quickly acquires surface vegetation of its own. Seeds that were collected with the thatching material and those dispersed by wind, rodents and birds rapidly take a hold. Subsequent root penetration of the roof causes rapid ingress of water and onset of decay. The presence of whole plants and the advancement of their growth can be taken as a measure of the condition of the roof. This could be used to identify the condition at the point when it was covered by a sheet roofing material or at the time of collapse.

A similar situation exists with respect to the invertebrate fauna of the roof. From the work undertaken as part of this project earth worms and woodlice have both been recovered from decaying *in situ* thatch. Other work, notably by Smith (1996), has indicated that the main element in thatched roofs from South Uist were taxa of what he calls the 'dry compost group'. Similar groupings occur in many other accumulations of vegetable matter; are not specific to thatched roofs and cannot therefore be used as indicators of such where recovered from archaeological samples. However, the roofs studied had probably not been maintained properly for some time and this may not be the case with all buildings. Kenward (pers. comm.) suggests that the presence of a rich synanthropic fauna (i.e. one associated with humans) could be used to imply that a roof is of considerable antiquity with continuity of occupation.

In addition to the above, the invertebrate flora from these roofs offer unique opportunities for providing basic entomological data for use by archaeologists and others (Kenward pers. comm.). These include:

- information of historical interest such as the presence of honey bees or bed bugs
- arrival of recently imported insects and their spread
- duration of synanthropic species following abandonment of houses.

4 TECHNIQUES OF INVESTIGATION

The buildings investigated as part of this project presented very different opportunities for analysis. The techniques required depended very much upon the condition of the building and its roof, the nature of the thatching material used and also the weather conditions at the time of the visits. Any detailed study should consist of recording in the field, bulk sampling of the different elements from the roof and detailed laboratory analysis of any samples taken. Although each building will inevitably have to be treated differently some basic suggestions are offered.

4.1 Preliminary Fact Finding

Any information that can be collected prior to visiting the thatched building is invaluable. A knowledge of the history of the building can help to explain field observations and enable the focusing of work on relevant site issues. In order to take full advantage of field trips interviews with owners or neighbours can be made. A knowledge of the history or the techniques used during construction might then help to focus questioning towards the less well-understood aspects of construction or building use. Previous knowledge of the architecture and present condition of the building will also enable a more accurate appraisal of the equipment needed and strategy required in order to sample the roof safely and make best use of the time in the field. During this preliminary phase of work the status of the building (i.e. whether it is a Listed Building or Scheduled Ancient Monument) should be ascertained and appropriate consent obtained before undertaking any destructive sampling.

Documentary and oral evidence can be used to provide a history of the building which enables the thatch to be put into context. The economic circumstances of the inhabitants may well have had a bearing upon the materials and methods used and any changes in these might be observed in the roof structure. Events such as the two World Wars, major trends such as agricultural improvement and dramatic economic shifts such as the development of the kelp trade in the Northern Isles would all have had an impact on the materials available, levels of maintenance and the rate of abandonment of buildings. Any specific events, such as the building of the house or the construction of a gable-end hearth (replacing the old central one) that can be dated from the historic record are of particular value. These enable us to build up a chronological framework that can be used to complement other dating techniques and will increase the value of observations relating to agricultural practices, the crops and land management.

For many buildings with surviving thatch there will be informants who lived or worked in them. Some may even have worked on the roof. If not collected now this information will soon be lost. With regard to documentary sources, some of the main sources of this material are discussed below.

- *Local libraries* - These hold a range of source materials including written, map and photographic. Where available, information regarding specific buildings can be extremely informative but records are patchy and relatively few vernacular buildings are likely to be covered in detail. There are, however, good chances of finding evidence relating to comparable buildings that will help to highlight any regional stylistic trends.
- *Scottish Record Office, Edinburgh* - This primarily holds written evidence and maps. The records include estate papers which can incorporate early maps and written descriptions. On occasions these may yield details regarding the construction of the building and sometimes the costs incurred. A second source of potentially useful material held at this location are the volumes of the Inland Revenue Surveys of 1910. These provide basic rental and valuation information which commonly includes short descriptions of the types of buildings present and their condition. Small sketch maps are sometimes included.
- *Royal Commission on the Ancient and Historical Monuments of Scotland, Edinburgh* - The Commission houses the National Monuments Record of Scotland. Here it is possible to access any details associated with Listed Buildings or Scheduled Monuments. Any material relating to buildings surveyed by the Royal Commission are held in regional Inventories. A photographic collection is maintained although the chances of finding evidence for specific vernacular buildings within this are slim. An air photograph collection is also housed here. These begin in the 1940s and

provide coverage of the whole country. Because of the small scale they are of only limited use but can be used to identify the point when a thatched roof was replaced with sheet materials, tile or slate. Also available at this location are the Ordnance Survey Name books. These contain notes relating to any place names used on Ordnance Survey maps, and, depending on the surveyor who undertook the work, include comments on the buildings surveyed.

- *The National Map Library, Edinburgh* - This library holds all of the modern and early Ordnance Survey maps. These begin in the 1840s although many areas were not mapped in detail until some years later. The 1:2500 maps are particularly useful for identifying the presence of buildings although, as with all maps, rebuilding on the site of earlier structures may not be readily apparent. The library also holds a number of estate and other maps that pre-date the Ordnance Survey Maps.
- *Scottish Ethnographic Archive, National Museums of Scotland, Edinburgh* - This archive contains material from a variety of sources and includes written accounts, interview transcripts, drawings, newspaper cuttings and photographs organised by subject and region. It is a good source of background information but is unlikely to include anything relating to specific vernacular buildings. The School of Scottish Studies, Edinburgh University and The Highland Folk Museum, Kingussie, are also good sources of similar information.

4.2 Field observations

A record of the external appearance of the roof should be made using the recording schedule outlined in Walker *et al* (1996, 15) prior to the removal of thatching material. The condition of the roof should be recorded because this may have a bearing upon those elements that might be expected to survive. The basic structure of the roof should also be recorded at this point. It should include the different materials present and should be used to determine the type of samples that should be taken. Whether the materials and thatching techniques used are uniform across the roof or whether there are specific areas where particular fixing techniques have been used should be noted.

At this point information regarding the context of the building should be recorded, for example; original and subsequent uses of the building; whether there is evidence for soot-blackening etc., which may indicate that there was originally a central hearth; whether it was originally, and still is, a rural or urban building; whether there have been any significant architectural changes during its life. These observations may add an extra dimension to any interpretation of the thatching materials.

4.3 Field excavation and sampling

It would be impractical to consider dismantling and recording of whole roofs but a sufficient area should be 'excavated ' to provide a representative picture of the techniques and materials used. The dismantled areas and subsequent sampling should include areas of particular interest such as at the eaves and skews where specific techniques that are not typical of the roof as a whole might have been used.

Experience has shown that a combination of *in situ* excavation and the removal of complete sections of roof (block samples) for laboratory analysis provides the best quality data. The *in situ* excavation enables the basic structure of the roof to be determined and helps to decide the types of samples that should be taken. However, in many cases, because of an unstable roof structure or poor weather conditions (particularly high winds) controlled excavation may prove difficult. Under such circumstances the value of any block samples is increased.

The size of the block to be sampled and the area to be dismantled will depend on the nature and condition of the roof and also on the resources available for removal of materials from the roof. Small blocks will inevitably lead to the truncation of long lengths of straw or other thatching material. This will be particularly prevalent with directional thatching materials and may result in loss of information. In such cases it is important that other samples of this material should be taken from adjacent excavated areas. The block sizes used throughout this project were 50 cm x 35 cm, this being the size of the collapsible plastic trays used to support the thatch from beneath. Even this relatively small block size proved to be difficult to extract using two people with ladders. Given more resources and a suitable method of lifting the samples much larger blocks including roof timbers and more representative areas can be removed and this has been achieved with success by the staff of the Highland Folk Museum, Kingussie (Ross Noble, pers. comm.). These blocks will also provide undisturbed samples for inclusion into any site archive.

The following sequence of actions is recommended:

- Record the external character of the roof as outlined in Walker *et al* (1996, 15).
- Locate a suitable position for excavation and sampling which provides a safely accessible and well supported area of roof which would enable removal of the thatched block either down through

the roof or out over the top. Avoid, if possible, areas which may not be typical of the rest of the roof such as the apex, eaves and skews. These should be sampled separately. The location of the excavated areas, the blocks and any other samples should be recorded on a sketch diagram of the building.

- Mark out the areas to be sampled using nails and string.
- Mark out an area adjacent to the block samples, ideally running from apex to eaves, which is to be dismantled *in situ*. The outline of this area should then be cut with a multi-purpose saw down to the basal layers of thatch. This may require the removal of any covering layers of chicken-wire. It should then be possible to remove distinct roofing layers one by one using standard archaeological techniques. Each layer should be numbered, labelled and bagged separately. Any relevant observations such as the nature of the material, the presence of an eroded surface and whether the material is directional or random, should be recorded at this stage. Sections through the thatch should be drawn and a complete photographic record made of work as it progresses. Details of any fixing methods would be recorded. Any turf layers should be exposed fully, cleaned and recorded in detail. Whether the vegetation is side up or down should be noted. Complete turves should be collected.
- The edges of the area identified for block sampling should be cut using a multi-purpose saw. This must include any basal layer of turves which should as far as possible be kept as part of the intact block. Uncontaminated samples from between overlapping turves may be needed for dating or pollen analysis.
- Before removal, the orientation of the blocks relative to the apex and eaves should be recorded. The blocks will also need to be supported from below. Throughout this project this was achieved using collapsable plastic trays 35 cm x 50 cm x 15 cm. These can pushed between the basal layers of thatch and the roof timbers and the sides erected. Depending upon circumstances, the block can then be lifted out from the roof or, as proved most convenient where supported mainly by *simmens* underneath, lowered into the building. A second tray over the top of the extracted block can be used to support the whole during transport.
- Samples of thatching materials used specifically at the apex, eaves or skews should be sampled separately, labelled and bagged.
- Separate samples of complete turves from several locations throughout the building should be boxed for later vegetation analysis.
- Samples of daub or mortar from the wall head or from the walls should also be collected at this time for possible analysis.
- If the whole roof is to be dismantled then there may be some value in removing a large sample of the turves and recording what proportion of them had been cut from different vegetation types.

Health and Safety

The sampling of thatched roofs has to be undertaken from the top of the roof. Rotten roof timbers and decaying thatch do not make stable working points and ladders should be used to support the weight of any people working on the roof. In some cases scaffolding might also be required. Special care must be taken in windy conditions especially when sheet metal has been cut from the roof. Goggles should also be worn in such conditions.

Equipment required

The following represents a list of general equipment which will be useful:

Multi-purpose saw with a long blade
Hacksaw
Wire cutters
Screwdrivers
Crow-bar
Secateurs
Hammer
Nails (various sizes)
Pointing trowel
Hand brush
Measuring tape
Collapsable plastic trays (two per block sample)
String
Bin liners
Plastic sample bags
Sample labels
Drawing equipment
Camera
Film (including 400 ASA)
Flash gun
Photographic scale
Plumb-bob
Ladders
Rope
Goggles
Hatchet

4.4 Laboratory dissection and recording

Excavation of the thatch block should be undertaken under laboratory conditions and detailed observations made regarding its structure and composition. This exercise should complement the observations in the field, especially where inclement weather or an unstable roof structure may have made more detailed recording difficult. During this phase thin layers which may otherwise have been overlooked should be recorded and sampled for later detailed analysis. Accurate measurement of the layers should also enable the construction of an isometric diagram of the block. Features such as eroded layers representing old surfaces that may not have been noted in the field may become apparent at this stage. Heather, for example, when exposed at the surface of a roof loses its leaves and much of the bark from the twigs giving it a grey appearance. Bracken fronds tend to become paler and more brittle if exposed. The presence of ropes can also be used to identify surface layers. Some forms of thatching, notably those using materials such as marram grass, cereal straw or rushes, tend to add surfacing materials on a regular basis, often annually. Decomposition of the older layers causes compression of the lowest layers and any original stratigraphy becomes obscured. In such cases dissection has to be by arbitrary spits. In this way it is possible to provide a chronological sequence of samples for more detailed analysis (below).

It is important to record the different orientation of materials within the roof. This will help to distinguish between directional or random thatches, and between layers used as the main thatching materials and those used as levelling layers or repairs.

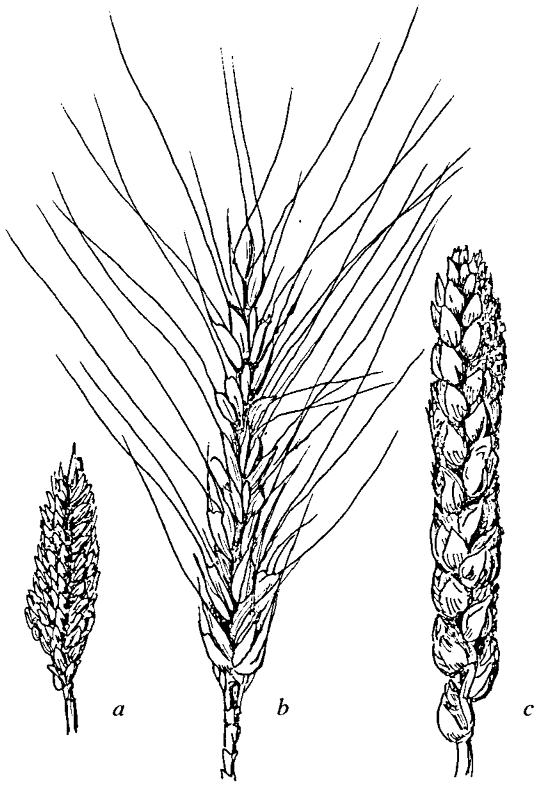
4.5 Detailed analyses

4.5.1 Botanical analysis of the thatch

Any botanical material from either the field excavation or from the block dissection should be identified as far as possible. The main thatching materials such as heather, bracken or cereal straw should be identified as should any inclusions within these. This will help to provide extra ecological data regarding the provenance of the thatching materials and, particularly with the cereal straw may identify some of the husbandry techniques used. Two levels of recording need to be undertaken, gross morphology and microscopic analysis. These are discussed below.

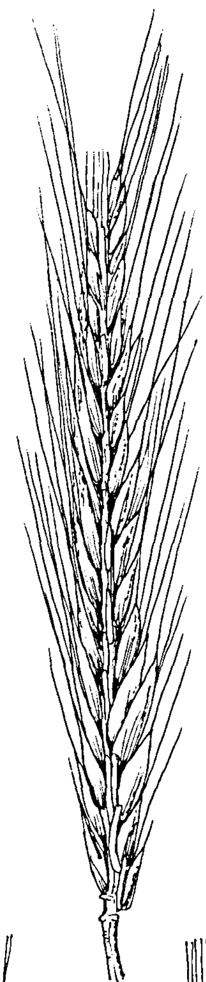
Gross morphology

Much relevant information can be obtained from gross morphology of plants from thatched roofs. Methods of preparing the materials are often apparent by the condition of the plants. Sometimes leaves are stripped from the stem, sometimes they are retained.

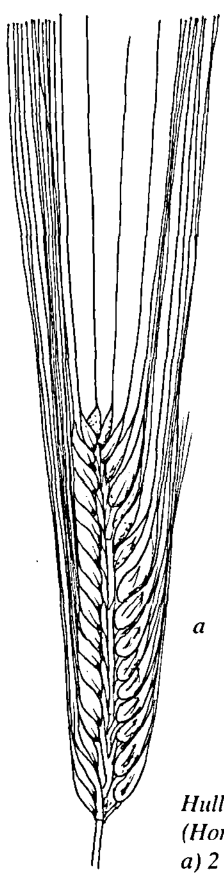


Wheats can occur in many different forms. (B.W.)
a) club wheat (Triticum compactum).
b and c) bread wheat with and without awns (Triticum aestivum).

Common oat (Avena sativa). (B.W.)

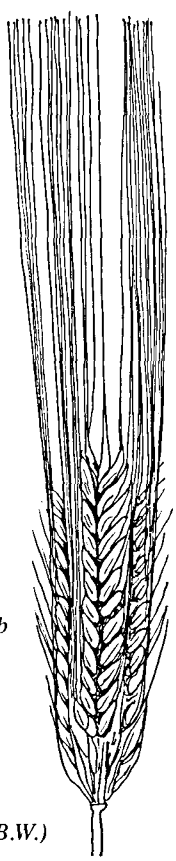


Rye (Secale cereale). (B.W.)



a

b



Hulled barley (Hordium sativum) (B.W.)
a) 2 row
b) 6 row

Characteristics such as the length and average stem diameter of the main thatching elements provide information regarding the maturity of the plant used and can be indicative of preferred materials, available resources and particular land management regimes. This is particularly true of heather where definite preferences for long springy stems existed. The presence of leaves, flowers or fruits can be used to imply different seasons of collection. Whether the materials have cut ends or retain adhering soil and fragments of underground organs can be used to distinguish between harvesting by uprooting or by cutting. In the case of cereals the condition of the plant might also enable identification of whether it had been threshed using a machine or if it had been drawn or combed prior to being used.

Cereals encountered on the roof are of particular importance. The major cereals cultivated in Scotland in the recent past were barley, oats, wheat and rye. Once removed from the roof they can readily be distinguished from each other and from other grasses such as marram or common reed by the morphology of the ears (see Hubbard 1980, Renfrew 1973). For information regarding the different cereal varieties used it is essential to have as much of the plant as possible for comparison with modern reference material. The length of the stem and the characteristics of the ligule (a structure found where the leaf joins the stem in grasses) are important features. Whether the ear is compact or lax is of great significance and with crops such as oat this can only be recorded if the whole upper part of the plant is present. In some cases, such as where the panicle has been preserved by the application of clay as a fixing, the original colour of the straw can be preserved and this too can be of diagnostic value. These cereals represent one of the few potential links between the crops described in early manuscripts and botanically recognised varieties. There are few reliable publications illustrating early cereal varieties in Scotland but Findley (1956) provides written descriptions of some of the main ones and Hervey-Murray (1980) outlines the basic terminology by which detailed botanical descriptions can be made.

Microscopic analysis

In some cases preservation is such that gross characteristics cannot be used to identify individual botanical constituents. With these it may be necessary to resort to microscopic features. The identification of some of the smaller grasses and rushes, even when they are in an ideal state of preservation, are, for example, made much easier by the use of low-powered microscopy.

Many of the layers on the roof contain a fine fraction consisting of invertebrate frass, detached leaves and other vegetative parts, seeds and fruits. Where cereals are present these wild species are likely to include the remains of cereal weeds which will provide good information regarding the ecology of the fields in which they grew. They are also important because it is these seeds that are most likely to survive in an archaeological context. The fine fractions from any important layers should be scanned under a low powered microscope. Any compacted or cereal-containing layers should be gently teased apart and sieved in a stack of laboratory sieves with the smallest mesh size being 0.25 mm. Any larger items in the greater than 1 cm category should be scanned but most of the readily identifiable components will be retained in 1 mm and 0.5 mm sieves. The fine fractions should then be scanned under the microscope. The most commonly occurring and readily identifiable botanical elements will be seeds and fruits of wild species and the grains, florets and chaff fragments of cereals. Most of these can be identified by reference to modern voucher specimens.

The interpretation of the fine fraction should be undertaken with reference to the ecological preferences of the species identified and ethnographic/ethnohistoric data for various parts of Scotland.

4.5.2 The turf

Various lines of investigation regarding the turf element are worthy of study and several different approaches are required in order to obtain full value.

The shape of the turves, in both section and plan, can be used to identify the implement that cut it. These characteristics should therefore be accurately recorded from several of the most complete turf samples from each building.

In many cases the turves retain well-preserved traces of the vegetation that was growing on the surface. The identification of the floristic component from a selection of turves therefore enables some conclusions to be drawn regarding the categories of land use and management techniques employed. This requires that small, often soot-blackened fragments of the surviving vegetation, including the moss, are identified by comparison to modern herbarium specimens. It would also be beneficial to extract seeds from the sediments themselves by flotation or wet-sieving in order to provide seed material that can be compared with charred or waterlogged seeds from putative archaeological turves.

The vegetation study can be complemented by pedological analysis of the turves. This is best achieved by thin section analysis as outlined by Bullock *et al* (1985). This technique requires that undisturbed pieces of turf or other sediments, such as daub, are taken using standard Kubiena tins. The samples are then impregnated with resin. Once cured, a process that can take up to three months, the hardened blocks are thin sectioned. The prepared sections are thin enough that the different mineral and organic components can be characterised using high powered microscopy. Mixtures with more than one source material can be identified and data relating to the preparation of the sediments can be obtained. When taking samples from thin sectioning it is essential to record the orientation of the Kubiena tin relative to the roof. Any interfaces between observable strata should also be sampled.

4.5.3 Invertebrates

All of the samples from the analyses undertaken here contained low numbers of insect and mite remains. Higher concentrations would be expected if larger samples were processed. Kenward (pers. comm.) suggests that several litres of materials such as thatch or turf should be subjected to paraffin flotation in order to concentrate the remains. These should then be sorted in industrial methylated spirit. He estimates that if processed dry, as the test cases examined here were, perhaps as much as half of the remains will have been overlooked. A recent analysis of beetle remains from thatched buildings from the Outer Hebrides has been undertaken with some success by Smith (1996).

4.5.4 Daub/plaster

Thin section analysis of daub and plaster has been identified as being an area of potential interest. A record of the location and condition from which any of this material was taken should be made (see section 4.5.2).

4.5.5 Dating

If a building can be demonstrated to be over 300 years old then it may be worth undertaking radiocarbon dating. A stratified sequence of thatch samples should be collected from the block sample in the laboratory. Each dating sample should consist of at least 5g (dry weight) well-preserved material from a single species. Care should be taken to avoid contamination during sampling and all dating samples should be immediately dried and bagged.

Samples taken for lead isotope dating should consist of 30g samples taken from a series of undisturbed strata. The aim should be to recover ten samples from any one thatch profile.

The incorporation of spheroidal carbonaceous particles into turves has been suggested as a chronological marker that could be used to identify the date before or after which the turf was positioned on the roof (see section 5.3). If this technique is to be used, samples which were uncontaminated by later carbon particles need to be taken. Samples taken from between two overlapping, and therefore sealed, turves would have to be used for this purpose.

5 DATING

The value of information gained from the investigation of old thatch will, in all cases, be enhanced if the thatch or its constituent parts can be accurately dated. Most surviving thatches in Scotland are likely to have been constructed in the last two hundred years and therefore on an archaeological timescale are recent in date. However, thatching materials and techniques have developed within this time period and one of the benefits of an archaeological approach to thatches will be a greater understanding of this history. The recollections of living thatchers only relate to the twentieth century; photographs extend the record back in to the later nineteenth century but they principally provide information about the surface finishes of thatches rather than details of construction materials and methods. Dating is also important in the investigation of topics other than thatching; information about agriculture, economy and environment should all ideally be placed in a tight chronological framework.

Various dating techniques have been used for material originating in the last few hundred years and their value in the dating of thatch is discussed below. Both useful and unsuitable techniques are discussed in order to provide the reader with some guidance on the techniques that are most likely to be of use.

5.1 Radiocarbon dating - *M Dalland and S Carter*

The theory

Radiocarbon dating is based on the predictable decay rate of an isotope of carbon, ^{14}C. This occurs at a rate that halves the concentration of ^{14}C in relation to the stable ^{12}C every 5730 years, which is known as the half-life of the isotope. In order to date material containing organic carbon one has to know two parameters:

The present concentration of ^{14}C in the sample and,

The concentration of ^{14}C in the organic material when it was formed.

The present concentration of ^{14}C isotopes in the sample can be measured in two different ways:

Directly by measuring the ^{14}C concentration using mass spectroscopy

Indirectly by measuring the present rate of ^{14}C decay in the sample.

None of the methods provides an exact measurement of the present ^{14}C concentration, but estimates the value normally within ± 50 half-life years. This means that there is a 68% chance that the true concentration of ^{14}C lies within 50 half-life years of the measured value. Both methods provide similar accuracy, but the advantage of the mass spectroscopy is that it can date very small amounts of organic material.

The concentration of ^{14}C isotopes at the time when the material was formed is worked out by measuring the ^{14}C concentration in samples of known age, normally dendrochronologically dated wood. From a series of dates of known age a calibration curve is built up. This curve links the present concentration of ^{14}C in a sample to calendar dates. By comparing the concentration of ^{14}C in the sample measured in half-life years with that of samples of known age on the calibration curve, the age of the sample can be estimated.

The practice

Thatch is composed of a variety of carbon-rich organic materials that can frequently be shown to have grown and been collected within a single year. In principle this makes thatch ideal material for radiocarbon dating; however, there are a number of methodological difficulties that complicate the situation. The calibration of a radiocarbon determination to produce an age estimate in calendar years presents greater problems. Inspection of the calibration curve from 1700 to 1950 reveals two age reversals, an earlier one at the start of the eighteenth century and a later one at the end of the nineteenth century. The later reversal is the so-called Suess Effect: high outputs of carbon derived from the burning of fossil fuels progressively diluted atmospheric ^{14}C concentrations from the later nineteenth century onwards. This results in organic material from this period appearing older than it is. In practical terms, the reversals in the calibration curve result in one radiocarbon determination corresponding to two or more separate calendrical time periods. For single radiocarbon dates this problem cannot be resolved unless other dating information can be presented to exclude one or more of the calibrated age ranges. The solution for thatches might have lain in the use of multiple dates from a stratified sequence of thatch (for so-called 'wiggle matching' on the calibration curve). However, the following example illustrates the problems associated with this.

- Surviving thatched roofs are not likely to be much more than 300 years old and most examples would therefore fall into the more recent parts of the calibration curve. Figure 1 shows the last 450 years of the calibration curve (Stuiver *et al* 1993). The horizontal axis shows the calendrical dates and the vertical axis shows the ^{14}C concentration measured in years BP. The grey zone around the mid-line denotes, to one standard deviation, the uncertainty in the calibration readings. Due to oscillations in the atmospheric ^{14}C concentration it can be seen that a sample which has a radiocarbon content equivalent to 150 years BP could, when compared with the calibration curve, come from any of the following calendrical dates - 1681, 1735, 1806 or 1936. Historical information on the buildings may enable us to exclude some of these dates, but the uncertainty would still be too great to differentiate between dates which are, in some cases, only a few decades apart. Furthermore, the ^{14}C measurements themselves are not exact, commonly spanning 100 to 150 years. This could place the measurement anywhere within the last 300 calendar years of the calibration curve. Only if it were possible to reduce the uncertainty in the radiocarbon essay down to less than ± 10 years BP would it be possible to distinguish between events a few decades apart. Even then one would have to rely on independent dating evidence which placed the dates within the steeper parts of the calibration curves such as AD 1600 - 1715, AD 1715 - 1755, AD 1795 - 1815 or AD 1875 - 1905. It would be virtually impossible to distinguish between dates that lay within the same flat part of the curve (AD 1755 - 1795 and AD 1815 -1875).

In conclusion, the nature of the calibration curve over the last 300 years makes the radiocarbon method unsuitable for investigating the construction and maintenance procedures of thatched roofs. It may, however, be of use for very broad age estimates in order to check if the roof pre- or post-dates AD 1650.

5.2 Lead isotope dating - *S Carter and T Holden*

The dating of events within the past few centuries is generally not attempted with radiocarbon because of the problems discussed above. Instead, a short lived isotope of lead (^{210}Pb) is used which offers high resolution dating of the last 150 to 200 years. This technique requires that samples are taken from a sequence of accumulating sediments enabling comparison in the concentrations of the lead isotope throughout the sequence (pers. comm. G Cook, SURRC). It is of most use in situations such as accumulating lake sediments or peats but may be of potential value in the dating of certain categories of thatch. Thatches such as those studied from Keils and Gimps where layers of thatching materials were added to the surface on an annual or biannual basis might provide good samples for this kind of dating method. The technique has not, however, yet been applied to these types of 'sediments' and a number of trial runs would be required in order to assess its practicability.

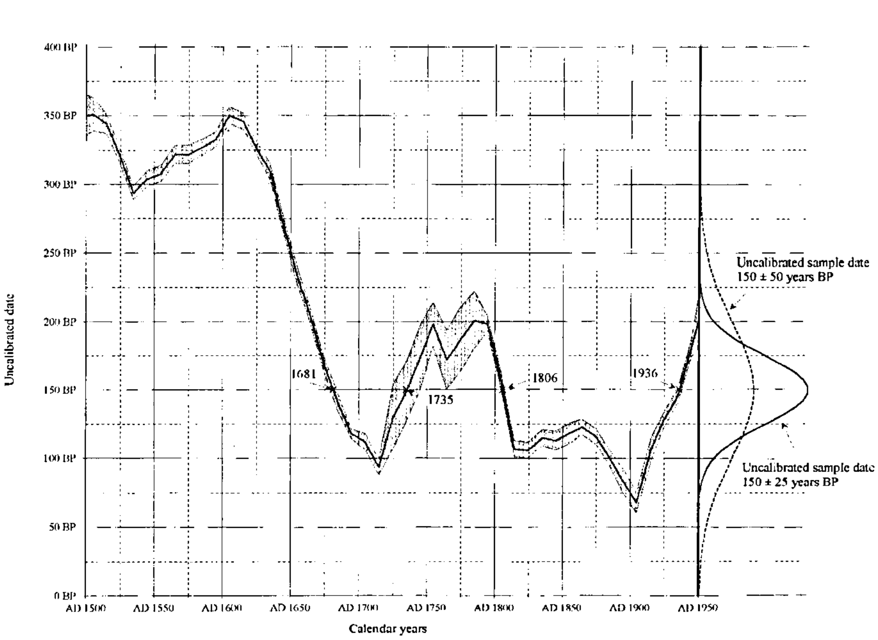


Figure 1
Part of a radiocarbon calibration curve linking radiocarbon content measured in years BP (vertical axis) to calendar dates (horizontal axis). The shaded area indicates the uncertainty in the curve to 1 standard deviation.

5.3 Dated stratigraphic markers - *S Carter*

If particular materials can be given a precise date, they can be used to provide maximum and minimum age estimates for undated material stratigraphically above and below. So far only one likely marker has been identified: *spheroidal carbonaceous particles* (SCPs). These are microscopic particles produced by the incomplete combustion of coal and oil at high temperatures (Wik & Natkanski 1990). As such, they are a product of recent industrial processes and their abundance reflects the degree of particulate atmospheric pollution. The particles are deposited on ground surfaces and therefore will appear in turves used in thatches. No precise date can be given for their first appearance but they only become common at the end of the nineteenth century and increase in abundance through the twentieth century. Therefore their presence will indicate that a thatch is no earlier than the late nineteenth century. This will assist with the interpretation of radiocarbon dates from overlying thatching materials.

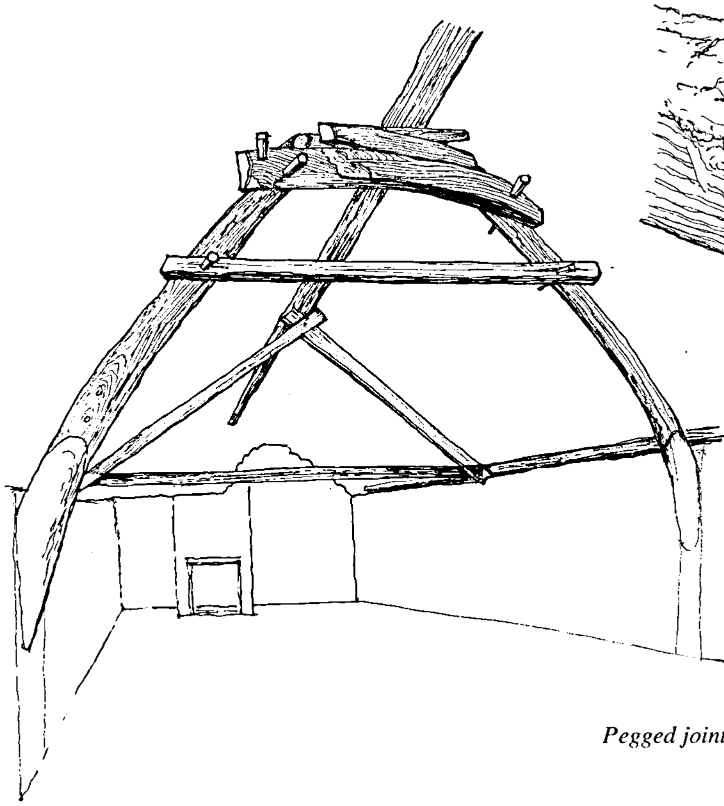
Two potential problems should be noted. Firstly, turves under thatch frequently become coated in soot from domestic fires. This soot should not be confused with SCPs but nevertheless, sampling from the surface of a turf protected by an adjacent turf is recommended. Secondly, because SCPs derive from heavy industry they are most common close to major industrial centres. Deposition of particles in the extreme north and west of Scotland may be too low to be detected and therefore there is potential for a false negative result and an incorrect assumption of an early date.

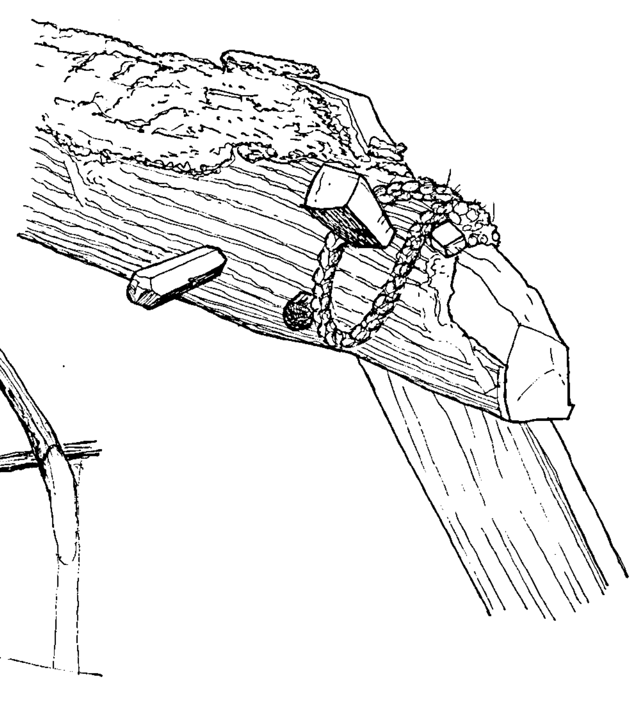
5.4 Dendrochronology

A thatch will always be younger than the roof timbers that support it so, in theory, dendrochronological dates for roof timbers will provide a maximum age for the thatch. Many roofs may, however, appear older than they actually are due to practices such as the re-use of earlier roofing timbers and the re-cycling of ships timbers which used to be widespread in Scotland.

5.5 Documentary evidence, architectural style and oral history

Given the relatively recent date of many of the surviving thatched buildings a chronological framework can be constructed using information from available documentary sources, surviving inhabitants and architectural features of the house itself. The quality of this framework can vary significantly from building to building. In some cases the information is sufficient to identify when certain features on the roof were added whereas in others they may only enable us to bracket particular features or materials between two chronologically disparate events. It might be possible,





Pegged joints from a typical Highland building. (B.W.)

for example, to identify that a particular layer was added after the removal of central hearth, identified from photographic evidence by the presence of a gable-end chimney, and before the addition of a metal roof identified from air photographs. At the very least this provides a range of dates for the use of particular thatching materials and puts them into some sort of historical context. The main sources of evidence include:

- *Oral history* - a relatively high proportion of these buildings are still owned by people who lived in or close by and who may in some cases even have helped with or witnessed thatching of the houses. This source of evidence is invaluable and should be collected in as much detail as possible through recorded interviews. Comments by interviewees can explain many of what would otherwise be confusing features and above all can explain why things were done the way they were. Interviews are not, however, always accurate recollections of the past and facts should, where possible, be verified by other means.
- *Architectural features* - Certain constructional features can be used to provide chronological information. Although vernacular buildings are notoriously difficult to date on stylistic grounds some features such as the presence of pegged joints or blacksmith-made nails can suggest that they are earlier rather than later. Of perhaps more use are the presence of more recent materials such as plastics, fishing nets, chicken-wire, sheet materials and their fixings which can, to some extent, be assigned to different periods.
- *Maps and plans* - Ordnance survey maps produced since the middle of the last century can identify when some of the more recent buildings were constructed. Earlier maps, produced by the large estates or the military are also occasionally available. However, as with most map evidence the rebuilding of structures on the site of earlier buildings is not always apparent.
- *Written* - Written evidence such as the accounts of some of the major estates can, in rare cases, provide good information regarding materials and methods employed and when buildings were constructed or renovated.
- *Photographs* - Photographic evidence, where available for specific houses, can be an extremely good source of evidence regarding the form of the roof and the fixing methods used. In some cases it is also possible to identify the materials used. Air photos, such as those taken by the RAF, are also of use and can, for example, help to determine when particular roofs were covered in later sheet materials.

6 WORKED EXAMPLES

The following examples represent a number of test cases used to develop and refine techniques. They do not therefore represent the results of a uniform strategy nor do they necessarily represent the best way of approaching the problem of recording thatched roofs. They are however an initial attempt at extracting maximum possible useful information. The levels of recording and sampling and the scope of the post-excavation analyses are very tightly linked to the financial and other resources available for each project. But it is hoped that by highlighting some of the benefits and problems associated with different techniques best use can be made of resources in future studies.

6.1 Jock's Croft, Lochearnhead, Stirling

6.1.1 Location and condition

Jock's Croft is one of four dilapidated buildings owned by the Cameron family of Lochearnhead and lying to the west of the A85 approximately half a mile north of Lochearnhead (NGR NN 585 245). There is a group of buildings named *Clachglass*, indicated on or close to this site on Stobie's map of 1783 but it is not clear whether these are the present buildings at Jock's Croft. The four buildings are clearly represented on the Ordnance Survey map of 1862 so must have been constructed some time before this. Mrs A. Cameron recalls that the house has not been thatched within the last 40 years and that it was last inhabited in the 1950's.

Jock's Croft, spring 1996. (H. McDonough)

Jock's Croft, spring 1996. (H. McDonough)

All of the buildings in this group now have corrugated iron roofs but Jock's Croft is the only one with any surviving traces of thatch beneath this. Air photographs taken of the site in 1946 seem to show that Jock's Croft is the only one of the four that does not have a metal roof at that time. In recent years the wind has torn away the metal sheeting on the eastern face of the roof and as a result the exposed thatch is in a poor state of preservation and much of it has fallen into the interior of the house. The western face of the roof is still completely covered by the sheet metal. At the time of the visit in January 1996 the thatch underneath was found to be in an excellent state of preservation even though patches had suffered from the effects of the weather or animal disturbance.

Oat straw from the roof. (T.H.)

6.1.2 Sampling

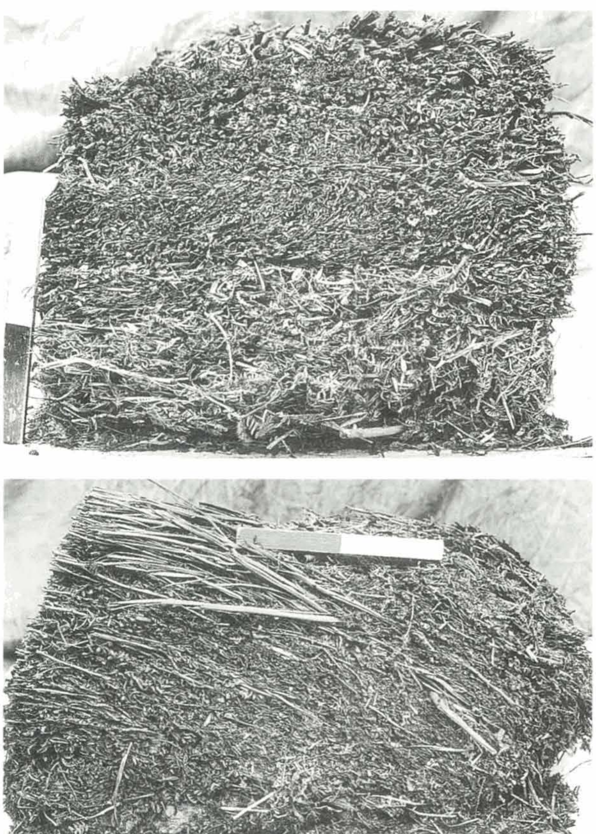
From a secure position on the roof it was possible to identify areas on the ridge where the apical thatch remained in good condition. This was chosen as the point most likely to produce well preserved thatch further down the pitch. It was possible to unscrew and bend back one of the metal sheets of the roof revealing an area of thatch measuring 60 x 200 cm. Within this exposure, an area 35 x 50 cm was marked out and a multi-purpose saw used to cut out a block of thatch down to the roof *cabers* and the turf overlying them. Having cut the block, the area directly down slope was excavated down to the turf by hand. In this way full lengths of bracken, cereal straw and other components, sometimes over 100 cm in length, were drawn from the matrix of the roof and bagged for later analysis. Once the underlying turves were reached it was possible to remove the block intact. The exposed turfs were then removed one by one and placed in a separate tray in the same relative positions they had occupied on the roof.

The same procedure was followed at the apex. In this upper part of the roof a number of wooden pegs (up to 45 cm long) had been driven in horizontally at intervals of about 60 cm along the ridge. These were removed to enable cutting and extraction of the block. Attempts were made to sample the eaves but these were highly eroded and appeared to consist of the same material as the main body of the roof. It was not possible to sample the areas adjacent to the skews or around the chimneys because of the dilapidated condition of the roof.

Following sampling and photography any loose material extracted, but not required for analysis, was put back into the excavated area. The corrugated iron sheet was then pushed back and screwed into its original position.

6.1.3 Composition of the thatch

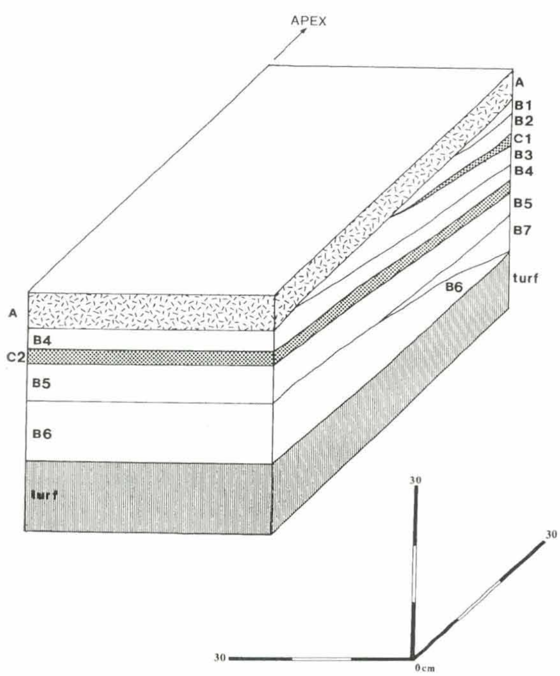
The upper layer of the thatch was between 6 and 8 cm thick and composed of fragments of the leafy parts of the bracken plant (*Pteridium aquilinum*) intermixed with occasional fragments of cereal straw. This could either have been deliberately piled onto the surface of the thatch when the metal roof was added or, more probably, was a wind-blown accumulation resulting from erosion elsewhere on the roof. Below this the main body of the thatch was composed of a repeating sequence of two courses of bracken to one course of oat straw. Whole bracken plants (including leafy material) had been used, their black underground portions (the stipe) pointing down the pitch of the roof and the leafy upper parts of the plant pointing towards the apex. The bracken was typically 100 cm long, laid in horizontal courses 20 cm apart such that the blackened ends of the stipe gave the appearance of stripes along the roof. Fifty-one black basal stems were counted from a single course from a length of 38 cm across the pitch. This should permit the calculation of the quantity of bracken required for a single thatching.



Sections through the thatch block.

The lowest bracken layer, while being of similar character to those above, contained patches which appeared to have been stuffed in rather than carefully laid. This layer also contained wads of rushes (identified as *Juncus acutiflorus*). It is likely that this was used as a levelling layer to help reduce the pitch of the courses overlying it.

On the basis of the remaining areas of the apex its form would appear to be flush (see Walker *et al* 1996 - descriptions of roof form). At the roof apex the orientation of the last row of bracken was reversed with the black stipes pointing upwards. No leafy material survived in these apical plants but it was unclear whether this was as a result of wind erosion or because they had been stripped prior to fixing on the roof.

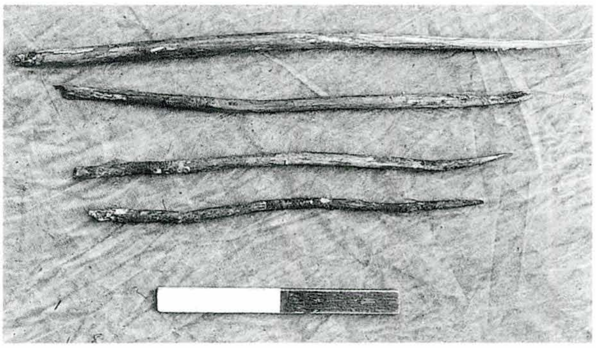


The thatch block from Jock's cottage.
a = disturbed bracken layer
b = bracken
c = cereal

Tippets or grips made of oat straw. (B.W.)

The layers of oat straw (*Avena sativa*) were approximately 2 cm thick and consisted of plants that were commonly between 95 and 100 cm long. These had been carefully arranged as a directional thatching material running down the pitch of the roof. At one level in the roof bunches of oat straw that had been twisted back on themselves were noted. These were approximately 70 cm long and probably represent *tippets* or *grips* (see diagram and Fenton and Walker 1981, 68) which would have been pushed into the thatch either as part of the original roof construction or, more probably, as part of a later repair. The oat straw had been harvested by cutting rather than uprooting, threshed and the whole upper portion of the plant had been used. Detached glumes were common but only in rare cases were the florets and enclosed grain recovered. The remaining parts of the plant offer good potential for identification to the level of variety. No evidence for cereal weeds was noted.

Parts of six separate turves were collected from beneath the sampled area. They had been positioned vegetation side down directly onto the *cabers* of the



Wooden pins taken from the roof.

roof and were organised in somewhat irregular overlapping rows so that at any point they lay three turves deep. Individual turves were somewhat irregular in shape but were in the order of 40 to 50 cm square. Each turf was approximately 4 cm thick in the centre but tapered towards the edges; this profile indicates that they were cut with a curved bladed *flauchter* rather than a straight spade and also accounts for the irregular edges of the turves. The vegetation on the turf consisted of plants typical of acidic heath. Heather (*Calluna vulgaris*), bilberry (*Vaccinium myrtilis*) and grass (cf. *Nardus stricta*) were noted. Mosses were also abundant including hair moss (*Polytrichum* sp.). The vegetation appeared to have been cut short before the turves were collected.

The only evidence recovered for the fixing of the roof was a number of sharpened pegs up to 45 cm long made of roundwood between 1 and 2 cm in diameter. These had been pushed horizontally into the thatch directly below the apex. Traces of straw ropes were recovered from isolated parts of the ridge only. The poor condition of these meant that their relationship with the pins or other fixing structures could not be determined. The absence of an arrangement securing the upper layers of the thatch to the roof suggests that this may have been removed prior to the fixing of the sheet metal.

6.1.4 Detailed analysis

Samples of cereal straw were selected for detailed botanical analysis and a sample of one of the turves was selected for thin sectioning. The turf sample was impregnated, sliced and ground to produce a standard 30 µm section.

Botanical analysis

Each cereal layer, confirmed as common oat (*Avena sativa*), was carefully pulled apart by hand in the hope of recovering the remains of crop weeds. Only one capsule of corn spurrey (*Spergula arvensis*), a common weed on acid soils, was recovered suggesting that the crop had been well cleaned before being placed on the roof. Much of the leafy material had also been deliberately removed from the straw. The straw had therefore been drawn (i.e. stripped of leafy material) during preparation.

Thin section analysis - *S Carter*

This turf was 4.5 cm thick, excluding the growing vegetation on its surface. Four distinct layers were described:

> Vegetation. 1.0 to 1.5 cm deep layer, dominated by bryophytes, in particular the moss *Polytrichum*, with some grass or sedge.
>
> Plant litter. 1.0 to 1.5 cm deep layer of highly porous microaggregates or amorphous plant litter with common roots growing through it.
>
> Ah horizon. A discontinuous layer, up to 6 mm deep, of poorly sorted sandy loam mixed with organic microaggregates (probably invertebrate excrement) and some plant roots.
>
> B/C horizon. At least 2 cm deep layer of poorly sorted sandy loam with frequent metamorphic rock fragments up to 12 mm across. Very few organic components.

The most striking feature of this soil profile is the absence of evidence for soil development. The A horizon is almost totally absent, represented only by a narrow zone of mixing between the shallow litter layer and the underlying subsoil horizon. When undisturbed, an A horizon of at least 10 cm depth might be expected in this freely draining profile. The conclusion must therefore be that the profile has been truncated in the recent past and the lost A horizon has not re-formed. Turf scalping is the most likely cause of this truncation but a single previous cut would have been insufficient to remove the entire A horizon. Unless scalping had triggered soil erosion, repeated scalping episodes are indicated.

This conclusion suggests that the turves were derived from an area traditionally used for scalping. Given the destructive potential of turf cutting, the restriction of the practice to specified locations seems highly desirable. The juvenile state of the heather growing in these turves supports the idea of earlier disturbance and illustrates the influence of turf scalping over the development of the heathland vegetation.

6.1.5 Summary and discussion

The friable, mixed nature of the uppermost layer of the surviving thatch makes it unlikely that it could ever have formed the exterior coat of a functional thatch. This was probably wind-blown debris but from the small sample studied could also represent material spread onto the existing thatch in order to improve sound and heat insulation and provide a more stable, compacted roof structure immediately prior to the fixing of metal roofing sheets. Beneath this, whole bracken fronds were placed on the roof in rows with the black underground part of the stipe pointing down the pitch. This situation is reversed at the apex with the uppermost row having the underground part facing upwards. The leaves appear to have been stripped of the plants in this apical row. The maturity of the bracken plants would be consistent with their having been collected by uprooting in the autumn.

A course of oat straw was interleaved with the bracken, apparently after every second bracken course. The ends of the straw were aligned with the ends of the bracken and may actually have been slightly exposed at the surface. The straw was laid in a directional fashion down the pitch. It would seem likely that this acted as an extra barrier to water passing into the roof, shedding water more efficiently than the bracken alone. This method of thatching may have been a response to the high value placed upon straw for animal fodder in the Highlands as opposed to the islands and coastal regions where winter grazing was more readily available. The straw was lacking much of its leafy material and crop weeds were largely absent, indicating that the straw had been drawn or combed.

It is likely that repairs were made to the roof at some point with handfuls of twisted oat straw being pushed into the existing thatch. Rushes and fragmentary bracken were also used in some parts of the roof construction. These are thought to have been stuffed into the lower courses in order to create the desired pitch for the application of subsequent courses.

Fixings for the thatch were largely absent from the sampled area and other accessible parts of the ridge. The only evidence was a number of small-diameter roundwood pins some 45 cm long driven horizontally into the area just below the roof apex. Fragmentary remains of straw ropes were also recovered from the roof apex but it was not possible to determine how these related to the wooden pins.

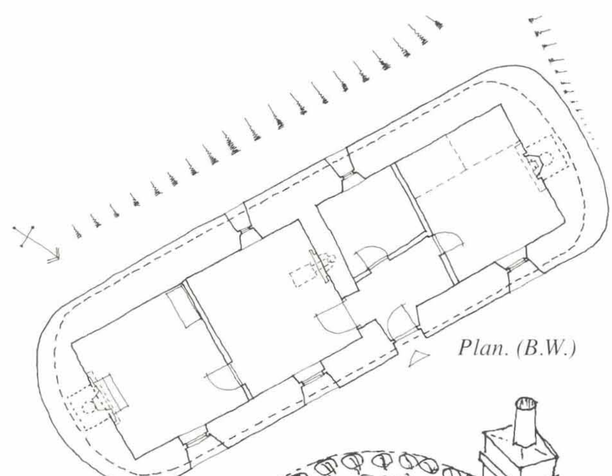
Underlying the thatch a layer of overlapping turves resting face downwards directly onto the roof *cabers* were recovered. The turves were apparently taken from an area of acid heath and may offer an insight into heathland management. Thin section analysis suggests that the heathland was an area traditionally used for scalping. It is probable that these turves represent the earliest features of the roof as they may have survived more than one re-thatching of the building. With the exception of the loose surface layers, which may have been put into the roof when it was covered in corrugated iron, it is likely that all of the superimposed bracken and cereal layers derive from one thatching episode. Repairs do appear to have been required from time to time and would tend to indicate that the thatch acted as a functional roof for some years before being covered by sheet metal.

No. 9 Locheport, Sidinish.

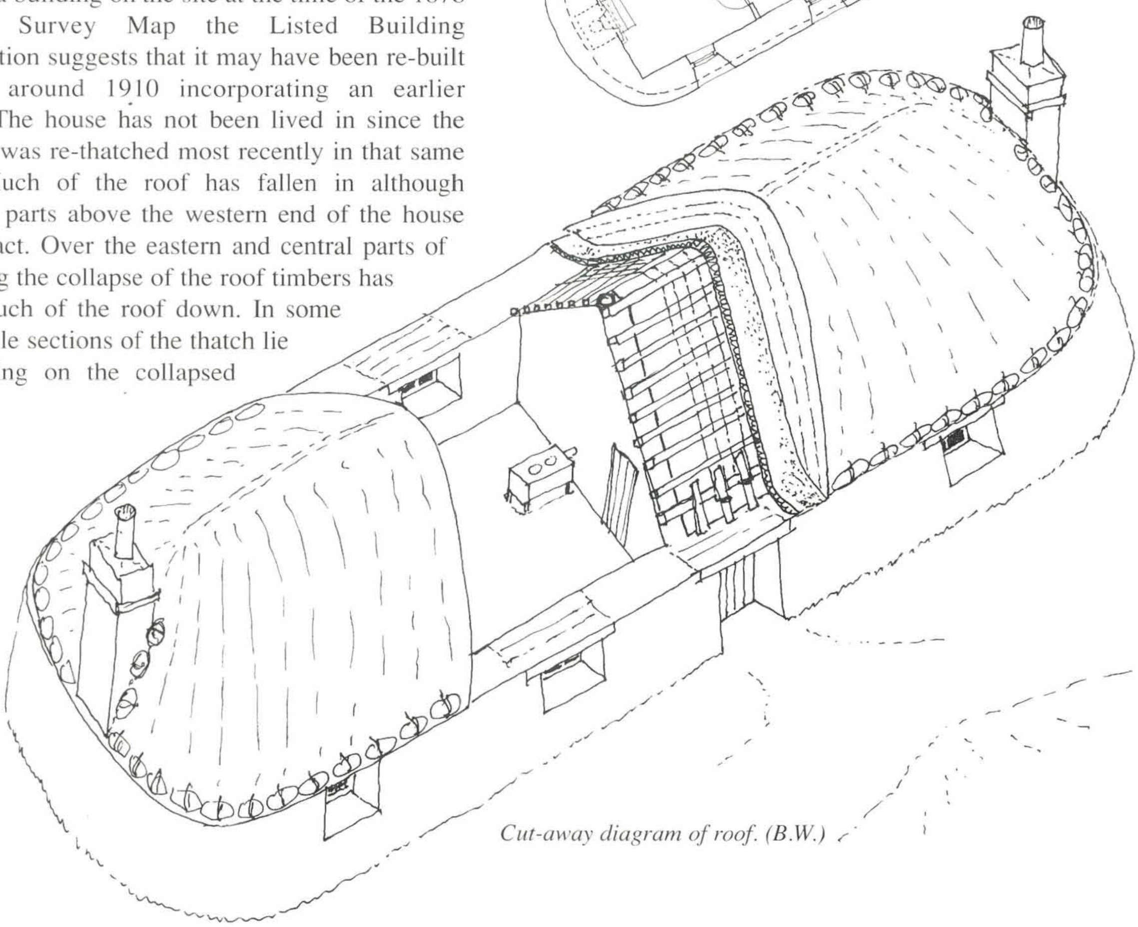
6.2 No. 9 Locheport, Sidinish, North Uist.

6.2.1 Location and condition

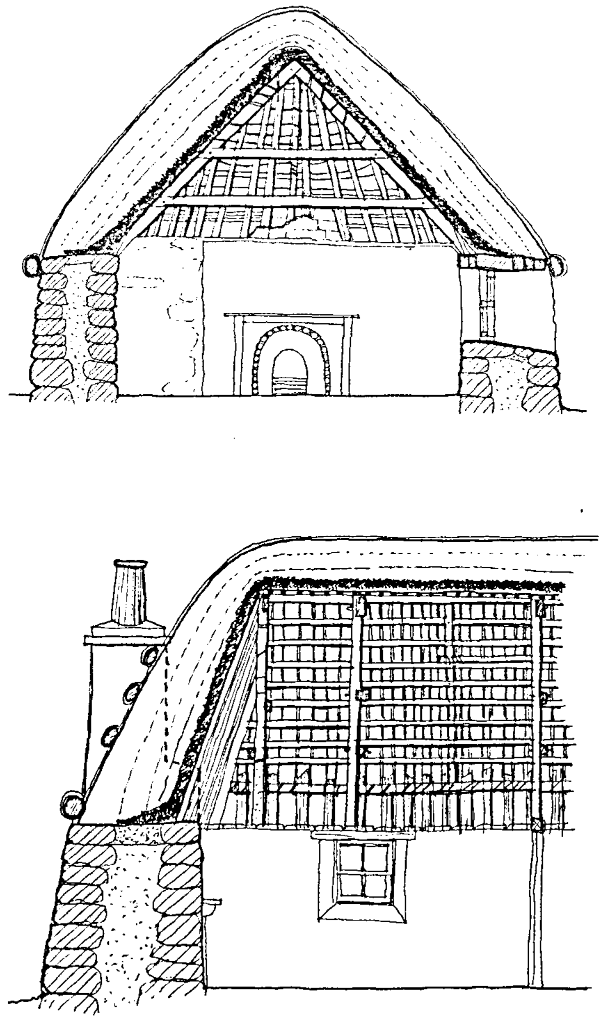
No. 9 Locheport, Sidinish, North Uist (NGR NF 8777 6315) consists of a dwelling and two small out-houses owned by Mr John MacDonald. A discussion of this and other houses at Locheport has been published by Souness (1991) and Walker (1989). One of the out-houses retains the lower turf layers of an earlier thatch but it was the main house, a listed building, which was the focus of this study. Although there would appear to have been a building on the site at the time of the 1878 Ordnance Survey Map the Listed Building documentation suggests that it may have been re-built sometime around 1910 incorporating an earlier structure. The house has not been lived in since the 1970s and was re-thatched most recently in that same decade. Much of the roof has fallen in although substantial parts above the western end of the house remain intact. Over the eastern and central parts of the building the collapse of the roof timbers has brought much of the roof down. In some places whole sections of the thatch lie intact resting on the collapsed timbers.



Plan. (B.W.)



Cut-away diagram of roof. (B.W.)



Sections through the building. (B.W. after Hadlington 1993)

6.2.2 Sampling

In the eastern part of the building a relatively undisturbed section of the collapsed roof remained intact, supported off the floor by the underlying roof timbers and secured by the chicken-wire covering. An area of this thatch immediately adjacent to the eastern chimney on its north side, was chosen because of its good condition and ease of access. By climbing under the collapsed area it was possible to insert a number of floor boards between the supporting timbers and the basal heather ropes and turves. These were nailed into position in order to make a secure base for the block sample. The chicken-wire covering from over the area to be sampled was cut but left in position. A block of approximately 120 cm x 65 cm was then cut with a multi-purpose saw. Directly to the side of the block an area of approximately 20 cm in width was also cut and excavated by hand. Samples of heather, bracken and straw were extracted from this area. Having excavated this area it was then possible to pass ropes around the block, using plastic trays and chicken-wire to support the sides. Once the ropes were pulled tight and the whole block secured it was turned onto its back and trimmed before being carried from the building.

Samples of the collapsed ridge turf were taken from the eastern side of the central chimney; samples of daub were taken from the wattle panels in the western room and also from the wall of the same room.

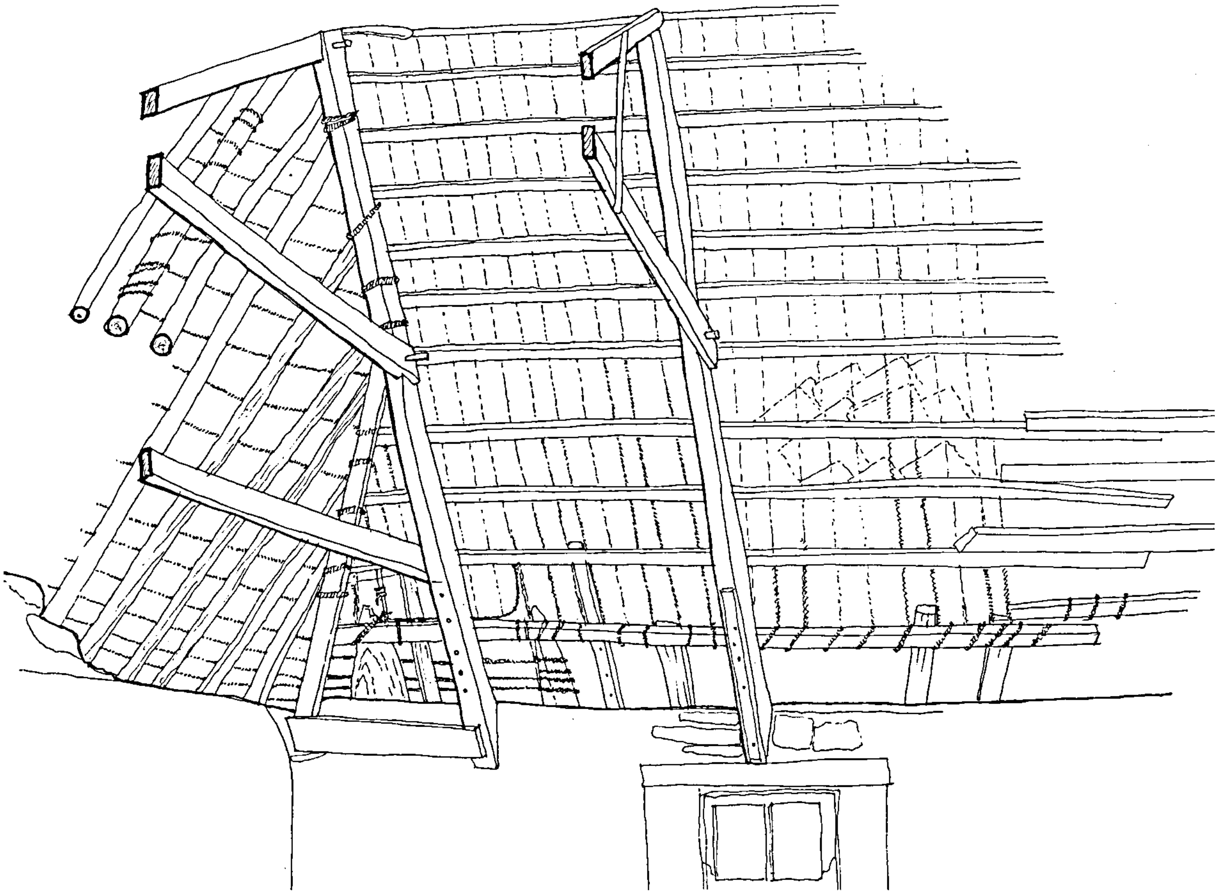
6.2.3 Composition of the thatch

The whole structure was up to 55 cm thick and was held in position by chicken-wire. The main bulk of the thatch was made of heather (*Calluna vulgaris*), its stems pointing towards the apex, interleaved with thin layers of bracken. At least four different re-thatchings with heather could be recognised. These were identified by the presence of an eroded surface indicated by a distinct surface in the heather where the bark and finer shoots had been removed by the wind showing the lighter coloured wood beneath. Over some of the earlier eroded surfaces remaining portions of heather ropes that would originally have held the thatch in position were also recovered. These were between 2 and 4 cm in diameter and, where present, were positioned at intervals of 20-30 cm running down the pitch of the roof. Directly adjacent to the chimney in the lowest of the heather layers the ropes were positioned closer together.

The heather used on each re-thatching had been compressed to approximately 8 cm deep. It was composed of horizontal courses comprising young stems some 60 cm long and with a maximum basal stem diameter rarely greater than 7 mm. Superimposed courses were such that no more than 20-30 cm of each was exposed at the surface. The heather had evidently been pulled from the ground (rather than cut) since many plants still had fragments of roots attached.

Within this heather matrix two layers of bracken (*Pteridium aquilinum*) up to 4 cm deep were identified. The majority of this had been cut rather than pulled from the ground with the cut ends clearly visible and the black basal part of the stipe largely absent. The stems were approximately 50 cm long and they had been laid in a directional fashion down the pitch with the leafy upper parts of the plant pointing towards the roof apex. Any parts of the fronds that had been exposed from beneath the overlying heather at the surface were severely eroded. Unlike the heather, no obvious coats or layering were noted within the bracken.

Beneath the heather and held in position by four heather ropes there was a layer of barley straw 4 cm thick. This had been laid more or less directionally down the pitch of the roof. The laminae had not been



Interior showing turves and roping techniques. (B.W. after Hadlington 1993)

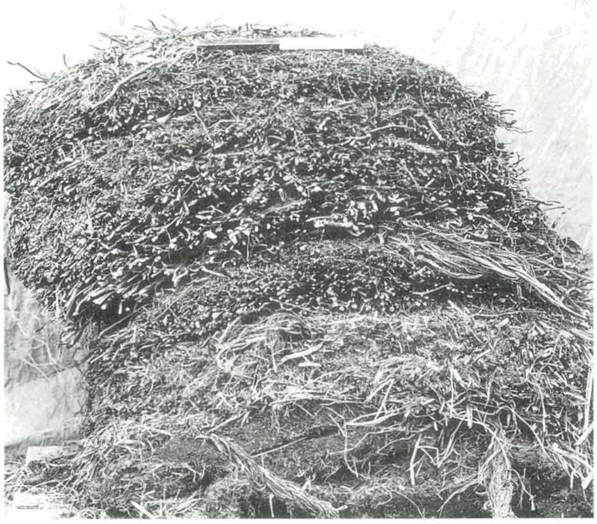
removed from the straw but these were only present as fibrous strands, the main body of the lamina having decomposed. Many of the weeds were still present so little initial preparation of the crop had been undertaken. Few of the leafy parts of the weeds were still present but the more robust parts of the stems could be distinguished from the accompanying cereals. The leafy material from both the weeds and cereals had evidently rotted *in situ*. Little evidence of remaining floral parts of barley was identified suggesting that these had been stripped from the straw prior to insertion into the thatch. Straw of full length was never recovered, it having apparently been cut into smaller pieces of approximately 35 cm length before thatching. It is not known whether this was a result of deliberate cutting or because it was a by-product of threshing which may have been undertaken by machine.

The final layer was 10 cm thick, containing bunches of marram grass (*Ammophila arenaria*), bracken (*Pteridium aquilinum*), soft rush (*Juncus effusus*) and barley straw. In some places this appeared to have been laid directionally but elsewhere it appeared to have been positioned in a more random manner. It is not clear whether this layer was a bedding layer designed to provide the correct pitch for the bulk of the roof or part of a functional roof.

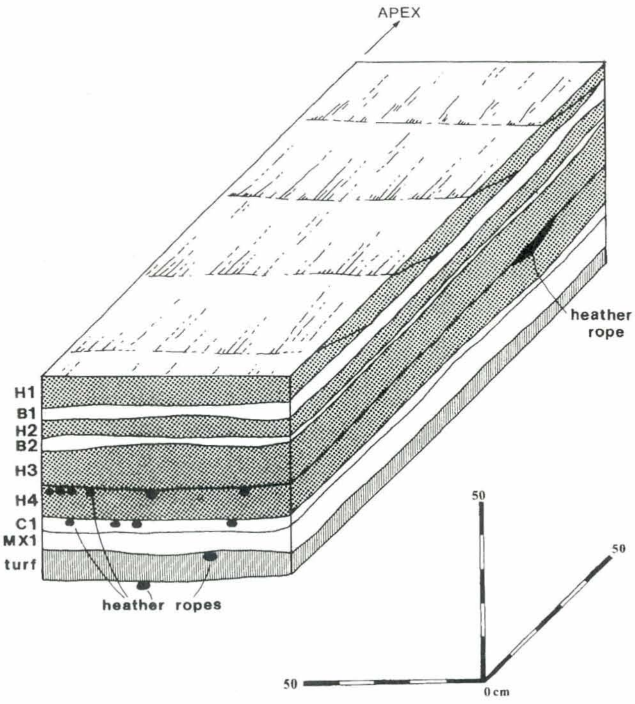
Between the roof couples and other roof timbers heather ropes running from eaves to apex had been used to support a layer of uniformly thick rectangular turves commonly as large as 55 x 40 cm and 4 cm thick. The rectangular turves had been arranged vegetation side down, with the cut edges at 45° to the horizontal and overlapped in such a way that in most places these were at least three turves deep. Information provide by the owner, Mr MacDonald, indicated that this was done deliberately so that the overlaps protected the structure from the prevailing westerly winds. The turves were held in position by a number of small, sharp wooden pegs and supported from below by timbers and at least one heather rope running from the eaves to the apex. One length of heather rope had been also been laid over the turves possibly indicating that this turf layer was in fact the only covering for a short period of time.

6.2.4 Detailed analysis

Both cereal containing layers were selected for detailed botanical analysis. The fine fractions were dried and sieved through 1 mm to 0.25 mm meshes. Sub-samples of the less than 1 cm fraction were then sorted using a binocular microscope and any identifiable plant parts (other than bracken and



Sections through the thatch block.



The thatch block from No.9 Locheport, Sidinish.
H1-H4 = heather B1-B2 = bracken
C1 = Cereal MX1 = mixed cereal, marram, rush
(A.T.)

heather) removed for identification (see Table 1). A sample of one of the turves from the base of the excavated area and a sample of daub were selected for thin-sectioning. The samples were impregnated, sliced and ground to produce a standard 30 µm thick section. The sections were examined under an Olympus BX50 polarising microscope.

Botanical analysis

MX1 - Mixed cereal, grass and rush layer. A sub-sample of 75 cm^3 was taken for analysis. The sample was dominated by bracken frond fragments, heather leaves and invertebrate frass (droppings) but numerous seeds and fruits of other species were also recovered (Table 1). These can be divided into two main groups a) species likely to have been growing as cereal weeds and b) typical components of acid heath. They are thought to have derived from the cereal and heather/bracken thatch respectively. The field weed component contains a number of species which are indicative of a nitrogen-rich soil (eg chickweed - *Stellaria media*) with others such as corn marigold (*Chrysanthemum segetum*) and corn spurrey (*Spergula arvensis*) being particularly common on sandy rather than peaty soils.

C1 - Cereal layer. A sub-sample of 100 cm^3 was taken for analysis. As with the previous mixed layer this was dominated by fragments of bracken frond, heather leaves and invertebrate frass. As can be seen from Table 1 although similar in character, the number of weed seeds recovered is less than that recovered from the mixed layer which lay directly underneath it. Fewer of the small dense seeds, such as chickweed and corn spurrey, are represented although more grass florets were present. This pattern might be a result of the smaller, dense seeds having fallen through the cereal layers into the layers below following continued wind disturbance. It is noticeable that by contrast the lighter grass seeds seem not to have travelled down through the thatch.

Thin section analysis - *S Carter*

Turf - A sample of one of the turves from the base of the excavated area was thin sectioned. The sampled turf was 4.5 cm thick excluding the surface vegetation layer and contained only two distinct layers:

- Vegetation. A 1.5 to 2.0 cm thick layer containing abundant moss stems and the bases of grass or sedge plants mixed with amorphous plant litter.

- Plant litter. A layer at least 4.5 cm thick of porous microaggregates of amorphous organic matter and abundant moss stems and plant roots. A single rhizome of bracken was present in the section.

Almost no mineral grains were noted in this thin-section but it is not clear whether the soil that the turf was cut from was a deep peat or simply had a surface organic layer slightly thicker than the turves that were cut from it. The presence of bracken (also noted in other turves from this sample) indicates that the soil was reasonably well drained and therefore a deep peat soil seems unlikely. It is more probable that this is a deep, mossy litter layer to a freely or imperfectly drained soil. The vegetation, abundant moss, grass, sedge and some bracken, growing in an accumulating mossy litter layer is consistent with former managed pasture now declining in quality.

Daub - This daub proved to have a relatively simple composition in thin section. The dominant component was a poorly sorted sandy loam with frequent small angular stones derived from local metamorphic rocks. There were rare fragments of peat up to 3 mm across and rare plant stem fragments. A few of the voids in the daub were in-filled with calcium carbonate, forming areas up to 4 mm in diameter.

The sandy loam that constitutes the bulk of the daub is simply local subsoil which has undergone no particular processing. The extreme rarity of the organic components suggests that their presence may be accidental rather than representing a deliberate temper. The carbonate in-fillings are secondary and do not form a part of the original daub mix. The most likely source for them is a superficial coat of lime plaster on the daub. None was noted in the field but the advanced state of disintegration of the Sidinish house may mean that nothing remains of such a finish to the internal wall surfaces. In this case, the carbonate in-fillings represent the only surviving evidence for the former appearance of the interior of this part of the house.

6.2.5 Summary and discussion

This thatch has clearly accumulated over a number of years. The presence of eroded heather layers and the heather ropes enable the identification of original thatch surfaces. At least four re-thatchings with heather have taken place but the presence of heather rope over the lower cereal and mixed layers suggest that the original thatch was a cereal one. If, as Mr MacDonald, the owner, suggests, the house is not much more than 100 years old then his estimation that a heather thatch could last as long as 20 years would be feasible. The absence of heather ropes over the upper layers of eroded heather probably identify the point at which netting and chicken-wire began to be used for the purposes of holding the thatch in position.

The function of some elements of the structure of the roof is unclear but may still be understood by some of the local inhabitants. For example, it is unclear what function the thin bracken layer between the layers of heather might have performed. This would appear to have been a sub-surface coat since only the outermost ends showed any sign of wind erosion or bleaching. Souness (pers. comm.) suggests that this might have been a bedding layer for the heather. In any event it was used in a very different way to the bracken in parts of the mainland (see Jock's Croft).

Following the initial cereal and marram thatch a change in the circumstances of the owners must have occurred and from that point onwards heather and bracken were exclusively used. The marram grass must have been brought from the west coast dunes because it does not grow in the eastern part of the island. The cereal straw and the weed seeds within this also suggest cultivation on the west coast. Many of the weed seeds such as sheep's sorrel, corn marigold, corn spurrey, early hair grass and creeping soft grass are strongly indicative of sandy soils (eg. Hanf 1983, Clapham *et al* 1962) which are only present on the western side of North Uist. Therefore a transition from materials deriving from the west coast to locally available resources is apparent. It is likely that the reasons behind this transition would be well known to some of the older inhabitants of North Uist or obvious from the historical record.

A high proportion of the taxa identified from the cereal-containing layers sampled consist of typical segetal species i.e. they commonly grow in agricultural fields. It is therefore almost certain that they must have arrived on the site along with the cereal straw used in the lowest layers of the thatch. Most are suggestive of spring sowing. Several of these species (sheep's sorrel, corn marigold and corn spurrey) are also indicative of somewhat acidic soil conditions which could possibly have prevailed over otherwise base-rich soils if rainfall was high and drainage good. The presence of chickweed as the most common component and annual poa grass give an indication that soil fertility was good, these being species which prefer well aerated, disturbed soils with a high nitrogen content.

The cereal straw itself was identified on the basis of occasional rachis fragments as the 6-rowed hulled variety of barley, commonly known as *bere*. This was a typical crop for the area until the recent past.

In addition to the plants associated with cereal cultivation a number are more likely to have arrived on site along with other material used in the

Table 1 - Species identified from the detailed analysis from No. 9 Locheport.

Species	*Common name*	*Plant part*	*MX1*	*C1*
Field weeds				
Atriplex hastata/patula	orache	nutlet	1	
Stellaria media (L.) Vill.	chickweed	seed	3	77
Spergula arvensis L.	corn spurrey	seed	1	12
Spergula arvensis L.	corn spurrey	capsule	1	1
Rumex acetosella agg.	sheep's sorrel	nutlet	3	1
Montia fontana L.	blinks	nutlet	1	
Brassica/Sinapis sp.	cabbage family	seed fragment	1	
Galeopsis tetrahit agg.	hemp nettle	nutlet	3	
Chrysanthemum segetum L.	corn marigold	achene	1	1
Sonchus asper (L.) Hill	sow-thistle	achene	2	8
Aira praecox L.	early hair grass	floret		2
Avena fatua L.	wild oat	floret		1
cf. *Agrostis* sp.	bent	floret		2
Poa annua L.	annual poa	floret	1	3
Poa pratensis L.	meadow-grass	floret	30	16
Poa palustris L.	swamp meadow grass	floret		1
Holcus mollis L.	creeping soft grass	floret	1	
Holcus mollis L.	creeping soft grass	spikelet	7	4
Heathland species				
Potentilla cf. *erecta*	tormentil	achene	2	1
Calluna vulgaris (L.) Hull	heather/ling	seed	2	
Erica cinerea L.	bell-heather	seed	7	3
Campanula sp.	bellflower	achene	1	
Juncus cf. *effusus*	soft rush	floret		5
Juncus sp.	rush	floret	2	
Carex nigra (L.) Reichard	common sedge	fruit		2
Carex sp.	sedge	nutlet	1	
Cereals				
Hordeum sativum 6 row hulled	bere barley	rachis segments		16
Hordeum sativum (hulled)	barley/bere	floret	6	1
Other				
Moss indet.				+

basal thatch. Rush, bracken, marram grass and heather were all recorded during the excavation of the thatch indicating a variety of different sources for the material used. Most of the non-segetal taxa identified from the fine fraction of the basal layers were, however, from areas of acid heath and are most likely to have been brought to the site incidentally along with the bracken, rush and heather. These acid tolerant species could have been collected from the immediate area of the site.

6.3 Keils, Jura

6.3.1 Location and condition

The small settlement of Keils is located on the east coast of Jura (NGR NR 5256 6830). In the mid-ninteenth century it had 22 occupied buildings with a population of 102 people but this has been in decline ever since (Wright & Tait 1994, photos p. 40-41). The building studied is owned by Mr Archie Black and lies directly to the west of his present two storey house and stack yard. The building was present on the first edition Ordnance Survey map (1882) and has, in his recollection, always been used as a byre. However, the presence of soot-blackened thatch, especially in the western end of the building, and the presence of a smoke-hole in the roof indicate that it was originally used as a dwelling. The site was recorded by the Royal Commission in the 1970s (RCHAMS 1984). In 1981 the roof timbers collapsed in such a way that the majority of the thatch was still supported off the floor but since this time the building has been unusable. A study of the building construction and some preliminary observations of the thatch have been made by Walker *et al* (1996).

Mr Black recalled that in his younger days he helped his father thatch the buildings and that one side of the roof would be re-thatched every year using rushes. He collected a sample of the rushes usually used which was identified as the sharp flowered rush (*Juncus acutiflorus*). On only one occasion does he ever remember cereal straw (oats) having been used on the roof, and this was probably an out of season repair.

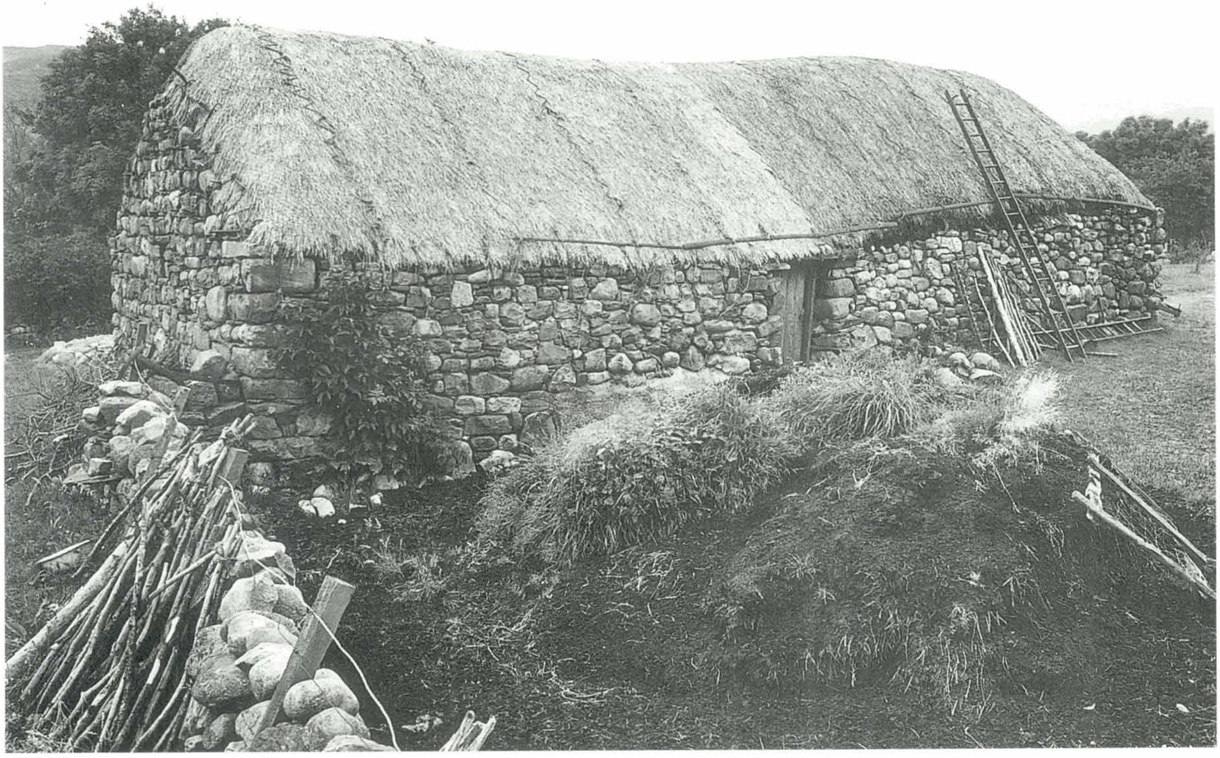
6.3.2 Sampling

Two block samples measuring approximately 35 cm x 50 cm and 30 cm thick were taken from a central portion of the roof just to the west of the line between the two opposing doors of the byre. It later transpired from the presence of a timber projecting vertically into the thatch blocks that they were probably taken from either side of the apex of the collapsed roof. Because the collapsed roof was no more than waist high it was easy to cut through the surface layer of chicken-wire with wire cutters and then to saw out two blocks. Collapsible trays were then pushed between the basal turves and the small diameter *cabers* enabling the removal of the intact blocks.

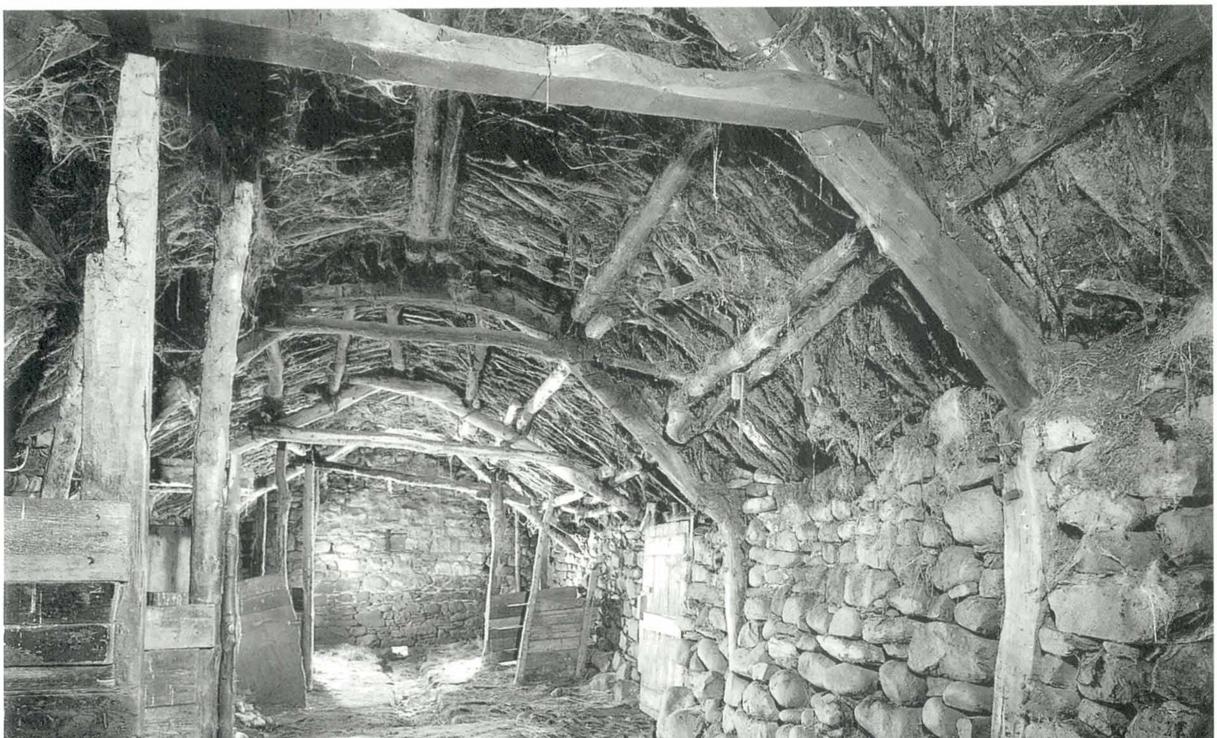
6.3.3 Composition of the thatch

The thatch consisted of a deep, compacted mass of vegetable matter the majority of which was apparently a species of rush (*Juncus* sp.) but also included some discrete layers, at least one of which included cereal straw. Samples of this were taken wherever it was exposed on the edges of the roof. The rushes had mostly been laid directionally down the pitch but in some areas bunches were up to 45° off this line. In cross section it was clear that the top 10 cm had been severely disturbed by the development of an actively

Keils 1974. (RCAHMS AG/6840)

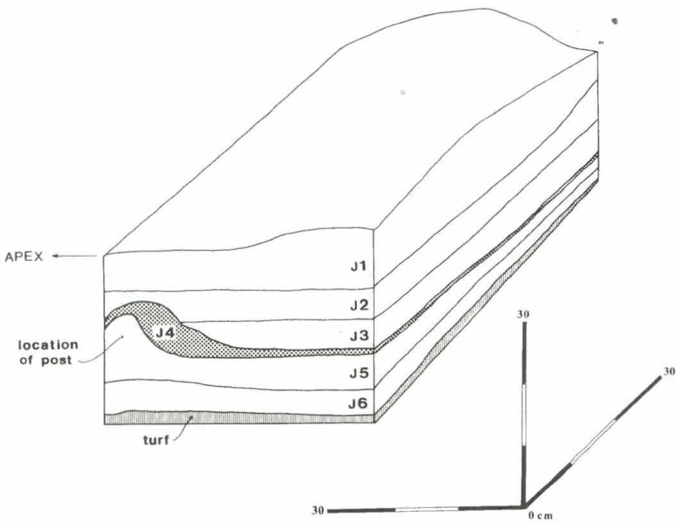


Keils 1974. (RCAHMS AG/6837)



Keils 1974. (RCAHMS AG/6839)

Sections through the thatch block.



The thatch block from Keils. J = rushes.

growing grassy layer. This had grown up through the chicken-wire that covered the roof. Below the surface layer a more distinct structure could be seen, consisting of degraded layers of rushes with occasional fragments of heather stem. Because of the delicate nature of the material it was not possible to dissect each layer separately and it was decided to sample it in a number of spits which were either arbitrarily defined or were delimited by an obvious change in stratigraphy. Large quantities of insect frass (droppings) were present in the structure. Some areas of poor preservation could be seen to run down the pitch of the roof producing gullies. These had evidently been filled with new rushes on subsequent thatchings. A layer of cereal straw was encountered towards the base of the structure. This had been laid in a directional pattern running down the pitch but it was not clear whether this formed a basal layer or an early surface of the roof. The length of the straw was greater than 50 cm and had been truncated by the cutting of the thatch block.

A basal layer was formed of peaty turves approximately 4 cm thick and laid vegetation side upwards. These were in turn supported by closely positioned *cabers* rarely more than 2-4 cm in diameter. On one collapsed portion of the roof in the eastern end of the building the turf was overlain by heather rope. This, together with the fact that the turves were vegetation side uppermost, indicates that the first functional roof may well have consisted of turves alone. No other evidence for the original fixings was encountered but pieces of scrap iron had been set at regular intervals around the upper part of the wall and had probably been used for the attachment of roofing ropes. Chicken wire has been used for holding the rushes in place in the recent past.

6.3.4 Detailed analysis

Two samples of rush and the cereal layer were selected for detailed botanical analysis. The fine fractions were dried and sieved through 1 mm to 0.25 mm meshes. Sub-samples of 100 cm^3 from the less than 1 cm fraction were then sorted using a binocular microscope and any identifiable plant parts (other than bracken and heather) removed for identification (Table 2).

Botanical analysis

J2 - Rush layer - A high proportion of this sample was composed of invertebrate frass but it was clear from the macroscopic plant remains that rush stems had formed the bulk of the thatch at this point. Two different rush taxa were present. The most common one was represented by fruits with a rounded or indented top. This feature (eg. Fitter *et al* 1984) is common to both the soft rush (*J.effusus*) and the common rush (*J.conglomeratus*) but the smoothness of the stem suggests that these are actually *J.effusus* (discussed further below). The second taxon demonstrated an acute tip to the fruit which matches well with the sharp-flowered rush known locally as sprots (*Juncus acutiflorus*), and indicated by Mr Black as being the preferred species. Evidence for cereals was totally absent and the other botanical elements, with the exception of heather, could have been accidently collected from the wet grassland or marsh along with the rushes. Fragments of heather are less likely to have been collected with the rushes and probably derive from decaying heather ropes used to hold down the rush thatch. The continued presence of delicate floral structures such as the florets of soft-grass would tend to indicate that the rushes were collected in the autumn.

J4 - Rush layer - Preservation of botanical elements in this layer was thought to be somewhat better than in J2 but the composition was largely the same, indicating a continued pattern of procurement of materials for thatching. Whole flower heads of *Juncus* were recovered from this sample. The heads were very compact, indicating either *J.conglomeratus* or the compact variety of *J.effusus* (var *compactus* - Clapham *et al* (1962) which is very similar.

Cereal layer - This layer was dominated by cereal straw which was identified as straw of the common oat by the presence of its distinctive florets. Although the straw appeared not to have been drawn it had probably been cleaned, the number of weeds of cultivation present being negligible and restricted to some of the taller species such as hemp nettle and corn marigold. These are typical components of sandy acidic fields in Scotland but offer little specific information regarding the fields in which they grew. The majority of non-cereal taxa must have originated from areas of acid heath and open grassland and much of it was probably collected inadvertently along with the rushes, the stem and florets of which also formed a significant part of this sample.

6.3.5 Summary and discussion

The thatched roof from this byre evidently represents a depth of thatch that has built up over many years. The initial layers of turf were laid vegetation side up on the *cabers* made of narrow diameter wood - willow, birch or hazel. At one location in the eastern part of the building the turves were directly overlain by heather ropes and the turf alone may therefore have formed a surface for a short period, at least in this part of the building. A layer of cereal straw was then laid over this in a directional fashion. This appears to have been partially cleaned as few weeds normally associated with cultivation were recovered. In the sampled part of the roof the straw was of the common oat although closer to the western gable, evidence of barley was also recovered. From this period onwards rushes seem to have been used to the exclusion of all other material although opinions have differed concerning the exact species used (eg. Souness 1986, Walker 1996). In part this is due to the similarity between two of the most commonly used rush species, *J. conglomeratus* (common rush) and *J. effusus* (soft rush), the latter of which has a form with a compacted flower that closely resembles the former. Hybrids between the two also exist (Clapham *et al* 1962). The material identified as part of this project indicates that the species used at Keils was probably *J.effusus* (soft rush) with quantities of *J.acutiflorus* (sharp flowered rush) also present. This is in keeping with observations that this was the preferred species employed by Jura thatchers (Walker 1996).

According to Mr Archie Black and Mr Sandy Buie of Knockrome one side of a building would be re-thatched each year (also Walker *et al* 1996). The thatch surviving today could therefore potentially represent a considerable number of thatchings. Unfortunately preservation is not good and it is evident that following the collapse of the roof in the early 1980s active plant growth and invertebrate activity rapidly began to reduce the vegetable matter to an amorphous peat. The upper layers have suffered most but preservation throughout the block samples taken was very variable. Souness (1986) records that rushes were prone to developing hollows or vertical tracks in old thatch and it is clear that similar erosion had also occurred a number of times in the Keils thatch.

The rushes had mostly been laid directionally down the pitch but it was not possible to determine whether horizontal courses were used, as described by Souness (1986) for a rush thatch from Lochalsh. The methods employed in the construction of the eaves or skews could not be determined but there was some evidence for the manner in which the rushes were tightly bound around a projecting timber and eventually came to cover it. The close proximity of this timber to the sampled area may account for the observation that some of the rush had been applied at 45° to the pitch.

With regard to the fixing of the thatch the only direct evidence was the single piece of heather rope over the turves and fragments of heather stem throughout the thatch which may have derived from deteriorating heather rope. In the early part of this century, before the ubiquitous use of chicken-wire for this purpose roping was evidently the favoured method of fixing thatch (see for example Cameron and Adam's photographs in Wright & Tait 1994). It is therefore likely that decaying ropes would have been removed prior to the application of new thatching material.

Table 2 - The identifications from the detailed analysis from Keils, Jura

Species	*Common name*	*Plant part*	*J2*	*J4*	*Cereal layer*
Field weeds					
Pteridium aquilinum (L.) Kuhn	bracken	frond fragment	+	+	+
Ranunculus flammula L.	lesser spearwort	achene	2	5	
Ranunculus repens L.	buttercup	achene	1		
Spergula arvensis L.	corn spurrey	seed	1	1	1
Montia fontana L.	blinks	seed	14		5
cf. *Filipendula ulmaria*	meadowsweet	achene	1		
Potentilla erecta (L.) Rausch	tormentil	achene	1	1	
Rubus fruticosus agg.	bramble	pyrene	1		
Polygonum cf. *persicaria*	persicaria	fruit			1
Rumex acetosella agg.	sheep's sorrel	nutlet	1		
Betula sp.	tree birch	nutlet	2		
Calluna vulgaris (L.) Hull	ling, heather	stem/leaf	39	29	7
Calluna vulgaris (L.) Hull	ling, heather	floret	1	1	1
Myosotis sp.	forget-me-not	nutlet	1		
Galeopsis tetrahit agg.	hemp nettle	nutlet			2
Prunella vulgaris L.	self-heal	nutlet			1
Chrysanthemum segetum L.	corn marigold	achene			1
Hieracium sp.	hawkweed	achene		1	
Sonchus asper (L.) Hill	sow-thistle	achene		1	
Juncus acutiflorus Hoffm.	sharp- flowered rush	floret	40	71	12
Juncus effusus L.	soft rush	floret	66	185	97
Festuca pratensis/arundinacea	meadow/tall fescue	floret		2	
Holcus sp.	soft-grass	spikelet	9	13	2
Holcus mollis L.	creeping soft-grass	floret		2	
Poa annua L.	annual poa	floret			1
cf. *Poa* sp.	meadow grass	floret	4		
Carex sp.	sedge	utricle	2		1
Carex sp.	sedge	nutlet	1	3	
Cereals					
Avena sativa L.	common oat	floret			12
Avena sp.	oat	floret			6
Avena sp.	oat	pedicel			95
Other					
Invertebrate eggs			12	3	1

6.4 Gimps, South Ronaldsay, Orkney

6.4.1 Location and condition

Gimps is a small farmstead consisting of one unoccupied dwelling, a number of out-houses (some of which are still in use) and a dilapidated water mill. The farmstead is located in the northern part of South Ronaldsay at Grimness (NGR ND 481 935). The farmstead is owned by Mr Alexander Scott and a detailed survey of the house was undertaken by Newman & Newman (1991). Gimps, together with the nearby buildings known as Derby (ND 539 036) and Gears (ND 538 037) are thought to represent some of the last surviving needle thatched roofs in Orkney. Newman & Newman consider that the building probably dates to 1830-1840. The *simmens* making up the lower layer may therefore also belong to this date but even if not original must be over 100 years old. The house appears on the first edition Ordnance Survey maps (1882) and according to the Ordnance Survey Name Books it consisted of a house with two rooms and a closet, with a thatched roof in fair repair. According to Mr Scott the house has not been lived in since 1989 when his mother left. It was partially re-thatched with oat and barley straw in 1986 or 87 but had not been surfaced with *simmens* since at least the 1930s. The thatch is rapidly deteriorating with most of the northern end of the roof already having collapsed into the interior. The roof of the southern end of the building is largely intact although it is unlikely to remain so for much longer. The soot-blackened *simmens* of the roof and the intact smoke-hole indicate that a central hearth must have been an original feature of the building.

6.4.2 Sampling

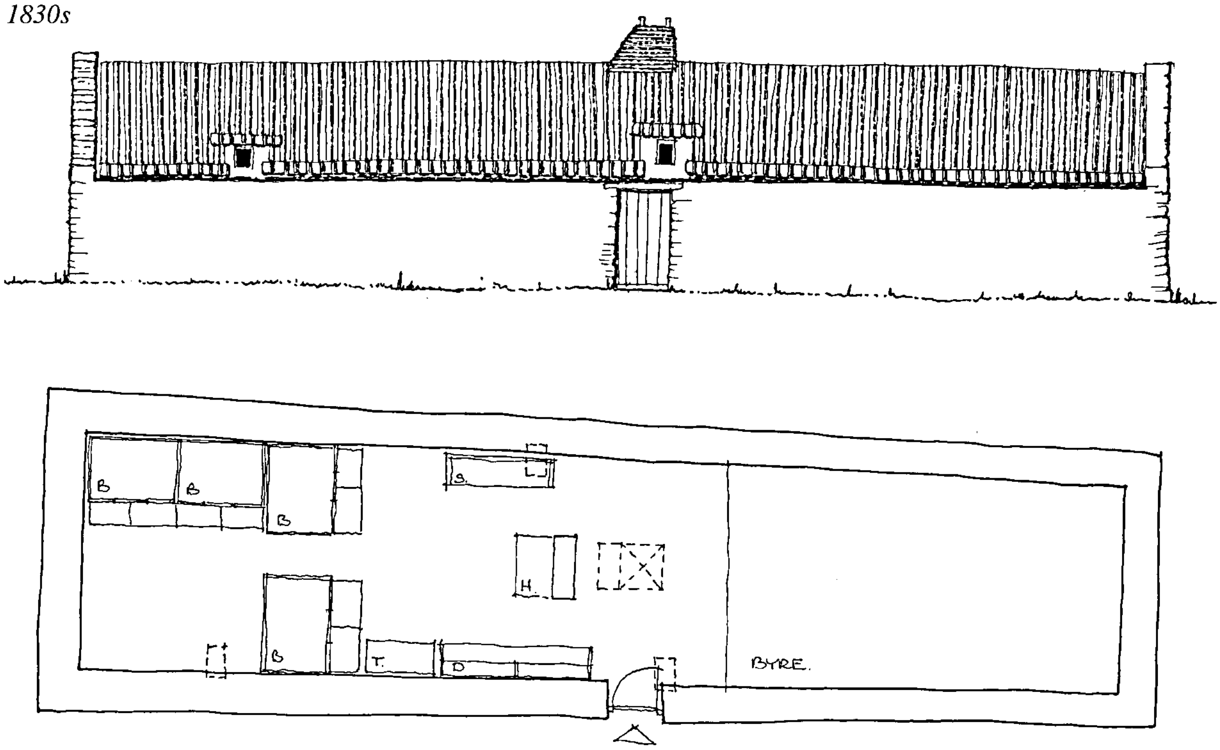
Two block samples measuring approximately 35 x 50 cm and 30 cm deep were taken from a point approximately 1 m above the door on the western face of the roof. Initially a square of appropriate size was cut with wire cutters into the chicken-wire which presently covers the roof. The perimeter of the block was then cut using a multi-purpose saw. A collapsable plastic tray was pushed between the lower *simmens* and the purlins. Two short wooden planks were then pushed between the tray and the purlins in order to support the full weight of the block. Once supported in this way it was possible to erect the sides of the tray, cut through one of the purlins on both sides of the block and lower this into the arms of a second person inside the building. A second tray was placed over the block and it was secured with rope.

Having removed one block it was easier to insert the collapsable tray and planks under the second block. After erecting the sides of the tray and placing a second tray over the top it was possible to lift out the block and carry it down the outside of the roof intact. The only problem encountered with this method of sampling was that with the second block one of the

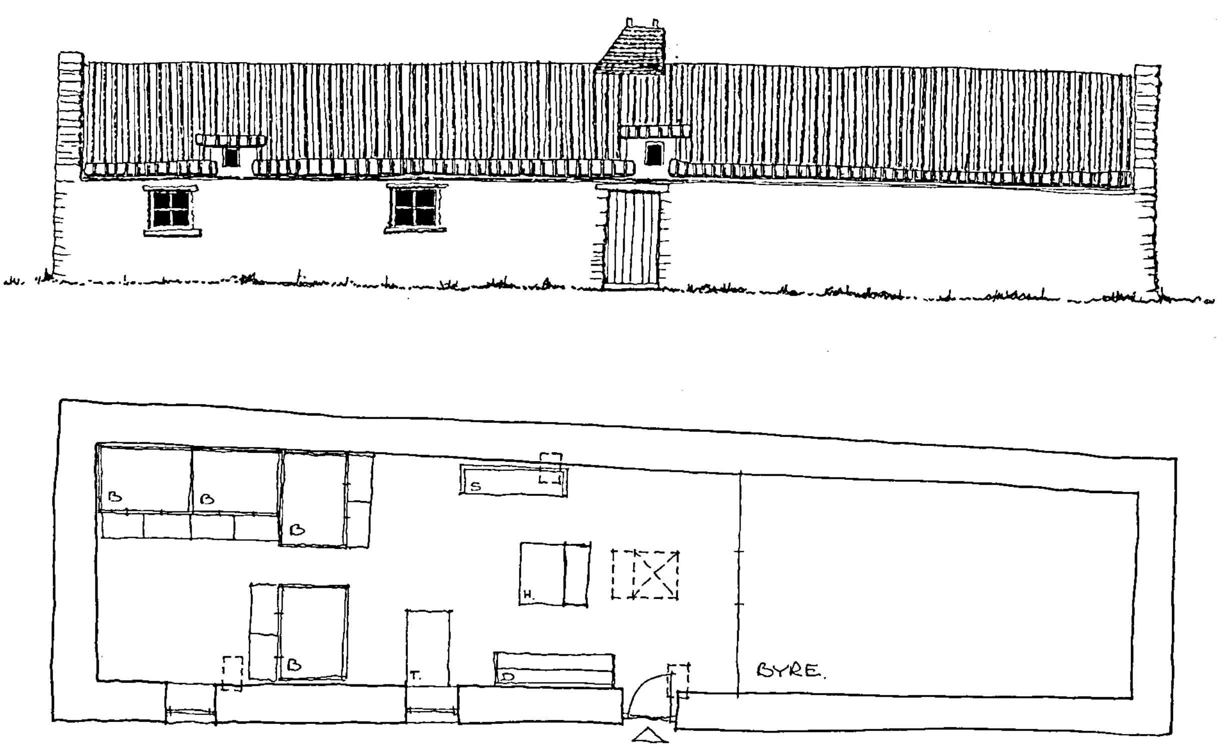
Gimps (1996). (T.H.)

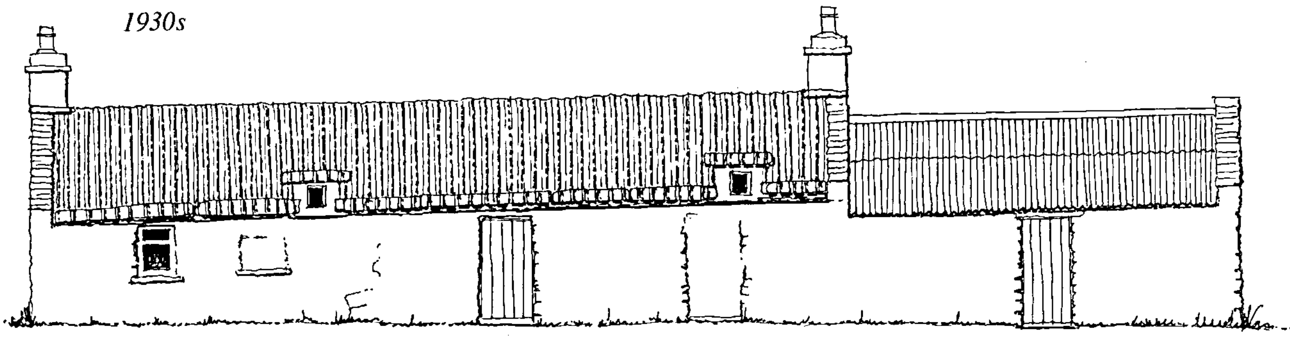
Elevations and plans. (B.W. after Newman and Newman 1991)

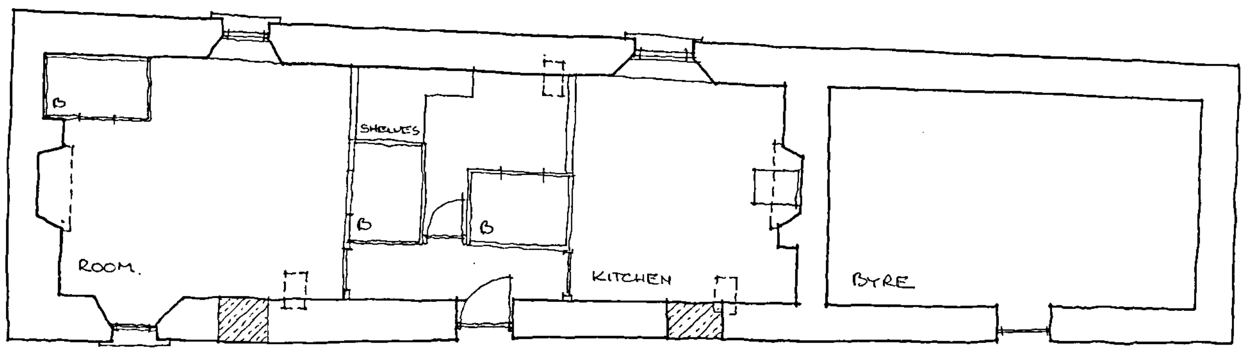
1830s

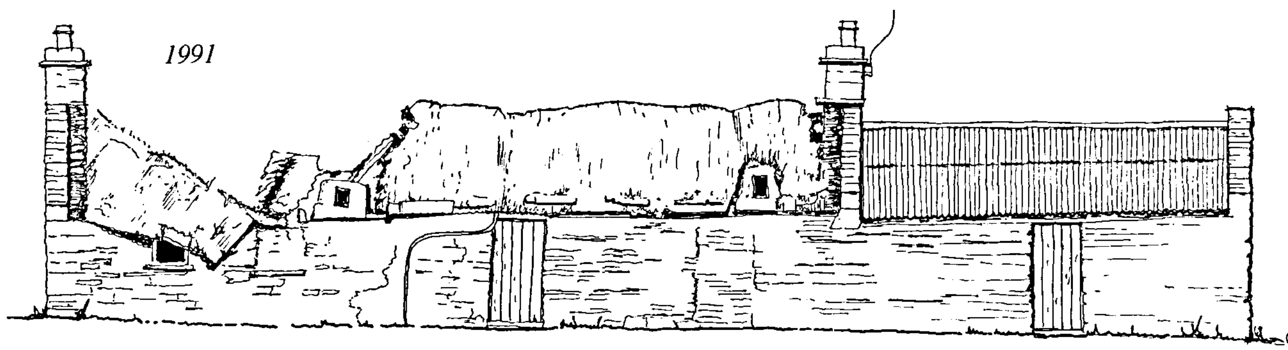


1900









large flagstones used at the eaves had been positioned above the lowest *simmens* but under the overlying thatch layers. This had to be pulled out of the sample causing some minor disturbance to the lower layers.

Other samples were also taken from areas of recent repair made in the apex of the roof, some loose *simmens*, areas of daub used for sealing the gap between the top of the wall and the eaves of the roof and some examples of daub/plaster from the upper part of the wall.

6.4.3 Composition of the thatch

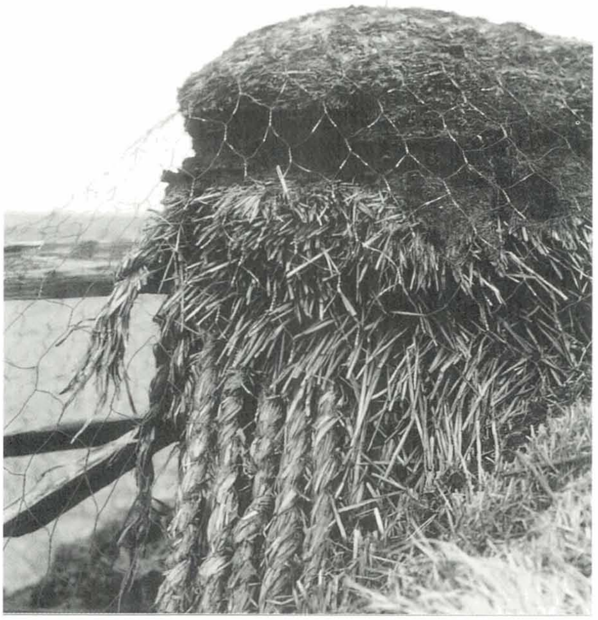
The roof was made up of successive layers of compacted straw which were the result of many re-thatchings. In cross section it was obvious that the top 10 cm had been severely disturbed by the development of an actively growing grassy layer dominated by meadow grass (*Poa* sp.) Earth worms and other invertebrates were present. Below the surface layer a more distinct structure could be seen, consisting of degraded layers of cereal straw with occasional evidence of *simmens*. Because of the delicate nature of the material it was not possible to dissect each layer separately and it was decided to sample it in a number of spits which were either arbitrarily defined or were delimited by an obvious change in stratigraphy. At a depth of 5 cm an empty crisp packet dated to December 1973 was encountered. This therefore identifies what was probably one of the last thatching layers or last repairs to the roof some time in 1973. Towards the base of the first spit the highly degraded remains of textile (probably sail cloth) were recorded. This may represent the very base of this last thatching layer. Preservation of organic material was found to improve in the lower layers of the roof but live woodlice were still encountered over 20 cm below the surface of the thatch. Some 30 cm below the surface a compacted layer of dark organic material 4 cm thick with gritty inclusions and thin laminae of cereal straw

Simmens from the internal surface of the roof.

was encountered. A sample of this was taken for the purposes of thin section analysis. The straw samples taken from beneath the compacted layer were soot-blackend and in an excellent state of preservation. These layers represent the best preserved cereal remains on the roof and must be a part of the first thatches used on this building. No turf layer was present but, between the purlins the lowest stratum of the roof was supported by lengths of straw rope (*simmens*) which had been wound back and forth from eaves to eaves across the apex, a process known as needling and well illustrated by Fenton (1976, 184) and for Gimps by Newman & Newman (1991) – (see also section 3.1.1).

6.4.4 Detailed analysis

Samples from four of the cereal spits taken at intervals through the thatch were selected for detailed botanical analysis. The fine fractions were dried and sieved through 1 mm to 0.25 mm meshes. Sub-samples of 100 cm^3 from the less than 1 cm fraction were then sorted using a binocular microscope and any identifiable plant parts (other than bracken and heather) removed for identification (Table 3). A sample of the compacted layer towards the base of the thatch and a number of samples of daub/mortar from the walls and the wall head were selected for thin sectioning. The samples were impregnated, sliced and ground to produce standard 30 µm thick sections. They were examined under an Olympus BX50 polarising microscope.



Straw over simmens held in place with chicken wire.

Botanical analysis

Sample 1 - a recent repair. This sample consists of a quantity of well preserved straw taken from the apex of the roof directly above the door. This was an area that had been repaired many times and it was likely that most of the sample derived from one of the latest repairs. According to the owner, Mr Scott, this was last done in 1986 or 1987 using both barley from his sister's farm on the other side of the island and oat straw from a nearby farm. Cereals had not been grown at Gimps since the 1970s. Chemical fertiliser and probably some herbicides would have been used. The detailed analysis confirms the use of the common oat as the main repairing material but lesser amounts of two-row barley had also been used. The weed flora was largely composed of wild grass species that would be common on sandy substrata but the single most common element was chickweed (*Stellaria media*), a strong nitrophile indicative of a fertile soil. The flora was generally lacking in species of acidic soils which is what would be expected from this part of Orkney but the presence of marsh fox-tail (*Alopecurus geniculatus*) does suggest damp ground.

C2 - One of the upper layers. This layer was dominated by invertebrate frass and plant rootlets deriving from the flora growing on the surface of the roof. The botanical remains from this layer were in poor condition, very brittle and readily turning to powder. The straw had been laid on the roof in a random fashion. Interspersed with the straw were lesser quantities of rush shown by the recovery of 56 rush florets (either *Juncus effusus* or *Juncus conglomeratus*). The presence of these rushes together with other moisture-loving species such as marsh hawk's beard (*Crepis paludosa*) indicates that the thatching material had been harvested from an area of wet ground. The low numbers of other typical weeds of cultivation which generally require a well aerated soil (eg. chickweed) would also tend to support this. There are two likely explanations for the composition of this sample, the former being the most likely:

- The sample could have been taken from an area of the roof that had been part thatched, or repaired, using rushes. The botanical element therefore relates to the environment from which the rushes were collected.

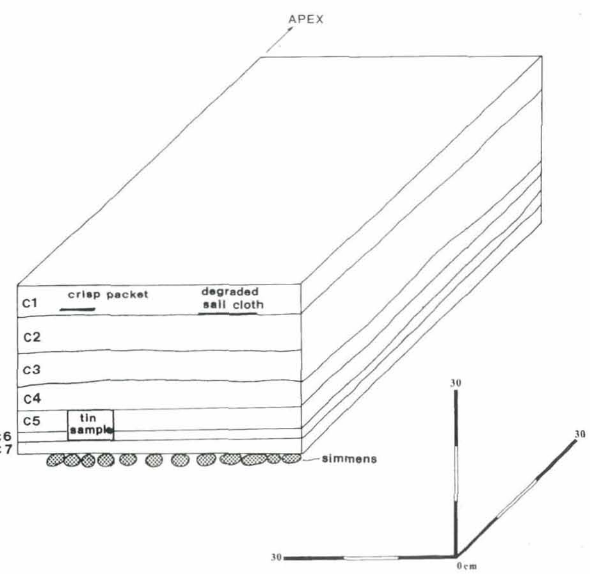
- The oat or barley crop could have been partially harvested from a particularly wet part of the fields in which species more commonly associated with wetlands were growing.

Either barley (2-row) or bere (6-row) was present in this sample but poor preservation made it impossible to distinguish between them. The oats were better preserved enabling the identification of both the common and the black oat. In this sample it was the common oat (*A.sativa*) that predominated; the black oats (*A. strigosa*) could represent weeds in the common oat crop. The black oat could be a serious weed for many years once a farm had switched to the cultivation of improved varieties of the common oat (Findley 1956). In any event, given Mr Scott's understanding that black oats would probably not have been grown since the Second World War, it would seem likely that this layer was put onto the house sometime after 1945.

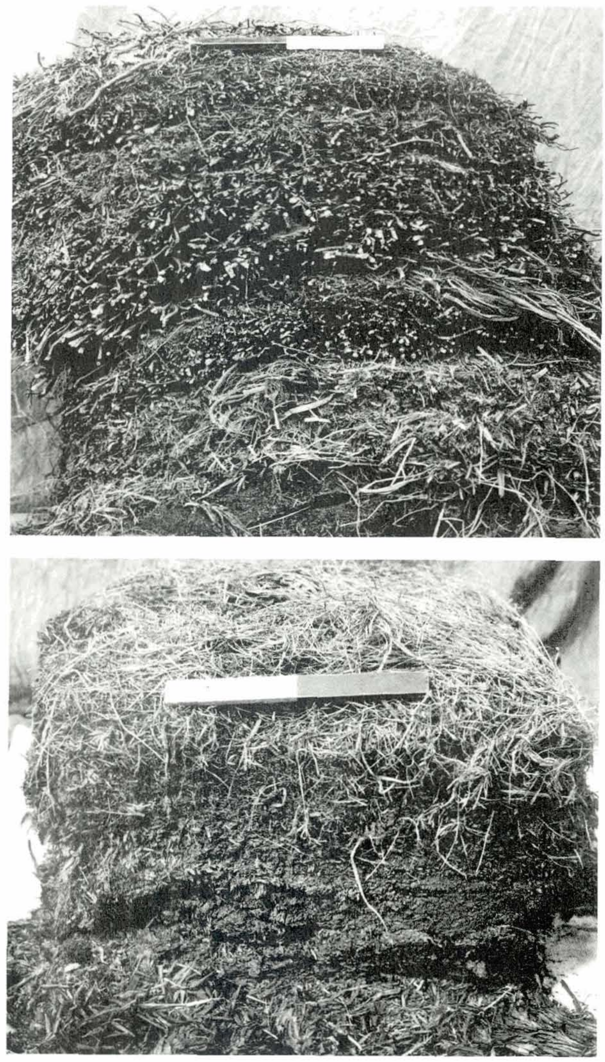
C4 - A layer from the middle of the thatch. This layer was similar in composition to C2 being composed of a high percentage of invertebrate frass. The species composition was also similar but fewer items were recovered. This lack of identifiable remains is presumably a result of the poor preservation at this level. The presence of common oat suggests this layer also dates to after the Second World War. Occasional highly degraded remnants of *simmens* were recorded.

C6 - A partially soot-blackened layer directly beneath the compacted layer (C5). The preservation of this distinct layer, situated below the compacted layer, was very different to that observed in the upper layers. The organic debris was not brittle and had been partially soot-blackened. It was therefore likely to derive from a period when the central hearth and smoke-hole were in use. The excellent preservation was partially a result of the remains having been kept dry by the presence of the compacted layer above and by the presence of tars and other related compounds from the fire soot. As with all the other layers recovered the cereal straw had been applied in random fashion. Although most of the barley remains could not be identified to the level of variety at least one rachis fragment enabled the presence of bere (6-rowed hulled barley) to be confirmed. Of the better preserved oat florets all were identified as the black oat (*A. strigosa*) the remainder being too poorly preserved to identify beyond the level of genus.

The weed flora, dominated by chickweed, was indicative of a fertile, well drained soil and was in many ways similar to some of the latest samples used in the repair of the apex (Sample 1).

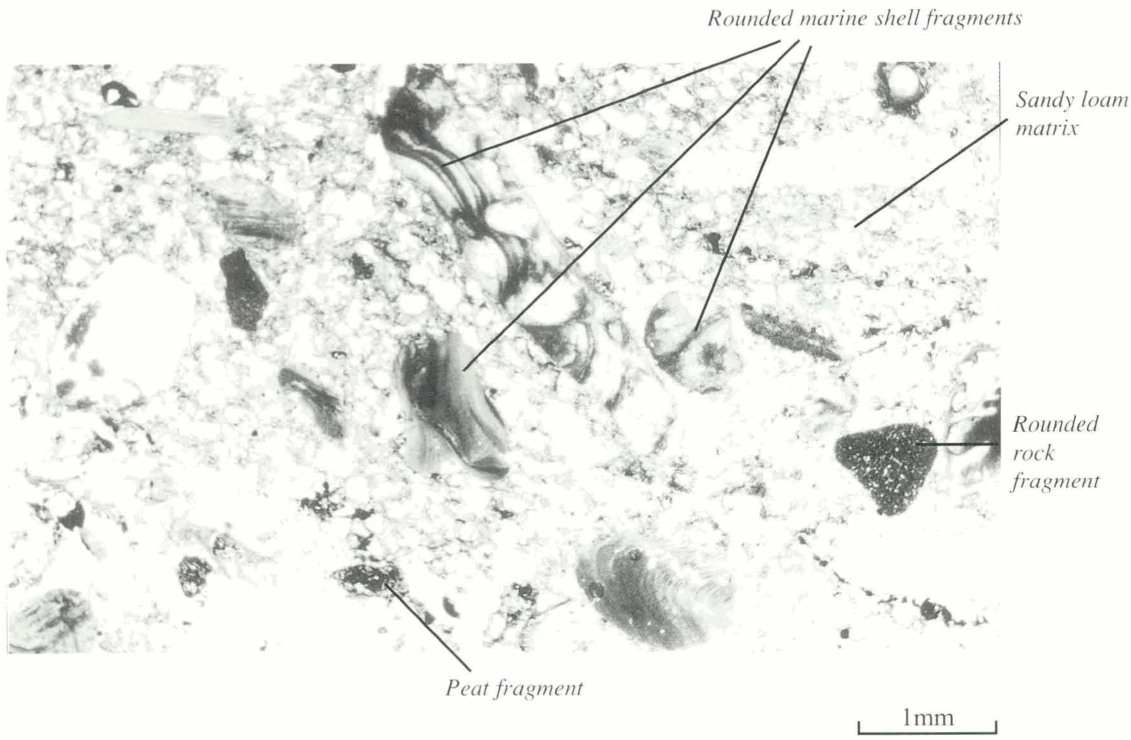


The thatch block from Gimps.

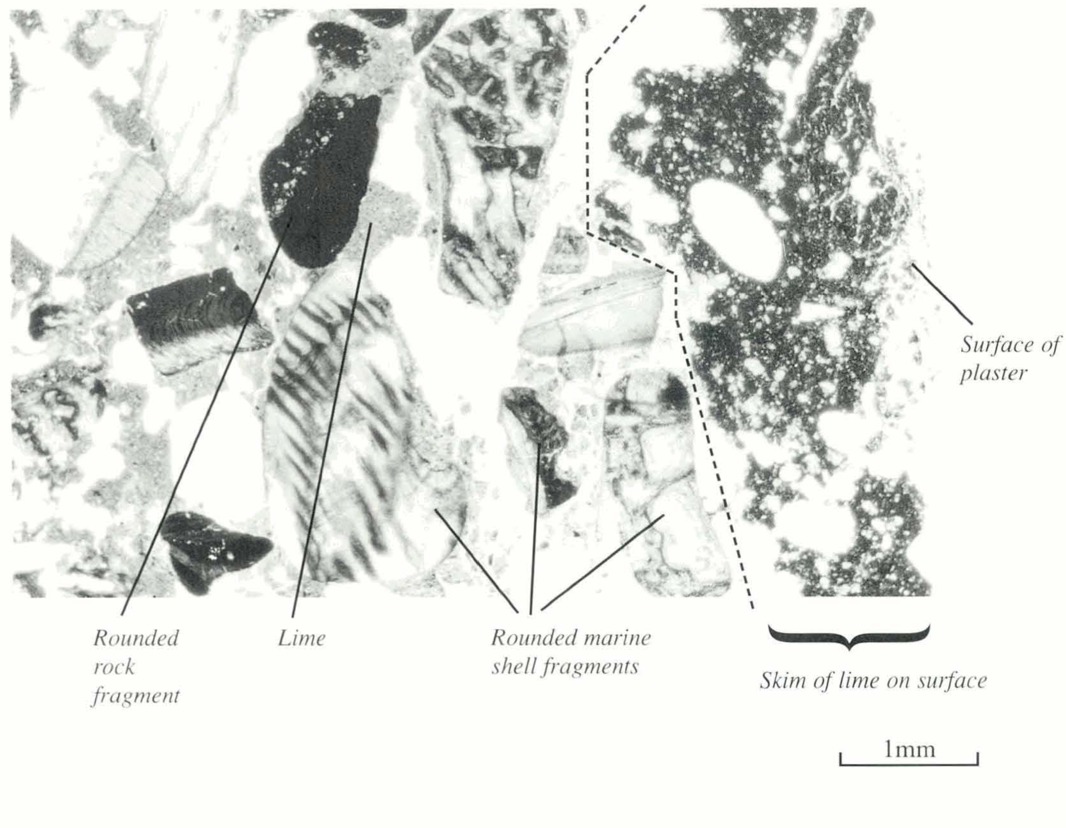


Section through the thatch block.

Gimps. Thin section of a sample of daub from the wall head. (S.C.)



Gimps. Thin section of daub and plaster from the wall. (S.C.)



C7 - Lowest soot-blackened layer. This layer was well preserved, similar in composition to the layer directly above, and heavily blackened with soot from the domestic hearth. Although much of the barley present could not be identified to the level of variety at least 15 rachis segments were identified as bere (6-rowed barley). Black oat was the sole oat species identified and the weed flora was similar in composition to that from C6.

Thin section analysis - *S Carter*

C5 - The compacted layer. During excavation of the thatch block, this was described as a 4 cm thick layer of dark organic material with gritty inclusions. The precise nature of this material and its origins were unclear; given the highly decomposed state of much of the Gimps thatch, it was suggested that this could be highly degraded cereal thatch. In thin section, it was seen to comprise a porous matrix of dark brown amorphous organic matter and highly decomposed plant cell residues. Embedded in this matrix were frequent silt and fine sand-sized quartz grains with a few larger fragments of siltstone. There were also frequent well preserved grass stems (probably cereal straw) showing a preferred horizontal orientation. The presence of well-preserved straw and highly degraded and amorphous organic matter mixed together in one layer demonstrates that the degradation must have occurred before the layer was deposited on the roof. Therefore, this compacted layer was a mix of straw and amorphous organic matter when it was added to the thatch. The amorphous matrix resembles peat and it is suggested that it was applied to the cereal thatch as a protective coat or fixing layer of wet peat and straw. The practice of protecting thatch with coats of clay, dung or organic muds is widely reported in Scotland (Fenton & Walker 1981).

The interface between the compacted layer (C5) and the cereal layers below was present within the thin section and this allowed their relationship to be examined. The top of the cereal layer (C6) was marked by three circular clusters of tightly pressed cereal straw forming the double strand of one *simmen* and part of a second. These overlay horizontally orientated straw which was covered with soot granules 10-30 µm in diameter. The amorphous organic matrix of the compacted layer partially surrounded the uppermost straws and the tops of the *simmens* beneath. The relationship in thin section between the compacted layer and the straw beneath it suggests that it was applied as a thick slurry to the cereal thatch when it was still in good condition. This could have occurred immediately after the roof was thatched, maintaining it in perfect, but fragile condition.

Daub from the wallhead - This was a sample of daub collected from the wallhead to the left of the door where it appeared to have been used to seal the space between the wall and the underside of the thatch. In thin section it was found to have a complex composition involving four or five separate materials. These were:

- *Shell sand* - Rounded elongate fragments of marine shells with frequent fragments of siltstone, well sorted in the size range 1 to 2 mm. Derived from a local shell sand beach.
- *Silt* - Well sorted angular grains of quartz and mica in the size range 10-40 µm with rare fine sand sized quartz grains. Derived from a local fluvial or lacustrine source.
- *Clay* - Pure clay or a heterogeneous mix of clay and silt. May be from the same source as the pure silt which contained deposits of silt and clay or mixtures of both.
- *Sandy loam* - Poorly sorted angular grains of fine sand and silt sized quartz and mica with some larger angular siltstone fragments. Derived from a local subsoil (till) source.
- *Organic components* - Fragments of peat up to 1 mm across (including a single carbonised fragment) and grass stems.

These five components occur in the following approximate proportions:

Shell sand	10%
Silt	10%
Clay	10%
Sandy loam	65%
Organics	5%

The sandy loam, best described as local subsoil, dominates the mix and the coarse shell sand is fairly well distributed through the daub. The silt and clay tend to occur in discrete masses, a few millimetres across, mixed only with each other. The organic components only occur in one part of the thin section, embedded in the sandy loam subsoil component.

Considerable effort has gone into the selection of materials for this daub, using shell sand and organic tempers and silt/clay to bind the rather coarse textured subsoil that forms the bulk of the mix. Less effort has gone into the actual preparation of the mix and, in particular, the manufacturers have failed to adequately break down the silt and clay.

Wall plaster - This is a sample of plaster taken from the inner face of the wall just to the left of the door. In thin section it was immediately recognisable as a lime plaster. Two layers were visible: a main sandy layer, at least 2.5 cm thick covered by a surface skim of lime only 0.5 to 4.0 mm thick.

The main layer consists of a coarse shell sand with rounded marine shell fragments in the size range 2 to 4 mm set in a matrix of calcium carbonate. The shell sand contains roughly 20% rounded siltstone fragments and probably derives from a local beach. The sand and lime are present in the proportions 60:40 in the thin section. The surface skim consists of almost pure calcium carbonate with only very rare silt and fine sand sized quartz grains. It fills irregularities in the surface of the sandy lime plaster creating a smooth finish to the wall. At high magnification, numerous pigmented particles are visible throughout the lime skim. These range from 5-50 µm across and are coloured bright red, blue or green in transmitted light. The composition of these pigments has not been determined but they appear to be responsible for the brown colour of the plaster.

Various features may be ascribed to degradation of the plaster. Cracks and surface irregularities in the lime skim are covered with a thin layer of organic growth up to 30 µm thick, probably fungal or algal. The lowest 200-500 µm of the skim is de-calcified and therefore partially detached from the underlying sandy plaster. In the sandy plaster there is a well defined continuous iron pan lying 7-9 mm in from, and parallel to the surface of the plaster. This is interpreted as the position of a wetting front penetrating from the surface. Iron oxides have gone into solution in the waterlogged surface zone and then precipitated at the interface with the dry, oxidising interior of the plaster. Surface wetting may also account for the partial decalcification of the skim. It is not known whether these degradation features post-date the abandonment of the house in 1989 or reflect longer term weathering of the plaster.

6.4.5 Summary and discussion

The basal layer of this thatch is formed by straw simmens over which layers of cereal straw were randomly spread. The repeated addition of straw, and sometimes rushes, has resulted in the build-up of a considerable depth of compacted organic matter. Traces of simmens within the straw matrix were only occasionally discernible in some parts of the thatch, primarily in the lower layers. This would be compatible with the owners assertions that the top layers of simmens had not been used since the 1930s at which point nets or chicken-wire would have been used for the same purpose. A hard layer of compacted material (Layer C5) was discovered 5 cm from the bottom of the roof. Thin section analysis has shown this to consist of a mix of straw and amorphous organic matter which had been applied to the thatch. The amorphous matrix resembles peat and appears to have been added as a protective coat in the form of a thick slurry.

The crops in the early layers of the thatch were the black oat and bere, these being contemporary with the use of a central hearth. According to Mr Scott these crops were rarely grown, except on the poorest ground, after the end of the Second World War. In the later periods they were replaced by the common oat and 2-rowed barley. Chickweed (*Stellaria media*), a prolific seed producer, is by far the most common weed species indicating the cultivation of a well fertilised arable soil. It is possible that some perfunctory cleaning of the straw may have been undertaken before or during threshing and this might have removed traces of species with larger seeds or fruits such as hemp nettle (*Galeopsis tetrahit*) and the docks (*Rumex* spp.).

In the later periods, a proportion of the thatch was made up of rushes (*Juncus effusus/conglomeratus*). This could be related to the reduced availability of cereal straw and the increasing importance of animal husbandry.

A number of trends can be seen from the detailed analysis. Preservation of plant remains is best in the lower layers of the thatch where they have been protected from the dampness seeping down from above. Invertebrate activity in these lower layers was at a minimum and a relatively high percentage of the weed seeds was still identifiable. The applied layer of organic mud must have had the effect of preventing water movement into the lower layers. These layers must derive from the earliest period of occupation, a period when there was an open central hearth in the house and it is likely that the soot and rising warm air through the thatch also helped to keep out moisture and preserve the straw.

It is understood that with roofs thatched in this needled style the surface layers needed repair most years (eg. Fenton 1978) primarily because of wind damage. As a consequence thick layers of alternating straw and *simmens* accumulated on the roof. At Gimps the preservation of this cereal straw, particularly in the upper parts of the roof, was very poor. It would appear that when the roof was being properly maintained the lower layers of the thatch would become flattened and brittle, slowly becoming compressed into a thick mat of dry straw and *simmens*. Compaction of the thatch above the applied organic layer can be demonstrated by the flattened and crumbly nature of the straw and the compressed and poorly preserved *simmens*. Once the roof stopped being regularly maintained by the continued application of layers of straw and *simmens* it is evident that water started to penetrate into the roof and was accompanied by plant growth and increased invertebrate activity. These rapidly destroyed the structure of the upper layers of the thatch allowing yet deeper penetration of water into the thatch. The block samples taken at Gimps were damp throughout the profile. As suggested by B. Walker (pers. comm.), it is

Table 3 - The identifications from the detailed analysis from Gimps

Species	*Common name*	*Plant part*	*Samp 1*	*Cereal layers* C2	C4	C6	C7
Field weeds							
Ranunculus repens L.	creeping buttercup	achene	2	1			
Stellaria media (L.) Vill.	chickweed	seed	44	3	4	92	90
Spergula arvensis L.	corn spurrey	seed	3	1	1	2	2
Raphanus raphanistrum L.	wild radish	siliqua				1	
cf. *Brassica rapa*	cf. turnip	seed					1
Euphorbia helioscopia L.	sun spurge	nutlet				2	
Rumex crispus L.	curled dock	utricle	1		1	6	
Rumex cf. *crispus*	curled dock	utricle		1			1
Rumex obtusifolius L.	broad-leaved dock	utricle	1				
Atriplex hastata/patula	orache	nutlet			1	2	1
cf. *Atriplex*	orache	nutlet	1				
Calluna vulgaris (L.) Hull	ling, heather	stem/leaf					1
Myosotis sp.	forget-me-not	nutlet			1	1	
Galeopsis tetrahit agg.	hemp nettle	nutlet	2		2		
Lamium purpureum L.	red dead-nettle	nutlet			1		
Crepis paludosa (L.) Moench	marsh hawk's beard	achene		3			
Matricaria matricarioides (Less.) Porter	pineapple weed	achene	1				
Sonchus asper (L.) Hill	sow-thistle	achene	1	1			
Juncus effusus/ conglomeratus	rush	floret		56	3		
Alopecurus geniculatus L.	marsh fox-tail	floret	16				
Cynosurus cristatus L.	crested dog's-tail	floret			2		
Festuca pratensis/ arundinacea	meadow/tall fescue	floret	11				
Holcus lanatus L.	creeping soft grass	spikelet	37				
Holcus lanatus L.	creeping soft grass	floret	2				
Holcus sp.	soft grass	spikelet		4	5	1	1
Holcus sp.	soft grass	floret		3	2		
Phleum cf. pratense	timothy	floret	1				
Poa annua L.	annual poa	floret	3	1	2		1
Poa pratensis L.	meadow-grass	floret	4	10	3		
cf. *Poa* sp.	meadow grass	floret				1	
Cereals							
Avena sativa L.	common oat	floret	75	11	5		
Avena strigosa L.	black oat	floret		2		12	4
Avena sp.	oat	floret		9	4	5	4
Avena sp.	oat	pedicel	+++	14	4	71	60
Hordeum sativum (6 row)	bere barley	rachis segment				1	15(5)
Hordeum sativum (6 row)	bere barley	floret					3
Hordeum sativum indet.	barley indet.	rachis segment	9 (2)	9(6)	20(10)	40(29)	55(28)
Hordeum sativum indet.	barley indet.	floret			1	3	14
Hordeum sativum indet.	barley indet.	lemma	1				
Hordeum sativum indet.	barley indet.	awn fragments	2				
cereal indet.		florets				8	10
Other							
Invertebrate eggs				+		+	+

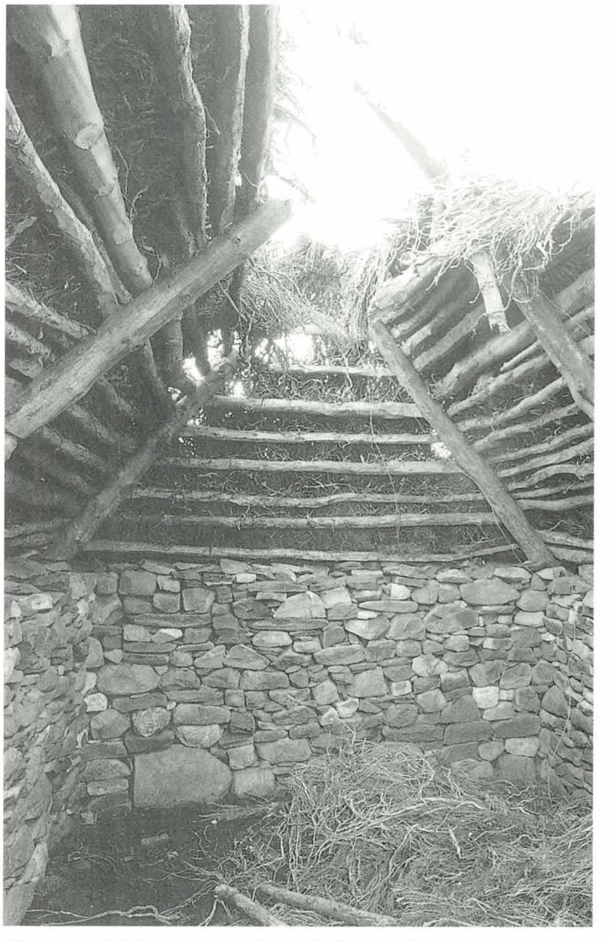
Key: + = rare ++ = occasional +++ = common ++++ = abundant

Numbers in brackets = number of fragments possible that the domestic fire might have had an important role in maintaining a dry environment in the house so preventing moisture from penetrating deep into the roof. In any event it is certain that by allowing a grass cover to develop on the roof the efficiency of the cereal straw to transmit water towards the eaves is severely hampered.

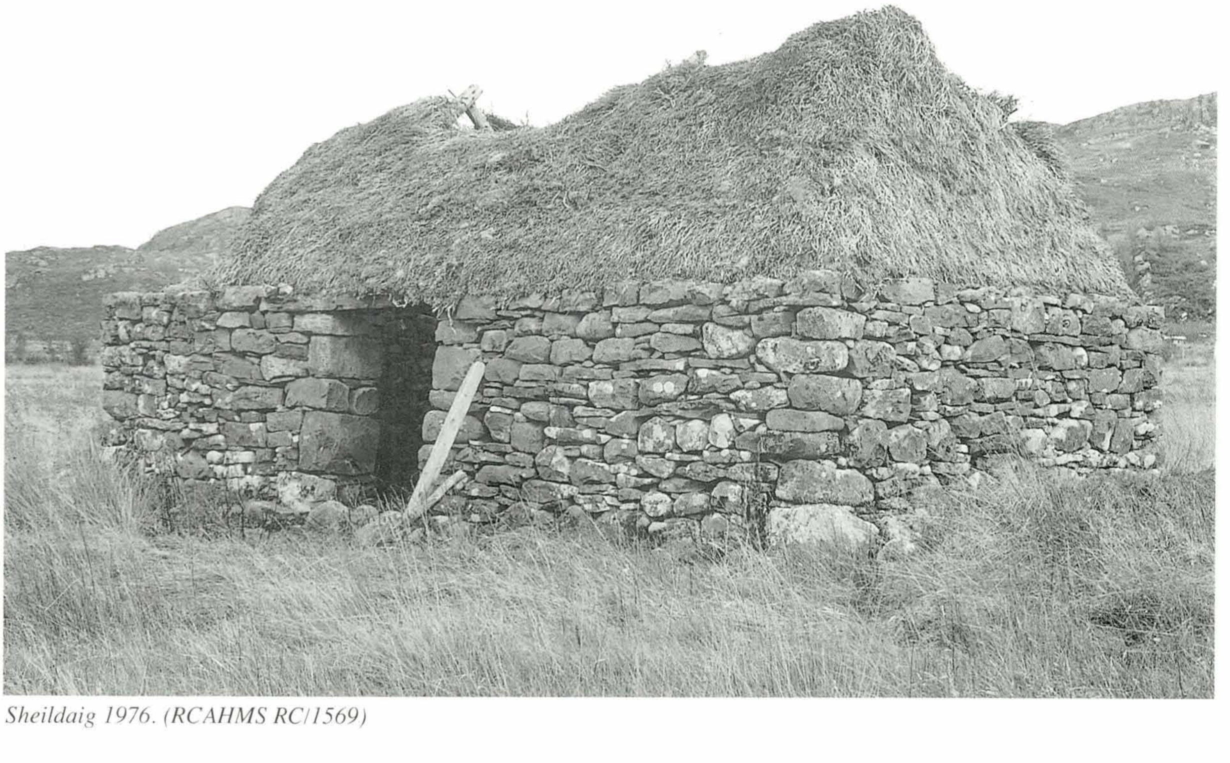
6.5 Hillside Croft, Sheildaig, Strathcarron, Highland

6.5.1 Location and condition

The sample is held at the Highland Folk Museum in Kingussie and was removed from a building along with the roof timbers a number of years ago. It was from a cruck-framed building thought to have been last thatched in the 1930s and which in recent years has been used as a barn. The sample consists of a block 140 x 220 cm x approximately 23 cm thick and includes the roof timbers overlain by a heather thatch. No more than two distinct layers of heather (*Calluna vulgaris*) were noted, the basal parts of the stems pointing up the pitch. The layers had been stitched into position using fine wire. The heather overlapped the timbers at the point where the eaves would have been and it was only at this point that significant numbers of leaves remained attached to the heather. This is probably a result of reduced wind erosion and weathering at this point. No other thatching materials appear to have been used in the construction and no basal layer of turf was present.



Shieldaig 1976, interior. (RCAHMS RC/1566)



Sheildaig 1976. (RCAHMS RC/1569)

6.5.2 Composition of the thatch

The heather used in this roof had been taken from stands of long heather yielding stems approximately 90 cm long with a maximum stem diameter of 1.5 cm. The fine material from the bottom of the thatch confirmed the identification of heather (*Calluna vulgaris*) but grass stems, tree leaves and other light material also present are likely to be secondary in origin, having accumulated while the samples were in storage. Amongst this debris is the skull of a small mammal suggesting that at least part of this fine fraction could have derived from nesting material.

6.5.3 Summary and discussion

Unlike other heather thatches investigated, such as the one from Sidinish, North Uist, long, mature heather has been used in this thatch with no sub-surface layers of turf or other material. This apparent simplicity of construction may reflect the fact that it was used as an outhouse rather than for human habitation. The absence of turf or other materials and the small sample size available precluded detailed analysis of the type undertaken for the other roofs investigated elsewhere in this volume.

6.6 Corse Croft, Huntly, Aberdeenshire

6.6.1 Location and condition

Corse Croft consists of a stone-built house and a number of outbuildings located four miles to the north east of Huntly, Aberdeenshire (Grid ref. NJ 5577 4422). During renovation of one of the outbuildings a turf gable wall was repaired and a number of the roof timbers needed to be replaced so the eastern part of the corrugated iron roof was lifted. On removal it was clear that remnants of the original thatched roof remained beneath the corrugated iron and it is these that form the basis of this analysis.

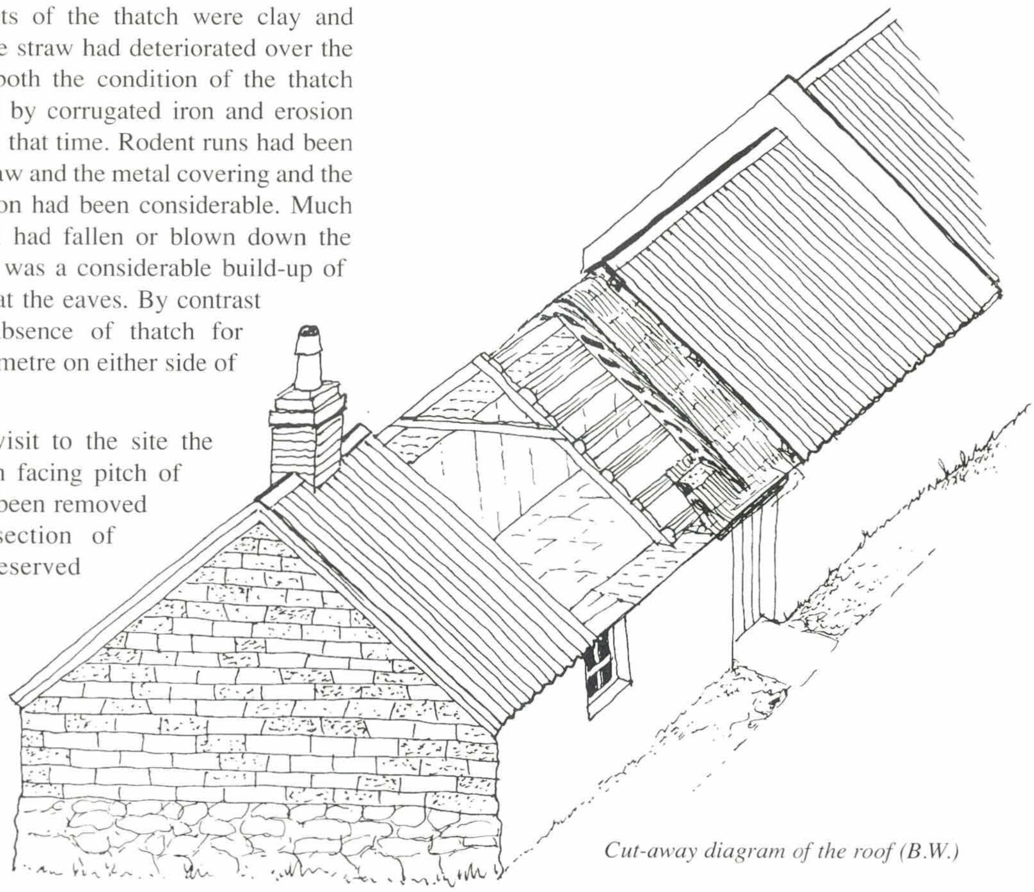
Oral tradition and the presence of a gable-end fireplace, indicate that the outbuilding was originally used as a dwelling although it has, for a number of years, been used for storage and as a lambing shed. The 1782 estate plan by Milne for the Duke of Gordon shows both this and a second similar building on the south side of the present garden to be present at that time. These buildings are therefore at least two hundred years old. RAF Air Photographs show that by 1948 both buildings had been roofed with corrugated iron.

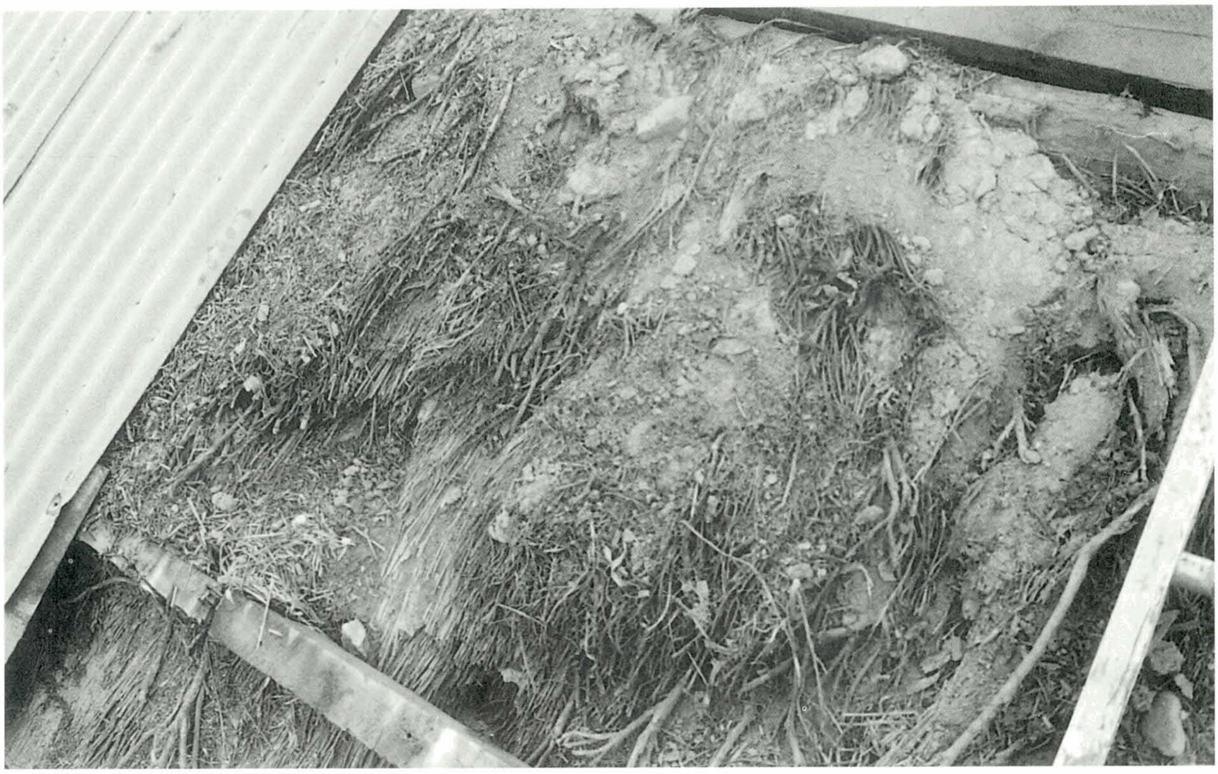
Corse Croft, Huntly, Aberdeenshire after removal of the sheet metal. (T.H.)


The eroded surface of clay, straw and broom. (T.H.)

The main constituents of the thatch were clay and straw but much of the straw had deteriorated over the years. This reflects both the condition of the thatch when it was covered by corrugated iron and erosion and disturbance since that time. Rodent runs had been made between the straw and the metal covering and the effects of wind erosion had been considerable. Much of the loose material had fallen or blown down the pitch such that there was a considerable build-up of fine organic detritus at the eaves. By contrast there was a total absence of thatch for approximately half a metre on either side of the apex.

At the time of the visit to the site the thatch from the north facing pitch of the roof had already been removed although a small section of albeit poorly preserved thatch had been retained and was examined in the field. The south facing side of the roof was still undisturbed and was therefore available for more detailed inspection and sampling.


Cut-away diagram of the roof (B.W.)



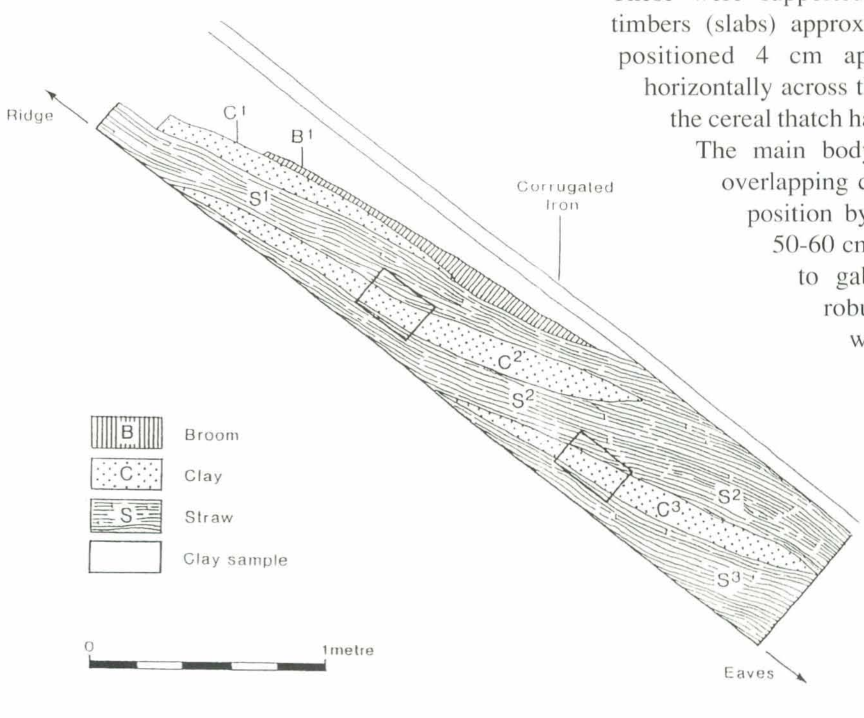
Close-up of the sampled area showing surface of broom. (T.H.)

6.6.2 Sampling

Two adjacent block samples with approximate dimensions 45 cm x 90 cm were cut from the roof just below the apex and directly up the pitch from the door. This point had some of the deepest surviving thatch and was without the overburden of loose material that had accumulated close to the eaves. Samples of straw were also taken from this area because in this position part of the framework erected for the corrugated roof had effectively pinned the straw in position so protecting it from wind erosion or other disturbance.

6.6.3 Composition of the thatch

There were a number of different elements to the roof. These were supported on a series of rough-sawn timbers (slabs) approximately 15 cm in width and positioned 4 cm apart. They had been fixed horizontally across the pitch as a sarking layer and the cereal thatch had been laid directly onto them. The main body of the thatch consisted of overlapping courses of cereal straw held in position by layers of clay 2-3 cm deep, 50-60 cm wide and running from gable to gable. These layers were very robust, not easily removed and would have formed a very effective fixing and waterproofing layer.



Section showing alternating clay and straw layers. (S.S.)

Section adjacent to sampled area. (T.H.)

The clay must have been somewhat plastic when applied because it had been pushed into the straw layers enveloping individual straws and holding them firmly in position. The clay preparation technique appears not to have been concerned with producing a uniform texture as stones up to 7 cm were noted in places.

Oat straw (*Avena sativa*) up to 70 cm long was identified and this had retained a pinkish hue, a feature of some older varieties of oats. The straw was laid directionally down the pitch with the panicle (the ear) pointing towards the ridge such that it was the tougher basal part of the culm that would have been exposed at the roof surface. Occasionally culms with their basal nodes were encountered. The persistence of these culm bases might imply that the crop had been pulled (ie uprooted) rather than cut but in the absence of more evidence from the eroded outer ends of the cereal thatch this remains speculative. The presence of significant quantities of leafy material within the straw layer suggests that it had not been drawn (i.e. stripped of its leaves) as part of the preparation procedure.

Towards the ridge and at the eaves above the door it was clear that broom had also been used in the roof construction. At the ridge the sharpened stems (probably formed during the cutting of the plant) were clearly pointing towards the apex and fixed with the same clay that had been used with the cereals. After sampling, the remaining part of the exposed roof was dismantled prior to replacing rotten timbers. During this work a number of further features came to light. Above the door the cut ends of broom had been pushed under the horizontal planks that made up the boxed structure over the entrance. These too, were fixed into position with clay. Three sharpened pegs, 30 to 45 cm long and 2 to 4 cm in diameter, had also been pushed horizontally into the thatch above the door. The largest of these retained a short length of coir rope which had been wound around the external end. In the lower portions of the roof, close to the eaves, other materials had been used perhaps to correct the pitch of the thatching courses. Rushes, grass and broom were identified and samples were taken for more detailed identification. A short length of straw rope and a knotted handful of straw were also recovered from the eaves but their original function was not clear.

6.6.4 Detailed analysis

Botanical analysis

Cereals and cereal weeds

The straw samples were carefully checked for any remaining non-cereal plants but none were encountered. The sample was then sieved in a 1 cm mesh and 150 cc of the resultant fine fraction checked under the binocular microscope. Any identifiable plant parts were removed for identification (Table 4).

The samples were dominated by oat, the only cereal recovered. These were in an extremely good state of preservation with both colour and structure, including the grain itself surviving. This had presumably occurred because of the presence of protective coats of clay both above and below which appear to have restricted the penetration of insect and fungal

Table 4 - Detailed botanical identifications from a straw sample from Corse Croft.

Species	*Common name*	*Plant part*	*Number*
Field weeds			
Spergula arvensis L.	corn spurrey	seed	2
		capsule	4
Galeopsis tetrahit agg.	hemp-nettle	fruit	2
		seed head	1
Agrostis sp.	bent grass	floret	2
Holcus sp.	soft grass	floret	2
Cereals			
Avena sativa L.	common oat - strong awn, primary grain	floret	6
	common oat - weak awn, primary grain	floret	4
	common oat - no awn, primary grain	floret	13
Avena sp	oat - indet.	floret	15

decomposers. The well-preserved oat florets revealed some interesting features regarding the variety of oats used. The morphology (i.e. general dimensions, the fracture scar at the base of the floret and the lack of a barb at the tip of the lemma), the colouration and the surface texture were the same in all well-preserved examples and characteristic of the common oat (*A.sativa* - eg. Hector 1936, Renfrew 1973). Some of the florets possessed a weak awn on the dorsal face of the lemma, others retained a strong awn and the remainder had none at all. This feature can be influenced by environmental conditions (Hervey-Murray 1980). All of the florets observed retained an intact rachilla ending in a papery, undeveloped grain. Renfrew (1973) and Hector (1936) indicate that the presence of an awn in the common oat (*A.sativa*) is only ever observed on the primary grain, therefore, the presence of an undeveloped secondary grain indicates that the surviving florets must have been from single grained spikelets. Such single grained spikelets could have been a feature of the variety grown or a result of environmental factors. This information can be used to discuss potential oat yields in the Corse Croft area. Accurate botanical descriptions of these early varieties are seldom available so it is not possible to be specific regarding the variety represented. However, it was noted that husks retained an orange pigmentation which together with the observation of areas of the pink straw where it had been sealed within clay indicates that these probably represent examples of one of the pink/red varieties of common oats (*A.sativa*). *Red* and *Sandwich* are two which were commonly grown in the last century and also in the earlier part of this (Findley 1956).

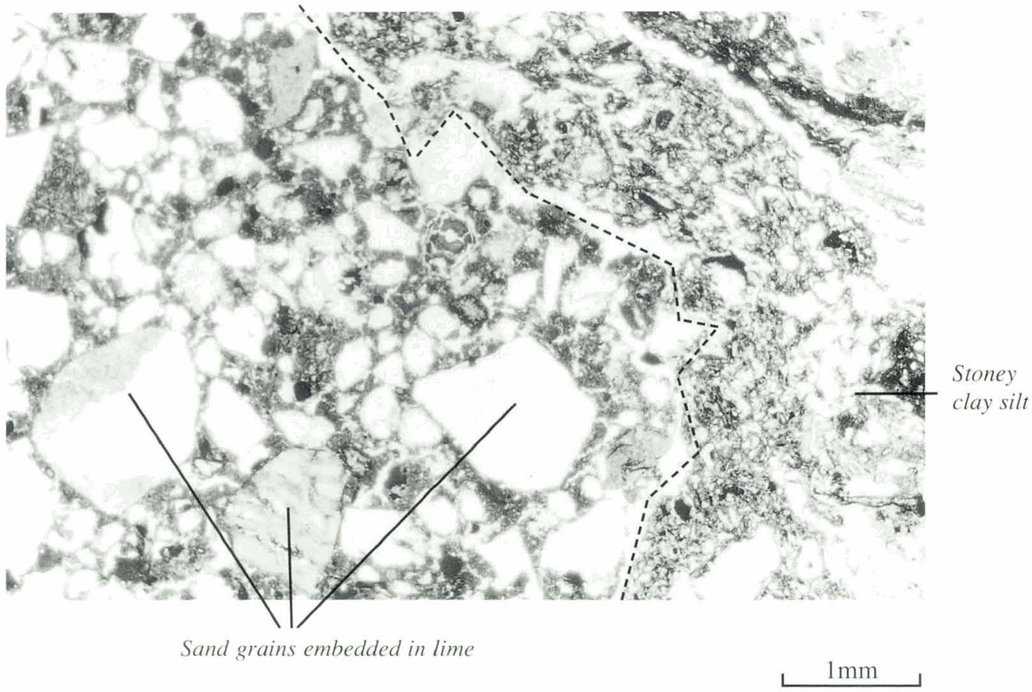
The weed seed element is very small indeed possibly because the crop had been cleaned before being used or because the field was not badly infested in the first place. Either way, it is likely that many of the smaller weeds would have been held in the basal straw which would have been exposed at the surface of the roof. It is this area which has suffered most from the effects of wind erosion and this would undoubtedly have had an effect upon the preservation of many of the weedy plant parts. Those plants that were identified from the oat crop were all common weeds of cereal crops growing on slightly acidic ground. They would have been typical of many areas of Scotland including Aberdeenshire.

Other botanical elements in the roof

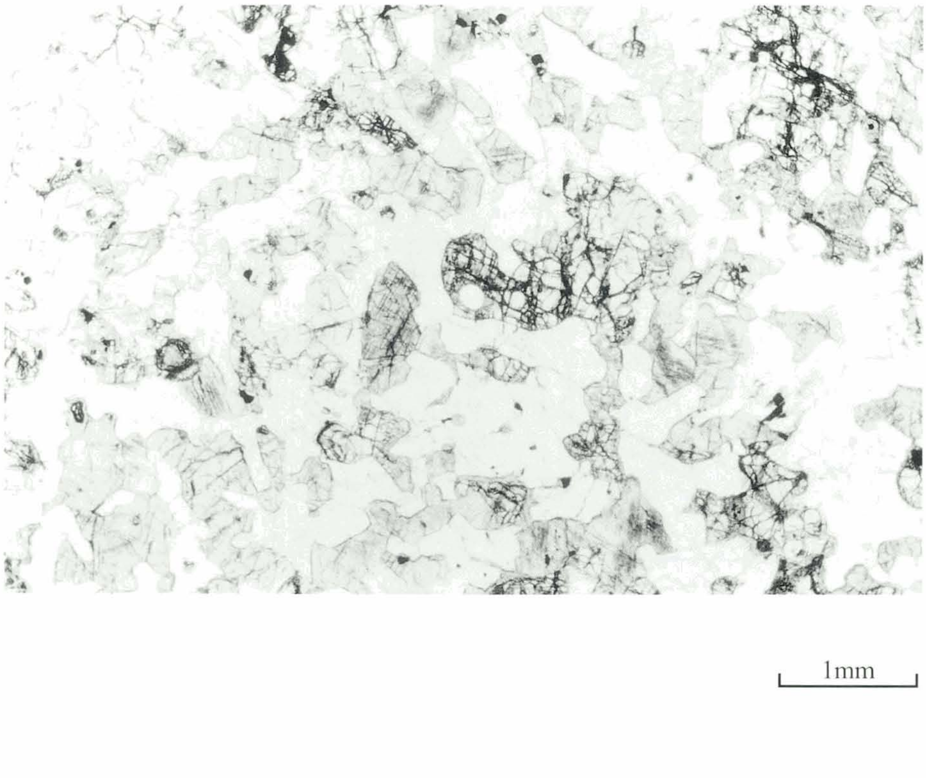
At both the apex and the eaves above the door sprigs of broom (*Sarothamnus scoparius*) had been used as a surface coat. These were up to 70 cm in length with a maximum stem diameter in the order of 1 cm and retaining a sharpened end where it had been cut from the main plant. The presence of mature pods and the absence of immature ones indicates that this was probably cut in the autumn. Over the door, at the eaves, the broom was held in place with a number of wooden pins. These were identified by Dr Susan Ramsay, Glasgow University, as being made of spruce (*Picea* sp.). She comments that although not native to this country spruce has been grown here since at least the 16th century. Given the likely date of construction of Corse Croft in the 19th century it would seem probable that it was grown locally.

During the dismantling of the roof various layers that were interpreted as stuffing or levelling layers were sampled. This was dominated by wild grass species with soft-grass (*Holcus* sp.) being the most common with traces of what appeared to be hair-grass (*Deschampsia* sp). The culms and capsules of rushes (*Juncus effusus/conglomeratus*), were both present as were occasional fruits of thistle (*Cirsium* sp.) and

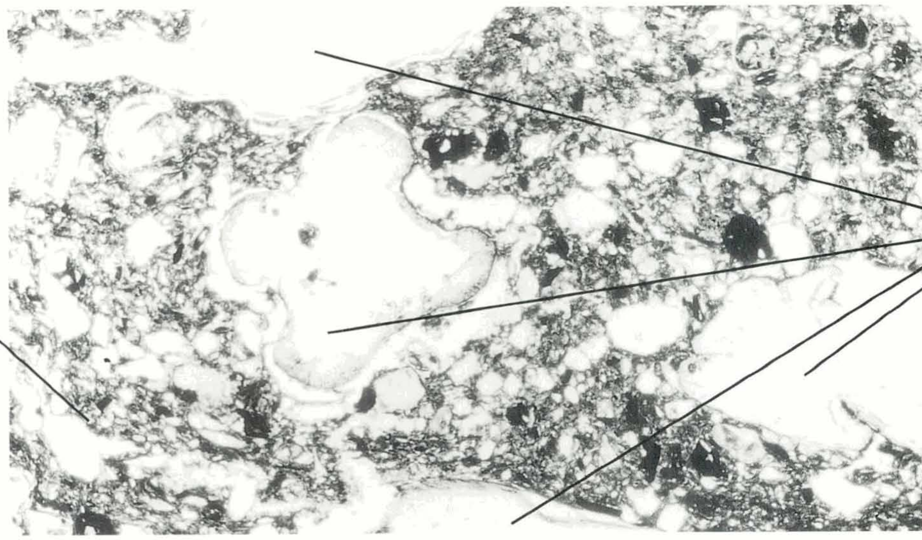
Corse Croft, thin section of clay. (S.C.)



Corse Croft clay, Norite rock fragment. (S.C.)



Corse Croft, thin section of clay. (S.C.)



sedge (*Carex* sp.). These are all likely to have been gathered from areas of damp pasture, field edges and waste ground around the site and do not suggest careful selection of materials.

Clay samples - *S Carter*

Two undisturbed block samples of clay were extracted from clay layers 2 and 3 during the laboratory excavation of the thatch block from this roof. Thin sections were prepared from both of these blocks using standard techniques (Murphy 1986) and described using the methods and terminology of Bullock *et al* (1985).

The two samples of clay were found to be identical. The groundmass comprises a dominant fine fraction of highly weathered clay and silt sized grains of uncertain mineralogy. Coarse mineral material includes dominant basic igneous rock fragments (up to 4 cm long), common plagioclase feldspar and other basic minerals and a few sand sized quartz grains. There are also rare fragments of lime mortar up to 15 mm across comprising microcrystalline calcite with common sand sized grains of quartz and a few larger fragments of acidic metamorphic rocks and crystalline limestone. Much smaller fragments (<1 mm) of microcrystalline calcite occur rarely throughout the groundmass.

The coarse mineral components are very variable in concentration creating some areas of sandy texture and other areas of almost pure clay silt. Organic components, other than cereal straws pressed into the clay during roof construction, are very rare with only single tissue fragments noted in each thin section.

This analysis of the thin sections shows that there are at least two distinct materials present in the clay samples: lime mortar and a stony clay silt.

The composition of the mortar indicates a local (crystalline limestone) source for the lime. Metamorphosed limestones are present less than 10 km to the north-west in Banffshire and were worked for lime into the 20th century (Robertson *et al* 1949). Sand has been added to the lime and its lithology indicates a local acidic metamorphic source (similar to that present in the turves in the gable wall). It is unclear whether the presence of larger lumps of mortar results from the incomplete mixing of a fluid mortar or the incorporation of roughly ground hard mortar fragments.

The composition of the stony clay silt is more complex. The bulk of the fine sediment is made up of highly weathered minerals and, given the presence of dominant basic igneous minerals in the course fraction, this material is interpreted as the product of *in situ* weathering of basic igneous rocks. Rocks of this type (Norite and Gabbro) are only exposed in small areas on the low hill tops immediately to the south of Corse Croft. The presence of some acidic metamorphic minerals could be the result of mixing in glacial till overlying the igneous bedrock but the similarity of the sand-sized grains to the sand component of the mortar suggests that this is the more likely source.

The clay used to fix the cereal straw can therefore be interpreted as a heterogeneous mix of a stony clay silt derived from a nearby basic igneous rock outcrop and a lime mortar, also made up from local materials. It is assumed that the role of the mortar was to create a harder-setting mix, more resistant to erosion.

6.6.5 Summary and discussion

Although the roof at Corse Croft was in a very poor state of repair when part of it was replaced it has provided important information regarding the construction of clay and cereal roofs. The main bulk of the roof was formed of alternating layers of a landrace of common oat which had a pink tinge to it. The straw was placed with the basal part running down the pitch in a directional arrangement. Each course of straw was held in position by a course of clay 2-3 cm thick on the upper half of the straw. This provided a concealed method fixing as described by Walker *et al* (1996, 35) and the clay would not have been visible at the surface of the roof. The clay used was a mix of a stony clay silt from a local source and a lime mortar, also made up from local materials. It is assumed that the role of the mortar was to create a harder-setting mix, more resistant to erosion.

Broom also appears to have been used in the construction of the roof at both the ridge and directly over the door at the eaves. At these points remaining fragments were also held in position by the layers of overlying clay and by sharpened straight pins made of spruce wood. The broom was not seen over the rest of the roof and it seems likely it was being used to protect the more vulnerable parts of the thatch.

The structure of the roof was such that, with the exception of any minor repairs made, all the elements present above the sarking layer probably relate to one thatching. There is no evidence for cumulative process as observed at No. 9 Locheport or Gimps. It might even be the case that the building has only been thatched once during its lifetime.

6.7 Johan Cottage, Fort Augustus, Highland

6.7.1 Location and condition

The house known as Johan Cottage is reputed to have its origins in the mid 18th century. It is situated just to the east of the north end of the Bridge of Oich, Fort Augustus (Grid ref. NH 3807 0943). Noble (pers. comm.) has suggested that some aspects of its architecture are more English than Scottish and it may therefore have been linked to the garrison there. Until recently the building was covered with corrugated iron roofing and it was only during renovation that it was recognised that areas of well-preserved thatch survived. The Highland Vernacular Buildings Trust were given a short time to record and sample areas of interest within the building.

6.7.2 Sampling

A large section of the roof including underlying timbers was removed by the Highland Vernacular Buildings Trust. Other samples of turf from the ridge and interior partitions were also taken and made available for analysis.

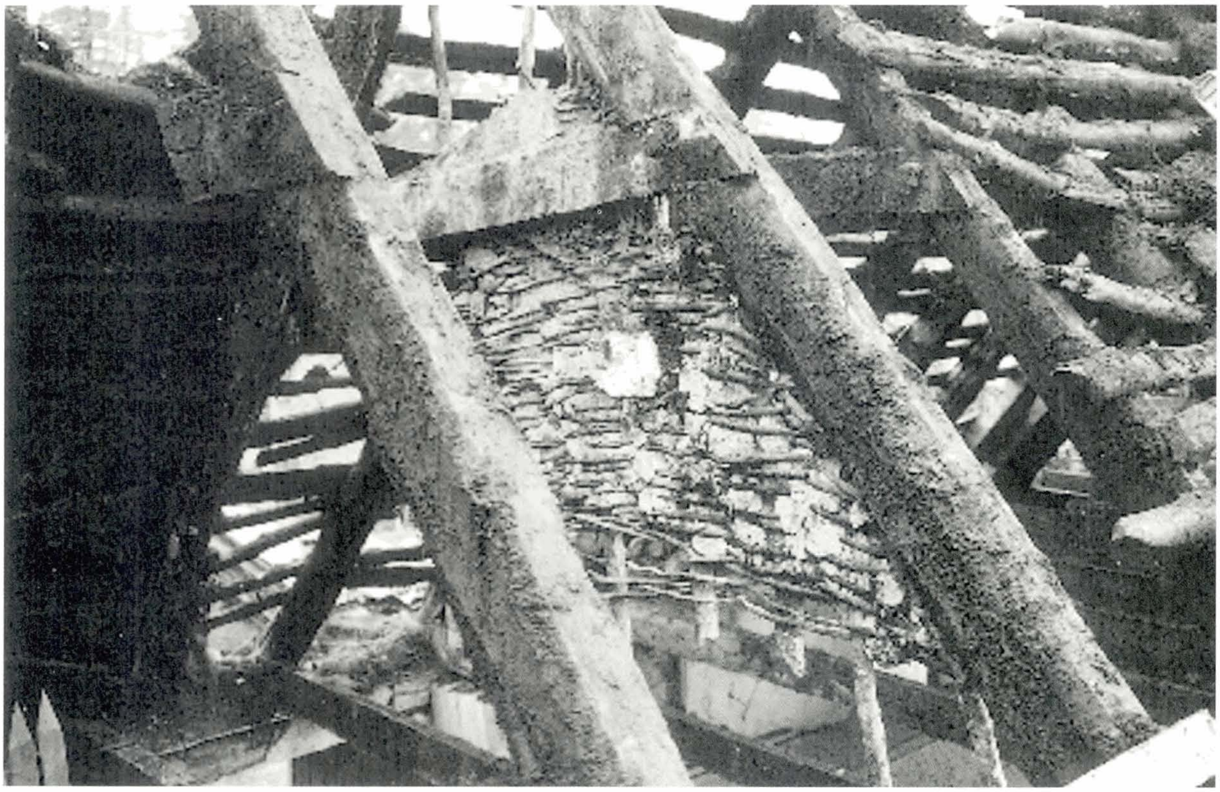
6.7.3 Composition of the thatch

The thatched roof was supported by a number of horizontal timbers. These were of Scots Pine (*Pinus sylvestris* - identifications by Susan Ramsay, University of Glasgow) and were neither of uniform length nor thickness. A layer of overlapping turves was

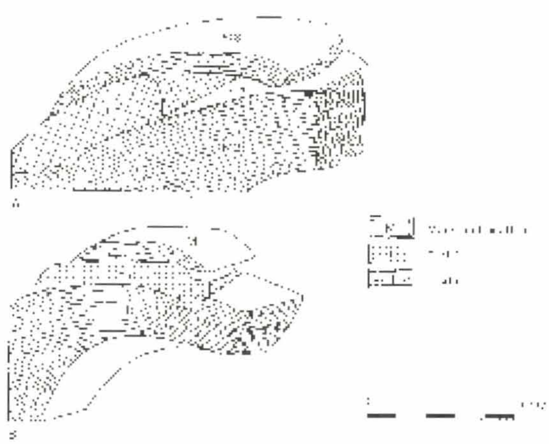
Johan Cottage, view of the north face of the roof. (S.Whymant)

Johan Cottage, view of the north face of the roof. (S.Whymant)

Johan Cottage, roof timbers following the removal of the thatch. (S.Whymant)



Johan Cottage, roof timbers and wattle panelling. (S.Whymant)



Isodiametric diagrams of the heather and 'turf' blocks from the ridge area of Johan cottage a) Block 1 and b) Block 2 (Item 7). (S.S.)

positioned vegetation side downwards on top of these timbers. They were heavily sooted on all exposed downward-facing surfaces and were between 3 and 4 cm thick with scalloped edges. They were generally sub-rectangular in shape with some of the biggest measuring 65 x 34 cm and were arranged such that the edges overlapped adjacent turves creating a basal layer some 8 cm deep. Above the basal turves was a layer of heather thatch. The full depth of the thatch, as revealed in the block retained for archive purposes, was 27 cm.

No erosion surfaces other than the uppermost surface were seen so there is no evidence that the sample represents the build-up of successive thatching layers. This could be because all the heather relates to a single thatching episode or because any evidence for the upper layers had been removed prior to adding the corrugated iron roof. A number of samples of the heather were taken from the roof. These were commonly 70 cm in length with stem diameters of up to 7 mm and were from relatively mature heather. The heather appears to have been uprooted and occasional wads of moss had become incorporated with it. Over parts of the surface the thatch seems to have consisted of highly fragmented heather (i.e. short lengths) with a high percentage of moss. Particularly in the area on either side of the ridge this mixture had been compacted and appeared to have been consolidated by the application of some other material. Over the ridge itself and down to at least 1 m on either side layers of turf or a mixture of mineral and peat had been applied to the surface of the heather. This was then finally capped with a second layer of consolidated heather fragments and moss. The whole surface was covered with a dusting of grey powder with occasional lumps. These resembled modern cement and may have been associated with the addition of corrugated metal sheeting. Evidence for fixing was largely absent but occasional sharpened pins were found to have been driven into the lower turf layers from the thatch above.

6.7.4 Detailed analysis

6.7.4.1 Botanical analysis

The heather which formed the bulk of the roof offered little additional information regarding the source of the material or the environmental conditions pertaining at the time. However, both the moss and the vegetation growing on the turves offer some scope for further analysis.

Moss - *A. McMullen*

All of the species identified in Table 5 are common constituents of the flora to be found on acidic heathlands, similar habitats in woodland clearings and almost invariably in association with ericaceous species. It is almost inconceivable that the species were growing on the roof as none are weedy colonists of disturbed substrates. The low presence of *Hylocomium splendens, Pleurozium schreberi* and *Rhytidiadelphus squarrosus* may suggest that they were adhering to the decumbent branches of the heather as it was gathered. Adhering moss of this type was noted in low concentrations throughout the heather thatch above. Such an explanation may also explain the presence of *Hypnum cupressiforme* var. *cupressiforme* which is commonly found growing in the heart of heather plants especially in the latter stages of that plant's life history as its crown opens permitting the entrance of more light.

Dicranum scoparium is less likely to have been brought in attached to heather plants because this moss has an upright, tufted habit that would make it less amenable to such inadvertent gathering. This moss must have been incorporated into the roof deliberately. Certainly, in the past, moss was widely used in building construction as a caulking material, most notably in the construction of timber houses (eg. Dickson, 1973 and Seaward and Williams, 1976) but the use of large quantities of moss in roof construction, as at Johan Cottage, would seem unprecedented.

Table 5 Moss taxa from a mixed heather and moss layer. Nomenclature follows Smith (1981) except * which is from Dixon (1954).

Species	*Occurrence*
Dicranum scoparium indeterminable variety	abundant
**Dicranum scoparium* var. *spadiceum* Boul.	rare
Hylocomium splendens	rare
Hypnum cupressiforme var. *cupressiforme*	rare
Pleurozium schreberi	occasional
Rhytidiadelphus squarrosus	rare

Turf vegetation

Three turves were taken for detailed analysis. These had all evidently been cut using a turf spade or *flauchter* since all had the convex underside typical of turves cut with this implement. They had, however, been cut from two very different sources.

- Two of the turves had been cut from the surface horizon of a peaty gley soil and consisted of a surface vegetation dominated by young heather (*Calluna vulgaris*) with a maximum stem diameter of 2 mm. Although badly degraded, one of the turves also had up to 40 % of its surface area covered by rush (*Juncus* sp.) and coarse grass. This vegetation, indicative of acid heath, would be in keeping with the peaty nature of the turf. The lack of older heather, other than the occasional woody root, indicated that the ground from which the turf was cut had been cleared of vegetation only a few years before. This implies a) that turves had been taken from the same area just a few years previously or, b) that the area had been recently managed by the use of fire. The presence of peat indicated that this was not taken from ground previously disturbed by tillage.
- The third turf consisted of mineral soil topped by a grassy vegetation. Although preservation was poor, this is thought to have included heath grass (*Danthonia decumbens*), a common component of acid grassland. The absence of peat suggests that the soil from which the turf was cut had recently been subjected to disturbance. This could be the result of natural processes such as deposition of river sediments but was probably the result of tillage associated with cultivation some time prior to the establishment of grass cover. The maintenance of a grassy surface vegetation was most likely the result of continued grazing of the area.

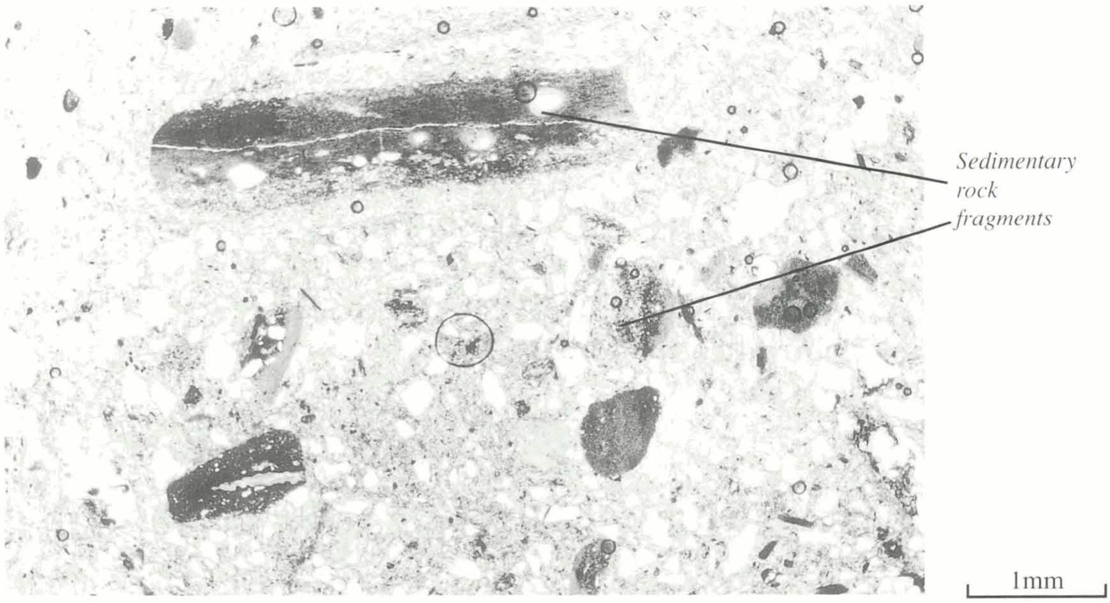
Thin section analysis - *S Carter*

The roof

Two samples collected from the thatch on Johan Cottage were selected for soil/sediment analysis, both from complex blocks of organic and mineral materials close to the ridge of the roof. The first was a dense layer of fragile and degraded heather and moss stems. This was selected for thin sectioning to discover if any other materials had been present and whether these had been responsible for the apparent solidity of the layer. The second was a complex block of mineral and amorphous organic layers, provisionally identified as a turf. This was also in a degraded state and it was not clear what it had originally comprised. It was block sampled in two places for thin sectioning. They were prepared using standard techniques (Murphy 1986) and described using the methods and terminology of Bullock *et al* (1985).

The following observations were made:

Johan Cottage, thin section of daub from the wattle screen.



- *Dense layer of fragile and degraded heather and moss stems.* In thin section this sample is seen to consist solely of heather and abundant moss stems. Unidentified material, also visible in hand specimens, appears to be invertebrate excrement created by the partial consumption of the plant tissues *in situ* on the roof. No further comment is possible.
- *Complex block of mineral and amorphous organic layer.* Two thin sections, (A) and (B), were prepared from this sample in order to examine the full range of sediment layers visible in the hand specimen. Both sections consisted of a series of sub-parallel horizontal layers. This stratigraphy is described in Table 6.

Discussion of the roof

The complex block of mineral and amorphous organic layers was found to consist of three principle layers; an organic layer sandwiched between two organo-mineral layers. This cannot represent a single turf unless it is argued that it was a complex accumulating sequence of organic and mineral sediments. This seems unlikely as a final vegetated organic top layer should be present to form a coherent turf. It therefore must be a composite of more than one original material.

Layer 5 in (B) offers the most secure interpretation. The band of culm bases at the top of this layer resembles an *in situ* grass or sedge dominated turf in original orientation. It seems certain that layer 5 is a grass/sedge turf laid vegetation-side upwards. The banded fabric of this layer indicates that it was a recently formed sediment and the fine texture is consistent with a lacustrine or deltaic alluvium.

It follows from this interpretation that layer 4 is not linked to layer 5 but must have been laid on top of it. There is no positive evidence that can be used to demonstrate whether Layer 4 is inverted or not relative to its natural orientation. The upper part of the stratigraphic sequence is repeated in both (A) and (B); layers 1, 2, 3 and 4 are common to both. Layer 3 is a narrow band of well preserved plant stem tissues between two highly humified amorphous peat layers (2 and 4). It is therefore improbable that these three layers were formed together. Layer 3 can be interpreted as a vegetated surface, either connected to layer 4 or inverted and linked to layer 2. Layers 1 and 2 are simpler to interpret if it is assumed that 1, 2 and 3 form a single inverted turf cut from a mineral soil with a shallow peaty surface horizon.

This interpretation leaves layer 4 disconnected from both above and below. The high degree of invertebrate disturbance that has occurred on this roof makes any further interpretation of the material impossible and the issue remains unresolved. It may be concluded that at least two turves from distinct sources are present in the sample, one right way up and one inverted.

The daub and mortar

Samples of daub or mortar from Johan Cottage were made available. Thin sections were made of these materials to study their composition and to recover any evidence for deliberate mixing or preparation techniques.

Daub taken from an internal wattle screen in the upper floor of the building.

This sample is dominated by mineral components with

Table 6 Johan Cottage. Descriptions of the stratigraphy in thin sections (A) and (B).

A)

Depth (mm)	Layer	Description
0-11	1	Organo-mineral sediment consisting of poorly sorted sand with small stones with few roots. High porosity intergrain microaggregate structure.
11-20	2	Organic sediment consisting of fragments of amorphous peat and microaggregates. High porosity intergrain microaggregate structure.
20-23	3	Dense band of moss and monocot stems with a parallel, horizontal orientation.
23-84	4	Organic sediment consisting of fragments of amorphous peat and microaggregates with occasional concentrations of horizontally orientated roots. High porosity intergrain microaggregate structure.

B)

Depth (mm)	Layer	Description
0-31	1	Organo-mineral sediment consisting of poorly sorted sand with small stones with few roots. High porosity intergrain microaggregate structure.
31-36	2	Organic sediment consisting of fragments of amorphous peat and microaggregates. High porosity intergrain microaggregate structure.
36-40	3	Dense band of moss and monocot stems with a parallel, horizontal orientation.
40-55	4	Organic sediment consisting of fragments of amorphous peat and microaggregates. High porosity intergrain microaggregate structure.
55-93	5	Organo-mineral sediment consisting of silt with occasional narrow bands of fine sand. Concentration of large monocot culm bases at top of layer. Intergrain microaggregate structure.

only very rare organic fragments (possibly plant stems). The bulk of the sediment is a poorly sorted mix of clay silt and sand; grains are angular and the mineralogy is acid metamorphic. The only notable feature is the presence of frequent rounded sedimentary rock fragments up to 5 mm long. They are mudstones and siltstones, some with repeating graded laminations. Clay in the mudstone bands is highly birefringent.

The local solid geology is dominated by acid metamorphic rocks but sedimentary rocks of Middle Old Red Sandstone age are present along the east side of the Great Glen. However, these are predominantly conglomerates and sandstones so a local origin for the mudstone and siltstone fragments seems unlikely. No convincing explanation can be offered for their presence in this daub.

Dust that was noted overlying the complex turf and heather thatch sequence at the roof ridge.

In section, the fragments consist of numerous regular, narrow parallel bands of graded sediment. Individual bands are 0.7-1.1 mm wide and grade from coarse silt down to clay. It is assumed to be an upwards-fining sequence but original orientation could not be determined.

The fragments are only very weakly cemented, easily crumbling to dust, and are clearly not rock fragments. It is assumed, given the fragile nature of the fragments, that they are the remains of a thin layer of sediment that accumulated over the thatch after it had been covered by the sheet metal roof. The form of the ridge of this roof is not known but repeated washing of sediment from a mortar fillet during rain showers could produce the observed laminations.

A sample of mortar from the outer face of the stone wall of the building - *S Carter*

It is a complex poorly mixed sediment with areas varying in texture from sand to silty sand, silt and clay. Mineralogy is acid metamorphic and there are very few organic components (a few stems and small peat fragments).

This is an unremarkable mortar made from a local sediment, with no evidence of careful preparation or the deliberate addition of other materials.

6.7.5 Summary and discussion

The thatch from Johan Cottage has various elements in it. A layer of turf was initially placed, vegetation side down, over a supporting layer of rough cut pine timber. The turves derive from two distinct areas. The first, a peaty turf, initially supported a vegetation dominated by heather and is likely to have been cut from an area of managed heathland. The presence of peat indicated that this had not been cultivated for many years. The second area from which the turves had been cut was an area of grassland which may, at some point in the past, have been cultivated. This would be compatible with an area of cultivated outfield land within a long fallow which had, for some time, been heavily grazed.

The main bulk of the roof was heather but it is not clear whether this represents a single thatching or the result of a build-up of heather over a number of years. At the apex of the roof a complicated arrangement of turves, other sediments and vegetable material had been positioned. The lowest layers consisted of heather, laid over the ridge. The uppermost layers of this contained substantial quantities of moss which appears to have been deliberately collected and added to the roof. This had been compacted into a brittle layer by the presence of insect droppings and it is not known how this would originally have been fixed. Above this layer was a series of mineral layers. Although complicated in structure it is clear that a mineral turf had been placed, vegetation side upwards, over the apex. Some time later an organic layer, possibly peat or dung, appears to have been placed/smeared on the surface and sometime after that a second turf was placed on top. The whole arrangement was capped by a second layer of fragmented moss and heather. Unfortunately it is not clear whether the observed structure is a result of a single construction event or the result of a series of re-thatchings involving removal and addition of different materials interspersed by periods when erosion of the surface by the action of the weather and natural decay would have occurred.

A number of mortar and daub samples were also taken from the thatch surface, wattle panel and the outer wall. The composition of these is compatible with a local origin for the materials used with the exception of quantities of mudstone and siltstone that were identified from the wattle panel. These minerals do not occur locally but no convincing explanation for their presence has been forthcoming.

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9 GLOSSARY OF TERMS

Awn: bristle-like projections present on the ears of some members of the grass family.

Bere: a variety of 6-rowed barley which used to be common in Scotland but is now rarely grown.

Cabers: long straight poles or rough timbers running from the eaves to the ridge.

Crook and caber: a method of fixing using horizontal poles laid across the roof and fixed with a hook shaped timber.

Cruck: pairs of large curved timbers used as the principal wooden frame for buildings.

Eaves: the lowest part of the roof overhanging the walls.

Fale: thick divots or turves used for building construction.

Flail: an instrument consisting of two joined poles used for threshing.

Flauchter: a broad bladed spade for cutting turf.

Frond: the leafy part of a fern.

Grip: see *tippet*

Lum: a Scottish name for a smoke vent, chimney or flue.

Needling: refers to a thatching technique where straw ropes (*simmens*) are used to support and restrain the thatch.

Raip and scob: a method of fixing using lines of rope or twine fixed at regular intervals by *scobs*.

Scob: a straight or doubled hazel wand used for fixing. Equivalent to the English spar.

Scob and wand: a method of fixing using thin timber wands held in position by scobs.

Secret fixing: a method of securing the thatch which is not visible at the surface.

Skews: the edge of a sloping roof at the point where it meets the gable wall.

Simmen: a hand made straw rope.

Stipe: the stem of a fern supporting the fronds.

Tippet: twisted bunches of straw used in the main thatch for repairs.