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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 January, 1st May and 1st October. 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, Soils and Plant Nutrition Department, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ, England.

GEOLOGICAL AND SOCIOLOGICAL PROCESSES IN PREHISTORY

By C.S.Briggs

ApSimon (Quaternary Newsletter No. 23) is right to reintroduce stone axe factories into the contentious area of prehistoric trade. Indeed, the work of Dr. Le Roux deserves greater consideration than it has hitherto received in Britain. Nevertheless, it was to the English working floors that I originally referred, and to these we must return. Since last writing, I have made further investigations of Lake District sites (Gp VI), their rocks, products and exports, and here advance my broader conclusions in advance of more definitive publication.

The Borrowdale factories are scattered over a wide area. Primary exposures are seldom tapped, and recycled rocks are the best-known source of the axes, as is also the case at Penmaenmawr (Clough, 1973, 36-37). Prior to the discovery of these sites, a number of Borrowdale axes had been discovered at sites throughout Cumbria (Fell, 1964). The evidence suggested to their discoverers (e.g. Cowper, 1934) that the axes had been made where they were found. The concept of trading these axes rests upon the evidence of the "roughouts". These are axes believed to have been made at the primary working floors and to have been carried to the occupation sites, where they have been excavated or have appeared as stray finds. Accordingly, these implements should be in a sharp, factory-fresh condition. In both Cumbria and Cornubia they comprise a third of the total axe population. With its scarcity of roughouts away from the factory, the Breton industry differs markedly from the Cumbrian, and we cannot draw the same conclusions from it (as noted by Le Roux himself, 1971, 283-284; 1973, 18).

Observations made by John Chapman, James Cherry and Stuart Needham (Carlisle Museum, Seascale and British Museum respectively) show that the roughout axes are not factory fresh. Indeed, whereas the sides and even the faces of unweathered specimens are sharp, their blades are blunted with wear. Being worn, it is clear they are not trader's goods in transit. It would appear they were flake axes intended for use without polishing. This is not surprising, since the use of recycled volcanics in Cumbria has a history going back to the Mesolithic (Cherry and Cherry, 1973).

At sites for which records survive, Cumbrian flake axes have been discovered alongside waste flakes presumed to have resulted from local manufacture. Indeed, within the area in which the flake axes occur

there is an enormous amount of recycled Borrowdale Volcanic material, the greater part of which appears to have been suitable for implement making (Mayoh, 1977). As recycled material was used in preference upon and around the primary exposures of the rock, why should it not have been throughout the whole Cumbrian massif, and indeed wherever the rock could be found ? The loss of one third of the traded product would seem an inordinately large deficit for a peasant community at subsistence level. It may be concluded that in the presence of widespread raw materials and in the absence of real artifactual evidence to the contrary (in the form of unworn roughouts), there is no real motive to trade, and as with many present-day peasant societies axes were made when and where they were wanted.

ApSimon's comments about the distribution of the French axes in relation to recycling pose a problem as crucial to French as to British archaeology and geology. In 1953 L'Hostis commented that "our Neolithic man did not waste effort in painful searching, and we have the impression that the beach and its pebbles provided most of his materials. In any case, the local subsoil is rich in petrological material and we think that a lot of the axes were made from boulders taken from it" (p. 155). ApSimon gives the impression that processes of recycling are as well known, or better known, in Brittany than in Britain. I am unable to find any geological studies which show this to be the case, and which prove the suggestion of L'Hostis to be invalid. Indeed, Charles-Tanguy Le Roux recently confirmed in conversation that no programme of collecting and slicing erratics has been undertaken, nor is any in mind for the future.

Although axes of Breton stone have been found in England (Giot, 1976), there are only five, and these need not indicate trade. The presence of suitable Breton axe-making rock was observed by H.H.Thomas almost 50 years ago (Engleheart, 1930). Both Engleheart and Mrs. Cunnington appreciated that suitable south-western and Breton material was to be found on southern English shores, and Professor Piggott believed until 1954 (p. 301) that most of the perforated implements were made from such transported pebbles. Recognition of Breton material along the south coast has been recently reaffirmed by the petrological work of Destombes (in Kellaway et al., 1975). This fact cannot be overlooked in any discussion of Holocene recycling. Neither can we easily dismiss the blocks of Breton and Cornubian metamorphic and igneous rocks described by Godwin-Austen (1857) without further geological explanation. Although ApSimon suggests that these rocks did not arrive by Holocene glaciation, he offe s no alternative explanation for them.

To my knowledge, Shotton and ApSimon are the first to suggest that the jadeite of which the British implements are fashioned comes from the Alps (cf. Campbell-Smith, 1963). Even in Brittany, where near-jadeite and fibrolites are common materials for artifacts, petrographic matches have never been found in primary geological exposures.

Finally, there can be little point in "elucidating social mechanisms in prehistory" without first thoroughly mastering our own understanding of the natural environment. Estimates of available hard stone, for instance, should be based upon systematic sampling. Some useful figures already exist. For example, out of 1100 boulders over 1 ft. in diameter on the south side of Flamborough Head, Lamplugh (1891, 408-410) found that 48-49% were hard crystalline rocks and only 1% was of local origin. From a similarly large sample taken around Dimlington (Holderness), over 20% derived from the Great Whin Sill (Gp XVIII)

(Stather, 1901). According to Campbell-Smith (1963b), 10-20% of the Bunter Pebble Beds, which are recycled over much of eastern England (Sabine, 1949; Rose et al., 1976), are from igneous and metamorphic rocks. Chesil Beach has yielded a large repertoire of igneous and metamorphic rock types, which may comprise up to 15% of the total pebble populations (Carr and Blackey, 1969, 138). If the population of Neolithic Britain ignored these deposits, there may indeed have been an axe-trading elite, as ApSimon argues. Certainly at the moment both archaeological and geological evidence provides many hypotheses with which to speculate.

However, in retrospect I cannot accept that my Yorkshire forbears ignored the boulders of Borrowdale and Great Whin Sill rock in east Yorkshire in favour of long treks to primary exposures, or of trade with canny Cumbrians. Nor do I see the rural north Welshman, long renowned for his thrift, doing anything similar when Lakeland rocks are so abundant along the coastal plain of Snowdonia.

I am indebted to Jim Cherry, John Chapman and Stuart Needham for kindly undertaking examinations on my behalf.

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Editor's note: This discussion is now closed.

INQUA NEWS

The tenth Congress of INQUA was held in the University of Birmingham from 16th to 24th August 1977, being preceded by ten and followed by nine field excursions that covered a variety of areas and Quaternary topics in England, Scotland, Wales, the Republic of Ireland and the Isle of Man.

A total of over 900 participating, accompanying and student members from 50 countries, including 167 participating or student members from the U.K. and 11 participating or student members from Ireland, attended the Congress. Accommodation was provided for the bulk of the participants in several Halls of Residence of the University and in the Holiday Inn in central Birmingham, but over a hundred members found their own accommodation and attended the Congress on a day-to-day basis.

Meetings of more than twenty INQUA Commissions and Subcommissions, together with meetings of a few IGCP Projects, occupied the first day of the Congress, whilst the other 5½ working days consisted of six concurrent lecture-discussion sessions on topics grouped under the titles: Quaternary Environments and Processes, Present Environments as Quaternary Analogues, Quaternary Flora and Fauna, Quaternary Stratigraphy, Man and The Quaternary.

Three symposia were included in the scientific programme. That on 'Antarctic glacial evolution and world palaeo-environment' was organised jointly with the Scientific Committee on Antarctic Research (SCAR). The others were on the themes, 'Dendrochronology' and 'Mapping and modelling Quaternary climates'. The latter of these was especially well attended and included a number of papers that were regarded as of outstanding significance.

Other features of the working part of the Congress were the display of more than 40 exhibits of very varied character (including a Sales Centre manned by members of the Quaternary Research Association), a bookstall organised by representatives of Geo Abstracts and a desk at which Professor S. Horie and his colleagues from Otsu Hydrobiological

Station, Kyoto University, Japan, distributed free copies of a 836-page volume on the palaeolimnology of Lake Biwa !

Provision was also made for the social and recreational sides of an international meeting by the staging of a concert of popular classical music in the Great Hall of the University by the City of Birmingham Symphony Orchestra, the serving of a Congress Dinner in Mason Hall, and the organisation of many bus excursions to places of historical and general interest on Sunday 21st August, a non-working day mid-way through the Congress. Also, an evening reception was given by the University after the Congress opening ceremony on 16th August, and a lavish civic reception was given in the Council House on another evening during the Congress. A further popular evening feature was the delivery of two lectures on 23rd August in the Great Hall of the University, the first by Professor W. Watts (Trinity College Dublin) on "Late-glacial vegetational events in western Europe and eastern North America", and the second by Dr. G. R. Coope (Birmingham University) on "The Giant Deer of Ireland: not fabulous but make-believe".

Publications issued to participating members of the Congress were:

Abstracts of papers presented at the Congress

British Quaternary Studies: Recent Advances. (A volume containing contributions by leading Quaternary scientists)

A map of the Quaternary deposits of Britain (published in two sheets by the Institute of Geological Sciences).

The new officers of INQUA, elected at the final session of the General Assembly on 24th August 1977, were:

President	:	Professor Jane M. Soons, University of Canterbury, Christchurch, New Zealand
Secretary-Treasurer	:	Professor Roland Paepe, Vrije Universiteit Brussel, Kwartairgeologie, Pleinlaan 2, B-1050 Brussel, Belgium
Vice-Presidents	:	Professor J.J.Donner, University of Helsinki, Finland
		Professor H. Faure, Centre National de la Recherche Scientifique, Marseille, France
		Professor K.V.Nikiforova, Geological Institute of the Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.
		Professor A.L.Washbirn, University of Washington, U.S.A.
Past President	:	Dr. V. Sibrava, Geological Survey of Czechoslovakia, Prague, Czechoslovakia.

The eleventh Congress of INQUA will be held in Moscow, U.S.S.R. in 1982.

THE INQUA LOESS COMMISSION

By I.J. Smalley

There are more than thirty commissions, subcommissions and working parties of the International Union for Quaternary Research and their function is to correlate and encourage the world-wide endeavours of Quaternary investigators. Commission no.4 is the Loess Commission; it was formed as a sub-commission at the 1961 INQUA meeting in Warsaw and upgraded to full commission status at the 1969 Paris meeting. The 1973 meeting in Christchurch N.Z. was not very successful for the commission since very few of the active members from Central Europe could make the long journey; this was fortunately not the case at the 1977 Birmingham meeting and the business meetings of the commission were encouragingly crowded.

One of the major aims of the commission has been the production of a map of European loess deposits. This will supercede the map produced by Rudolf Grahmann in Leipzig in the early nineteen thirties which has been the standard map of European loess distribution for more than 40 years (reproduced by Charlesworth, Flint and Woldstedt). The production of the map is being directed by Gunter Haase of the DDR Academy of Sciences at Leipzig. Data for the UK part of the map was supplied by John Catt and publication is planned as an adjunct to Petermanns Geographische Mitteilungen. It was hoped to have both sheets (east and west) ready for 1977 but there have been delays. The most serious delay was caused by the lack of a suitable topographic base for the eastern section of the map but I.P. Gerasimov of the Soviet Academy of Sciences has now managed to supply this.

At the Birmingham meeting, Julius Fink handed over the presidency to Marton Pecsi who, as director of the Institute of Geography of the Hungarian Academy of Sciences, is well placed to promote the future activities of the commission. Fink, of the Geographical Institute in Vienna, has guided the commission through its early years and has been particularly successful in the fields of stratigraphic correlation across national boundaries and of detailed studies of particular loess sections (e.g. that at Krems in Austria). The major stratigraphic publication is probably 'La Stratigraphie des Loess d'Europe' which was published as a supplement to the Bull.de l'Asso.Franc. pour l'Etude du Quat. for the 1969 congress. Copies of this are still available; some were on sale at the Birmingham congress. Fink (1976) has also reviewed the commission's activities in Eiszeitalter und Gegenwart (27, 220-235).

The new INQUA regulations require a fairly rapid turnover of commission personnel and the new establishment is: president M.Pecsi (Hungary); vice-president B.Frenzel (Germany BRD), secretary O.Fränzle (BRD) and a group representing Europe: J-P.Lautridou (France), J.Fink (Austria), J.Macoun (Czechoslovakia), A.E. Dodonov (USSR) and I.J.Smalley (UK). Activities in North America will be co-ordinated by R.V. Ruhe(USA), and J.M. Bowler (Australia) will do the same for Australasia and the Pacific regions. With the stratigraphic correlation and map production programmes virtually completed the commission will now be looking at more easterly deposits, and concentrating on practical aspects of loess such as irrigation and foundation engineering problems.

The move to the east has already begun and the commission made a field trip to the western parts of the Soviet Union (Ukraine and Moldavia) in 1976. Closer contacts are being developed with Soviet loess investigators and with the next INQUA congress scheduled for Moscow in 1982 there should be an opportunity of seeing some of the famous Russian loess deposits which have been the background to so much controversy. G.A. Mavlyanov, director of the Institute of Geology in Tashkent, has proposed an excursion to regions east of the Caspian Sea and this could offer a rare opportunity of seeing and sampling the famous Tashkent loess. There is some hope that the commission may also gain access to the loess in north China. J.M. Bowler reported at Birmingham on the links established between Australia and China. A group from the Australian National University has visited the classic loess regions of north China and brought back samples and loess literature. Important papers will be translated and published in English. In particular the major loess works by Liu Tung-sheng and his collaborators will be made available. The contact at present established is at governmental level, but the commission hopes to participate in studies of one of the world's most fascinating and still problematic loess deposits.

Loess studies in the UK are developing and there is an increasing appreciation of the contribution made by loess material to the soils of eastern England. One paper in the loess group at Birmingham concerned UK loess (D.N. Eden on 'The Loess of North-East Essex') and there is no doubt that although the British deposits are of modest size they do have a contribution to make to the overall European picture.

NOTES ON EARLY FLANDRIAN DEPOSITS IN THE KENNET VALLEY (BERKSHIRE)

By D.T. Holyoak

Large gravel pits have been excavated over the past two years in the floodplain of the R. Kennet at Thatcham, new Newbury. These have exposed up to 3 m of gravels resting on London Clay and capped by 1-2 m of Flandrian peat and tufa. Higher layers of peat were apparently removed by peat-digging before the last century.

Studies of the floodplain gravels by Cheetham (1976) suggest they were deposited by a system of braided channels during the Devensian. Small lenses of sand and silt in the upper half of the gravels have yielded plant macrofossils and Mollusca. One silt lens gave a C 14 date of 9909 ± 75 years BP (BM- 1402) from wood fragments, and contained leaves of Betula nana and Arctyostaphylos uva-ursi among other plants, and a molluscan assemblage including Columella columella and Pisidium obtusale var. lapponicum.

Deposition of peat on top of the floodplain gravel was apparently preceded by a long period during which the area was colonised first by scrub and then by birch woodland. A tree stump rooted in the top of the gravels was dated at 9280 ± 89 years BP (BM- 1358) (P.Worsley, pers.comm.) and the following dates were obtained for Cheetham (1976) from basal peat at a site 1.5 km away: 8928 ± 71 (BM- 1135) and 9223 ± 100 years BP (BM- 1136).

Bones of Bos primigenius and Cervus elaphus, found beneath peat on top of the gravels, apparently date from the period between about 9900 and 9300 years BP.

The Thatcham Mesolithic site investigated by Churchill (1962), Wymer (1962) and others is less than 200m from the edge of the new gravel pits, near the bluff of the 2m river terrace. Churchill's work shows that birch and pine were present there by 9868 ± 160 years BP (Q-651), while charcoal from hazel nuts and wood at a hearth site produced the early date of 10,058 ± 170 years BP (Q-658). At the level where worked flints were most abundant (dated c. 9808-9698 years BP, Q-650, Q-677) a characteristic Zone V pollen spectrum dominated by pine was obtained.

Closed woodland vegetation would thus seem to have appeared later on the floodplain gravels than on the soils of the 2m terrace. A more open character of the vegetation on the floodplain during the period from about 9900-9300 BP may have made the area attractive to both the large ungulates and to Mesolithic man. This and other factors could account for the concentrations of Mesolithic flints discovered along the edges of the floodplain by Froom (e.g. 1972, 1976).

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A LAST INTERGLACIAL SITE IN THE EAST MIDLANDS OF ENGLAND

By A.R.Hall

This short note contains a brief description of the litho- and bio-stratigraphy of a new Last Interglacial (Ipswichian) site near the village of Wing in Rutland (now Leicestershire).

Borehole evidence had shown that a sequence of boulder clay and interglacial peats and clays occupied a small, deep, steep-sided and closed basin cut into solid ironstone and Lias clays on the interfluve between two small streams flowing in large valleys near Wing. Pollen analysis indicated that the interglacial deposits were of Ipswichian age, with a particularly marked Carpinus component (Zone III) and the virtual absence of Picea and Abies. Zones II-IV were represented, together with a continuous record into the Early Devensian, making this one of the most complete sequences yet available for the Ipswichian in Britain. Unfortunately, although a rich macrofossil flora provided valuable information about the local vegetational and environmental history, the similarly local provenance of the pollen rendered

comparison and correlation with pollen diagrams from other sites difficult. However, some parallels were found with sites in north-west Europe, where small basins have been described.

Through much of its existence the basin at Wing must have contained a lake, often of some considerable depth, but during Zone III of the Ipswichian a birch-Sphagnum bog evidently extended across its surface. However, this was inundated with minerogenic sediment during the climatic deterioration of Zone IV, and a lake was re-established in which Early Devensian silty clays accumulated, filling the basin and sealing off the peats beneath.

The boulder clay which appeared to floor the basin is lithologically similar to the Oadby Till in the Melton Mowbray - Leicester area to the north-west, and the dated interglacial deposits above reinforce the view that the till is no later than Wolstonian in age.

Although the origin of the basin at Wing remains uncertain, it is likely that only the action of ice or subglacial water could have excavated a depression some 15m deep and about 100m across in this unusual topographic setting. An alternative explanation, involving excavation of a gull, was dismissed on grounds of field evidence, especially the nature of the basin.

Four interesting new palaeobotanical records were made during the investigation.

THE FIRST RECORD OF A FOSSIL NALED IN BRITAIN

By P. Coxon

Naleds, icings or aufeis are described by Muller (1947) as "a mass of surface ice formed during the winter by successive freezing of sheets of water that seep from the ground, from a river, or from a spring". Naleds form sheets of ice on floodplain surfaces, and are usually less than 1m in thickness and 0.5km^2 in extent. However, naleds associated with springs can also be quite large (French, 1976), and Shumskii (1964) reported one 27km long, 10m thick, and containing up to 5 x 10^6 m^3 of ice.

The literature concerning naleds is quite extensive, and they are frequently referred to in groundwater investigations and other studies dealing with permafrost and periglacial conditions. They have been discussed by Anisimova et al. (1973), Ferrians et al. (1969), Thomson (1966), Brown (1970), Cailleux (1973), Nekrosov and Gordeyev (1973), Baranowski (1977), French (1976), Cegla and Kozarski (1977) and Washburn (1973). Kozarski (1975) described oriented kettle holes in outwash plains of the last glaciation in north-west Poland. Their shape (ellipsoidal or very elongated), position (on outwash plains some distance from end moraines) and depth (which corresponds to the known thickness of naleds from periglacial areas in Spitsbergen and Siberia) suggest that they were formed by melting of buried ice or naleds. As naleds are characteristically shallow, their form is not readily fossilised. They are all too easily overlooked, or ploughed over so that their imprint is missed.

Investigation of a hollow in the floodplain of the Little Ouse River has shown the fossil structure characteristic of naled depressions described by Kozarski to be present. The fossil naled is

now a small elongated and enclosed fen called Bugg's Hole lying about 1 km north-west of Thelnetham in Suffolk at Grid Reference TM 005 793. At its present extent it is 350 metres long and about 50-60 metres wide. The results of 79 boreholes in and around the fen give a very good idea of the morphology of the hollow. They show that the basin was once more extensive and elongated, approximately 500 metres long and 60 metres wide. There is no rim to the basin and it is no deeper than 180 cm. The boreholes all show that the basin is lined with sand and gravel. Within the hollow there are two slightly deeper troughs present either side of the centre. Bugg's Hole has remained a shallow hollow probably due to the input of a spring feeding the basin at its western end. This spring has a high and constant discharge from chalk on the slope to the south of the basin, and presumably prevented any attempt to drain the basin and work the area.

Naleds require an input of water from varied sources to form. The sources can include springs, percolating water from nearby rivers, and river floodwater. Assuming that the spring behaved in the Devensian as it does now, then the hollow would have had a direct and continuous source of water. Also, a palaeochannel about 150 metres to the north-east of the hollow is clearly visible both in the field and on aerial photographs. If this channel was active during the formation of Bugg's Hole, it too could have provided a supply of water by percolation and perhaps flooding. With mean annual temperatures during the coldest part of the Devensian in southern England estimated at -6°C to -8°C (Williams, 1969), then the water from the spring and/or river would have frozen in successive sheets to form a naled on the floodplain surface. Such a sheet of ice would prevent aggradation at that point, and together with freeze/thaw action would produce a hollow in the sands and gravels of the floodplain.

A Livingstone core (2") taken from the hollow showed grey clays at the base overlain by organic detritus. The clays form a layer about 40 cm thick over most of the basin. Pollen analysis of the core showed that the lower sediments were Late Devensian in age with the presence of pollen of Betula, Pinus, Salix, Juniperus, Hippophae, Helianthemum, Thalictrum, Filipendula, Gramineae and Cyperaceae. The sediments above 70 cm in depth were greatly disturbed and contained high frequencies of the pollen of Cannabis. This upper organic detritus is believed to have been disturbed by the wretting of Cannabis within the hollow, perhaps as late as the last century when Tithe records show extensive Cannabis cultivation in the area.

The Late Devensian pollen assemblage at the base of the hollow is very similar to that found in ground ice depressions at Thompson Common in Norfolk (Bradshaw, unpublished). The Thompson Common site also contains very high frequencies of Cannabis pollen at the top of the sequence. Kozarski (1975) noted that the oriented kettle holes produced by naled ice also contain pollen dated to the beginning of the Flandrian and probably earlier.

The floodplain depression at Bugg's Hole appears to have formed due to the massing of ice in layers to produce a naled. The ice formed an elongated hollow by preventing aggradation and by freeze/thaw action. When the ice melted during the Late Devensian, the hollow began to fill with sediment, and as the hollow was difficult to drain the fossil form of the naled has been preserved.

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DEVENSIAN ELEPHANTIDAE WITH REFERENCE TO THE TERRACES OF THE WARWICKSHIRE AVON

By P.F.Whitehead

Palaeoloxodon antiquus Falconer and Mammuthus primigenius Blumenbach shared a common ancestor, and both underwent rapid evolution but along diverging lineages (Zeuner, 1958, 1959; Kurtén, 1968). At the point in time when M3's contained (14-)16-21 laminae, the transition from Archidiskodon meridionalis Nesti to M. primigenius includes what is called Mammuthus (= Parelephas) trogontherii Pohlig. Undoubtedly teeth are the yardstick by which this evolutionary process may be rationalised.

The Elephantid teeth discussed here form part of a comprehensive macro-vertebrate bone assemblage from the Devensian of the Warwickshire Avon Valley. The Avon Valley contains five terrace levels, mapped and numbered by Tomlinson (1925), to which Shotton (1968) has applied a time scale. Three of the five terrace deposits have to date produced elephant remains, although the Ipswichian gravel spreads of No. 3 level have yielded only one M1 of M. primigenius type, found during the last century and now in the Department of Geological Sciences at Birmingham University. Only the vegetation of interglacial ecosystems could mutually satisfy both P. antiquus and M. primigenius in northern Europe, and if both "true" species coexisted that must on present knowledge have been during the Ipswichian. In certain unusual mixed faunas, however, coexistence in life cannot be regarded as proven (e.g. Shotton, 1968).

Avon No. 4 terrace deposits have been ascribed to the Lower Devensian and may ante-date the Chelford interstadial. Avon No. 2 terrace deposits and their tributary correlatives are within reach of C14 dating and are Mid-Devensian. Of the 140 elephant teeth (including fragments) that I have collected and catalogued from Avon No. 2 terrace, 50 are complete enough to measure. I have applied to these teeth the measurements of laminary frequency (L.F.) and the inversely proportional laminary index (L.I.) (Morrison-Scott, 1948). The L.I. is very similar to the length:lamellae quotient (LLQ), except that the L.I. applies only to the occlusal surface. Elephant molars exhibit horizontal curvature, which creates buccal convexity and lingual concavity. Sagittal curvature would produce different LLQ's on any one tooth if the measurement was applied to both distal and proximal ends of the laminae. The L.I. minimises distortion resulting from such curvatures.

Ill-advisedly perhaps, I have regarded talons as laminae for purposes of metrication, for the most anterior and posterior enamel loops behave so much like laminae that their inclusion has little effect on the laminary index measurement. The occluded dentine of truncated roots has, however, been excluded from this measurement. Although this may be regarded as a novel departure, it is one of simplification. Much of the old literature (e.g. Busk, 1868; von Zittel, 1925) is confusing on the question of techniques of biometrication.

From the Carrant Main Terrace (= Avon No. 2), L.F.'s range from 6.1 to 12.5 and L.I.'s from 10.1 to 16.5. The assemblage therefore has the general flavour of M. primigenius. There is a tendency, though not an exclusive one, for upper molars to be more compressed

than lower molars. Most upper molars have L.F.'s of 8.5-11.0, whilst many lower molars including all M2's have L.F.'s of 6.1-8.5. On a graph there is no clear segregation of the scatter about foci, which detracts from, but does not dispel, the possibility of ecologically differentiated races. Wide ranges of laminary compression could be an expression of ontological variation. From my own evidence, it is not clear either what the effects of sexual dimorphism (other than that of absolute tooth size) might be. At Achenheim-Hangenbieten, Guenther (1971) seems to record a distinct Weichselian horizon in which M. primigenius forma trogontherii predominates. Lower and Middle Devensian Mammuthus teeth from the English Midlands (including those from the Upton Warren site) show no characters which suggest temporal distinction. In Poland, Kubiak (1965) measured 90 or so elephant teeth from sites of various ages, and found that M2's may reach an L.L.Q. of 18.0, whilst those for all other Mammuthus teeth did not exceed 15.0. Guenther (1973) referred Weichselian teeth from Ehringsdorf to M. primigenius forma trogontherii with L.L.Q.'s as low as 12.5, well within the limits of the sample here described. Curiously, many of the teeth so referred by Guenther (and all in his Table 11) are M2's. Are Guenther and Kubiak interpreting the same thing differently. Although I may not always do so, I presently hold the view that the bone material from the Carrant Main Terrace (but not all other sites of similar age in the Avon Valley) is broadly homochronic. Although this cannot be proved, the evidence which that belief hinges on is:

a) radiometric dates cover only some 5,000 years of the late Mid-Devensian (Shotton et al., 1974, 1975) up to about 32,000 BP. (A buried channel ante-dating the main aggradation, but still to be dated, contains Bison (91%), Rangifer tarandus L. (2%) Coelodonta (0.5%) and Microtidae, but no elephants; this fauna may be closer to the thermal maximum of the Upton Warren interstadial complex),

b) the faunal spectrum constructed from vertebrate bone from one horizon is ecologically coherent and uncontaminated by derivations which might imply conflicting biozones,

c) successful finite C14 dates on mammalian bones in Britain are in agreement with evidence from other sources. Many such dates are referred to by Stuart (1977), and others would include Birm-466 (Mammuthus tusk, R. Dikler, Gloucs.) and Birm-656 (Bison sacrum, Broadway, Worcs.); these dates reinforce the previously assumed correlation of both sites with Avon No. 2 terrace.

d) some appendicular bones show "chromatographic" zones of iron and manganese precipitated out of solution. This is due to alternate wetting and drying, which could be explained by transportation of the bones. In the knowledge that this process would be enhanced by bone mineralisation, and that in the Carrant Valley vertebrate remains today occur almost exclusively at the gravel-Lias junction in a permanently moist, base-rich groundwater situation, this could be against very close homochronism. Yet it need not imply marked heterochronism. In other words, the bones may have been sub-fossil while the Devensian river was still active.

This is an interim summary of the problems which beset an understanding of Elephantid teeth in the Upper Pleistocene. Since substantial assemblages of broadly known age are still open to nuances

of interpretation, it is clear that characters of isolated or small groups of teeth are practically useless as tools of biostratigraphic correlation, except in the widest sense.

I specially wish to acknowledge the assistance of Professor F.W. Shotton F.R.S. I have also benefited from the professional services of many people, including Professor E. Guenther, Dr. Frances Bell, Miss Ann Conolly, Dr. J. Tallis, Mr. J.M.Hodgson, and in the field H. and S. Walkley, G. Evans, T.D. Holland-Martin and the late H.Green.

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QUATERNARY STUDIES AT KEELE

By E.A.Francis

Keele was the first of the British University foundations to be set up after the second world war, and began as the University College of North Staffordshire in 1950. In spite of this name, it has always been independent, and has conferred its own degrees from the outset. This independence was given full recognition in 1962 by the Charter of Incorporation as the University of Keele.

The original idea of Keele's foundation was to leaven the normal specialised type of University education by instituting a four-year course which would provide all undergraduates with an initial common foundation year covering various aspects of the world and its problems, followed by the study of at least four subjects, which should not be restricted either to the arts or to the sciences. This broad education was designed to provide students with a background to enable them to meet the intellectual challenges presented by modern western civilisation. The idea of an educational community was held to involve the residence of both students and staff, and at the present time about 90% of undergraduates, 88% of all students, and about 54% of academic staff live on campus. Lord Lindsay's concept of a "right balance between specialisation and expert knowledge on the one hand and a wide outlook and general understanding on the other" seems appropriate for the development of an educational environment in which multi-disciplinary courses such as Quaternary Studies might flourish. However, in practice such inter-departmental courses are few, and are restricted to such combinations as Philosophy, Politics and Economics, or Mathematics, Physics, Electronics and Computer Science.

Undergraduates may now take either a four-year or a three-year course. In the former, the first year is spent on the foundation year, which has survived with periodic minor modifications, and the following three years include study of two subjects at principal level and two at subsidiary level each for one year. In the three-year course, the foundation year is omitted. Students who study two natural sciences at principal level generally have the option in the final year of specialising in only one of these. All students are candidates for degrees with honours. Keele is still a small University with only about 2750 students. The breadth of the commitment undertaken by all students results in a complex timetable, which still extends into Saturday mornings, and there is little latitude for the introduction of new combinations of subjects or even for the inception of new ancillary optional courses. In consequence, Quaternary Studies are not a prominent feature at Keele. This is regrettable, because study of the history of our natural environment on a scientific basis would be eminently suitable in the context of the ideals for which Keele still stands.

Former members of staff with Quaternary interests include Russell Coope and Frank Moseley, who were both in the Geology Department during its early years. Geoffrey Boulton was a Demonstrator in Geology in the mid-1960's, following two years with the Geological Survey, and took his first excursion to Spitsbergen at that time. Kath Gee (née Simpkins) was a research fellow shared between the departments of Geology, Biology and Geography from 1970 to 1973. At present, various members of staff have Quaternary teaching and research interests. In the Geology Department, Professor G. Kelling works on marine geology, and J. Collinson has studied the sedimentology of sands, including the deltaic deposits of the Tana River in Norway. B. Holdsworth works on the Cenozoic Radiolaria biostratigraphy of tropical oceans. In the Department of Education, D. Thompson, a member of the first intake of students at Keele, works on the sedimentology of the Trias, and has collaborated with Peter Worsley (who was also a Keele graduate) on Quaternary deposits in Cheshire. In the Department of Adult Education, Francis Celoria is a well known archaeologist with Quaternary interests.

Currently two members of the academic staff have specific interests in the Quaternary. E. Derbyshire was also a member of the first intake of students at Keele, and following research at McGill and Monash Universities returned in 1966 as a member of staff in the Geography Department. He is responsible for all teaching and research in Physical

Geography, and his courses include a final year option on Quaternary Studies introduced in 1969. He has always been interested in Quaternary geomorphology and climatology, and has been Secretary of the British Geomorphological Research Group. In recent years he has become particularly interested in tills and their geotechnical characteristics. Among several research students under his supervision is Martin Lee, who is concentrating on the geotechnical properties of modern tills in Norway. E.A.Francis went to Keele in 1972, and is a member of the Geology Department and Warden of Barnes Hall. He was formerly in the Institute of Geological Sciences for 13 years, and at Newcastle University for 4 years. He has been Secretary (1968-70) and Vice-President (1970-72) of the Quaternary Research Association, and Secretary-Treasurer of INQUA (1969-73). His interest in glacial sediments began during field survey of part of the Co. Durham coalfield, and was extended into the periglacial environment during field surveying in the south-west Pennines. He is now engaged in a study of the glacial sediments in the Cheshire-Shropshire basin, including the borderland of north Wales, and he has recently been joined in this work by Hilary Davies. After graduating at Cambridge, Hilary studied the petrography of tills in eastern England, and is now based in The Wirral. M. Lee is also studying some aspects of the tills in this area.

In conclusion, although Keele does not give prominence to the teaching of Quaternary Studies, much Quaternary research is actively pursued in more than one department. This is concentrated on the sedimentological and geotechnical aspects of glacial deposits.

CALENDAR OF MEETINGS

March 11th, 1978	William Pengelly Cave Studies Trust Ltd. Deposits in Sea Caves. Further details and booking form included with this Newsletter.
April 7th-11th, 1978	Quaternary Research Association annual field meeting and Annual General Meeting, Keele. Further details and booking form were issued in November, 1977.
June 2nd-4th, 1978	Quaternary Research Association field meeting, Hertfordshire. Further details given in the circular issued with this Newsletter.
September 25th-29th 1978	Quaternary Research Association field meeting, Oban. Further details given in the circular issued with this Newsletter.
January 4th-5th, 1979	Quaternary Research Association Discussion Meeting, London. The Lateglacial environment of the British Isles and comparisons with N.W.Europe.

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