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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.

THE ABBEY PISTON CORER

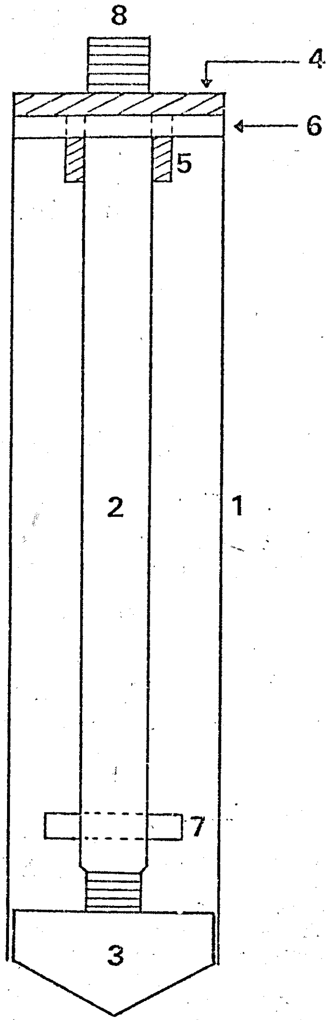
By M. J. C. Walker and J. J. Lowe

This short note describes a hand-operated piston corer that has been used in Scotland by the two authors, and which is now available to Quaternary scientists in the British Isles. The corer operates on the Dachnowski principle, but significant modifications have been incorporated which make it superior to the original Dachnowski model. This new sampler is called an ABBEY CORER[3].

The Abbey Corer consists of a steel chamber 66 cm in length, with an external diameter of 5.6 cm and an internal diameter of 5 cm (1). The centre rod (2) is made of solid steel and is 3 cm in diameter. The nose cone (3) is also of solid steel and is detachable from the centre rod. The top plate (4) is attached to the centre rod by steel wing-pieces (5), and the latter enable the entire sampling chamber to be turned in sediments when closed. The locking plate (6) screws into the top of the sampling chamber, and is easily removed thus allowing the chamber to be cleaned out thoroughly from both ends. A solid steel bar (7) is fastened through the centre rod immediately above the nose cone. When the centre rod is withdrawn and turned through 90°, downward progress of the sampling chamber is effected by the pressure of (7) on the locking plate (6). The centre rod is attached to the extension rods by a robust thread connection (8). The extension rods themselves are made of mild steel, are one metre in length and have thread connections. The T-bar handle which screws onto the rods is specially strengthened. Auger fitments are also available to allow penetration through particularly coarse horizons and subsequent sampling in underlying softer material.

Experience has shown that the Abbey Corer is best used in association with a level (mounted at the side of the sampling site) and a surveying staff. The procedure is as follows. The closed chamber is lowered to the level at which sampling is to begin. The staff is placed on top of the handle of the extension rods protruding above the bog surface. The extension rods are then raised until the sampling chamber is fully opened, and the whole equipment forced downwards until the reading on the staff placed on the handle coincides with the first reading obtained. At the point the chamber is full. The sampler is then raised and the core (ca. 60 cm by 5 cm) is extruded onto semi-circular guttering pipe. Finally, the extruded core is sealed in adhesive plastic sheeting so that it is airtight. Further readings on the level ensure that an accurate stratigraphic record is maintained during the removel of successive cores.

In common with many piston samplers, the Abbey Corer occasionally becomes blocked by very coarse sediments. In addition, some soft materials (e.g. fine clays



The Abbey Piston Corer.

1. Sampling chamber
2. Centre rod
3. Nose cone
4. Top plate
5. Wing pieces
6. Locking plate
7. Steel bar
8. Thread connection

and fibrous peats) tend to be compressed in the sampling chamber, and small quantities of water may seep in through the holes in the locking plate. However, after sampling over 50 sites in the Scottish Highlands during the past three years, we feel that these problems are more than outweighed by the many advantages of this corer. It is relatively light and can thus be used to sample fairly remote sites which may be some distance from a road. It is easy to operate, and two people can usually sample all but the most resistant of sediments. Where coarser horizons are encountered, the strengthened handle allows the equipment to be hammered into the deposits. If, however, it proves impossible to force the chamber into sands or gravels, the augers can be used to bore through the obstruction thus enabling sampling to continue at depth. An important feature is that the sampling chamber dismantles completely, and, therefore, cleaning the apparatus is a straightforward process. The cores themselves are virtually free from contamination, and are sufficiently large to allow for pollen and macrofossil studies, as well as for sedimentological analyses and radiocarbon dating. The Abbey Corer was developed in the Geography Department, University of Edinburgh, and was built by Mr. A.G. Reid, Abbey Tool and Gauge, Spylaw Road, Kelso, Roxburghshire, Scotland.

DURHAM UNIVERSITY VESTFIRDIR (ICELAND) PROJECT, 1975

By B. S. John

This report follows two earlier short notes concerned with the work of the D.U. Vestfirdir Project; they appeared in Quaternary Newsletter, No. 10 (June, 1973) and No. 15 (February, 1975).

The major objective of the Project fieldwork is the clarification of Late-glacial and Holocene climatic oscillations and glacier response characteristics in the N.W. Peninsula of Iceland. This peninsula supports only one plateau ice cap (Drangajökull) at the present day, but another small ice cap (Glamujökull) was present during the Little Ice Age and possibly during earlier Neoglacial phases also. In addition, there are a number of small cirque glaciers. There appears to have been little synchroneity of glacier response to climatic changes, and fieldwork to date has concentrated on the identification and dating of at least seven retreat or readvance stages. These have all occurred during the last 13,000 years.

The fieldwork programme for 1975 extended from June to late August, and involved the following personnel; B.S. John, M.J. Alexander, P.A. Rafferty, and Miss G. Foulger (Durham); R.J. Mednis (St. John's, Newfoundland); and E. Larusson (Reykjavik, currently at Durham). For the first time the Project work included geophysical investigations, and seismic studies were undertaken in Kaldalon and Önundarfjördur in order to determine the thickness and nature of glacial and non-glacial sediment sequences. The other fieldwork has designed to provide detailed information for selected critical localities. PR, EL and GF worked for the most part in the western fjords, concentrating on the area around Dyrafjördur. Some time was spent by BJ, MA and PR on the south coast of the peninsula, examining features in the vicinity of a massive landslide near Reykholar, and the 1975 fieldwork also involved the first detailed investigations of the Hunafloi coast in the east. Studies of strandlines, soil development and landslides were completed in the vicinity of Holmavik and as far north as Veidileysufjördur. Towards the end of the field season detailed studies were undertaken in Kaldalon, and a light aircraft was hired to take BJ, MA and RM across Drangajökull to Reykjafjördur. Here there is a fascinating sequence of at least 7 late-glacial and Neoglacial moraines; the valley may well be the ideal type locality for the establishment of a Vestfirdir glacial chronology.

The 1975 field season was the longest undertaken so far by the Project members, and undoubtedly the most successful. Several Late-glacial fossiliferous sites have been discovered, and we have now examined a number of sites where there appear to be stratigraphic sequences extending through the whole of the Holocene. When radiocarbon dating of peat, wood and marine mollusc samples is complete there

there should be a good basis for an absolute chronology of glacial oscillations and sea-level movements in Vestfirdir.

So far the Vestfirdir Project has cost approximately £4,300 and we have recently received an extension grant of £1,487 from the NATO Scientific Affairs Division. This will guarantee at least one more field season, and a party of 6-8 will be in Vestfirdir again during the summer of 1976.

A NEW ISOPACH MAP OF THE QUATERNARY OF THE NORTH SEA

By V. N. D. Caston

An isopach map of total Quaternary thicknesses in the North Sea has been constructed from information obtained from over 200 wells drilled in all five sectors, supplemented by seismic reflection profiles and published information. The new data is of variable quality, as the base of the Pleistocene is not always easy to define either on lithological or palaeontological evidence, especially in the northern North Sea. Overall, however, it forms a coherent picture, particularly to the south of 58°N.

The most conspicuous feature of the map is the considerable thickness of Quaternary present in a linear trough trending north-northwest for over 750 km down the centre of the North Sea, the southern limit of which has been well documented in the Netherlands (Jong 1967, Zagwijn 1974). This linear trough corresponds approximately in position to the underlying Central Graben, which has been identified as a major structural feature of Mesozoic and Tertiary age (Kent 1975), and contains at least two closed basins in which maximum Quaternary thickness exceeds 1,000 m. An area exceeding 600 m in thickness centred at about 53°N, 4°E is displaced westwards from the Central Graben and appears to be a direct extension of the Quaternary grabens and horsts recognised in the Netherlands. Further north, although there is inadequate data, there appears to be relatively little Quaternary off the east coast of England, and virtually non at all north of about 54°30', which corresponds to the mid-North Sea High. What little evidence we have suggests that to the east of the Orkneys and Shetlands Quaternary cover is also fairly thin, perhaps less than 100 m or so out at least as far as 0°, and this corresponds to the East Shetlands Platform. There is a small embayment, towards the Moray Firth, perhaps associated with the Moray Firth Basin. On the eastern side of the North Sea there is little data, but certainly off the Danish and German coasts there appears to be only a fairly gradual westward increase in Quaternary thickness as far as a line that corresponds roughly to the edge of the Central Graben. Off the west coast of Norway there is a linear deep with over 400 m of Quaternary, which corresponds approximately with the Viking Graben, then a zone in which the Quaternary is locally less than 100 m thick, comparable with the Vestland-Stavanger Ridge on Kent's (1975) map, and finally another linear Quaternary deep, which corresponds to the northern part of the Bergen Basin.

It is felt that the relatively close correlation between the distribution of Quaternary sediments and the underlying Mesozoic/Tertiary tectonic features suggests that Quaternary sedimentation in the North Sea has been strongly influenced by these older structural patterns. Putting it another way, we have evidence from a study of the Quaternary that the deep seated structural movements responsible for the North Sea basin development have been active virtually to the present day. Average Quaternary sedimentation rates may have been as high as 0.3 to 0.5 m per 1,000 years which is up to ten times as high as the comparable rate for the Tertiary.

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The paper, of which this is a summary, was read at the joint meeting of the Challenger Society, the Marine Studies Group of the Geological Society of London and the Quaternary Research Association, held at Burlington House, London on October 22, 1975.

QUATERNARY CLIMATES

The following summaries are of some of the papers read at the Quaternary Research Association's Discussion Meeting on Quaternary Climates, held at Manchester on January 3, 1976.

The Reconstruction of Atmospheric Circulation Regimes of the Quaternary

By P. M. Kelly

Climatic change can be viewed as a response to variations in the nature of the general circulation of the atmosphere. In this paper, a review is made of various techniques for deriving information concerning past configurations of the atmospheric circulation and extending the data base necessary for the identification of the causes of climatic change. Although there is a pressing demand for reliable climatic forecasts to aid economic and social planning, there is little agreement amongst meteorologists and climatologists on the causes of climatic change and it is considered unwise to produce forecasts based on purely statistical considerations, and not on an understanding of the mechanisms underlying past climatic variation. Many climatic controls have been proposed, but the evidence necessary for validation of any hypothesis is difficult to obtain because of the short climatic data base and restricted knowledge of past variations in the atmospheric circulation.

Instrumental observations of the atmospheric pressure field have been taken over the last three hundred years. These enable the northern hemisphere atmsopheric circulation fluctuations of the present century to be defined in detail and allow some conclusions to be drawn concerning earlier fluctuations through the use of indices, of wind speed and direction and the position and intensity of major features of the general circulation, derived from the historical pressure data. Various methods are now being employed to extend this limited data base back in time. These techniques can be based on identification of correlations between varying features of the atmospheric circulation and climatic or proxy-climatic indicators, subjective assessment of the most likely atmospheric circulation configuration required to explain climatic anomalies derived from historical or other evidence, or numerical modelling of the atmosphere with different boundary conditions corresponding to the chang[illegible] condition of the earth's surface.

In such analyses, a major problem lies in the necessary assumption that the relationship between the atmospheric circulation and, for example, the proxy-climatic indicator that has been observed during the present period, has not changed with time. The degree of error that such an assumption leads to can be ascertained by comparison of the results of different methods of reconstructing past atmospheric circulation regimes.

This verification of the techniques should be regarded as an essential step in the study of climatic change and will ensure a reliable data base for use in the search for the causes of climatic change.

Reconstruction of the Atmospheric Circulation at the Maximum of the Last Glacial Period

By J. Williams

In recent years the development of numerical models of the atmospheric circulation has progressed, so that some of these models, of varying degrees of complexity have been used to investigate the atmospheric circulation with different boundary conditions. Several models have now been used to look at the response to inclusion of glacial period boundary conditions (Williams *et al.*, 1974; Alyea, 1972; Saltzman and Vernekar, 1975; Gates *et al.*, unpublished; Manage *et al.*, unpublished).

Experiments have been made with the global circulation model (GCM) of the National Center for Atmospheric Research (NCAR), Boulder, Colorado, U.S.A. to simulate the atmospheric circulation with boundary conditions representing those of January and July at the present day and at the last glacial maximum (18,000-22,000 BP). Input is required of orography and albedo of land surfaces and ocean surface temperatures on a 5^0 grid. For the simulation of the last glacial maximum this information was derived from geological and palaeobiological evidence.

The results of the experiments have been described by Williams (1974) and Williams *et al.* (1974). The NCAR model is a global, detailed model including many physical processes and describing the detailed evolution of the weather. Other models, ranging from simpler than to as complicated as the NCAR model, have been used to look at the effect on the model atmosphere of glacial period boundary conditions. Results of two studies using global models and CLIMAP input data have not yet been published. Alyea (1972) used a 2-level, quasigeostropic spectral model of the northern hemisphere to simulate the atmospheric circulation of July at the present day and at the last glacial maximum. Saltzman and Verneker (1975) used a zonally averaged equilibrium model. The three published studies have found the glacial atmosphere to be colder and drier than at present, with increased cyclonic activity in certain regions, stronger west-east winds and a larger equator-to-pole temperature gradient.

Each model has limitations but the fact that they give broadly similar results is encouraging. These first studies of the sensitivity of models to glacial boundary conditions show that a new field has opened up for palaeoclimatologists interested in past equilibrium climates.

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Late Neoglacial Snow Cover on Baffin Island, Northwest Territories, Canada, Indicated by Lichen Trimlines: Mapping and Energy-Balance Modelling

By L. Williams and T. Davis

Much speculation about causes of ice ages has been concerned with hypothesizing adequate mechanisms to account for the ultimate distribution of glaciers and ice sheets (and other indicators of cold climate) at glacial maxima. Yet because of the influence of large areas of snow and ice on climate (providing positive feedback by lowering temperature and steering storm tracks) it has long been recognized, but is often overlooked, that the initial climatic change need not be so severe as that represented by conditions at glacial maxima. Recently, a number of computer models of global climate have suggested that climate is extremely sensitive to small perturbations in external conditions when feedback effects of changes in snow cover are included.

The extensive plateaus of the Canadian arctic provide an ideal setting for the creation of widespread perennial snow cover with a moderate drop of the snowline. It has been suggested that a large part of the North American ice sheet developed <u>in situ</u> from such snowfields, rather than by invasion of ice flowing from isolated centres of accumulation. Its apparent rapidity of growth, as indicated by rapid fall of eustatic sea level, can then be explained by the positive feedback of extensive perennial snow cover.

It has been observed (by J.D. Ives) that large areas of plateau on Baffin Island appear light-toned on air photographs, which on field checking were found to be so because the rocks have far less lichen cover than those in adjoining areas. These were interpreted by Ives as representing the extent of a former widespread snow cover, which was dated at about 300 years before present. Similar areas have since been observed in northern Labrador. The existence of extensive snow cover in the late Neoglacial (or "Little Ice Age") suggests that a similar, but probably even more extensive snowcover existed in the initial stages of a major glaciation.

This paper reports the results of detailed mapping of the "lichen-free" areas on Baffin Island from satellite photographs. From this mapping, the geographical variation of late Neoglacial snowline over Baffin Island is determined. This snowline is then interpreted in terms of climate by means of an energy-budget snowmelt model applied to a grid over Baffin Island. It is found that the late Neoglacial snowline on Baffin Island can be accounted for by any of the following differences with the 1963-72 climate: (1) snowfall doubled over the northern part of the island and increased by 40% over the southern part, (2) a uniform summer temperature decrease of 1.4°C, or (3) a 5% reduction of incident solar radiation associated with a summer temperature decrease of 1°C. Other investigations with the model have shown how much more extensive perennial snow cover could be expected over arctic Canada with greater amounts of climatic change. It is suggested that the extent of snow cover required for significant positive feedback which would lead to ice sheet growth be studied with atmospheric models.

COMMENTS ON THE BRITISH GLACIAL-INTERGLACIAL SEQUENCE

By D. F. Mayhew

As a zoologist who has studied some of the mammalian evidence by Dr. Sutcliffe (Quaternary Newsletter 17, 18) I wish to suggest that it is insufficient to justify a change in the generally accepted view of the last interglacial as summarised in the table put forward by the Geological Society in 1973. Leaving aside discussion of terrace heights on which I do not feel able to comment the evidence given by Dr. Sutcliffe concerns presence, absence and relative abundance of certain mammal species at selected sites. Emphasis has been placed on the relatively small number of specimens of larger mammals and it could be argued that discussion of absence or relative abundance may be misleading unless accompanied by a consideration of the ecology and taphonomy as well as of sampling statistics involved in the recovery of specimens.

The mammalian evidence for considering the Trafalgar Square fauna to post-date that of Ilford hinges, if I understand Dr. Sutcliffe correctly, on the occurrence of a "relatively primitive" mammoth at Ilford and the presence of Microtus nivalis in the Glutton Stratum of Tornewton cave as well as in terrace deposits at Crayford. It is also suggested that an early age for Crayford is supported by the allocation of ground squirrel remains from this site to the extinct species Spermophilus (Urocitellus) primigenius by Gromov. This evidence is, however, subject to the following qualifications.

It is suggested that at Ilford most of the elephant remains are of an early form of mammoth with affinities to the Middle Pleistocene Mammuthus trogontherii. Studies based on differences in molar enamel patterns of elephant teeth require the use of large samples if ontogenetic and individual variation are to be excluded from inter-population comparisons; at present I regard this statement of relationship as unconvincing as too little is known of the details of elephant evolution in relation to local stratigraphic sequences.

It is assumed that the extant species of vole Microtus nivalis is a stratigraphic indicator taxon which did not re-enter Britain after the "hippopotamus stage" and that the identification is correct. Both assumptions are open to question. Identification of fossil vole lower first molars as M. nivalis is not a straightforward matter as samples of recent M. oeconomus may contain variants indistinguishable from M. nivalis (Storch, 1974) and the phylogenetic separation of these two species may have been relatively recent. It is noteworthy that specimens from Tornewton cave identified as M. nivalis were derived from levels yielding larger numbers of teeth identified as M. oeconomus (Kowalski, 1967). The lower first molars from Crayford identified and illustrated by Hinton (1926, p. 131, fig. 66) as M. nivalis do not closely resemble the morphology of recent M. nivalis given on the same figure but are more similar to the forms transitional between this and typical M. oeconomus (=M. ratticeps) illustrated by Storch (loc. cit.).

After extensive comparisons with continental fossil material and Palaearctic living species I (Mayhew, 1975) have referred the Crayford ground squirrel specimens to the living Siberian suslik (Spermophilus (Urocitellus) undulatus. Material of probable Devensian age from Ightham and Fisherton belongs to the living red-cheeked suslik Spermophilus (Colobotis) major. Fossil ground squirrels offer the potential for stratigraphic correlation as they appear to have immigrated into Europe on relatively few occasions. At present, however, this cannot be done because their remains have only rarely been related to local stratigraphic sequences and because their taxonomy is confused. For example, S. undulatus has not been recorded fossil on the European continent probably because the name *S. primigenius* has been used instead for the remains. This determination has then been used to date sites to an early part of the Pleistocene leading precisely to the sort of stratigraphic circular argument which we should avoid in Britain.

In summary I would suggest that our knowledge of mammalian history and our confidence in specific determinations of mammal remains is not yet such that we can always rely on them for stratigraphic correlations. In my view the faunal differences between the sites dicussed by Dr. Sutcliffe are most economically explained not by the assumption of two separate warm phases but by accepting a change in fauna through a single Ipswichian interglacial which paralleled the postulated vegetational changes (Stuart, 1974), even if this requires an adjustment of fixed views regarding warm and cool faunas.

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CARGOES AND FIELD CLEARANCE IN THE HISTORY OF THE ENGLISH CHANNEL

By C. S. Briggs

Kidson and Bowen have written an interesting account of the difficulties which beset mapping out the glaciation of the South of England (1976). Their arguments explaining the coastal presence and inland absence of large foreign boulders, are, as they state, fundamental issues which require examination in some detail. The three main points considered in their argument concern shore migration, floating ice and the recent introduction of foreign boulders through ballast or wrecks. It is proposed here to consider only the problems of ballast, and wrecks, and of the collection and utilisation of field stone (for both structures and artifacts) in historic and prehistoric time, which they rejected outright as an explanation for the apparent absence of recognisable glacial material inland.

Wrecks of building stone and ballast deposition

Kidson and Bowen claimed that much far-travelled material now found in beaches has been introduced as ballast or building stone from offshore wrecks; the suggestion is that granite, Portland and Purbeck stone may be discovered among the boulders under consideration. They also claimed that stone "quarried at Caen and elsewhere in Normandy and Brittany was transported for the building of hundreds of Norman churches and cathedrals in England". They believe that there was good reasoning behind Reid's view (1892), that "there had always been some uncertainty as to which of the far transported blocks found on the Sussex coast were genuine erratics, and which had been brought as ballast, or had been derived from wrecks". It seems strange that even after eighty years, no geologist should have questioned Reid's hypothesis and the writer feels that a re-examination of Reid's argument is long overdue.

The early short-distance coastal movement of building stone is well attested from the archaeological record. A Roman barge still bearing part of its cargo of Kentish ragstone was recently excavated at Blackfriars (Marsden, not dated); the stones were shapeless and each weighed 25-30 kg.

During medieval times, owing to the high cost of overland carriage, shipping stone of various kinds was not an unusual activity (Knoop and Jones 1933, p. 45; Salzman 1952, pp. 349-354). Short distance carriage of small quantities of rock was quite common, but the carriage of large amounts over long distances was very costly and such trade tended to enjoy only the highest patronage. In consequence, medieval accounts contain remarkable datail of contemporary building costs; thus losses at sea are usually documented. It is known, for example, that 14 out of a fleet of 15 ships bearing Caen stone sank during the reign of William I (Brown et al., 1963, p. 491 fn.). This particular fleet has never been located, and even if it were, it is likely that submarine chemistry would have reduced its load to a heap of sand. A stone-carrying barge was discovered near Hadleigh in the nineteenth century, and this probably sank during the winter of 1317-18 (Brown et al., 1963, p. 662, fn. 6). Coastal carriage for Welsh castle-building is very well documented, but quarries were usually less than 30 km from the building site (Taylor 1961, p. 124).

Whereas the early carriage of relatively soft sedimentary building stone is well recorded, the carriage of metamorphic and igneous ones (except of slates and related rock types locally in Wales and Cornwall) did not become common until the later Industrial period. Indeed, Cornish granite was "little used until the fifteenth century, and even then it was not quarried, but obtained in blocks on or near the surface of the soil" (Cox 1914, p. 225). The difficulties of quarrying and transporting such hard rocks were not fully overcome in Britain until the invention of cheap steel drills, steam hammers, carborundum polishers and large merchantships. Thus the use in 1817 of Aberdeen granite at the Custom House site in London (Crook and Port 1973, p. 425) and of costly columns of the same rock at the British Museum in 1834 (op. cit., p. 411), were early examples of a booming fashionable trade, though granite of an unspecified type was being shipped at extortionate cost even before the commencement of the War with France in 1792 (op. cit., p. 89).

Whatever the number of wrecks with such cargoes, it is important to consider the distance over which such ships would disperse their cargoes in the course of time, through initial impact and subsequent tidal scour or drift.

The past decade has seen an enormous growth of interest in wrecks off northern coastal waters. Sténuit has examined several, and his work at Port ná Spaniagh off County Antrim has demonstrated that even in the presence of Atlantic rollers, relatively fragile artifacts may not travel any distance (1972). Further documentation of the recovery of unabraded archaeological material from Atlantic waters comes from the much-publicised dive upon a reef off the Scilly Isles, which has so far yielded a good percentage of the so-called Lady Hamilton's Treasure (Late Bronze and Early Iron Age decorated pottery from Greek colonies in Italy). In neither of these cases has material been found further than about 400 m from the site of the wreck, which calls to question the idea of wrecks spewing out cargoes of granite on to the Ocean floor, later to be dæsseminated among otherwise erratic free storm beaches, thus heaping confusion upon the future unsuspecting geologist.

The word 'ballast' is first recorded in a shipping connection in 1530, though its more common use was as a term for roadmetal (Arkell and Tomkeieff 1953, pp. 2, 59). Ballast for keelweight does not appear to have become commonplace until the fairly recent development of large merchantships; indeed, pig iron has been cast a special shape to accommodate problems of portage. Often, however, ballast comprised waste material such as furnace dross and ash, which would be shot out at agreed localities, usually some distance out to sea, in order not to hinder shipping lanes or increase the silting of harbourmouths.

In view of our considerable knowledge of wrecks and of ballast, there should in future be little difficulty in identifying rock types deriving from them, or of discovering their sources of origin by petrography or the use of historical records.

The utilisation of field stones and the recognition of erratic boulders

In raising the question of whether or not man collected and utilised erratics at an earlier period, Kidson and Bowen have touched upon a sensitive and fundamental aspect of British Pleistocene glaciology. The recovery of information from early and uncontaminated sites, by archaeological excavation, alongside a systematic knowledge of the petrography of erratics is felt by the writer to merit fuller discussion than it has hitherto received.

1. The Geological record

Whereas it has long been known that 'foreign' stones may be found at considerable distances from their origins (Arkell and Tomkeieff, 1953), few systematic examinations of them have been undertaken, and few studies made from thin sections, by which precise comparisons can be made with source rocks. Harmer's macroscopic identifications (1928) reflected the limitations posed by a lack of thin sections, and it is unfortunate that his East-West line - drawn upon the map published posthumously - from the Thames Estuary to the Bristol Channel - should still remain a barrier alike to investigation and progressive thought. In the south of England, the approach which may have developed into a useful method of investigation - that seminal, seemingly anachronistic work of Judd (1902) - was dampened by Thomas (1923). It is sad that the medieval myth perpetrated by the chronicler Geoffrey of Monmouth should have so influenced the investigation of archaeology and glaciology as to have hidden our open-mindedness beneath the singular controversial shadow of Stonehenge. It is salutary that Kellaway has penetrated that shadow and published his belief in the value of collecting and examining erratics in thin section (1971). Unfortunately, data from thin sections of the erratics collected by him and others has not received the same press as the prolific and revolutionary ideas which have otherwise characterised his work.

The writer believes that petrographic examination of erratics - even if only from beaches - is long overdue, since several recent archaeological publications raise issues as fundamental to a knowledge of Pleistocene glaciation as they are to the nature of prehistoric settlement in Britain.

2. The utilisation of fieldstone for structures

It is a widely-held belief that prehistoric man in Britain was willing and able to carry the new materials for building ritual monuments over long distances. Regrettably, Stonehenge has often been central to these arguments. The question of whether man or ice was responsible for bringing the bluestones to Stonehenge has received a great deal of publicity, so much so, that information taken from similar early sites in Wessex and elsewhere has been either ignored or overlooked. The writer believes that useful information is to be gained from the examination of sites and finds made in areas where the nature and direction of ice is not in dispute, and that an extrapolation of this information into the South of England may add a further dimension to the enquiry.

It must be borne in mind that preselite is only a small part of the Stonehenge assemblage, which also comprised sedimentary, igneous and metamorphic rocks; not all of these would usefully have lent themselves to the production of artifacts, and therefore, it would have been pointless for man to carry them there (Gowland and Judd 1902, pp. 106-119). The recognition of a similar assemblage in the fossil soil at Windmill Hill is also noteworthy (Keiller and Smith 1965, 110-120).

In the so-called Highland Zone, Neolithic and Bronze Age cairns contain rock fragments, which were probably won from land clearance in their immediate vicinity. In many years of experience of opening British Barrows, Greenwell had 'never seen anything to lead to the conclusion that a material foreign to the spot on which the barrow was erected had been used in its construction (Greenwell and Rolleston 1877, p. 5). In the case of the one exception which he noted (a barrow in Cleveland examined by Atkinson), sand, basalt and rolled pebbles were recorded, and as it was pointless for prehistoric man to carry material to that particular spot, one can only assume that the basalt was dolerite from the Great Whin Sill, and that the sand had been part of a local deposit. The cairn assemblage is geologically significant in that it preserved a unique local erratic population. Similar boulder assemblages from beneath barrows have been noted in Wales by Fox (1959), though these had rarely travelled any distance.

Stone cairns are much less common in the Lowland Zone; their frequency is likely to be connected with the relative presence or absence of erratic boulder material from the surface of the chalk, and the local substitution of stone cairn matrix giving way to earth, clay or turf (Ashbee, 1969). As cairns often seem to have acted as rubbish dumps for unwanted stone in the Highland Zone, the inclusion of a 9 ton preselite boulder at Boles Barrow in the Lowland Zone, may have something to do with the difficulty of breaking it up. The same may be said of the sarsens found with the preselite boulder at Boles, which also occur commonly in Downland barrows (Kellaway 1971, pp. 34-5).

There is a strong case to be argued for the routine collection and examination of all stone from archaeological excavations in areas of glacial controversy. It seems odd that while data as small as pollen grains and micro-lepidoptera from archaeological and recent geological contexts should be closely studied, larger pieces of evidence such as stone should still often remain ignored. There seems good reason to believe that erratic boulders may have continued to form major quarries for local exploitation until a quite recent date. The keep at Wareham Castle, Dorset had numerous foreign stones incorporated into the rubble of its walls (Renn 1960, p. 60). The precise origin of the granite, quartz and greenish slate which comprised this fill has not been adequately explained, but was suggested to derive from ballast (op. cit. p. 56). However, ships returning from foreign shores during the medieval period were more likely to carry cargoes of economic worth (Salzman 1964, passim), so there remains the possibility that a glacial gravel was quarried locally at Wareham for this fill.

Collecting and using fieldstones for basic economic activities was formerly such a common pursuit that it has received little attention in the literature. It is hoped that by citing examples of the use of erratic boulders outside southern England, some idea may be gained of where they may be sought and found there.

On the Vale of Glamorgan, chert, quartz, limestone, whinstone trap and porphyry were noted in 1815 (Davies 1815, p. 203). At that time, field stones were 'becoming more generally used on roads, wherever ..... convenient' and were 'preferable not only to the rabb, or shale of the quarries, but also to the river stones and gravel of the shale tract. Fieldstones, in the shale tract, consisted frequently of substances foreign to the tract, and 'were commonly of a rounded and abraded form' (op. cit., p. 381). In Argyle, 'numbers of large polished and grooved blocks of hard stone, foreign to the district had been freshly dragged from a field, and were piled along the roadside for building fences' (Campbell 1865, p. 74). Elsewhere, in his travels along the Clyde Valley and its environs, J.F. Campbell observed boulders being incorporated into fences (op. cit., pp. 93, 97), and near Dalwhinney Inn, a railway bridge of erratic-carried granite had been erected (loc. cit., pp. 124-5). Even houses have been built of erratic boulders in Holderness (Pevsner, 1972, pp. 56-7). If, in the presence of modern machinery and a healthy workforce, man scours the land to scavenge stone, then is he not more likely to have done so at an earlier period, particularly where local bedrock was found to be of a limited value for his needs?

The apparent absence of erratic boulders from the present-day land surface of Wessex may be attributable to factors other than that there never were any there in the first place. We simply may not have looked for them in the right places.

3. The petrographic examination of prehistoric artifacts

Hand in glove with the concept that prehistoric man spent much of his time and most of his energy lifting and shifting Welsh dolerite and other rocks in the construction of ritual monuments, is the belief that he was also an avid and well-organised trader of implements. These implements - Neolithic stone axes, and perforated axe types of the Bronze Age, are thought to have been carried by man from 'factories' (i.e. excavated or presumed workshop sites) found on the older, harder rocks in the West and North of Britain, to settlement sites in the Lowland Zone.

The writer has discussed elsewhere certain archaeological objections to this hypothesis (Briggs 1976a) and in a critical review of recently-published work in this field, has suggested an alternative and geological hypothesis (1976b). The argument for an alternative geological hypothesis is based upon distribution maps of Cummins (1974) and Peacock (1969).

Cummins drew distribution maps of Neolithic stone axes, using density contouring per total axe population for any given rock type. The maps incorporate data from the Council for British Archaeology's Implement Petrology Survey. This survey has, over the past forty years, sectioned several thousand implements and Cummins' distribution maps form an important milestone in the history of the investigation of prehistoric implements. It would be impossible to discuss all the groups and their distributions here, but it is noteworthy that the maps do demonstrate an high density of Cumbrian axes in Lincolnshire, and of Cornish axes in Essex. These high densities were inexplicable to Cummins except in terms of the 'bulk carriage' of implements over long distances by people seeking out "markets ..... to trade," notwithstanding the obvious proximity of flint and considerable quantities of (what was previously thought to be) Scandinavian erratic material along the beaches of eastern England; this proximity would surely obviate any need to trade, particularly at a time when society was living close to subsistence level. The present writer believes that the presence of Cumbrian axes in Lincolnshire is probably a reflection of the local use of available Lakeland glacial erratics in that area. By extrapolation, Cornish stone in Essex must be explained in terms of some kind of natural west-east stone-carrying movement. In the absence of precise petrographic information from East Anglian beach pebbles, Kellaway's argument (1971, 1976) for a west-east glaciation of southern England provides a solution of remarkable coincidence.

The writer has questioned the conclusions to be drawn from Peacock's work on thin sections of Neolithic pottery from the south-east England. Peacock argues that a diminution in a west-east direction of certain mineral constituents derived from the gabbroic clay on the Lizard is evidence for Neolithic pottery trading in that direction. It seems that the observed phenomena more likely reflect a natural west-east movement of the clay, a movement which also took Cornish stone to Essex.

It is unfortunate that erratics are often unrecognizable due to exterior alteration, which make them similar to the deposit in which they are incorporated; for example, stone axes often undergo textural and colour changes and may be distinguished from other fieldstones only by their shape. The conclusive recognition of field stones deriving from any great distance, and their distinction from locally-occurring stone, therefore, becomes a systematic time-consuming occupation involving chipping, breaking, and thin-sectioning, and this to small pebbles which may have suffered structural alteration to their outer shells through the chemistry of a local environment. It is little wonder that neither geomorphologists nor archaeologists have become ardent amateur petrographers, and that the petrologist has apparently devoted himself to more fundamental issues of petrogenesis. Hopefully, in future, greater attention may be paid to uncontaminated early ground surfaces, or to the stones incorporated into early man-made structures, particularly in areas where the actual direction of ice movement is in some doubt.

Conclusion

It may be appreciated from the foregoing arguments that many questions of glacial movement derive not only from stratigraphic observation, but also from consideration of a wide range of archaeological and historical data. Indubitably, much of the evidence for a southern glaciation is capable of alternative explanation: this note deals very briefly with only two of the many issues involved. However, to reject alternative explanations without proper examination, merely because of the lack of convincing stratigraphical succession, and to condemn the attempts of those who have carefully sifted the available evidence, producing a working hypothesis though not effecting a precise formula, seems a condemnation of the motives of science itself.

The petrographic comparison of known erratic material from southern shores with that of quarrystone and historic records should leave no doubt as to its origins in the mind of the careful investigator. Even without petrography, there seems insufficient evidence to suggest that either wrecks or ballast might ever have had any significant influence upon beach boulder populations. There is an obvious need for systematic fieldstone collection, and a census of excavated stones, whether from archaeological, building or pipeline trenches, in areas where theories are almost as numerous as erratic sightings. The fresh macroscopic and microscopic examination of primary collected data seems fundamental to any solution and ought not to be lost sight of in the pursuit or propogation of theory. The outcome of such investigation may not provide a full picture of the glaciation of southern Britain, but it should at least help test existing theory and could well provide fresh insight into the complexity of the problem. Surely, outright rejection of historic sightings of 'foreign' stones, and of stones which were converted to artifacts is a challenge to the historic and archaeological record, and forces the reader to turn to Walter Davies, who realised that 'they must have been brought from a distance; and by what means less objectionable than a deluge?' (1815, p. 381).

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QUATERNARY STUDIES AT BIRKBECK COLLEGE, UNIVERSITY OF LONDON.

Quaternary studies and kindred research at Birkbeck College, is at present being carried out in the Departments of Botany, Geography and Geology. Three general topics are under investigation: a) The study of Tertiary taxa and plant assemblages, with particular reference to southern England; b) Late Tertiary and early Pleistocene palaeoenvironments around Lake Turkana in northern Kenya, with particular reference to the habitat of early man; c) Middle and late Pleistocene sediments and landforms in various parts of Britain and northern Scandinavia.

Although the study of Tertiary flora is strictly beyond the range of Quaternary research, similar principles and techniques are used and the results have a close relationship with results derived from the study of early Pleistocene flora. The work is directed by Professor W.G. Chaloner who is head of the Botany Department. At the present time research is being carried out by Miss Margaret Collinson, who is concerned with Tertiary fruits, seeds and fern sporangia as a basis for the interpretation of fossil plant assemblages, and Peter Smith, who is investigating Tertiary epiphyllous fungal spores and their palaeoclimatic implications.

The work done at Birkbeck College on the late Tertiary and early Pleistocene palaooenvironments around Lake Turkana (formerely Lake Rudolf) is part of an international, multidisciplinary project directed by Richard E. Leakey of the National Museum of Kenya investigating the origin, age and habitat of early man. Those from Birkbeck College who are concerned with the project are Frank J. Fitch who is geochronologist, and is responsible, along with Dr. John A. Miller of Cambridge University, for dating the tuffs, that lie within the sedimentary sequence, by the potassium argon method; A.J. Hurford, who is responsible for dating the same material by the fission track method, and Dr. Ian Findlater who has completed a study of the depositional history of the basin, and is now regional geologist to the expedition.

Most studies of middle and late Pleistocene sediments and landforms are either process or regionally orientated. Of the first type Alan Boatman of the Geology Department is investigating the sedimentology of the Red Crag in Suffolk and Essex; Dr. Bryn Roberts of the same department is studying the depositional processes associated with glacifluvial sediments near Cardigan in Wales, and Jim Rose of the Geography Department is concerned with local and regional variations in till lithology in East Anglia. The large scale study is in conjunction with Dr. R.M.S. Perrin and Mrs. Hilary Davies of the Department of Applied Biology at Cambridge. In addition, Jim Rose is concerned with Late Glacial fluvial processes in low relief catchments. This project involves a study of Late Glacial Palaeoenvironments along with Dr. Charles Turner (Open University), Dr. Russel G. Coope and Mike D. Bryan (Birmingham University). Regional studies are widely distributed and are entirely the concern of Geographers. Jim Rose, Peter Allen and Colin Whiteman are investigating the Middle Pleistocene stratigraphy in southern East Anglia; Jim Rose, Jocelyn Letzer, John Boardman, and Mike Edwards are mapping and analysing glacial landforms and sediments in north west Yorkshire and eastern Cumbria; and Jim Rose is studying glacial and shoreline landforms and sediments in the Glasgow district. In conjunction with Francis M. Synge of the Irish Geological Survey, Jim Rose is also studying the glacial and shoreline landforms along the southern shore of Varangerfjord, north Norway.

In addition to these research topics aspects of Quaternary Studies are taught at the undergraduate level in cources on Climatic Change (Dr. Derek O. Lee, Geography) and Palaeoenvironment Analysis (Jim Rose and guest lecturers, Geography). Reference to Quaternary Studies is also made in other courses taught in the College, such as Palaeobotany (Professor W.G. Chaloner, Botany), Glacial Geomorphology (Jim Rose, Geography), Hydrogeomorphology (Dr. Ian Reid, Geography), and Geochronology (Frank Fitch, Geology).

CALENDAR OF MEETINGS

22 August - 2 September, 1976	Quaternary Research Association study course southern Norway.
11-12 September, 1976	Yorkshire Geological Society field meeting on glacial and periglacial deposits of Holderness and the Yorkshire Wolds. Leaders J.A. Catt and P.A. Madgett.
24-26 September, 1976	Quaternary Research Association weekend field meeting, north Norfolk. Leader H. Evans; further details given in the circular for June 1976.
15-17 October, 1976	Geologists' Association field meeting on the Pleistocene geology and archaeology of the Gipping Valley, Suffolk. Leaders J. Rose, J.J. Wymer and P. Allen.
30 October, 1976	William Pengelly Cave Studies Trust seminar on underground sites in south-east England, Institute of Geological Sciences lecture theatre, Exhibition Road, London. Further details from J. Wilmutt, 80 De Beauvoir Road, Reading, Berks.
8 January, 1977	Quaternary Research Association Discussion Meeting, Durham.
1-5 April, 1977	Quaternary Research Association annual field meeting and Annual General Meeting, Bristol.

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