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Postglacial hunter-gatherers and vegetational history in Scotland

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SUMMARY

The evidence for vegetational change during the millennia between the first human settlement and c 3000 bc is reviewed. Aspects considered include the extent to which hunter-gatherer activities influenced broad- as opposed to small-scale changes in the palaeofloras of Scotland; the range of interpretations which may be placed upon the presence of charcoal in relation to the intentional use of fire; the potential defects of floristic inference as illustrated by hazel and bog-myrtle pollen; and the spatial, ecological and chronological components of the transition to agriculture.

It is stressed throughout that, relative to other possible causal factors, much of the available environmental evidence regarding man's role in landscape change before the widespread adoption of crop husbandry is uncertain.

INTRODUCTION

In 1954, in a paper on the pollen analysis of a peat deposit at Kingsteps Quarry, Nairn, Elizabeth Knox reported palynological evidence from a deposit which also contained charcoal and lithic material ascribed to the Mesolithic period. The same year saw the publication of the report on Professor Clark's excavations at Star Carr in the Vale of Pickering (1954), in which Professors Godwin and Walker discussed their palaeoecological studies at the now-classic sites in its vicinity. Both the Scottish and English studies were circumspect in their conclusions. However, the palynological evidence, taken in conjunction with other macrofossil remains in the case of Star Carr, drew attention to the possibility of discerning man's impact on the vegetation before the local appearance of agriculture.

Since that time, a number of studies have appeared which lend varying degrees of support to the concept of environmental impact by Mesolithic populations in the British Isles (eg Dimbleby 1962; Keef *et al* 1965; Simmons 1969; 1975; 1979; Simmons *et al* 1975; 1983; Smith 1970; 1981; Smith *et al* 1981; Jones 1976; Sims 1978). A range of models of hunter-gatherer economic and social behaviour, drawing on anthropological literature on contemporary and near-contemporary hunter-gatherers, has been strongly adopted by some archaeologists (eg Evans 1975; Mellars 1976; Jacobi 1978; Mellars & Reinhardt 1978), whilst Morrison's recent synthesis offers a

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brief uncoloured survey of some of the relevant palynological literature (1980, 106–13) and Simmons (1983) traces the development of ideas about Mesolithic impact in upland Britain.

This paper examines the evidence for vegetational change during the millennia in Scottish prehistory between the first human settement and c 3000 bc, when archaeological evidence for the presence of agricultural societies is supported by the earliest of a suite of radiocarbon determinations from Scottish Neolithic sites. However, this date should not be regarded as sacrosanct, and we shall discuss below intimations of possible earlier Neolithic activities.

The discussion is divided into five sections:

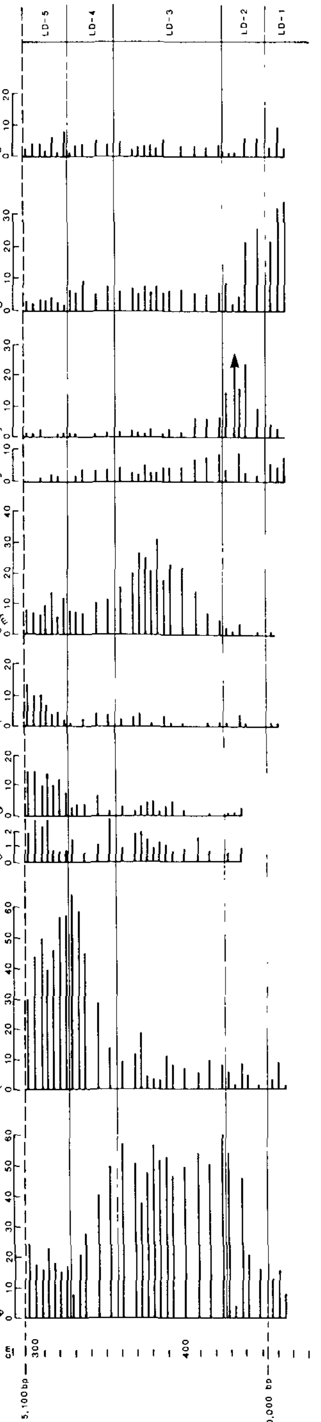
(i) general vegetational changes
(ii) 'small-scale' vegetational changes
(iii) fire and charcoal
(iv) hazel or bog myrtle?
(v) the transition to agriculture

GENERAL VEGETATIONAL CHANGES

The Mesolithic period may be differentiated from the preceding final stages of the Palaeolithic by changes in the artefactual record consequent upon the adaptation of food procurement and other technologies to new environmental conditions (Clark 1981). For present purposes, it can be taken to lie between 10000 and 5000 radiocarbon years bp (*sensu* Simmons *et al* 1981). In the vegetational record, the principal feature of this period is the spread of trees and shrubs, beginning with the pioneer taxa of birch, juniper and willow. Following this, the traditional 'Boreal' woodland period is marked by the dominance of hazel and the rise to prominence (depending on local factors) of pine, oak and elm. In turn, this stage was succeeded by the alder-dominated 'Atlantic' period.

Vegetationally and archaeologically, a transitional stage was reached in the centuries around 5000 bp, when the woodland cover, in many areas interspersed with more open peatlands, was subjected to the predations which are conventionally attributed to Neolithic colonizers. A summary diagram of such changes at Loch Davan, Aberdeenshire, is shown in illus 1 (pollen sites are located on illus 2). For Scotland, available radiometric dating for Mesolithic sites so far indicates initial occupation during the seventh millennium bc (6244±350 bc (SRR-160) and 6013±200 bc (SRR-159) at Lussa Wood I, Jura (Mercer 1974); 6050±65 bc at Redkirk Point, Dumfriesshire (UB-2445) (Masters 1981); 6100±250 bc (NZ-1151) at Morton, Fife (Coles 1971)), although claims have been advanced for an even earlier human presence in the Atlantic west (Mercer 1979). It would appear from this evidence that man has existed in Scotland at least from the time of the hazel maximum as indicated by pollen studies.

This expansion of hazel in the pollen record, and its persistence at peak frequencies, has been associated traditionally in the literature with the establishment of hazel scrub, rather than with tree-forming 'woodland' stands. The hazel (*Corylus avellana*) is thought to have been favoured by the postglacial warming of the climate coupled with the ability of the plant to colonize more rapidly than other thermophilous trees (Godwin 1975). Whilst such an increase might occur perfectly naturally, the association of hazel-maximum pollen spectra with Mesolithic flint assemblages, hazel-nut shells (where these do not display evidence of collection by rodents or squirrels) or charcoal (eg Clark 1954; Shippea Hill, Cambridgeshire, Clark & Godwin 1962; Iping Common, Sussex, Keef *et al* 1965) offers circumstantial evidence for an anthropogenic role in the ecological sequence at this time (Smith 1970; Smith *et al* 1981; Simmons *et al* 1975). However, a



ILLUS 1 Pollen diagram from Loch Davan (selected taxa): the pollen sum is percentage of total land pollen

note of caution needs to be sounded: it is also possible that the perceived relationship between the spread of hazel and the distribution of Mesolithic communities may concern the changing patterns of Mesolithic settlement mirroring the migration of this component of the temperate woodland cover. Moreover, as noted elsewhere (Edwards 1982, 16–17), it is possible that the rise of hazel during the present interglacial – continuing a trend already apparent in earlier ones – may have its origins in environmental conditions (such as the availability of suitable refugia) or in changes in hazel biotypes.

The occurrence of fire has been suggested to improve browse for animals, thereby potentially encouraging higher stocking rates, or permitting forest-dwelling species to be hunted more readily in open spaces, although this latter suggestion is perhaps not uncontentious. A compendium of anthropological comparanda for such practices has been assembled (Mellars 1976). It has been argued that fire would also promote the spread of understorey plants with edible fruits or berries. The hazel, if it is favoured in the recolonization of fire-cleared areas – an hypothesis which has been challenged by Rackham (1980, 104) – might thus produce more edible nuts, and more pollen. Fire may also have been used to stampede game, although such 'uncontrolled' hunting appears incompatible with the evidence for selective culling of land and marine species from a number of Mesolithic sites in Britain and beyond. Late hunter-gatherers may therefore have used fire intentionally, having perhaps seen its effects when woodland had caught fire accidentally, either adjacent to domestic sites or naturally, as a by-product of lightning strikes (Komarek 1967; 1968; Thompson 1971). It is perhaps worth remarking that postglacial mixed woodland at high temperate latitudes may not have ignited very easily (Rackham 1980; Rowley-Conwy 1981), at least without a measure of active preparation (eg ring-barking) or deliberate fire-setting. Such suggestions are, of course, conjectural, but do not differ in this from other generalized explications of broad vegetational changes.

It has also been suggested that the subsequent rise in alder (*Alnus glutinosa*) representation at the 'Boreal-Atlantic' transition (around 5700 bc) might be related, at least partially, to the activities of Mesolithic man (Smith 1970; Simmons 1975). In this case it is thought that the decrease in the representation of certain tree taxa, such as hazel, birch and pine – which may be attributed in part to anthropogenic activities – permitted alder to encroach on areas occupied by these arboreal types, particularly if, as is generally accepted, this was a period of increasing wetness which would favour the spread of alder independent of any human intervention. It should be noted, however, that increased percentages of *Alnus* pollen would in any case result from a lower contribution from other tree types, irrespective of any spread of the alder. Human agency has also been advanced as the possible cause of a secondary rise in hazel pollen frequencies around the time of the 'Boreal-Atlantic' transition, and subsequent to the initial peak in *Corylus* values. The fact that this secondary rise is a less common feature in the pollen record (Smith 1970) adds to its significance as a possible indicator of human activity. Such a secondary *Corylus* maximum is found in various diagrams, from localities widely distributed across the Scottish landscape: Lock Ashik, Skye (Birks & Williams 1983); Oban (Donner 1957) and Aros Moss, Argyll (Nichols 1967); Side Moss, Midlothian (Newey 1967); Netherley Moss, Kincardine (Durno 1956); and Loch Maree, Ross and Cromarty (Birks 1972).

If it is considered that hunter-gatherer activities played a detectable part in the vegetational changes discussed above, a possible control would appear to be offered by comparing the distribution of Mesolithic remains with that of pollen diagrams exhibiting the phenomena under consideration. Whilst this method has been used in previous studies (see below) to suggest 'natural' changes in areas believed to have been devoid of Mesolithic groups, the nature of the survival of the evidence is such that the absence of man cannot be inferred with any degree of certainty. The survival of archaeological evidence is liable to bias, perhaps no more so than in the case of hunter-gatherer sites. With the exceptions of some shell-middens (those not covered by marine deposits resulting from eustatic rises in sea-level) and caves, many Mesolithic sites may be considered to be archaeologically invisible, except in Stevenson's 'zone of destruction' (1975). In these latter parts of the landscape, artefactual and other human detritus may be exposed by natural or later human agencies, including excavation on sites of very different periods, for example in medieval Aberdeen (Kenworthy 1982). It is thus unsurprising that the concentration of known Mesolithic sites is in coastal and riverine areas.

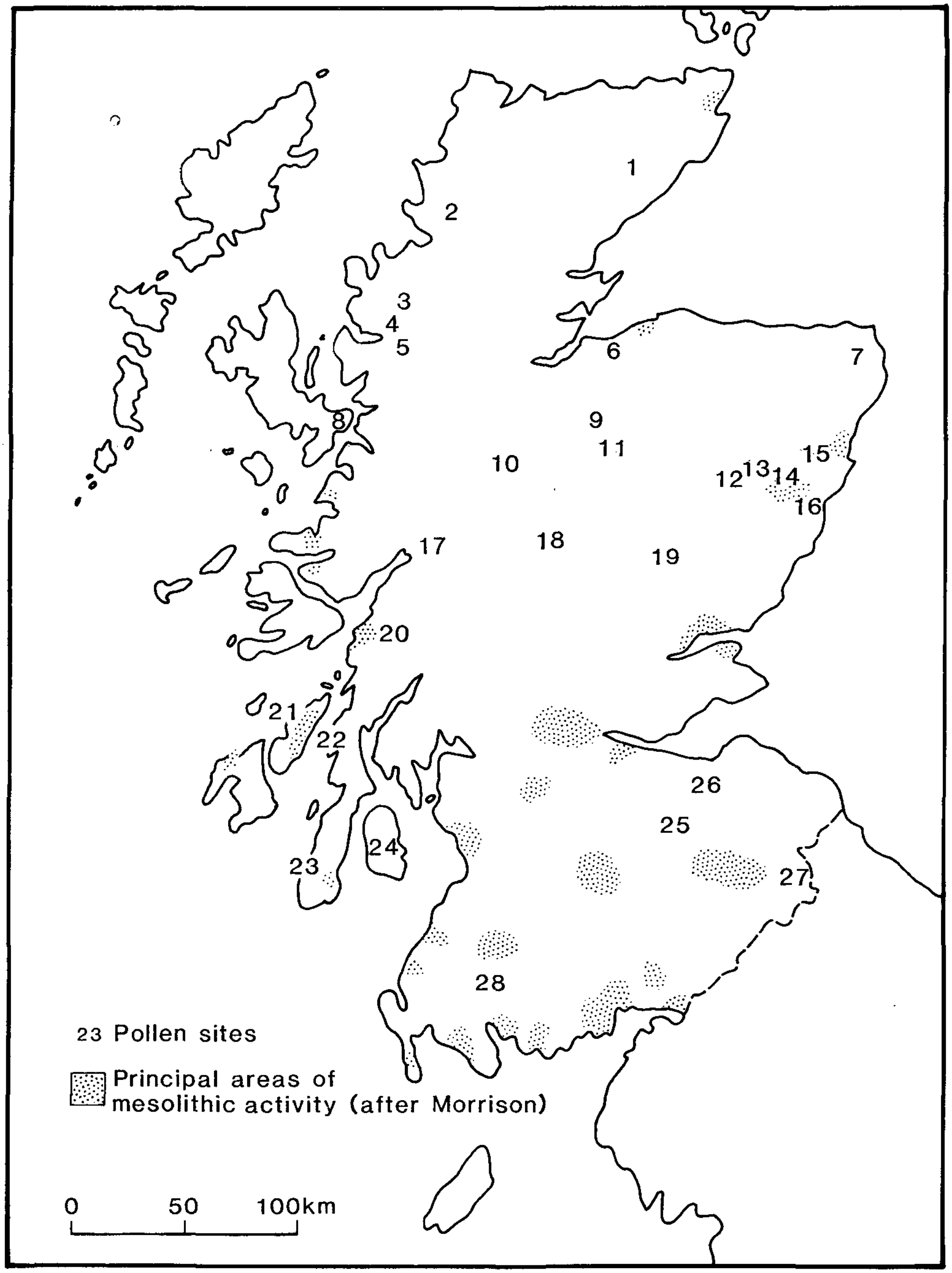
The degree to which this pattern, despite its manifest biases in data-collection, mirrors ancient reality may be considered to involve two key variables. One is the resource-base of inland Scotland, away from the river arteries, and of the uplands, for hunters-and-gatherers. Recent commentators (Morrison 1980; 1982a; Price 1982; 1983) have stressed the general inhospitality of much of inland Scotland during the early- and mid-Postglacial. The second key variable, the size of the human population, and the concomitant possibility of a high population pressurizing resources which may be considered to have been marginal, is much more difficult to assess. Atkinson's (1962) figure of 60–70 persons for the total Mesolithic population of Scotland at any one time may be suggested to have been a gross underestimate, in part, as Morrison (1983) has indicated, the result of considering sites in isolation rather than as components of more complex networks. However, the available archaeological evidence would not sustain the suggestion that population figures are likely to have been such as would have caused a generalized depletion of resources across the landscapes of Scotland, rather than more localized impacts. In sum, it may be suggested that hunter-gatherer penetration of Scotland's inland and upland areas away from the major river valleys is likely to have been too ephemeral to have caused detectable changes to the vegetation cover, in gross terms at least, during the period in question.

Sites displaying the major vegetational characteristics discussed above and potentially outwith the range of early human interference are numerous. A non-exhaustive list would include Lochs Clair, Tarff and Borralan (Pennington *et al* 1972); Loch na Moine (Durno 1958); Allt na Feithe Sheilich (Birks 1979); Drumochter (Walker 1975); Goyle Hill (Durno 1959); Kinghouse 1 (Walker & Lowe 1977); Upper Eddleston valley (Newey 1967); and Linton Loch (Mannion 1978) (illus 2; table 1). Clearly, the perceived remoteness of at least some of these sites from areas of human settlement is perhaps contentious. They may, however, indicate that vegetational changes, independent of human activity, yet comparable in nature to the changes detected in areas where man was demonstrably present, were a feature of the inland landscapes of Scotland.

SMALL-SCALE VEGETATIONAL CHANGES

Inferences with regard to the duration or the extent of the impact of human communities cannot generally be made on the available data. Such inferences would require palynological and temporal data of a spatial nature which can only be provided by multiple-profile studies (Edwards 1979a; 1983; Innes 1981). The use of the term 'small-scale' in this paper thus lacks both chronological and geographical parameters and refers only to phases of clearance activity recognized in pollen diagrams in which the spectra typically display temporary and low frequency reductions in tree pollen values and increases in the representation of herbaceous taxa. In essence, the evidence is not dissimilar – with the exception of the absence of any direct evidence for agricultural activity (eg cereal pollen) – from that conventionally ascribed to 'landnam' activities associated with initial agricultural communities in temperate forest areas (Iversen 1956).

Perturbations in the pollen records for upland sites such as Barfield Tarn (Pennington 1975) and Ehenside Tarn (Walker 1966) in the Lake District, Blacklane Brook on Dartmoor (Simmons 1964; Simmons *et al* 1983) and North Gill on the North Yorkshire Moors (Simmons 1969a; 1969b) have been assigned to possible Mesolithic activity, on the basis that the oscillations in question predated the elm decline. Such inferences were based on the assumption that the widely-



ILLUS 2 Scottish pollen sites mentioned in the text (for key see table 1)

recognized elm decline was an indication of the presence of agriculturalists, and hence might be taken conventionally to mark the start of the Neolithic period. More recent work, in particular from Northern Ireland, suggests that the pattern is, inevitably, more complex. At Ballyscullion, Co Antrim, a clearance phase dated to c 3700 bc by radiocarbon assay coincides chronologically with the earliest Neolithic evidence from the settlement site of Ballynagilly, Co Tyrone (Smith & Pilcher 1979). Such manifestations clearly precede the elm decline, which, where it has been fixed by radiocarbon dating, normally occurs c 3100–3000 bc. A consideration of pre-elm decline agricultural activity in the British Isles is presented by Edwards and Hirons (1984; and see related discussion in Groenman-van Waateringe 1983). Eight sites in Great Britain and Ireland are mentioned which show evidence of cereal pollen at dates in the fourth millennium bc preceding the elm decline. These results have been obtained in recent pollen analyses and thus it appears possible that previous occurrences have been passed over in favour of the traditional orthodoxy, which sees the elm decline (whether anthropogenically caused or not) as coeval with the first agricultural activity. These records of early cereal cultivation may be taken as support for a 'pioneer' phase of Neolithic colonization, as suggested on other grounds by I F Smith (1974), Bradley (1978), and AG Smith *et al* (1981). Alternatively, Mesolithic acculturation, including reception of the materials and techniques of cereal cultivation, may be involved. Recent discussions (*in* Woodman 1976; Cohen 1977; Burenhult 1980; and Lynch 1981) indicate something of the range of possibilities.

Thus the elm decline may not be taken as an absolute divide between 'Mesolithic' and 'Neolithic'. It is also worth noting that the palynological record, in particular for the northern parts of Scotland, suggests that the thermophilous elm was never plentiful. To that extent, the

TABLE 1

Pollen sites mentioned in the text and located on illus 2

1 Loch na Moine (Durno 1958)
2 Loch Borralan (Pennington *et al* 1972)
3 Loch Maree (Birks 1972)
4 Beinn Eighe (Durno & McVean 1958)
5 Loch Clair (Pennington *et al* 1972)
6 Kingsteps Quarry (Knox 1954)
7 St Fergus Moss (Durno 1956)
8 Loch Ashik (Birks & Williams 1983)
9 Allt na Feithe Sheilich (Birks 1975)
10 Loch Tarff (Pennington *et al* 1972)
11 Loch Pityoulish (O'Sullivan 1976)
12 Loch Davan (Edwards 1978)
13 Braeroddach Loch (Edwards 1978)
14 Nethermills (Ewan 1981)
15 Loch of Park (Vasari & Vasari 1968)
16 Netherley Moss (Durno 1956)
17 Kingshouse 1 (Walker & Lowe 1977)
18 Drumochter (Walker 1975)
19 Dalnaglar (Durno 1965)
20 Oban (Donner 1957)
21 Lealt Bay (Mercer 1969)
22 Drimnagall (Rymer 1977)
23 Aros Moss (Nichols 1967)
24 Machrie Moor (Robinson 1983)
25 Upper Eddleston valley (Newey 1967)
26 Side Moss (Newey 1967)
27 Linton Loch (Manion 1978)
28 Cooran Lane (Birks 1972)

detection of the elm decline is more difficult to achieve in some Scottish pollen records (eg Dickson 1981) and this feature is thus less helpful in providing a vegetational reference point in the north. It is in this context that the few apparent small-scale pre-elm decline vegetational disturbances from Scottish sites must be considered, against a framework which is presently unsatisfactory given the absence of radiocarbon dates for some of the sites.

The most detailed evidence for pre-elm decline fluctuations in the pollen diagrams from Scotland comes from Aros Moss on the Kintyre peninsula (Nichols 1967). At a level slightly above the rational *Alnus* limit, (which occurs at a depth of about 410 cm), there are reductions in alder, elm, pine, birch and hazel with coincident peaks of *Calluna* (heather), Rumex (sorrell and/or dock), *Pteridium aquilinum* (bracken) and Gramineae (grasses). We consider the changes outlined above as being clearly defined in this horizon alone at Aros Moss, although Nichols (1967, 176–7) suggests that palynological phenomena indicative of variations in the local vegetation are also observable in adjacent levels, therefore allowing these modifications to have been spread over a longer period.

Whilst Nichols concedes that changes in local mire ecology (or temporary alterations, of unspecified origin, to the make-up of the forest surrounding the Moss) could explain such apparently short-lived changes, he considers that a natural seral development is likely to have been less abruptly marked. He therefore proposes that an anthropogenic explanation is also feasible: the establishment of grasses, heath plants and bracken may have occurred on land cleared by fire, although the presence of charcoal in the deposit is not noted in the original report. It is also of interest to note that at the 410 cm level, taken by Nichols to represent the boundary between Boreal (zone VI) and Atlantic (zone VIIa) (c 5500 bc), the pollen of *Hedera helix* (ivy) reappears. A possible role for the foliage of this plant in West European Mesolithic economies has been discussed by Simmons and Dimbleby (1974). Ivy is normally regarded as an insect-pollinated species, but it is possible that its representation at Aros Moss reflects dispersal by either browsing red deer or perhaps, in part, by human agency. Mesolithic activity in the area is recorded in the form of flints from both Lange Links, Machrihanish and Campbeltown, respectively 1·5 km W and 5 km E of Aros Moss (McCallien 1936; McCallien & Lacaille 1941). Morrison (1928b, 11) however, discusses the inadequacy of such archaeological evidence for detailed correlation with the environmental indications. Furthermore, the Aros Moss ivy evidence is far from being a clear indication of human manipulation of a forest plant. The low values for *Hedera helix* pollen, which stand at around 2% of the tree pollen sum, may simply reflect 'natural' representation in the vegetation. Moreover, the taxon is also present, although in lesser amounts, in zone IV (pre-Boreal) and early zone VI at the site, both periods during which anthropogenic activity may otherwise be discounted in the Kintyre pollen diagram.

Pollen and charcoal analyses of peat cores from Machrie Moor in the west of Arran are presented by Robinson (1983). At a level dated to 6715±155 bc (GU-1427), charcoal is present and values for heather pollen increase to form a continuous curve. A second phase of possible disturbance begins at 5950 bc and continues beyond the end of the Mesolithic period. This phase is marked by fluctuations in the arboreal pollen counts, including the appearance of pollen of the light-demanding ash and a peak in the Coryloid (cf hazel) pollen curve. *Plantago lanceolata* and *Ranunculus* are present, as are bracken spores and charcoal. Robinson, expressing doubt with regard to the efficacy and regularity of natural fires, interprets the above-mentioned changes as responses to fires caused by Mesolithic communities.

The Kingsteps Quarry, Nairn study (Knox 1954) was carried out with the intention of dating the peat by pollen analysis. This peat deposit, which had from time to time yielded stone artefacts ascribed by Lacaille and others to the Mesolithic, also contained lenses of charcoal, birch twigs and hazel nuts. Examination of the pollen record from two short profiles at Kingsteps indicated that the lowest level, marked by substantial drops (from 90% down to less than 10% of total tree pollen) in *Pinus* frequencies, and by a rise in *Alnus* (from 20% up tò about 80%), exhibits the typical characteristics of the Boreal/Atlantic transition (zone VI/VIIa). The tops of the profiles display a conspicuous increase in non-arboreal pollen, primarily Ericaceae (heaths), Cyperaceae (sedges), and Gramineae (grasses). The date of this radical change in favour of non-arboreal taxa cannot be established with certainty, since radiocarbon dates were not obtained, nor do changes in the arboreal pattern betray any datable diagnostic features. High values for both alder and birch pollen were recorded throughout the upper levels of the profiles, but this feature is a recurrent characteristic of other diagrams from northern Scotland into recent times (Durno 1957; Birks 1975), where calculations are based on total tree pollen, rather than on alternative pollen sums. Amongst other herb pollen types recorded by Knox were *Plantago,* (cf *P maritima*), *Armeria, Chenopodium,* Caryophyllaceae, Compositae (of *Taraxacum* and *Matricaria* types), together with *Pteridium* and other cryptogams. Some of these would be not unexpected in environments altered by man. The lithic material was found distributed through the profiles. Knox considered the site initially to have been a small lake, in which case the absence of aquatic pollen types is surprising, though such taxa may not have been recorded. Whatever the nature of the immediate environs of the profile sites, Knox concluded that her work provided evidence of Mesolithic coastal settlement in the late Boreal and early Atlantic periods. Assuming that the artefacts from Kingsteps have not moved down through the profile as the result of faunal activity, or of the periodic drying-out of the peat surface and its consequent erosion by wind (which is certainly possible given the quantities of wind-blown sand noted in the profiles), then the artefactual evidence for the presence of Mesolithic man may be matched, if only circumstantially, with the vegetational changes noted above. Further diagnosis is precluded by the absence of dating evidence for the upper part of the profiles in which the vegetational changes occurred; these could, however, be not more than a response to a drying peat surface, geomorphological changes to the coastal habitat, browsing animals, or – bearing in mind the presence of charcoal in the profiles – to fire, however caused, in the vicinity.

Another Scottish site for which possible Mesolithic influence on the vegetation has been invoked is at Loch of Park, Aberdeenshire (Vasari & Vasari 1968). This lies some 6 km from the main concentration of Mesolithic sites on the Crathes-Banchory reach of the Dee in north Kincardineshire (Paterson & Lacaille 1936). The palynological changes under discussion occur within the span of zone VIIa as identified by the Vasaris. Here, a slight reduction in elm pollen is matched by the appearance of non-tree taxa such as Caryophyllaceae, Compositae, *Plantago lanceolata,* and *Rumex*. Such evidence for plants favouring open conditions is supplemented by such heliophytic macroscopic remains as *Pteridium aquilinum, Ranunculus* sp, and *Calluna vulgaris*. The Vasaris inferred that these changes were attributable to Mesolithic man and cited affinities with the Aros Moss (Nichols 1967) and Ulster (Morrison 1959) patterns. However, at Loch of Park, the reduction in elm pollen values is more than compensated for by the percentage increase in pine representation: thus the reduction may reflect a non-anthropogenic effect, perhaps related to pollen production, and/or highlighted by the statistical method used. Whilst the horizon is marked by an increasse in herbaceous pollen, many of the types also appear sporadically lower down the profile in association with pollen assemblages which may pre-date human occupation of the area. In sum, the evidence, which lacks secure dating controls, is best regarded as inconclusive.

At Nethermills in the Dee valley close to Banchory, Ewan (1981) has analysed a shallow peat deposit lying within an abandoned stream channel on a terrace of that river. This peat was overlain by topsoil which incorporated Mesolithic flints. In zone 5b of the pollen diagram, sharp declines in birch pollen and Filicales spore frequencies are matched by a simultaneous increase in the representation of *Plantago lanceolata* and Umbelliferae. Whilst accepting that these variations could result from local autogenic changes in pollen and spore accumulation rates, Ewan considers that an argument for anthropogenic influence is equally feasible. The lack of secure chronological controls for this profile impedes fuller interpretation. Although an apparent Boreal-Atlantic transition occurs lower in the profile, there is no clear elm decline. Moreover, the Mesolithic material in the overlying soil may well be temporally and spatially displaced as a result of ploughing activity. The site, however, remains of considerable significance and would repay further study.

A sixth site presents a somewhat different set of evidence. At Cooran Lane in the Galloway Hills a blanket bog deposit analysed by Birks (1975) produced evidence for fire disturbance in sample levels dated to 5591±120 bc (Q-874). *Betula* pollen values fall, *Pinus* expands and *Hedera helix* makes its first appearance in the pollen record. Values for Gramineae, *Melampyrum* (cow-wheat, associated with fire-cleared ground in Scandinavia (Godwin 1975, 320)) and *Pteridium aquilinum* increased and large numbers of charcoal micro-fragments were also encountered. Interestingly, there is an inverse correlation between the charcoal curve and the path taken by that for *Corylus/Myrica*. Birks acknowledges that such features in Scandinavian pollen diagrams have been ascribed to fire and perhaps attempts at forest clearance by early farmers. The date would appear to preclude Neolithic activity, but Mesolithic man was dismissed from consideration on the grounds that 'no evidence of occupation has been found in the hills' (Birks 1975, 206). The changes were thus attributed to a natural outbreak of fire at a time when the bog surface was sufficiently dry to ignite. However, this site may be considered as a potential illustration of the dictum about absence of evidence: surface lithic finds, including a microlithic element, have been recovered from the southern margin of Loch Doon, 8 km north of the Cooran Lane site, as well as in an extension of the same valley system (Ansell 1969–1975). Further fieldwork demonstrates that indications of inland penetration of SW Scotland by hunter-gatherers is more widespread than previously thought (Edwards *et al* forthcoming), and thus the likelihood of interference in the vegetational sequence being attributable to Mesolithic penetration of the area increases accordingly. A similar situation may exist at Drimnagall, Argyll, where Rymer (1977, 219) states that 'the archaeological evidence does not allow for any anthropogenic explanation of the spread of *Corylus* in this area of Scotland'. This contention understates the likely level of Mesolithic activity in this area, close to Jura (Mercer 1972).

In concluding this section, it is perhaps worth reiterating a fundamental point. The early postglacial woodland did not everywhere form a continuous canopy, and both intermittently beneath it, as well as beyond it, herb communities were consistently represented, if in varying quantities. It should not be forgotten that large areas, especially in the uplands, were distinguished by the growth of blanket and basin peats. The general existence of small amounts of non-peatland herbaceous pollen taxa in many Scottish pollen diagrams and at all levels between the end of the lateglacial and the elm decline periods, should guard against the inference of Mesolithic man lurking behind every palynomorph. Whilst Mesolithic activity may have contributed to, or been responsible for, the expansions of non-arboreal species in pollen diagrams from sites such as Lealt Bay on Jura (Mercer 1968) or Dalnaglar in upland Perthshire (Durno 1965), such human interference may not have provoked the similar vegetational changes, recorded at isolated or perhaps unattractive locations such as Drumochter (Walker 1975) or Loch Pityoulish (O'Sullivan 1976). Many ecological factors can be advanced to explain the representation of non-arboreal taxa, and man is merely one of them. Apart from factors of plant competition, it may prove necessary to reassess the evidence for the role of animals in disturbing vegetation and promoting the spread of those plants which are normally interpreted as signals of human intervention (Smith 1970; Mellars 1976; Coles & Orme 1983; Buckland & Edwards 1984).

FIRE AND CHARCOAL

The presence of macro-fragments of charcoal on Mesolithic sites such as Birkwood, Banchory, Kincardineshire (Paterson & Lacaille 1936) or Lussa River, Jura (Mercer 1972), and more particularly in micro- and macro-fragment form in polleniferous deposits as at Kingsteps Quarry, Nairn (Knox 1954) or Beinn Eighe, Ross and Cromarty (Durno & McVean 1959) has lent support to a variety of hypotheses which advocate intentional use of fire in either woodland removal or more usually animal management practices (summarized in Smith 1970 and Simmons *et al* 1981). However, this correlation is only one of several possibilities that can be suggested. The presence of charcoal merely indicates that wood or other plant tissues have been ignited, and not the use of the resultant fires for anything other than perhaps domestic use (Edwards 1979a). Even the presence of charcoal along with the variably 'pyrophilic' pollen of say hazel, birch or open land herbs is not conclusive evidence for calculated, fire-induced, vegetational changes – such opportunistic taxa may spread as a result of grazing pressures or woodland removal by axe-felling or ring-barking, activities which may have been co-spatial with domestic fires.

Charcoal can, in fact, be found in polleniferous deposits throughout the postglacial period in places and at times when signs of early man are completely absent. Any assessment of the significance of the presence of charcoal would be best established on a quantitative basis (Green 1981; Clark 1982). In this way, and correlating the evidence with other aproaches, it may prove possible to differentiate between 'prescribed burning' of woodland, to use Stoddard's phrase (1968, 191–2) and natural fires or 'background noise' resulting from fires for cooking and heating purposes. At Loch Davan, Aberdeenshire, for example (illus 1 and Edwards 1978), microscopic charcoal (in quantitative units of 20 microns square) was counted along with pollen and expressed as part of the total land pollen sum. Values for charcoal are low and relatively constant from the beginning of the postglacial until horizons datable by radiocarbon to the Bronze Age, when the first notable expansions occur. A similar pattern was found at neighbouring Braeroddach Loch (Edwards 1979b). Whilst British woodland may in many circumstances have been difficult to ignite, natural fires must clearly be taken into account when seeking to explain the presence of charcoal-bearing deposits. In this regard, the reader is also directed to arguments concerning sub-peat burning advanced by Boyd (1982a; 1982b) and Moore (1982) as well as a report of the occurrence of 23 lightning-strike fires over a two-day period in the Galloway Hills (Thompson 1971).

HAZEL OR BOG MYRTLE?

The pollen grains of the hazel (*Corylus avellana*) and the bog myrtle (*Myrica gale*) are not easily differentiated with the light microscope, standardly used in pollen studies. There is probably a high degree of morphological overlap at least in the European genera, and recent experiments suggest that it is not possible consistently to separate pollen of these two species (Edwards 1981). In so far as the presence of *Corylus* has played a prominent role in attempts at reconstructing the ecology of the Mesolithic period and bearing in mind the fact that many pollen diagrams come from acid peat bog areas which are favoured by *Myrica,* then it would seem important to be sure that vegetational changes under consideration concern hazel rather than bog myrtle! The evidence of plant macro-remains from archaeological sites is plentiful in the case of hazel – the nuts of which were perhaps distinctly more palatable than the roots or stems of bog myrtle – although we may remark that a male bud of *Myrica* was found, as well as hazel-nut shells, at Lussa River, Jura (Mercer 1972).

The electron microscope permits the separation of *Corylus* from *Myrica* pollen (Bradley 1958; Pilcher 1968) and it was used on fossil coryloid-type grains from both Loch Davan and Braeroddach Loch (Edwards 1981). Although the method permitted only a small and statistically unsatisfactory number of grains to be counted, both *Myrica* and *Corylus* pollen were identified in all the pre-elm decline samples examined. These data do not necessarily encourage a serious questioning of an early postglacial hazel rise – on palaeoecological grounds *Corylus* is still the better contender – but they do indicate potential defects in floristic inference.

THE TRANSITION TO FARMING ECONOMIES IN SCOTLAND

Although somewhat tangential to the main topics discussed above, the availability of an increasing series of radiocarbon dates indicating a chronological overlap between late hunter-gatherer communities and initial farmers in Scotland allows a number of speculations about the potential effects on the vegetation of the resulting economic systems during the centuries of transition. In accepting a broad definition of what constitutes farming, such as that advanced by Fowler (1983, 2) – 'the regulated production of a crop larger than the breeding stock, whether it be of plants or animals' – it is possible to argue that some forms of Mesolithic activity, such as selective culling of deer populations, may have matched this criterion. Whilst the detection of the key exotic elements of flora and fauna has formed the long-term mainstay in determining the presence of early farmers, it is possible that this approach has masked initial farmers' interest in products culled from the wild. Pioneer agricultural communities may be surmized to have worked on 'satisficing' rather than 'maximizing' strategies. In northern Scotland in particular, they may be considered to have perceived a need for a variety of foodstuffs to be hunted, gathered, or fished, near at hand, in case their imported plants and animals did not flourish in what may have been a novel and testing environment for them (cf Coles 1976).

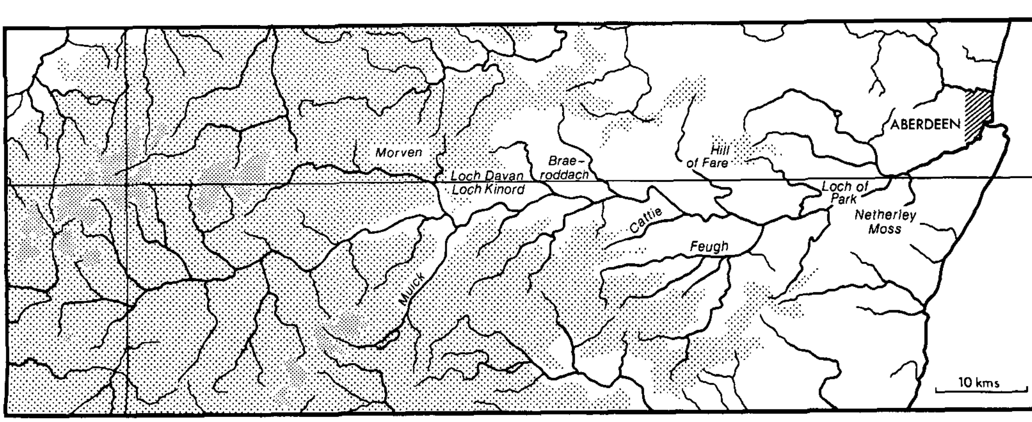
Clearly, there is at least the potential that such hunting/gathering/cultivating/stock-raising 'mixed' economies may have been present in localities which were ecologically marginal in terms of the cereals and new types of livestock: portions of such environments are often suitable for pollen studies today. Contrastingly, the two systems may have been practised contemporaneously over the same tracts of land, as happens in parts of southern Africa at the present time.

A critique of the contribution of palynological research to the elucidation of early Old World agricultural systems (Schoenwetter 1981) draws attention to the fact that the dominant approach concentrates on delineating the environmental impact of initial farming communities on the natural vegetation record. In essence, such an approach runs the risk of treating agriculture (and, to a lesser extent, hunter-gatherer impacts, since their scale, whilst largely unquantified, is avowedly smaller *sensu lato*) as if they were 'a palaeoenvironmental event similar to a climatic change or the evolution of an ecosystem' (Schoenwetter 1981, 269). Schoenwetter goes on to point out (1981, 271–2) the variety of food-procurement systems which co-existed in the American landscape in comparatively recent times. There is obviously potential for much greater variety in these at the continental scale offered by Schoenwetter's New World listing than in Scotland. None the less, the topographic variability of this country, and the consequent marginality of parts of the landscape in agricultural terms, may have permitted a range of 'mixed' economic systems to develop.

Similarly, taking into consideration Ammerman and Cavalli-Sforza's wave-of-advance model (1971; 1973; 1979), with its potential for a recurrent series of frontier contacts between farmers and hunter-gatherers, it is self-evident that this progression must have run up against limits, however temporary, which permitted hunter-gatherer communities to survive, relatively unaffected by the new food-procurement system, beyond them. Corollaries of this hypothesis are the speculations, first, whether hunter-gatherer communities may have survived in the more restricted environmental ranges left to them, perhaps provoking differentiable environmental impacts, and second, whether at least some of the palynological evidence for environmental degradation, noted for more inland and upland sites contemporary with the initial agriculturalists, may not have been caused by final hunter-gatherer groups.

One archaeological dimension of this problem is identified by Schoenwetter (1981, 271) as concerning 'the historical pattern of the conversion of the native economy to the introduced economy in any given district'. The dominant model in Old World prehistory had tended to favour fairly rapid ousting of hunting and gathering by farming, and the Scottish evidence has been subsumed into this pattern with little comment. As an example of the possible variations on this scheme, some of the evidence from one Scottish river catchment will be discussed.

The Dee of Aberdeenshire and Kincardineshire drains the southern slopes of the Cairngorms and the north side of the Mounth and flows eastward for about 135 km to join the sea at the southern end of Aberdeen bay (illus 3a). In its upper reaches, the river flows along a comparatively narrow valley, with little associated valley-bottom land. As an indication of the potential wealth of this area to hunter-gatherers, a substantial proportion of the 3700 red deer shot annually in the North-East (Walton 1969) in recent years came from the deer-forests in the vicinity. Contrastingly, the areal extent of agriculture in this landscape, although not immutable (Shepherd & Ralston 1981), appears always to have been restricted. The middle reaches of the river begin some way east of its confluence with the Muick, and extend as far as Crathes. Here, associated low-lying land is confined to a belt between the Hill of Fare to the north and the northern perimeter of the Mounth to the south. A noteworthy feature of the western part of this stretch is the inland basin of the Howe of Cromar, edged on the west by Morven and on the south by the course of the river. East of Crathes, the river flows in a widening valley, as the gently undulating, but not particularly productive land which forms the immediate hinterland of Aberdeen is reached.

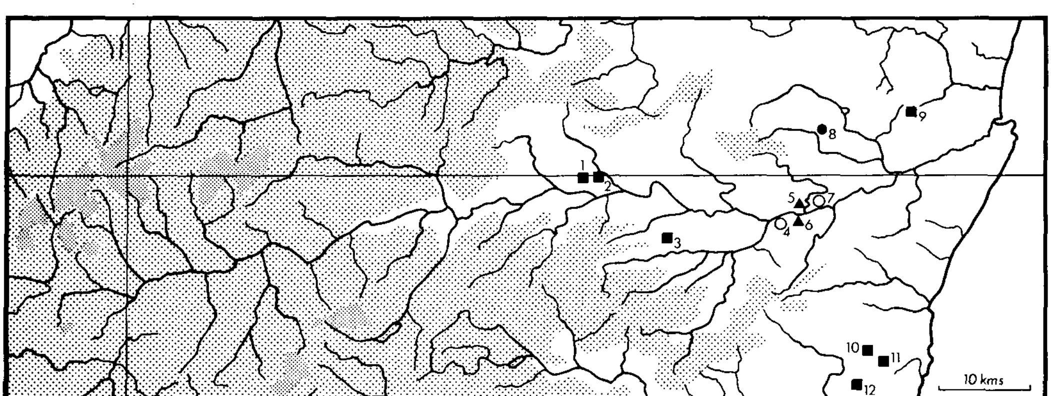


ILLUS 3a The Dee Valley, showing features mentioned in the text. Contours at 1000 and 3000 feet

Neolithic monuments are known as far inland as Cromar and the interfluvial ridge between the Feugh valley and the Burn of Catt, both right-bank tributaries of the Dee, on the middle reaches of the river. The independently-dated record of early human occupation here is restricted to environmental data. It is towards the east end of the same stretch that most recent work on early communities has taken place (Ewan 1981; Kenworthy 1981; Ralston 1982), and includes excavation of both Mesolithic and Neolithic settlement sites as well as environmental reconstruction (illus 3b).

Towards the coast, where most recent discoveries have arisen as a by-product of the excavation of medieval Aberdeen, the flint assemblages recovered testify to the utilization of that area by hunter-gatherers (Kenworthy 1982). At the time of writing, available evidence suggests that practitioners of both economic systems were essentially restricted to the lower and middle reaches of the river. Radiocarbon dates for archaeological sites allow the suggestion of an established Neolithic presence some distance inland in the North-East by c 3000 bc. The earliest of the Balbridie timber hall dates belong here (3210±70 bc, GU-1038i; 3070±100 bc, GU-1038ii), and are statistically inseparable from the first of those obtained for the Dalladies long barrow, located a similar distance inland on a terrace of the North Esk, (3190±105 bc, I-6113), although it should be remarked that the excavator preferred the later, and mutually consistent, dates from the East Kilbride laboratory (Piggott 1972, 44). Similarly, the occupation traces sealed below Boghead mound in Speymouth Forest have produced evidence for primary use c 3000 bc (2996±175 bc, SRR-683; 2948±60 bc, SRR-686; 3009±110 bc, SRR-689). On a regional scale, this was clearly a time of environmental change, marked for example by the beginnings of peat accumulation on the Moss of Cruden in Buchan (3070±95 bc; NPL-94: Stewart & Durno 1969), as well as the first intimations of anthropogenic interference, recognized by Edwards (1979b) at Braeroddach Loch (3345±155 bc, UB-2073).

This last takes the form of a decline in tree pollen relative to that of herbs and shrubs. The indications are thus for the spread of grassland, accompanied by *Plantago lanceolata* and *Pteridium*, which, whilst they may be acceptable as indicators of pastoralism, were also sporadically represented in the Braeroddach Loch profile at earlier dates. There are no signs of arable cultivation at this early stage in the pollen record, and the Neolithic monuments in the



ILLUS 3b Selected Mesolithic (O) and Neolithic (square=long cairn; triangle=hall; circle=occupation) sites. 1, Balnacraig; 2, Balnagowan; 3, Finzean; 4, Birkwood; 5, Crathes; 6, Balbridie; 7, Nethermills; 8, East Finnercy; 9, Cloghill; 10, Bruxie Hill; 11, Blackhill Wood; 12, Hillhead Plantation

vicinity, with which this activity may be inferentially linked, are unexcavated. Compared to later changes in the pollen record from these sites in the Howe of Cromar, this initial phase of activity may be considered to represent a low level of environmental impact and may even represent more regional activity (Edwards 1979a, fig 1).

Whilst our evidence is clearly biased by a variety of factors, it seems none the less reasonable to contrast the plentiful indications of cereal, more particularly emmer, cultivation provided by plant macrofossils at Balbridie (Ralston 1982), with the absence in the pollen record from Cromar of arable activity at this period. Whilst pastoral-led clearance in Cromar is certainly one possible explanation, other suggestions can be advanced to account for this differential. For example, it is distinctly possible that inland basins, such as Cromar, on the Highland edge may well have been unattractive to pioneer farming communities. Lying in the lee of the high summits of the Cairngorms, and at 57 degrees N, such areas may be considered to have offered many of the locational, physical and vegetation characteristics which might have supported the continuation of a hunter-gatherer life-style, perhaps in an attenuated form, at a time when agriculture was already becoming established in more favoured zones, for example in the main river valleys. The western margin of the basin offers an abrupt transition between upland and lowland, with all that this may imply for the exploitation of red deer and other mammals. The Dee's resources in terms of fish need no comment here: other water-bodies, notably the kettle-hole lochs of Davan and Kinord, continue to attract numbers of wildfowl (Marren 1979).

The indications of vegetational change at this time in the Cromar basin pollen profiles (Edwards 1978) are qualitatively little diferent from those detected at Nethermills zone 5b (Ewan 1981), which, whilst not fixed in absolute chronological terms, is perhaps reasonably attributed to Mesolithic activity, although Ewan also considered the possibility of disturbance attributable to first farmers. The initial impact monitored at Braeroddach Loch has been attributed to the effects of grazing stock: however, even had an element of pastoralism been represented as an initial 'Neolithic activity' this far up the valley, it is clear that some form of co-existence between, say seasonal transhumance and the needs of a hunting economy may have been possible then, as indeed it is, in very different circumstances, at the present day.

Finally, we may note that this initial clearance phase at Braeroddach Loch ('zonule 1' in Edwards 1979a) lasted for approximately three-quarters of a millennium, enough time for a complex interplay between hunters and farmers to evolve. In the absence of dated archaeological evidence from the basin itself, it is not feasible to gainsay the possibility of a relatively precocious Neolithic presence in the area (for example on the basis of stone axe finds). Whatever the socio-economic make-up of the human communities which contributed to the initial environmental impact at Braeroddach Loch, their influence eventually waned and near-complete forest regeneration took place before the middle of the third millennium bc. An alternative explanation for the zonule 1 changes might postulate that overgrazing by browsing mammals in a relatively restricted range may have been responsible. Subsequent overkill, perhaps symptomatic of a hunter-gatherer economy under the stresses which derived from their increasing marginality as parts of their former range were taken over by farmers, might have allowed a similar pattern of regeneration to develop.

In sum, whilst it is clearly possible that some detectable interference in the palynological record which has been attributed to later hunter-gatherer communities may rather betray the effects of pioneer farmers, we may suggest that the converse–perhaps especially in the absence of any indications of cereal cultivation – may equally be true. If we accept that, for the fourth millennium bc at least, the obtaining of a radiocarbon chronology for the environmental record alone may be insufficient to separate the effects of hunter-gatherers from those of farmers, the need to anchor palynological work by examination and dating of the archaeological sites within the assumed catchment becomes all the more significant.

Until such times as this can be achieved, and in the absence of diagnostic pollen indicators (eg cereals), it is perhaps reasonable to suggest that fourth millennium impacts of the kind noted at Braeroddach, and potentially detectable elsewhere on the Highland edge and in other localities perhaps not immediately favourable to pioneer agricultural procedures, may represent either hunting-gathering or farming activities, or indeed their co-existence. Thus the possibility that 'Mesolithic impacts' are being overlooked, because of the perceived lateness of the associated absolute dates, should be borne in mind.

CONCLUSIONS

The Scottish evidence for vegetational change, broadly contemporary with the Mesolithic period, has been discussed. There is no doubt that vegetational changes did occur at this time but beyond possible small-scale disturbances – which themselves may have resulted from accidental burning, unmanaged animal populations browsing at will, or minor autogenic ecological changes – there is no proof that broader, more general, vegetational patterns were effected by man. However, the association of macrofossil and archaeological data on individual sites permits the reasonable inference that Mesolithic man used the resources of his environment. The problem remains that what is detectable at the site level is not necessarily apparent at a broader scale in the work available for review. A further possibility, that some of the environmental changes, contemporary with the beginnings of agriculture in absolute terms, may result from hunter-gatherer pressures on increasingly marginal areas, is also noted.

Concepts related to the intentional manipulation of the environment by early settlers represent a further level of abstraction. The speculation that Mesolithic man in Scotland helped to accelerate major vegetational changes, which were perhaps already under way as a result of seral, pedological or climatic processes, or still more that he was the causative factor behind such changes, must meantime remain an interesting conjecture. Progress in this sphere will depend upon well-structured research programmes. In these, the nature and weight of the evidence should combine to allow more conclusive interpretations from say, the pollen diagrams, than has hitherto been possible.

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