QUATERNARY NEWSLETTER

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Quaternary Newsletters are issued in February, June and November. Closing dates for submission of copy for the relevant numbers are 1st February, 1st June and 1st November. Contributions, comprising reviews, notices of forthcoming meetings, news of personal and joint research projects, etc. are invited. They should be sent to the Secretary of the Quaternary Research Association, Dr. J.A.Catt, Pedology Department, Rothamsted Experimental Station, Harpenden, Herts., AL5 2JQ, England.

QUATERNARY FEATURES OF RHUM, INNER HEBRIDES

Report of Field Meeting, 20-24 May 1976

By J.D.Peacock

The meeting was attended by 12 members, including the leader. Thanks are due to the Nature Conservancy Council, who allowed us to use the hostel at Kinloch Castle, and to the Warden, Mr. Corkhill, who arranged transport to distant parts of the island.

The object of the excursion was to examine evidence bearing on the glacial and late-glacial history of the island, the "pre-glacial" raised rock platform and cliff, and the deep disaggregation of basic and ultrabasic plutonic rocks at various localities. Rhum has long attracted igneous geologists, but the geomorphology, which is a microcosm of that of the coasts and mountains of the Scottish Highlands, was relatively neglected until recently. This situation has now been partly remedied by the publication of several papers and maps (see references), but an integrated published account is still wanted, and a variety of formidable problems remain. These include (a) the age of the deeply decomposed bedrock and the processes leading to its formation (Tertiary deep weathering has been suggested by Ball (1964), and accelerated weathering consequent on a hydrothermal event by Peacock and Michie, 1975), (b) the apparently different behaviour of individual Late-glacial corrie glaciers in positions of similar aspect, (c) the nature of the fluted drift on the island, and (d) the formation of marine platforms and cliffs, and their preservation during glaciation.

The following notes describe the excursion routes followed by the party on Rhum, and it is hoped that they will be useful to future visitors to the island. They are best read in conjunction with the 1-inch geological map, or the 1:20,000 geomorphological map of the island.

Day 1 - Kinloch Area

The features seen include those left by the main Devensian ice of the Scottish mainland, which crossed Rhum from east to west, evidence for a small subsequent low-level valley wall glacier in Kinloch Glen, deeply weathered gabbro and ultrabasic rocks, and the raised marine platform and back feature north of Bagh na h-Uamha.

1. Follow road westwards from Kinloch for 2km. Striations of mainland glaciation are visible on Torridonian Sandstone slabs by the roadside. There is a quarry in deeply decomposed ultrabasic rock (NM 377998). A short distance to the west, E-W striae crossed by S-N striae can be seen; together with a number of small morainic mounds, these are taken as evidence for a very small Late-glacial valley wall glacier of possible Loch Lomond Readvance age on the south side of the glen.

2. Ascend south face of glen to rocky knobs west of Loch Bealach Mhic Neill, where many fine roches moutonnées and whaleback forms of main Devensian age occur on the ultrabasic rock. Superficial jointing is possibly more pronounced on the south side of the whalebacks.

3. Traverse south-eastwards to head of Corrie Dubh (NM 387997) to see weathering of gabbro and ultrabasic rock, and fresh-looking moraine mounds of possible Loch Lomond Readvance age, and thence eastwards to Bagh na h-Uamha (structural benches in Torridonian Sandstone). From Bagh na h-Uamha to Rubha Port na Caranean, there is a well-marked marine rock platform with back-feature at about 37 m above local O.D. At Rubha Port na Caranean the remains of the village are built on a well-marked shingle ridge of post-glacial age at 8 - 10 m above local O.D., from whence the coastal track can be followed back to Kinloch. The glaciated marine platform at about 37 m O.D. can be seen again on the north shore of Loch Scresort.

Day 2 East Coast of Rhum

Numerous striated surfaces show the divergence of westward-moving mainland ice against Rhum to the north and south of Fearann Laimhrige, and evidence is seen for the Late-glacial (probable Loch Lomond Readvance) glaciation in Coire nan Grunnd and Dibidil. The southward continuation of the raised marine rock platform and cliff is well-glaciated adjacent to Sheir a' Mhaim-ard.

1. Take Dibidil track from Kinloch. At outflow from Coire can Grunnd, deeply decomposed gabbro underlies moraines of probable Loch Lomond Readvance age west of the track, and a fine boulder moraine extends some 200 m down the slope to the east. The age of the corrie glaciation is fixed by crossing striations at a locality (NM 411967) where NW directed striae of the main Devensian glaciation are crossed by later ENE striae associated with ice from Corrie nan Grunnd.

2. Adjacent to Sgeir a' Mhain-ard the raised rock platform and cliff exhibits striations and roches moutonnées formed by the south-westward passage of main Devensian ice.

3. At Dibidil low mounds of till and gravelly drift extend down valley to the limit of the post-glacial marine transgression at about 10 m above O.D. Unlike similar localities outside the supposed Loch Lomond Readvance limit on the island (e.g. at Harris), there is no Late-glacial beach here, presumably because it was removed by the valley glacier in Glen Dibidil. This situation is analogous to that on the mainland (McCann, 1966).

4. The excursion can be continued by walking up Glen Dibidil and returning to Kinloch across the summits of Askival and Hallival. According to J. Rose (personal communication) westward directed striae of the mainland glaciation occur on the Hallival/Askival ridge (NM 394959).

Day 3 South and Central Rhum

The object of this part of the excursion is to examine the Late-glacial raised beach overlying the 'pre-glacial' marine rock platform at Harris, and to visit morainic features of probable Loch Lomond Readvance age, including the fluted drift of Glen Harris. The route starts at Harris.

1. Gorge of Duian River (NM 337960) cut into about 20 m of decomposed layered ultrabasic rock. The decomposition has preferentially affected rocks previously altered by processes connected with the intrusion of gabbro sheets (Wadsworth 1961).

2. Opposite the mausoleum south of the above section the river has cut through superficial deposits (Late-glacial beach gravels resting on till) into decomposed ultrabasic rock of the 'pre-glacial' marine platform. The fine Late-glacial beach with several shingle ridges at about 30 m O.D. is formed of granophyre pebbles derived from the west.

3. Ascend the Abhainn Fiachanis to see the small terminal moraine at a locality (NM 350945) and arcuate terminal moraines of a small corrie glacier a short distance east of Loch Fiachanis. Both features are thought to be of Loch Lomond Readvance age.

4. Contour northwards into upper Glen Harris. Edge of probable Loch Lomond Readvance glacier marked by edge of very bouldery drift. Fluted drift in the upper reaches of the glen is best viewed from the back wall of the valley, but several flutes are easily visible at close quarters. The flutes are parallel to the former direction of ice movement. Return to Kinloch via Corrie Dubh.

Day 4 Western Rhum

In this part of the island the deposits of corrie glaciers of probable Loch Lomond Readvance age occur on the north side of the granophyre hills, and the raised marine platform and cliff are very well developed (McCann and Richards 1969).

1. Proceed west from Kinloch and take the old track to Bloodstone Hill which leaves the road near the bridge (NM 360994). Former corrie glacier (NM 330995) marked by large moraine mounds but no distinct terminal features; a little to the west a similarly situated corrie glacier gives rise to very well marked arcuate terminal moraines (NM 318996) and low bouldery mounds of granophyre blocks.

2. From Schooner Point (NM 306985) a fine view is obtained of the raised marine platform, the inner part of which is obscured by extensive slope deposits. The platform and back feature are here at a much lower level (20 - 23 m O.D.) than on the east coast, perhaps because of the differential developments of various facets, tilting, or faulting.

3. The return to Kinloch can be made across the summits of Sron an t-Saighdeir and Orval, where large fossil stone polygons occur among the granophyre debris.

4. If time permits, the deeply decomposed rock exposed south of the Salisbury Dam (NM 364998) can be examined. It is crossed by faults of the Long Loch system. The rock is disaggregated rather than decomposed, and contains fresh olivine.

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THE STONE AXE TRADE AND QUATERNARY GLACIATION

By F.W.Shotton

The article by C.S.Briggs in the July issue of Quaternary Newsletter conceals under its title concerned with the controversial 'English Channel Glaciation" what I would regard as completely untenable views on the manufacture and distribution of stone axes. I do not intend to debate the alleged glaciation, but would merely point out that a hypothesis which requires stone axes to be fashioned from glacially transported erratics and excludes their dispersal by trade from recognised manufacturing sites neither supports nor refutes any scheme of glaciation if the hypothesis itself is untrue. I would maintain emphatically that this is so, and would invite readers to search Briggs' article for a single item of fact, as distinct from unsupported assertion, which bears upon his hypothesis.

Workers on the petrology of stone axes recognise a number of constant rock types, to which they have given group numbers. Some of these groups are identical with rocks used at large factory sites, for example VI (Langdale), VII (near Penmaenmawr), IX (Tievebulliagh and Rathlin Island in Antrim) and XXI (Mynnydd Rhiw in the Lleyn Peninsula). Others, equally characteristic petrologically, can be matched with a specific rock outcrop, sometimes very restricted, sometimes widespread, but as yet a factory site has not been located. When completed axes or axe-hammers of these petrological groups are found often hundreds of miles from their points of origin, it has confidently been assumed that they were dispersed by Neolithic and Bronze Age people, which is trade. Briggs' contention is that there was no trade, that the rock types were carried afield by glaciers, and that the erratics were picked up and fashioned into implements near to where they were subsequently found. He cites two abundant petrological groups in support of his view, so we may examine the quality of evidence which he brings forward.

Group I is a uralitised gabbro found as polished axes, most of which have a characteristic shape. Everyone agrees that the rock is Cornish, and a concentration of local finds places the source of origin somewhere near Penzance - possibly offshore. Significantly also, about 40 % of the records are unfinished "rough-outs", which with one exception(in Devon) all occur in Cornwall. Cummins (1974, pp. 201-205) produced a map showing the variation in relative concentration of Group I axes

in this country. This map is only partial since it omits (through lack of published data) any information about south-east England, the West Midlands, north-west and north-east England, Wales and Scotland. On this map Group I axes reach their biggest proportion of axe finds in Essex. On this evidence alone, Briggs sees support for his idea of glacial transport of the gabbro from south-west Cornwall. Apart from the fact that the postulators of the Channel or Salisbury Plain glacier have not forced it into Essex, not a single fragment of unworked Group I rock has been produced from the route of the alleged glacier. Briggs can only hint that, if petrologists would only examine the pebbles of East Anglian beaches, they would find the raw material of Group I axes. I do not think they would, for the erratics of the east coast are moderately well known, but the point seems to be of little relevance if the rock is not to be found scattered over southern England.

However, the strangest feature of Briggs' contention is his disregard of all but a selected bit of Cummins' diagram, for this shows that even in Yorkshire Group I axes constitute between 5 and 10 % of the total found. Is this material also to travel initially by glacial transport ? If so, it involves an ice movement of 350 miles from Penzance to Flamborough Head, which offends all my ideas of how ice moved. Briggs could not know, from Cummins' map, that Group I axes also occur quite frequently in Worcestershire, Warwickshire, Shropshire, Cheshire, Staffordshire and Lancashire, and these occurrences again forbid any interpretation based on glacial transport. So if dispersal by natural agency is ruled out, we have to accept carriage by man, which is trade; and what is sauce for the Yorkshire goose is sauce for the Essex gander !

The other cited case is that of Group VI. These axes are the cream of the Neolithic axe trade; they are shaped, ground and polished to a standard pattern by craftsmen of the highest order, to produce a tool of beauty as well as utility. Several large working sites exist on the screes below the Landale Pikes, though the stone selected for working was virtually restricted to scree from a relatively thin outcrop of a distinctive banded, epidotised andesitic ash. The factories must have produced many thousands of axes, judging by the myriads of waster flakes and the numbers of rough-outs, mostly rejected as faulty. But where are the finished polished axes ? Certainly not at the factory sites, where they are virtually unknown, but to the north, east, south and south-west. Group VI was the most coveted of all axes in Neolithic trading; it is found in Scotland and literally everywhere in England; it gets into Wales along the coastal fringes of Flint and Glamorgan, but apparently not into the interior of Wales, which was dedicated to Group VII from near Penmaenmawr. It is not logical to ascribe this universal distribution to glacial transport of raw material, followed by a meticulous selection by man, and in any case such an explanation would still leave unresolved what happened to all the axes that began at the Langdale factories. So it may not be necessary to use any words refuting the special case which Briggs brings up, namely the unusual concentration of Group VI axes in Lincolnshire. As with Group I, no positive evidence for glacial transport is produced. He cites the well-known transport of Lake District rocks to the east coast (Shap Granite, for example), but fails to take into consideration the geographic position of Langdale in relation to ice flow over Stainmore or to the Irish Sea; and since Group VI is a Borrowdale rock but not all Borrowdales are Group VI, his recollection of picking up Borrowdale Volcanics on the east coast in his boyhood is hardly convincing evidence.

No one doubts that many a Neolithic man picked up a stone which he felt was suitable for making a cutting tool, and chipped it and rubbed it until, with luck, it was a presentable implement. Such action does not do away with his dependance upon the great axe factories of Palaeozoic England and Wales, any more than it does of the Neolithic flint mines in the Chalk, whose finished products pushed far to the west and north. It will be noted that Briggs argued only about Groups I and VI, and chose not to mention other groups. There occur in Britain Neolithic stone axes which come from Brittany, and even axes of jadeite which probably originate from somewhere in the Mediterranean area. Even in the Neolithic, therefore, we have a cultured, sophisticated people, who were familiar with trading, both internally and from overseas. When we come to the perforated stone implements of the Bronze

Age, and find them far from their sources of origin with accompanying objects of that man-made alloy of copper and tin we call bronze, no-one can doubt the existence of commerce. Before it is dispensed with in the Neolithic, there will have to be an overwhelming petrological and geological case, which Briggs has certainly not provided.

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VARVE, TREE-RING AND C^{14} CHRONOLOGY OF CLIMATIC CHANGE

By D.J.Schove

The following is a summary of a lecture given at the Discussion Meeting on Quaternary Climates at Manchester, January 3rd, 1976.

Varve chronologies are reliable indicators of summer temperature fluctuations, and series from different parts of the world can be teleconnected (Geografiska Annaler, 53A, 1971, 214-234). Series from Finland, Sweden, Canada and the U.S.A. have thus been brought into a coherent scheme for over 4,000 years of the Late-glacial, from 12,600 B.P. through a Bölling magnetic reversal to c. 8,700 B.P.; however, some errors are not yet eliminated. Boreal varves have been counted reliably (e.g. in Germany and Switzerland), but more measurements are needed. Varves for the past 4,000 years have been measured in the U.S.S.R., but the dating is not yet agreed. It is nevertheless encouraging the find the well-known "sawtooth signature" of the 1530's (a zig-zag curve found in tree-rings in Europe and Asia) in south Russian varves in the correct decade. "Glacial" varves from deep lakes frozen once a year can be counted more accurately than other forms, and the connections between these series are being facilitated by the development of a technique at Wisconsin (information from Professor Bryson) for extraction of cores, which are subsequently frozen for preservation and study.

Tree-ring series being developed (Medieval Archaeology, 18, 1974, 165-172) in Ireland by Baillie and others at Belfast, the Rhineland and the Danube valley, promise to rival the Bristlecone Pine series in length, but more floating chronologies before 6,000 B.P. are needed, so that a sure link with the varves of c. 9,000 B.P. can be made.

A C^{14} chronology of climatic changes was established by using weighted dates as the basis of histograms, and deleting the last two figures of the dates as not significant. The results were termed (sub) stades, the Bölling at 12,300 B.P. being stade 123/2, the thermal maximum of c. 3375 B.C. stade 53, and the Little Ice Ages being stades 45, 32, 28, 23/2 etc. (World Climatic Chronology and Lake Biwa. In: S. Horie (Ed.). Palaeolimnology of Lake Biwa and the Japanese Pleistocene, 1975, Vol. 3, 429-437).

M.Sc. IN QUATERNARY STUDIES

A new two-year, part-time course starting in January 1977, will be offered jointly by the Department of Geography, Polytechnic of North London, and the Geography Section, City of London Polytechnic. The degree is awarded under the auspices of the Council for National Academic Awards. It is offered in response to long-standing demand from graduates working in south-east England. Although there are several part-time Masters courses available in Geography, Geology and Biology, this is the first dealing specifically with the study of the Quaternary.

The aim of the course is to promote a fuller understanding of the nature and implications of the events of the Quaternary period, by offering practical instruction in the analysis of various types of evidence relating to the Quaternary, and by providing an appreciation of the concepts underlying the reconstruction of Quaternary environments. Part of the work of the degree is to investigate the nature and sequence

of events that occurred during the Quaternary. The course also examines Quaternary change and development as a basis for understanding many aspects of the present physical and biological landscape.

Teaching of the course takes place on two evenings a week for six terms. After an initial introduction, which considers the aims, progress and framework of Quaternary studies, the bulk of the first year concentrates on the principal analytical techniques used by a wide range of disciplines in the study of the Quaternary. These are grouped into four main areas: morphological evidence; analysis of sediments; biological investigations; and dating techniques. The final part of the first year concentrates on palaeoclimatic reconstruction, allowing an integration of many of the techniques considered previously, as well as examining the validity and accuracy of methods for determining climatic parameters.

The second year of the course develops discussions on a more conceptual plane. Models of Quaternary environmental change suggested by various authors will be critically examined in such fields as climatic change, landform development, biological development, and the impact of man in the Quaternary. The final part of the course considers some of the general problems arising from Quaternary environmental reconstruction, especially those of correlation and the functioning of physical and biological systems.

Each student will also carry out a piece of work in a field of their choice to be submitted as a dissertation towards the end of the course. The aim of the dissertation is to allow students to utilise techniques studied during the course, and to apply them to a specific problem. It is hoped that dissertations will reflect the interdisciplinary nature of Quaternary studies. Fieldwork within the course will consist of two residential field courses of about a week's duration held during vacations, as well as occasional one or two day field courses at weekends.

It is anticipated that prospective candidates will have either an honours degree in a subject related to the Quaternary (e.g. Geography, Geology, Botany, Zoology, Archaeology, or Soil Science) or will have relevant professional experience. It is hoped that the course will contribute significantly to the status of students either as teachers and lecturers, or as research workers in universities, colleges or government institutions.

The course tutor is Dr. Richard Bryant, Geography Department, Polytechnic of North London, and the assistant course tutor is Mr. Hammond Murray-Rust, Geography Section, City of London Polytechnic. Further information and application forms can be obtained from either of them, or from the Admissions Office (Quaternary Studies), The Polytechnic of North London, Holloway Road, London N7 8DB (Tel: 01-607 2789). The closing date for admission to the course starting in January 1977, will be in late November.

THE EXTENT OF WORLD GLACIATION DURING THE LITTLE ICE AGE

B.G.R.G. Small Research Group on Neoglaciation

Durham, Saturday, May 15th, 1976

By B.S. John

The inaugural meeting of the Neoglaciation small research group of the British Geomorphological Research Group was held at Durham in May. The meeting occupied a full day, with paper sessions and discussions from 10.15 to 17.00; about 20 Neoglacial enthusiasts attended, and we were happy to welcome as a guest Wibjorn Karlen of the Naturgeografiska Institution, Stockholm. The meeting was entertaining and fruitful, and all agreed that a further meeting should be held within a year. The following are the abstracts of the seven papers presented:-

GLACIER AND CLIMATIC FLUCTUATIONS INFERRED FROM TREE GROWTH VARIATIONS OVER THE LAST 250 YEARS, CENTRAL SOUTHERN NORWAY by J. Matthews (University of Edinburgh)

A Pinus sylvestris (Scots pine) tree-growth series from near the tree-line in upper Gudbrandsdalen, southern Norway (Sl⁹astad 1957), was analysed and possible relationships to glacier and climatic fluctuations explored. The series was smoothed (by harmonic analysis) and calibrated using a variety of independent glaciological, geomorphological and climatological data from Storbreen (Jotunheimen), the Storbreen gletschervorfeld and Dombas meteorological station. The smoothed and calibrated growth curves were then used to make inferences about the number, date, magnitude and duration of glacier fluctuations and summer temperatures from 1700 A.D. to 1950 A.D. At least 10 major oscillations in the tree-growth data, reflecting fluctuations in summer temperature of amplitude 1.0°C to 3.0°C, are believed to be indicative of glacier fluctuations. These fluctuations are superimposed on a general trend of glacier retreat and a long-term warming of 1.0°C since 1750 A.D. Limitations, problems and possible directions for development of dendroglaciological and dendroclimatological techniques were suggested.

A LICHENOMETRICAL STUDY OF THE NEOGLACIAL END MORAINES OF THE OKSTINDAN GLACIERS, NORTH NORWAY, AND COMPARISONS WITH SIMILAR RECENT SCANDINAVIAN STUDIES by N.J. Griffey (University of Sheffield)

A lichenometrical study of the 14 major Neoglacial end moraine sequences deposited by the Okstindan glaciers revealed the presence of a similar recent sequence and, in four instances, older Neoglacial end moraines immediately outside these sequences. Using lichenometrical and historical data from Okstindan and other Scandinavian glacierized regions, the deposition of the similar end moraine sequence was assigned to the period between A.D. 1920 and an undefined part of the 18th century. The older end moraines could not be dated through lichenometry, although it was evident that they were considerably older than the others. The difficulties involved in correlating the lichenometrical data of different researchers were stressed.

LITTLE ICE AGE GLACIER AND CLIMATIC FLUCTUATIONS IN LAPPLAND, NORTHERN SWEDEN by W. Karlen (University of Stockholm)

Historical information concerning marginal fluctuations of Swedish glaciers is restricted, and it has been found difficult to date moraines fronting Swedish alpine glaciers with any standard technique. In an attempt to learn more about their fluctuations the lichenometry technique was employed. The maximum diameter of certain lichens (Rhizocarpon geographicum and Rhizocarpon alpicola) was measured on over 200 moraines fronting 50 glaciers in Lappland. The results showed a distinct "grouping" of lichen diameters. The maximum lichen diameter was about 21 mm for the youngest group of moraines and about 410 mm for the oldest. Studies of lichen growth rate, in widely different environments, were carried out. These studies suggested very similar growth rates in all regions where moraines were examined. The relative ages that the maximum lichen diameters indicate have, to some extent, been transformed to real age. This was possible because mining has been carried out at several places in the Swedish mountains since the 17th century. By measuring the maximum lichen diameter at waste tips around these mines a lichen growth curve could be constructed for the last 300 years. Many moraines in Lappland are too old to be dated by this curve. These will not be discussed here. A few moraines which might date from the beginning of the Little Ice Age were found; however, moraines from this period are

not often preserved because they were overrun by later advances. Around A.D. 1600 many glaciers first retreated from their Little Ice Age maximum extent. This event was followed by a series of marginal fluctuations, during which the glaciers returned almost to their previous maxima. Many glaciers also retreated from moraines around 1650, 1700, the end of 18th century, 1850, 1890 and 1910-1920. In front of only a few glaciers moraines formed in the beginning of the 19th century were found. The results indicate that glaciers in Sweden continuously fluctuated in size from before late 16th century up to the beginning of the 20th century. The lichenometry results also demonstrate that, in the large scale, Swedish glaciers fluctuated in phase with glaciers in the Alps and other parts of the northern hemisphere. In Scandinavia it is frequently assumed that most glaciers reached the largest post-glacial extent around 1750 because a few outlet glaciers around Jostedalsbreen (Norway), according to historical records, reached their largest extent at this time. The results from Lappland indicate that this assumption may be incorrect.

THE MAGNITUDE OF LITTLE ICE AGE EVENTS IN SPITSBERGEN
by G.S. Boulton (University of East Anglia)

Relatively little deglaciation has occurred since the Little Ice Age maximum glacial extent at the end of the last century. The considerable magnitude of this event is revealed by studies of sedimentation rates in fjords beyond the margins of calving glaciers on the west coast of Spitsbergen. Sedimentation rate versus time estimated from palaeomagnetism and ^{14}C dates shows a rapid decrease after about 4000 years B.P. of between one and two orders of magnitude. A rapid increase in sedimentation rate of a similar magnitude occurred at some time between 1500 and 800 B.P. These differences are analogous to the differences of sedimentation rate between those valleys in which glaciers calve into the sea, and those in which only very small glaciers or no glaciers at all occur.

THE MAXIMUM EXTENT OF GLACIERS IN N.W. ICELAND DURING THE LITTLE ICE AGE by B.S. John (University of Durham)

In Vestfirdir (N.W. Iceland) there are three types of glacier which can provide information on Little Ice Age climatic and ice edge oscillations. These are (a) the "permanent" ice cap of Drangajökull, whose outlet glaciers react sensitively to small-scale climatic changes; (b) the "intermittent" ice cap of Glamujökull, which appears and disappears in response to medium-scale climatic changes; and (c) the small cirque glaciers which are concentrated in four groups in the northern parts of Vestfirdir. Glamujökull was a product of the Little Ice Age, and it had a life of something over 300 years. The ice cap was restricted almost entirely to the Glama plateau. It does not seem to have supplied any outlet glaciers long enough to descend the trough heads of the radiating valleys around the plateau edge, and there appear to be no large Little Ice Age moraines even on the plateau above 600 m. However, small morainic ridges provide some clues to the dimensions of the ice cap. Most of the evidence for the extent of Drangajökull during the Little Ice Age comes from the outlet glacier troughs of Kaldalon, Reykjafjördur and Leirufjördur. In each trough there is a sequence of Neoglacial moraines, and the innermost ones almost certainly date from the period 1750-1900. Most work so far has been done in Reykjafjördur, where nine ice edge positions are now established. From the evidence of morphological relationships, pedology and lichenometry it seems that there are three Little Ice Age moraines, dated to 1840-50, 1860-70, and 1914-20. In spite of local mythology, the most advanced stillstand of the Reykjafjördur glacier occurred in c. 1850 rather than 1756. Most of the cirque glaciers in the uplands are fronted by prominent moraines. Where there is a single moraine this presumably marks the maximum Little Ice Age advance. However, the glaciers near Hrafnsfjördur have multiple moraine sequences. One of these has three fresh Little Ice Age moraines and three older moraines, these latter may well date from earlier Neoglacial advance phases, and they may correlate with the "outer moraines" of Reykjafjördur.

LATE NEOGLACIAL MORAINES OF THE BRITISH COLUMBIA COAST MOUNTAINS by I. Evans (University of Durham)

Most glaciers in this part of the Coast Mountains have single morainic ridges relating to a probably nineteenth-century advance which has not been exceeded for many centuries. Lateral moraines are well developed, with little gullying; moraines frontal to glaciers over 1 km long have often been destroyed. During the 1950's and 1960's, larger glaciers have continued a slow decline. In the Shulaps Range and on the northeast side of the Bendor Range, most moraines are rounded, fat and of porridge-like appearance; these are assumed to be ice-cored. Most occur at altitudes where permafrost is expected; above 2,130 m in the Bendor Range, or 60 m higher in the Shulaps. Compound lobate rock glaciers are found in the same areas, especially on Rex Peak. Flutes 0.5 to 2 m high spaced at roughly 25 m occur up-ice from both 'ice-cored' and 'normal' moraines. Østrem and Arnold's (1970) 1/2,000,000 map of southern British Columbia omits half of these features as well as a larger proportion of the 'normal'sharp moraines farther west.

GLACIER FLUCTUATIONS IN SOUTH GEORGIA AND PERU by C. Clapperton (University of Aberdeen)

Because South Georgia lies south of the Antarctic Convergence and the Peruvian Andes are in the tropics, it is interesting to compare the nature and extent of glacier fluctuations during the last two centuries. Within one kilometre of the present glacier snouts two distinct groups of lateral-terminal moraine complexes can be distinguished from each other on the basis of relative position, degree of weathering and solifluction disturbance, nature and amount of plant covering and absolute dating. The group of small 'fresh' moraines extending for between 50 and 500 m from the glacier snouts (depending on the size and type of glacier) possibly relate to the overall recession of the glaciers from advances (1) between 1924 and 1936 in South Georgia, and (2) between 1910 and 1932 in Peru. The contiguous and partly overridden group of older moraines extending a few tens of metres beyond the latter almost certainly relate to the Little Ice Age. The C^{14} dating of peat beneath these deposits in South Georgia indicates that the glaciers were advancing after 1795 A.D. Peat found beneath the deposits in Peru is being dated. Groups of larger and older moraines more than two kilometres beyond the present glaciers in both localities may mark the positions of earlier Neoglacial advances.

Following the presentation and discussion of the seven papers there was some debate on a proposed sequence of Neoglaciation for the Northern Hemisphere. This is summarised in Table 1. The discussion could have gone on ad infinitum, and it was felt that this topic deserved a meeting all to itself, preferably early in 1977. Miss Astrid Ogilvie of the School of Environmental Sciences offered to organise such a meeting at Norwich, on the subject of Glacier Oscillations during the Holocene. All who are interested in participating are asked to contact her for further information.

Xth SEDIMENTOLOGY CONGRESS

The tenth International Congress on Sedimentology will take place in Jerusalem Israel, July 9th-14th, 1978. One of the themes of this congress will be the sedimentary aspects of geomorphology, palaeoclimatology and hydrogeology, which will include discussions on palaeotemperatures as reflected in Quaternary sediments, sedimentological criteria for reconstructing climates, duricrusts and palaeosols, slope processes and geomorphic responses to sedimentation, sedimentary responses to groundwater, geochronology of sedimentary processes, isotope geochronology and palaeoclimatology, fluviatile and lacustrine sediments, glacial and pluvial sediments and geomorphology, marine and continental terraces. Further details may be obtained from Prof. A. Horowitz, Institute of Archaeology, Tel Aviv University, Ramat Aviv, Israel

Table 1. A proposed sequence of Neoglaciation in the Northern Hemisphere (after Denton and Karlen, 1973)

Glacier expansion phase	Coldness peaks	Duration of cold interval
Little Ice Age (Fourth phase of Neoglaciation)	200 B.P. (1750 A.D.)	450-30 years B.P. (1500-1920 A.D.)
Third phase of Neoglaciation	2,800 B.P.	2,400-3,300 years B.P.
Second phase of Neoglaciation (following Hypsithermal Interval)	5,300 B.P.	4,900-5,800 years B.P.
First phase of Neoglaciation (during Hypsithermal Interval)	7,800 B.P.	7,000-8,200 years B.P.

NEW PUBLICATIONS

Pleistocene Rodents of the British Isles. By A.J.Sutcliffe and K.Kowalski. Bulletin of the British Museum (Natural History), Geology, 1976, Vol. 27, No. 2, pp. 31-147. Price: £7.40.

Fifty years have elapsed since the British Museum published M.A.C.Hinton's Monograph of the Voles and Lemmings (1926), and the advances made over this period in rodent studies both in Britain and abroad and also in our knowledge of Quaternary stratigraphy and chronology have made a complete revision necessary. Sutcliffe and Kowalski do this by describing in turn the main British fossil rodent localities, and then discussing systematically the 37 species known from these; finally, a synopsis of the Quaternary history of rodents in Britain is given. Ten faunal stages are recognised in the British succession, two in the Lower Pleistocene (the Red Crag and the Pastonian /Icenian stages), three in the Middle Pleistocene (the Cromerian sensu stricto, the Westbury stage of the Mendip fissure, and the Hoxnian stage), four in the Upper Pleistocene (the Middle Thames Terrace, the Tornewton Cave Glutton Stratum, the Joint Mitnor and Devensian stages), and one in the Holocene. Distribution maps are provided for most species, but diagnostic morphological details of bones and teeth are not. This omission is bound to limit the appeal of the publication, and make it seem rather expensive.

Studies in the Scottish Lateglacial Environment. Ed.: J.M.Gray and J.J.Lowe. To be published early in 1977 by Pergamon Press, Oxford. 200 pp. approx.

This volume, which should become available early in 1977, will contain contributions on the Late Devensian glaciation of north-east Scotland (C.M.Clapperton and D.E.Sugden), Lateglacial raised shorelines and deglaciation in the Earn-Tay area (R.A.Cullingford), the "Oban-Ford" moraine (J.M.Gray and D.G.Sutherland), the Loch Lomond Readvance in the northern mainland of Scotland (J.B.Sissons), Stratigraphical and faunal evidence for Lateglacial and early Flandrian environments in south-west Scotland (W.W.Bishop and G.R.Coope), Evolution and Chronology of Lateglacial marine environments at Lochgilphead, Scotland (J.D.Peacock, D.K.Graham, J.E.Robinson and I Wilkinson), Reconstruction of the Lateglacial environment in the southern and eastern Grampian Highlands (J.J.Lowe and M.J.C.Walker), Lake sediments and the Lateglacial environment in northern Scotland (W. Pennington), Radiocarbon dating of the Lateglacial and early Flandrian vegetational succession in the Scottish Highlands and the Isle of Skye (Y. Vasari), and will conclude with a synthesis of the Scottish Lateglacial environment (J.M.Gray and J.J.Lowe).

CALENDAR OF MEETINGS

15th December, 1976	Geological Society Ordinary General Meeting, Burlington House, Piccadilly, London, 4 p.m., including J. Rose and P. Allen: Middle Pleistocene Stratigraphy of south-east Suffolk.
8th January, 1977	Quaternary Research Association Discussion Meeting, Durham (see enclosed circular for further details)
1st-5th April, 1977	Quaternary Research Association Annual Meeting, Bristol (see enclosed circular for further details)
30th-31st May, 1977	South African Society for Quaternary Research. Conference on Late Caenozoic studies in southern Africa, at the Natal Museum, Pietermaritzburg. Preceded and followed by short excursions in the Natal coastal area. Further details from Dr. O. Davies, Natal Museum, Loop Street, 3201 Pietermaritzburg, S. Africa.
16th-24th August 1977	Tenth INQUA Congress, Birmingham, with pre-Congress and post-Congress excursions to all parts of Britain. (see enclosed circular for further details)

Compiled and duplicated for circulation to Quaternary Research Association members and others by the Honorary Secretary, Quaternary Research Association, Pedology Department, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ, England.