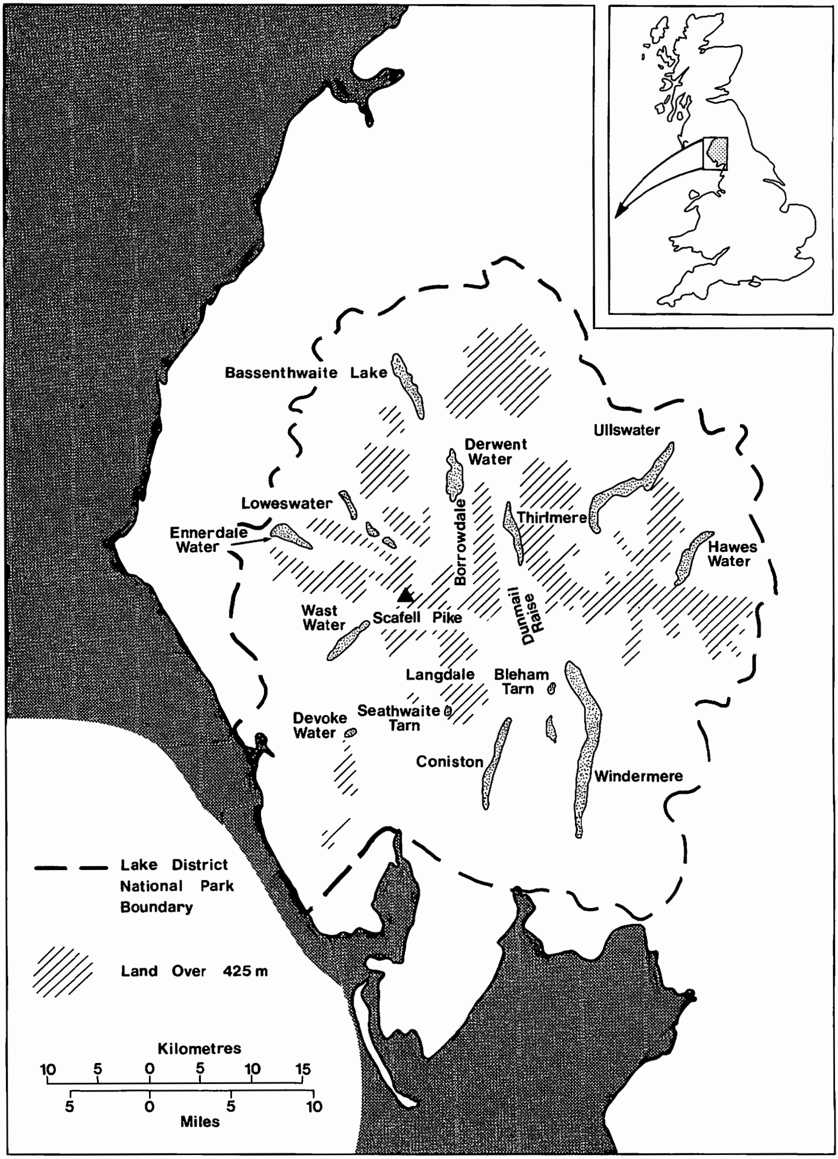

Fig. 1.1 Map of the Lake District with place-names referred to in the text.

PRE-VIKING CHANGE IN THE CUMBRIAN LANDSCAPE

Peter Vincent

The compact region we call the Lake District is an area of fell and crag, lake basin and partly wooded valleys. The region more or less corresponds to the Lake District National Park which was formed in 1951 [Fig. 1.1]. Interestingly enough the prime purpose of the National Park is the enjoyment of natural beauty and one is tempted to ask whether or not Scandinavian settlers and the hordes of day trippers arriving on a summer Sunday had some shared experience in being drawn into this landscape. For Viking and day tripper alike natural beauty must have been, and is, hard to perceive, for some of the personality of this part of the Cumbrian scene is due to the veneer of change wrought by progressive human interference over the last three to four millenia. Unfortunately it is not often possible to dissect a landscape and make definitive statements as to what is natural and what is due to man, but herein lies much of the interest of landscape studies.

THE SURFACE OF THE LAND: ROCKS AND EROSION

On the grand scale we can be safe. A great deal of what we see in the Lake District landscape is an expression of geomorphological history and of the characteristically rocky nature of the country. The importance of these two determinants cannot be emphasized enough since they both profoundly influence soils and drainage and, consequently, vegetation.

Although the geological history of the Lake District is complex a few major events dominate the story.[1] If we could switch on a time machine and cast ourselves back some 600 million years we would find most of northern and western Britain submerged beneath a deep sea which had developed in a crustal sag. Geologists call such sags geosynclines. To the north and south of this sea lay land masses whose surfaces were being lowered by erosion as sediments were carried into the geosyncline. In the deeper parts of the sea fine muds and silts accumulated. These were later to become the Skiddaw slates of Cambrian age [Fig. 1.2].

Gradually the geosynclinal trough filled and was closed by the movement of the bordering land masses. As a result of these crustal movements vast amounts of volcanic lavas and ashes poured into the closing geosyncline. Some 20,000 ft (6,100 m) of these Borrowdale Volcanic Series now crop out in central Lakeland. As this Ordovician volcanic activity died down the sediments were gently folded into mountains which were to be inundated by a shallow sea into which land-derived sediments poured,

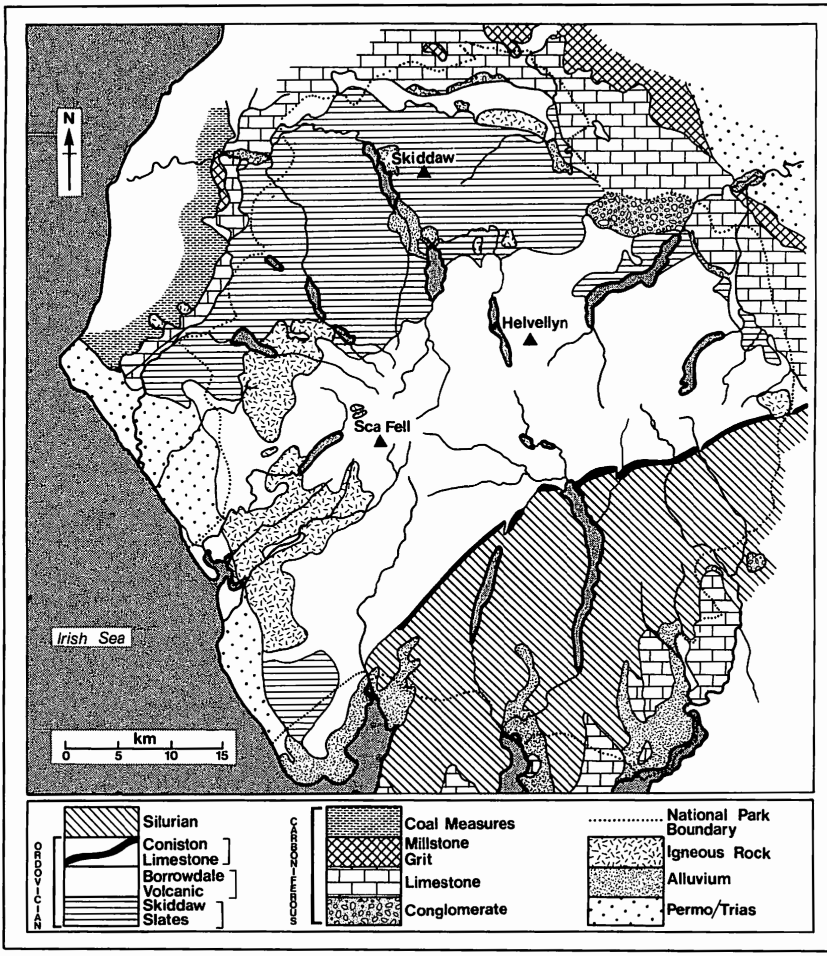

Fig. 1.2 Geological map of the Lake District.

burying the volcanic landscape. These sediments are the grits and flagstones of Silurian age and are now exposed to the south of the Borrowdale volcanic rocks [Fig. 1.2].

At the end of the Silurian period a further mountain building episode, the Caledonian orogeny, folded all the Lake District sediments once more into what must have been huge mountains. Probably as a direct result of this uplift and the departure of the seas, the landscape became arid and the Lake District mountains of this Devonian period, some 400 million years ago, must have resembled the interior mountains of the present-day Sahara. At this time, too, large plugs of coarse-grained igneous rocks were injected into the roots of the Devonian mountains and today these granite intrusions can now be seen at the surface at Shap, Eskdale and Skiddaw.

Only small patches of Devonian sedimentary rock remain visible but they do give rise to the distinctive outline of Mell Fell, north-west of Ullswater.

The youngest rocks of the National Park, though not of Cumbria, are the massive limestones of the succeeding Carboniferous Period which were laid down in a sea that progressively inundated the Devonian landscape [Fig. 1.2]. Although it is probable that younger rocks also covered the Lake District, these, along with the central zone of Carboniferous rocks, have been removed by erosion.

In the landscape today there is a stark contrast between the Borrowdale volcanic zone, with its crags and ravines, and the gentler topographies of the Skiddaw slate country and the Silurian flagstones of southern Lakeland. The physical appearance of the Lake District, however, though dominated by geological events in the Lower Palaeozoic geosyncline does, in some measure, derive some visible qualities from the various geomorphological processes that have left their imprint, and we need to go back to the Tertiary Period, some 70–72 million years ago, to understand the origin of many of the present-day landscape features.

In spite of the dominance of the valley scene in most peoples' perception of the Lake District landscape, a truer impression would be gained by a glance at the rolling landscapes above the valley sides. Geomorphologists can identify in this upland landscape surfaces of gentle relief which bear little relation to rock structure. These surfaces are variously called planation surfaces or erosion surfaces and, while there is much heated debate as to their origin, they represent landscapes whose ultimate base-level of erosion was controlled by sea-level either directly or indirectly [Fig. 1.3].[2]

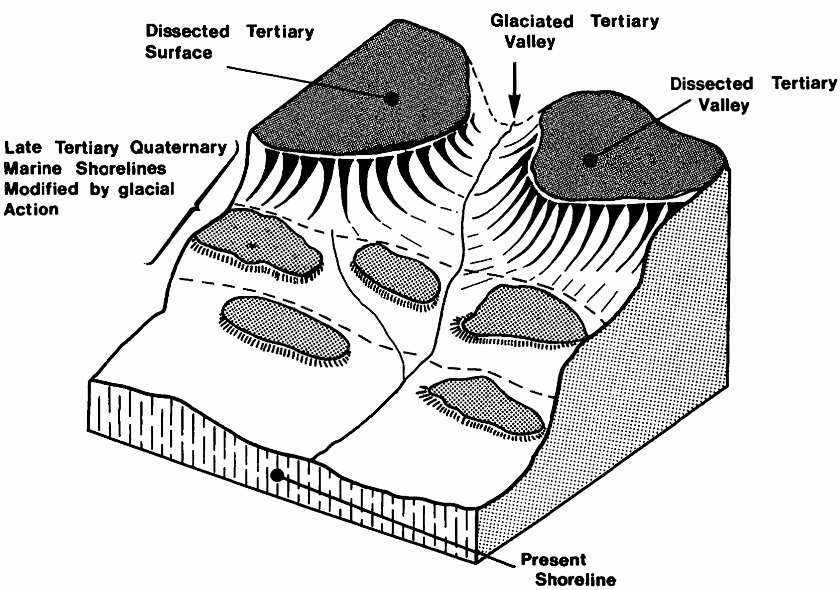

Fig. 1.3 Idealised geomorphological units in southern Lakeland.

Periodic falls of sea-level induced the fragmentation of older, higher surfaces, by increasing the rate of fluvial incision and weathering penetration.

Much of the rolling plateau-like topography of the Lakeland fells represents the fragmented elements of a staircase-like sequence of planation surfaces developed during Tertiary times — and in passing one might note that the vidda landscapes of Norway, lying above the coastal fjord systems, have exactly the same origins.[3] Moreover, a careful inspection of the Lake District drainage system by cartographic and field observation has revealed that during Tertiary times the drainage was essentially north–south, with the main watershed running east–west through Dunmail Raise [Fig. 1.4].[4]

The glaciated valleys which are so much part of the Lakeland scene are deeply incised into this old upland landscape. The history of glaciation is complex and much evidence has been removed, but we know that during the last two million years there have been at least two glacial episodes in the Lake District.[5]

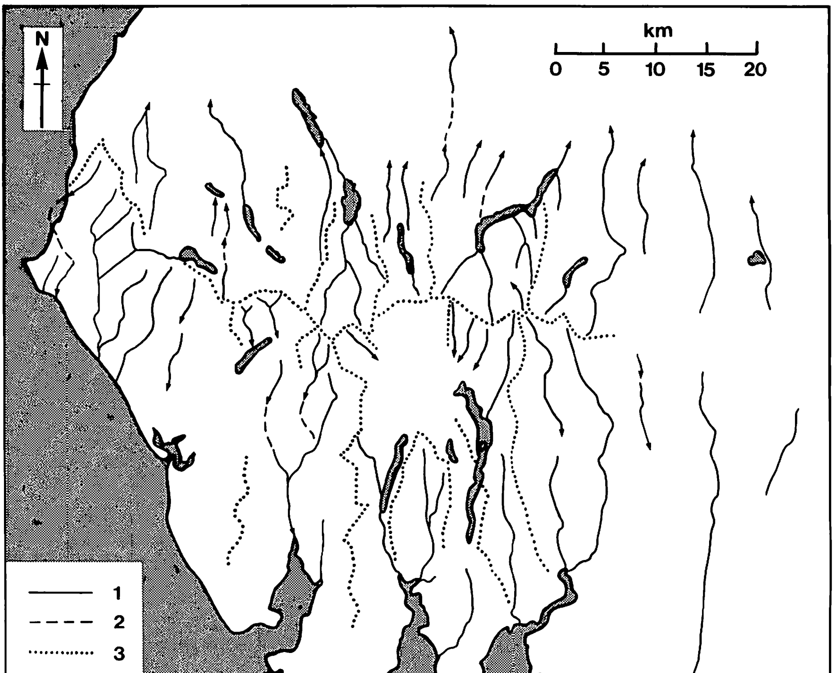

Fig. 1.4 Reconstruction of the Tertiary drainage systems according to Linton — 1. present-day rivers; 2. reconstructed courses; 3. inferred Tertiary watersheds.

From our point of view it is of interest to note two products of these glacial episodes. First, is the radiating pattern of valleys and lake basins which was formed as ice flowed away from the centre of an ice dome positioned over the Scafell Range. This radial ice drainage profoundly altered the simpler Tertiary drainage system and, of course, produced the radiating pattern of overdeepened basins which are presently occupied by lakes.[6] Second, the glaciers swept the rock surfaces clean of soils and weathered material, and laid down a patchwork of glacial clays and gravels on the more gentle slopes. These glacial substrates are the parent materials for the deeper soils of the region.

THE DEVELOPMENT OF THE VEGETATION COVER

Towards the end of the last major glacial episode, the late Devensian, which dates from about 25,000–13,000 B.C., we find the first indications that the lake basins were to become important repositories of information concerning environmental changes in their catchment areas. We know, for example, that the wastage of the last ice from the Lake District was not a simple process. If we examine the lake sediments which were being deposited at this time we find a sequence of varved clays, organic muds and more varved clays. This three-fold division of the Late-Glacial deposits indicates that the process of varved clay sedimentation, controlled by the seasonal melt of glaciers, was interrupted by a short non-glacial phase which is commonly called the Allerød Interstadial [Fig. 1.5]. At Windermere the beginning of this period is radiocarbon dated at 9920 ± 120 B.C. This mild interlude lasted until about 8800 B.C. and both macro and micro fossils of *Betula pubescens* (brown birch) and the more warmth-loving *Betula pendula* (silver birch) are present in Allerød sediments, suggesting that the valley bottoms were occupied by a thin birch forest on stable soils that were beginning to accumulate an appreciable organic matter content.[7]

In all lake sediments from north-west England there is a considerable change in the environment at the top of the Allerød muds and the remains of plants intolerant of low temperatures disappear and are replaced by arctic species such as *Betula nana* (dwarf birch) and arctic-alpine species such as *Salix herbacea* (least willow). During this post-Allerød climatic recession there was renewed glacial activity confined to the corries and, at the same time, the complete disturbance of the juvenile soils by intensive frost churning. On the glacially steepened valley sides frost activity generated vast aprons of rock rubble that even now provide an insecure footing for colonizing plants.[8]

This short spell was to last for only 500 years or so, and after about 8300 B.C. there was a progressive post-glacial amelioration to the climatic optimum of the present Flandrian Interglacial. In the post-glacial period both the study of subfossil pollen grains and of lake geochemistry have been extensively used to reconstruct the changes in vegetation and soils of the Lake District.

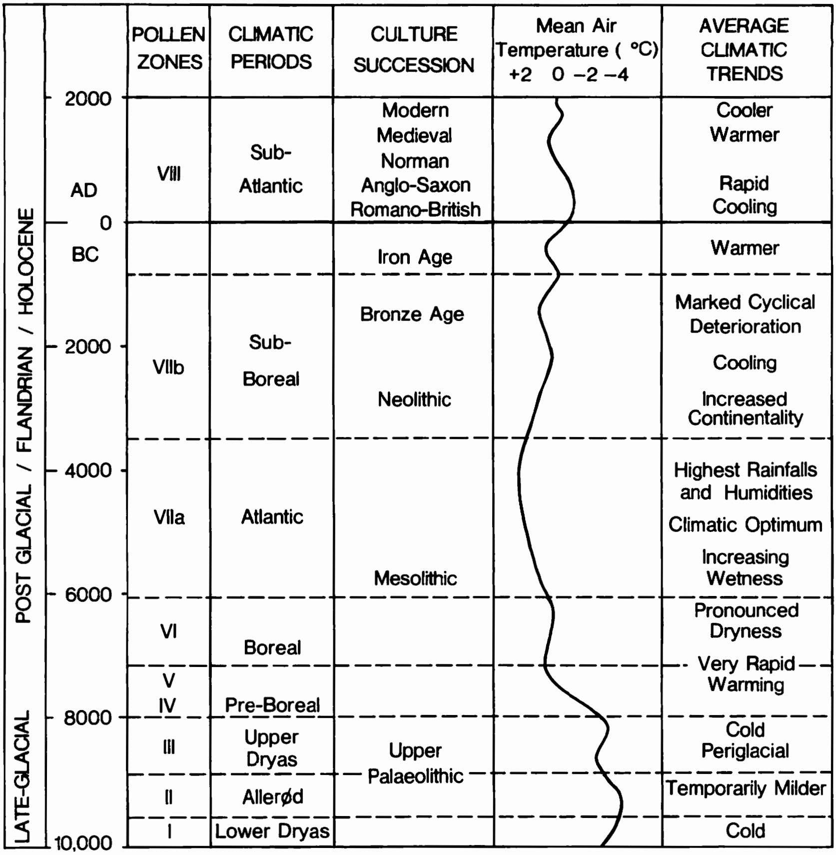

Fig. 1.5 Pollen zones and climatic sequence in the Lake District.

The palynologist tries to reconstruct vegetation changes by identifying plant microfossils, mainly pollen grains (but sometimes spores) which are liberated in their millions by flowering plants. These grains are identifiable, sometimes to species level, and because they have a very resistant outer coating they are usually well preserved in non-oxidising environments. Pollen is liberated into the air and it falls slowly to earth to be trapped on suitable substrates such as lake bottoms and wet bog surfaces where it becomes entombed by the accumulation of sediments or vegetation. Likewise the geochemist studies the changes in the elemental composition of the lake sediments as these elements come ultimately from the weathering processes occurring in the soils and rocks of the catchment area. Both these methods allow the expert to build up a detailed case-history of environmental changes, both natural and man-induced, which have occurred in each of the Lake District catchment areas.

In the lake sediments the early post-glacial change to organic mud corresponds with the pollen record of a developing forest. If we use the post-glacial zonation of Blytt and Sernander the early post-glacial period, from zone IV to VIIA, is characterized by the development of a closed forest up to an altitude of at least 2500 ft (763 m), with shade intolerant plants restricted to mountains tops and cliffs, and to sites of prolonged soil disturbance [Fig. 1.5].

During the pre-Boreal period much of the woodland would have comprised birch and juniper scrub which might have been dense in the valley bottoms and thin on the skeletal soils of the valley sides. With increasing warmth and the immigration of more demanding trees, a forest of hazel, oak (*Quercus petraea* — sessile oak) and elm spread into the Lake District, and competitively excluded the birch which was becoming widespread on the rolling upland surfaces. The presence of Scots pine during the early post-glacial was evidently controlled as much by soil type as by climate and it is now believed that pine forests were established on the shoulders of the glaciated valleys on the nutrient-poor shallow soils.

By the Atlantic period, the climatic optimum, most of the well-drained lowland soils and the deeper soils of the upland slopes, which had remained as freely draining brown earths, were covered by an oak-elm forest. On the limestones of the Lakeland fringe ash and lime were more common and in the wetter valley bottoms on gley soils, developed on heavy glacial clay, alder must have been common.

During the Atlantic period Britain became an island as seas flooded the shallow continental shelf, and climatologists generally agree that the consequent establishment of a maritime circulation around the British Isles increased the oceanity of the climate. However, there is no evidence for any increase in the rate of erosion of the Lake District soils due to the increased oceanity and precipitation. In the lake basins the Atlantic climatic optimum of deciduous high forest coincides with chemical indications of minimal erosion. Sodium and potassium ions which are bound to the mineral fraction of the soil are sensitive to leaching and these are at a minimum on the lake sediment curves, whilst carbon, derived from the accumulation of organic matter in the topsoil, shows a maximum.[9] Throughout the Lake District at this time it is evident that the continuous forest cover effectively controlled erosion, even in an oceanic climate. Any soil material washed into the lake basins during this period must have been confined to the topmost humus layers of forest soils.

HUMAN EXPLOITATION: FOREST CLEARANCE, GRAZING AND FARMING

At the end of the Atlantic period there was a significant fall in the quantity of elm pollen reaching the lake sediments and palynologists call this sedimentary horizon the elm decline. In the Lake District this has been radio-carbon dated to between 3150 B.C. and 3390 B.C. The very close association of the elm decline with the occurrence of cultural indicator pollen such as *Plantago lanceolata* (ribwort plantain), together with stratigraphic changes in the lake sediments indicating severe erosion of organic soils and then successively deeper mineral horizons, is a feature of several Lakeland sediment sequences.[10]

For example a sediment core from Angle Tarn at 1600 ft (488 m) above sea-level and not far from the Langdale Neolithic axe factory, shows successive inwash of organic soil (distinguished by its high carbon values), weathered mineral soil (distinguished by high sodium and potassium), and lastly unweathered mineral soil (comparatively rich in calcium as well as sodium and potassium). Such stratigraphic changes are found only in those lakes where the pollen evidence demonstrates partial forest clearance at the elm decline; and the distribution of these lake basins coincides with the distribution of the early Neolithic population. The evidence for soil erosion and human interference with the primary forest is, therefore, quite strong.

Once the brown earths of the forest were eroded, trees had difficulty in regeneration; as a result much forest in these cleared patches was replaced by shallower rooting and less demanding grassland, heath and peatland communities. On the gently rolling upland surfaces the blanket peat which had started to form during the Atlantic period continued to grow through early sub-Boreal times and at least some of the upper birch woods were inundated by bog growth.

From about 1700 B.C. to 500 B.C., the latter half of the Sub-Boreal period, there were important environmental changes brought about by Bronze Age cultures. The most striking was the permanent change in the upland oak forest which was severely reduced. In some tarns, such as Devoke Water and Seathwaite Tarn, the sediments show a significant fall in carbon content associated with a greatly accelerated rate of mineral deposition. No cereal pollen is found at this level and it is supposed that the woodland clearance and subsequent soil erosion reflects the activities of a pastoral economy in which much of the replacement of trees by grassland was the result of grazing and felling. The prevailing treelessness of great areas of the uplands of the Lake District must date from these Bronze Age clearances.

The climatic deterioration in the centuries around 800–500 B.C. is likely to have made the Lake District less attractive to new settlers, particularly for communities based more on cereal cultivation than a pastoral economy, and there is little evidence for forest clearance in the later Sub-Boreal (Iron Age). Indeed the climatic deterioration caused a regeneration of peat growth and where grazing pressure had been reduced, the development of secondary birch thickets.

For the next thousand years or so there is little evidence of environmental change in the Lake District, but about A.D. 400–600 many upland tarns have pollen sequences which show an extensive clearance of woodland representing a penetration of cereal cultivation into the uplands to an altitude of about 900 ft (275 m), higher than at any time before or since.[11] It is thought that there must have been a period of dryer climate about this time forming a respite from the generally cool and wet Sub-Atlantic period. In such areas of cereal cultivation profound soil changes took place and this level is identified in several sediment columns as a *Calluna* (heather) horizon. Evidently the earlier Bronze Age clearances had partially podsolized the soils which subsequently became colonized by heather which itself was removed as a result of disturbance and tillage.

By late Romano-British times there can be no doubt that much of the Lakeland landscape was treeless with extensive areas of the upland surfaces covered by peat bogs, acid grasslands and moorlands whose soils had been impoverished as a result of erosion and truncation. In contrast there is some evidence from sites such as Bleham Tarn that the valley bottoms in the central and southern part of the Lake District were still wooded. These forests were never cleared by Bronze Age activity probably because they were too dense.

At Bleham Tarn there is a large influx of grass pollen high up in the sediment column and it is suggested that this corresponds with the partial clearance of these remaining valley-bottom woodlands by Norse immigrants who may have brought with them the ancestors of the Herdwick sheep so common in the Lake District today. The beginnings of a sheep economy, which was to be continued a few centuries later by the Cistercian monks, was the death-knoll to most of the remaining natural woodland in the Lake District. Nibbling armies of sheep can effectively transform scrub and woodland to acid grassland within a few centuries and much of the deciduous woodland of the Lake District today has in fact been planted, though admittedly with local species.

CONCLUSION

It is clear that many natural and man-made changes took place in the Lake District landscape up to the period of the Scandinavian settlement. It is equally clear that the Lakeland environment was very sensitive to human impact. Conservationists need look no further than the bottom of the Lake District tarns if they need evidence for the serious environmental degradation consequent upon exploitation by man; whilst ecologists and historians may speculate on the more specific nature and effect of Norse immigrant activity.

Notes

[1] Two excellent texts dealing with the geology of the Lake District are: i) F. Moseley (ed.), *The Geology of the Lake District* (1978); ii) Yorkshire Geol. Soc. and Cumberland Geol. Soc., *The Lakeland District* (1982).

[2] One attempt to map the extent of erosion surfaces was made by J. T. Parry, The erosion surfaces of south-western Lake District, in *Transactions of the Institute of British Geographers* (1960) XXVIII, 39–54. Parry's views have been recently contested by S. J. Gale, The geomorphology of the Morecambe Bay karst and its implications for landscape chronology, in *Zeitschrift für Geomorphologie* (1981) XXV, 457–69.

[3] See J. Gjessing, Norway's Paleic Surface, in *Norsk Geografisk Tidsskrift* (1967) XXI, 69–132.

[4] This interpretation is due to D. Linton, Radiating valleys in Glaciated lands, in *Tijdscrift Nederland kon Aardriks General* (1957) LXXIV, 197–312. It is unfortunate that this important paper is so little known. Linton clearly dispels the myth of radial drainage on an uplifted dome of New Red Sandstone.

[5] In the Keswick area some highly weathered tills (boulder clays) have recently been discovered. Their presence implies at least two glacial episodes. Undoubtedly the Lake District was glaciated several more times but no evidence remains in this highly erosive environment.

[6] See D. Linton (1957) op. cit.

[7] The Allerød muds contain considerably more total carbon and significantly less iron and manganese than the varved clays. As soils matured and gained organic matter, humic acids were leached out and transported into the lake basin.

[8] W. H. Pearsall and W. Pennington in their book *The Lake District* (1973), suggest that the formation of scree has been accelerated since prehistoric clearance of native woodlands from the mountains. It is difficult to envisage the geomorphological process they had in mind. It is preferable to think of screes as being re-activated as a result of vegetation disturbance.

[9] See F. J. H. Mackereth, Some chemical observations on post-glacial lake sediments, in *Proceedings of the Royal Society* (1966) CCL, Series B. 165–213.

[10] A complete discussion of vegetation change in the Lake District is provided by W. Pennington, Vegetation History in the north-west of England: a regional synthesis, in D. Walker and R. G. West (eds) *Studies in the Vegetational History of the British Isles* (1970).

[11] Ibid.