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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 articles, reviews, notices of forthcoming meetings, news of personal and joint research projects, etc. are invited. They should be sent to the Editor of the Quaternary Research Association, Dr. D.H. Keen, Department of Geography, Coventry (Lanchester) Polytechnic, Priory Street, Coventry CV1 5FB.

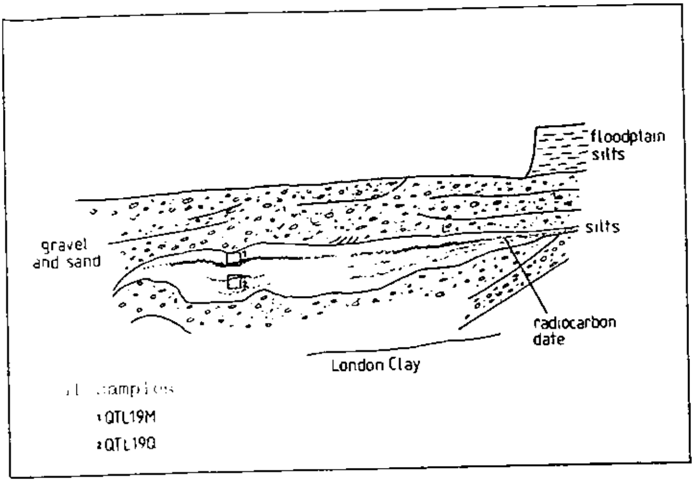
THERMOLUMINESCENCE DATING OF THE KEMPTON PARK SILTS

by G.A. Southgate

Thermoluminescence (TL) dating of sediments can be achieved if the sediment in question undergoes sufficient bleaching of its TL signal prior to deposition. Berger and Huntley (1982) and Huntley et al. (1983) have expressed doubts as to whether this is the case for river silts. A test of the applicability of TL dating of a particular sediment type is to date a known age sample and compare the results. This has been done for the alluvial silts at Alton Road Quarry, Farnham (Bryant et al., 1983) where two TL dates have been obtained: 106 ± 11 ka (QTL19I) and 107 ± 15 ka (QTL19J). A radiocarbon date of 36,600 (+2 400, -1 800) BP (Q-2354) was produced from plant macrofossils extracted from the same section as the sample QTL19I. The inconsistency would seem to suggest that the TL dating of alluvial silts is, at the least problematical. The alluvial silts at Kempton Park also have radiocarbon control and therefore a further testing of the technique is proposed.

The Kempton Park Silts (fig.1) have been described by Gibbard et al. (1981). They occur as a channel-fill within a braided river gravel accumulation. These, Kempton Park Gravels, form the deposits upon which the 'Upper Floodplain' Terrace is developed at their type site.

The silt yielded fossil macroscopic plant remains, molluscs, ostracods and insects. The insect and ostracod faunas indicate that the silt was deposited during a period of climatic deterioration from an initially warm, to a later cold continental climate. A radiocarbon date of 35,230 ± 185 BP (Q-2019) was obtained from plant macrofossils recovered from the top of the silts. Gibbard et al. (1981) concluded that the silts were deposited during a cooling phase of the Upton Warren Interstadial Complex which post-dates 42 ka.



<u>Figure 1</u> Kempton Park section showing the positions of the TL samples and from where the radiocarbon date was produced.

No samples of the Kempton Park silts were taken specifically for TL purposes. The only available samples were those taken for pollen and mollusc analysis. It was not possible to return to the site to collect further samples, nor to make <u>in situ</u> measurements of the environmental radiation.

Two samples were analysed; both came from section A at the Kempton Park site (fig. 1). Cohesive blocks of the silts were pared down to remove any light-affected material and then treated with HCl to remove any calcium carbonate. The 4-11μm fraction was deposited on 1cm diameter aluminium discs. These were heated at 5C/s in an argon atmosphere to 460C. Observations were made using an EMI 9635 photomultiplier tube fitted with a Corning 5-58 colour filter and a Chance-Pilkington HA-3 heat-absorbing filter.

The natural TL glow curves obtained had peaks at 250C and 320C (fig.2) which is similar to the glow curves obtained from other alluvial silts. Three methods of Equivalent Dose (ED) determination were applied: they are shown in figure 3. The 'partial bleach' (R-beta) method (fig. 3a) of Wintle and Huntley (1982) uses a short fixed bleach. The assumption is that a fixed fraction of the radiation induced TL is bleached irrespective of the magnitude of the dose. A small bleaching time is used to avoid bleaching any signal which was not bleached upon deposition (Huntley, 1983).

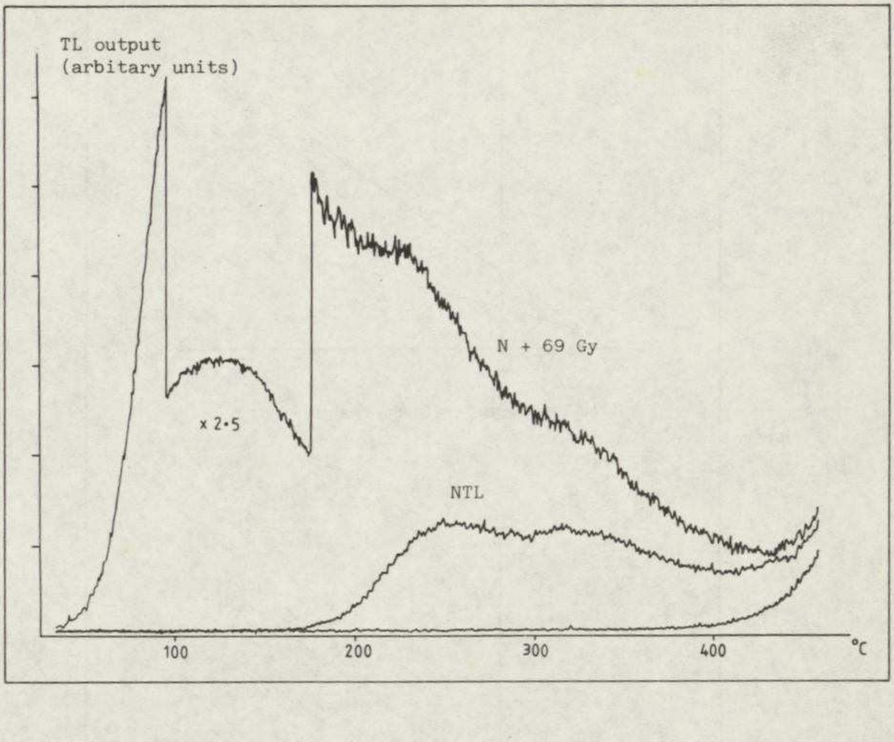
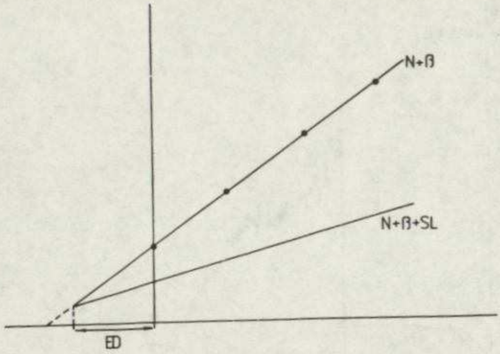


Figure 2 Glow curves from QTL19M: NTL = natural thermoluminescence, also shown is the output after an irradiation of 69 Gy.

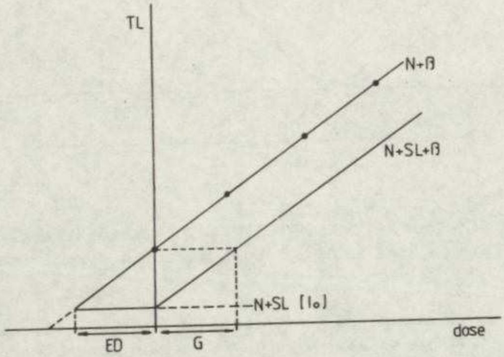
The two 'total bleach' methods: method (ii) and method (iii) of Wintle and Proszynska (1983), rely upon the long bleaching of the sample to an arbitrary level which describes the residual level of the TL due to unbleachable components. If the sediment was bleached long enough prior to deposition this artificial residual level is negligibly different from the deposition residual level. Method (iii) involves a regeneration of the TL signal from the residual level to its natural level and as such is only applicable if the TL sensitivity (as compared to the method (ii) results) remains unaltered.

In this study the samples were placed under a Boots 300W sunlamp at a distance of 30cm for bleaching: for 30 minutes for the R-beta method and 450 minutes for the total bleach methods. Reasonable ED plateaux were obtained in the glow curve region 280-320C (fig.4), which is also the region where the dose sensitivity remained unchanged. Below 270C there is the problem of the thermal instability of the TL signal. Above 320C the TL signal becomes non-linear at the doses used. The non-linearity creates inaccuracies in the linear least-square fits used to calculate the EDs.



'Partial bleach' method of ED determination

Figure 3.a



'Total bleach' methods of equivalent dose determination

Figure 3.b

Figure 3 (a) the partial bleach method of ED determination, for explanation see text.
(b) the total bleach methods of ED determination. Method (ii) involves the subtraction of the residual from the additive dose curve (residual = I_o). G is the ED from method (iii). For further explanation see the text.

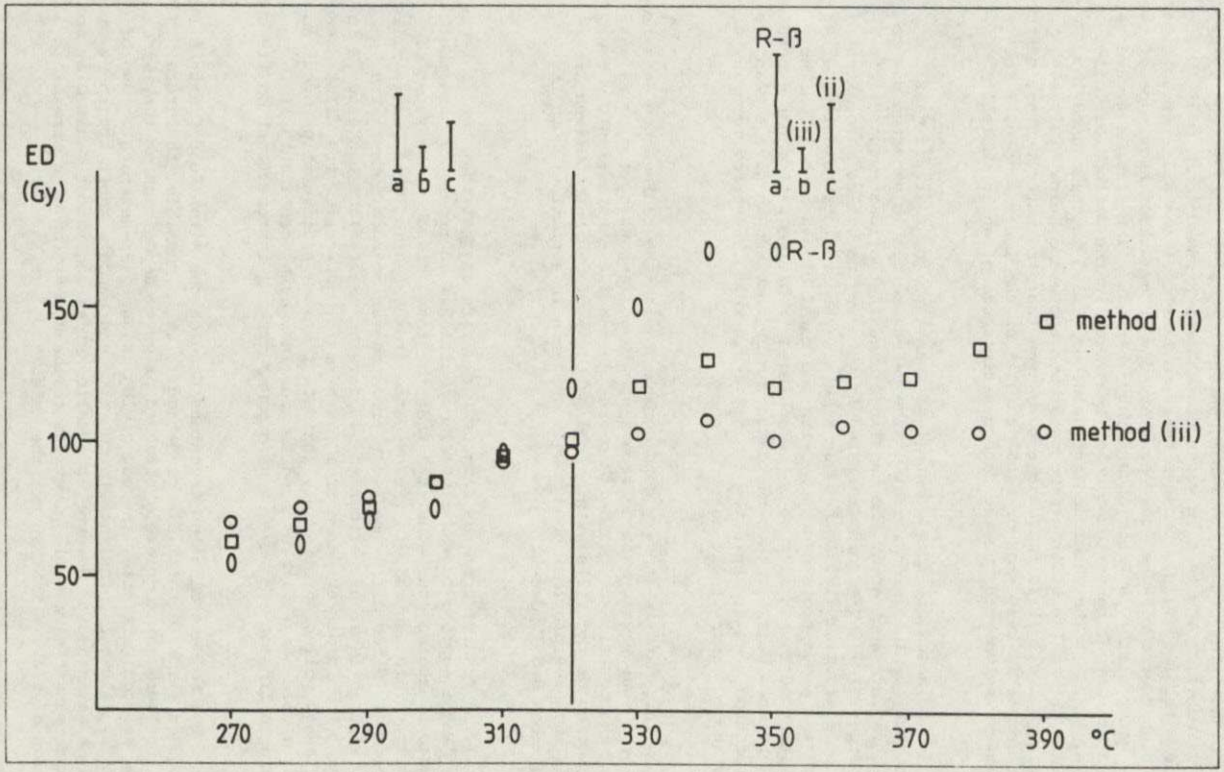


Figure 4 ED vs. glow curve temperature plot for QTL19Q for the three methods used. The two sets of bars; a, b and c are the mean error bars of the determinations for less than and greater than 320°C.

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Alpha-counting was used to determine the uranium and thorium contents of the samples. The sealed and unsealed count-rates were within 7% of each other which indicates that there was no radon loss. The potassium contents were obtained commercially. The alpha efficiency factor was determined for QTL19Q (see table 1) and assumed to be 0.1 ± .01 for QTL19M. The saturation water content of QTL19Q is 0.37 (wt. water/wt. dry sediment). The in situ water content was assumed to be 0.75 ± .25 of the saturation value, because the fine fabric of the silts gives rise to a high degree of adhesion; however, due to a lack of knowledge of the sites water history,a large uncertainty is used. The error attached to the water content generates much of the error in the dating (Divigalpitiya, 1982). The water content value of QTL19Q was also used for QTL19M. Since the silts are bounded both above and below by freely draining gravels it is reasonable to assume that the water content of the upper sample is less than or equal to that of the lower sample. The complete results with the age determinations are given in table 1.

The dates are consistent (less than 1 per cent significant difference). The larger error of the R-beta method is expected due to the acute intersection of the two lines used in the least-squares fit (see fig. 3a) - the errors generated in this way negate to some extent Huntley's argument (1983) that the R-beta method is intrinsically better due to the assumptions necessary with the total bleach methods. The deposition of such a silt would be achieved in a time period not exceeding a few hundred years. Thus the dates can be combined to give a mean age. The weighted mean of the dates is 36.6 ± 6.4 ka. The error term is twice the standard error of the mean.

This date is in very good agreement with the radiocarbon date from the site; which was produced from a sample corresponding to, or slightly above, the position of QTL19Q (Gibbard, personal communication). The association of the silts with a cooling phase of the Upton Warren Interstadial Complex provides good fossil evidence in support of both the radiocarbon and TL dates.

The results from the Kempton Park Silts suggest that the TL technique can be applied to the fluvial depositional environment; and that complete bleaching can occur such that the total bleach methods can be applied. This contradicts the evidence from the Alton Road Quarry silts where the TL dates differ markedly from the radiocarbon date. The possibility exists that either the TL date or the radiocarbon date is in error. The fossil evidence from the site is equivocal: the plant macrofossils and pollen spectra only indicate that the sedimentation occurred during a cold stage with a trend towards increasing continentality. The single find of a *Mammuthus primigenus* tusk is insignificant on its own.

The ED determination technique used on the Alton Road Quarry silts was method (iii), a total bleach method. It is possible, therefore, that the silts were not completely bleached prior to deposition as they were at the Kempton Park site, thereby giving an age over-estimate. One of the valley sides is proximate to the site and hence a short transport time could be envisaged. However, the valley sides consist of Gault Clay and a short transit time would give rise to the deposition of a sizeable fraction of clay. This is not the case.

Table 1. Determinations for the TL dating analysis.

Sample	K_2O (%)	Total α-counting rate ($ks^{-1}cm^{-2}$)	Th (ppm)	U (ppm)	α-efficiency factor	dose rate (mGy/a)	ED (Gy)	TL age (ka)
QTL19M	1.41 ±.01	0.473 ±.012	4.63 ±.97	2.61 ±.30	nm	2.48	(ii) 93.5 ±13.8	37.6 ±6.3
							(iii) 91.5 ±10.8	36.8 ±5.6
QTL19Q	1.17 ±.01	0.444 ±.014	3.37 ±1.07	2.73 ±.34	.083 ±.009	2.13	(ii) 72.5 ±21.0	33.9 ±9.0
							(iii) 79.7 ±10.5	37.3 ±6.3
							R-beta 70.8 ±39.4	33.1 ±15.1

Weighted mean of all the above dates:

36.6 ± 6.4 ka

N.B. (ii), (iii) and 'R-beta' refer to the ED determination methods mentioned in the text.

There is some archaeological evidence which militates against the radiocarbon date. The Wrecclesham gravels which contain the organic silts at Alton Road Quarry have been correlated with the deposits underlying the Railway Terrace (Bryant et al., 1983). These deposits have provided finds of Mousterian 'bout-coupe' hand-axes which are generally assigned to late Ipswichian and early Devensian times (Roe, 1981). The 'bout-coupe' hand-axes are unabraded in the gravels whilst the majority of other implements are in a rolled condition (Oakley, 1939). Thus the hand-axes are less likely to have been reworked from earlier deposits. Therefore, the Wrecclesham gravels are correlated with deposits likely to be late Ipswichian or early Devensian.

In conclusion, the results from Kempton Park indicate that alluvial silts can be completely bleached prior to deposition and hence the TL technique can be applied, even using the total bleach methods. The Alton Road Quarry silts may not have been completely bleached, though this is unlikely; and there is limited evidence suggesting the radiocarbon date is in error.

Graham A. Southgate,
Sub-department of Quaternary Research,
Godwin Laboratory
Cambridge CB2 3RS

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A MAMMALIAN FAUNA OF NORTHERN CHARACTER IN YORKSHIRE AT ca. 83,000 years B.P.

By A.J. Sutcliffe, T.C. Lord, R.S. Harmon, M. Ivanovich, A. Rae and J.W. Hess

Although the history of the Quaternary in the British Isles has been reconstructed in considerable detail back to the generally available limits of the radiocarbon dating method, about 45,000 years ago, and although the Ipswichian Interglacial apparently provides a distinctive datum of considerable warmth at about 120,000 years ago (oxygen isotope stage 5e, Gasgoyne et al, 1981), the events of the intervening period of time are less well understood. With relatively few absolute dates available there has been much speculation about the number and magnitude of climatic fluctuations and the relationships between locally established stadial and interstadial episodes within this part of the Pleistocene. The establishment by the uranium series method on secondary calcium carbonate of a date of ca. 83,000 years, for a climatically significant mammalian fauna from Stump Cross Cave, Yorkshire, is therefore of special interest.

Stump Cross Cave is a commercial show cave. Since 1955 remains of Pleistocene mammals have been accidentally discovered at four separate sites as the result of digging operations to improve the tourist route and to extend the wild part of this extensive cave system. In 1955 incomplete associated skeletons of four reindeer, *Rangifer tarandus*, were found in the "Reindeer Cave" (Site I, Collins 1959). Parts of two wolverines, *Gulo gulo*, were found at the foot of the Entrance Steps (Site II) in 1964, and of six wolverines and other mammals in the "Bowling Alley" (Site III) in 1980. An associated skeleton of another wolverine was found in a deeper part of the cave system (Site IV) in 1981. This is the richest collection of remains of this animal, a rare species in the British Pleistocene, yet found at any British locality. From both palaeontological and radiometric evidence it is concluded that the bone deposits at Sites II and III, situated in the same level, at a horizontal distance from one another of only 50 metres, represent the same event in the history of the cave. The remaining part of this note is restricted to the evidence from these sites only. No dates are yet available for Sites I and IV.

Other mammalian species represented at Site III in addition to wolverine, include wolf, *Canis lupus* (part of an associated skeleton of a young adult and a single bone of a second, older animal); fox (two specimens only, of size intermediate between red fox, *Vulpes vulpes* and arctic fox, *Alopex lagopus* - genus undeterminable); reindeer (one specimen only); and ox or bison, *Bos* sp. or *Bison* sp. (also only one specimen).

All except two of the specimens from Sites II and III are of carnivores, suggesting a selection mechanism in the primary accumulation; in this instance intentional entry of the cave by wolverines and wolves. The bones were nevertheless finally emplaced in water-laid sediments, making the interpretation of these animals' activities in the cave difficult. The wolverine and wolf remains occur in approximately their natural proportions, with even the small bones of the feet present, suggesting that they had not moved far from the original site of carcass deposition. Few of the wolverine bones are complete. Some of them, together with a wolf tibia, show tooth marks and splintering which, from its nature, must have occurred when the bone was fresh. Many small fragments of bone, some freshly splintered, some extensively eroded and apparently from the stomach of a carnivore, supplement the more complete remains and are accepted as an integral part of the bone deposit. It is inferred that predators had access to carcasses of carnivores within the cave, from which they were impeded from returning to the surface by the cave topography; that skeletal parts were partly consumed not long after the death of animals represented; and that most or all of the damage was caused by wolverines themselves, thus providing an instance of cannibalism by these animals.

Over 30 uranium series dates were obtained for speleothem samples (both in situ flowstones and derived fragments incorporated in the cave sediment) spanning the period of time from ca.230 Ka almost until the present day. Only one fossiliferous episode is apparent from the radiometric evidence and it occurred within the interval 108 $\pm$ 18 to 81 $\pm$ 5 Ka. The unweathered condition of the mammalian remains, with instances of intact incisor rows, indicates that the interval between their final emplacement and subsequent burial by calcite precipitation was not great. Only some of the radiometric evidence can be included here, for reasons of space. The data for four samples immediately encrusting bone fragments is nevertheless of special importance. (see table on p.11).

We believe that this tight grouping of ages places the date of the fauna at or shortly before the mean age of 83 $\pm$ 6 Ka at the 95% confidence level.

The dating of a mammalian fauna with wolverine and reindeer in Yorkshire at ca. 83 Ka is of special palaeoclimatic interest in view of the proximity of Victoria Cave, near Settle, situated only 23 km away at approximately the same altitude, making faunal comparison feasible uncomplicated by major geographical factors. The Ipswichian *(sensu stricto)* interglacial hippopotamus fauna from this site has been dated to ca. 120 Ka, correlated with marine isotope substage 5e (Gasgoyne et al, 1981). Too close analogy should not be drawn between the Stump Cross fauna and that of any present day biome, because current evidence suggests that there sometimes existed during the Pleistocene biomes quite unlike any existing at present (Hopkins, 1982). The living wolverine is nevertheless an animal of restricted geographical distribution, typically inhabiting forests and treeless highlands of the circum-boreal region; sometimes also penetrating onto the tundra. It is adapted to very cold conditions and commonly occurs in association with reindeer (which provide

Site	Lab Number	Description	U(ppm)	$^{234}U/^{238}U$	$^{230}Th/^{234}U$	$^{230}Th/^{232}Th$	Age (Ka)
II	HAR 2674	Flowstone encrusting wolverine skull	0.10 ± .01	1.29 ± .08	0.54 ± .04	14	82 ± 8
IIIA/B	SURRC 535	Flowstone encrusting partly digested bone fragment	0.11	1.18 ± .04	0.55 ± .03	17	84 ± 8
IIIA/B	HAR 2663	Flowstone encrusting partly digested bone fragment	0.33 ± 0.1	1.44 ± .06	0.55 ± .03	95	83 ± 6
IIIC	HAR 2653	Calcite layer in stalagmite encrusting bone fragment	0.26 ± .01	1.87 ± .08	0.55 ± .03	72	81 ± 5

its principal food), and wolf. The Stump Cross fauna, which lies firmly within the later part of oxygen isotope stage 5, apparently indicates a substantial deterioration of climate between c.120 and 83 Ka.

A fuller account of this work has already been written and was recently submitted to the Editor of *Geology*.

We gratefully thank Mrs. B. Gill and Mr. G. Hanley, Proprietors of Stump Cross Cave, for permitting this study and for their constant encouragement.

A.J. Sutcliffe, British Museum (Natural History), London SW7 5BD; T.C. Lord, Pigyard Museum, Settle, N. Yorkshire; R.S. Harmon, Southern Methodist University, Dallas, Texas, 75275; M. Ivanovich and A. Rae, Uranium Series Disequilibrium Section, AERE, Harwell, Oxfordshire, OX11 ORA; and J.W. Hess, Water Resources Center, Desert Research Institute, Las Vegas, Nevada, 89107.

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Appendix. Access to Stump Cross Cave.

Q.R.A. members not already familiar with Stump Cross Cave, especially those leading field parties, may be interested to know that the Bowling Alley, where most of the remains described above were found, is readily accessible as part of the normal tourist route in this cave. Although the unconsolidated deposits at the main ossiferous site are now obscured by a wall, similar deposits and excellent sections of locally dated flowstone are still exposed in other parts of the tunnel. Since the cave is situated immediately alongside the main road between Grassington and Pateley Bridge a visit to the Bowling Alley can be achieved in a remarkably short time. There is also a Visitor's Centre at the Cave. Ask Mrs Gill or Mr Hanley, who offer a special welcome to Q.R.A. members, about discount.

A NEW APPROACH TO DRIFT MAPPING IN EAST ANGLIA

By S.J. Mathers and J.A. Zalasiewicz

In East Anglia conventional mapping, involving the identification of soil types and the recording of features and sections together with shallow hand augering, is often hindered by the widespread occurrence of surficial solifluction and cryoturbated deposits which obscure the underlying geology. Such deposits are commonly thicker than the length of the hand augers used (1.3m) and, where they are stony, prevent penetration. In addition, geomorphological features related to the Quaternary geology are poor, exposures are scarce and soil types are seldom diagnostic.

Most of the surface deposits in East Anglia are glacial in origin and thick boulder clay covers large areas. In the Aldeburgh-Orford area the deposits include complexly interdigitating outwash sands, gravels and silts, lake deposits and thin tills. The integrated use of the EM31 Terrain Conductivity Meter and an extendable auger have greatly aided the investigation of this glacial complex by rapidly and cheaply providing information from below the disturbed surface layer.

The EM31 Terrain Conductivity Meter

The EM31 is a readily portable, non-contacting terrain conductivity meter manufactured by Geonics Ltd., Ontario (Zalasiewicz and others, in press ; McNeill, 1980). It can be used rapidly and effectively to distinguish between high and low conductivity sediments and in particular, to distinguish clay from sand, gravel or carbonate deposits. The effective depth of penetration is about six metres. The instrument is carried by a shoulder sling, weighs 9kg and comprises a central control panel from which two booms extend; these house the transmitting and receiving coils which are 3.7m apart and use a power source of eight 1.5v batteries.

By systematically taking readings at a fixed interval (10-50m) along a network of traverses the EM31 can be used to produce a contour map of conductivity values in millimhos per metre. Up to 500 readings can be taken in a day, providing sufficient data to contour an area of between one and two km^2.

Pipes and underground cables produce anomalous readings and ground near wire fences should also be avoided. A water table at shallow depth also enhances ground conductivity. Some allowance needs to be made, therefore, for anomalies attributable to these causes.

Extendable Augers

Extendable augers like those manufactured by Eijkelkamp, Giesbeck, Netherlands have long been used in field mapping by other northern European geological surveys but have not been widely employed in BGS where the emphasis to date has been on pre-Quaternary deposits. These augers (Fig.1) which have interchangeable cutting tools for sand and gravels, clay and soft sediments, have been used to provide lithostratigraphical information and to calibrate conductivity readings. Representative uncontaminated samples can readily be recovered from depths of about four metres. Although these samples are somewhat disturbed, structures such as bedding and grading can still be recognised and the samples are adequate for mineralogical, particle size or micropalaeontological analysis. The auger will penetrate most unconsolidated sediments with the exception of coarse gravels and waterlogged sands. About 15-20m of strata can be augered, logged and sampled in a day, assuming that 4-6 holes are drilled.

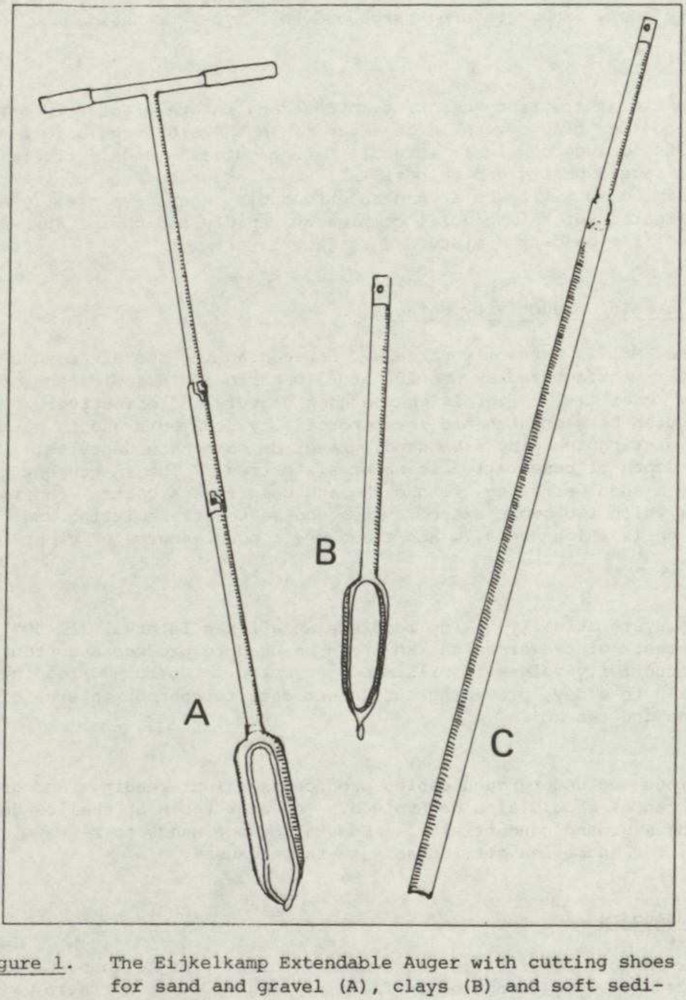

Figure 1. The Eijkelkamp Extendable Auger with cutting shoes for sand and gravel (A), clays (B) and soft sediments (C).

Integration of techniques

In the Aldeburgh-Orford area, mapping with the conductivity meter yielded a regional conductivity contour map, a small portion of which is depicted in Figure 2. It indicates the areal distribution of clay-rich (high conductivity) deposits and sand and gravel (low conductivity) deposits. Abrupt conductivity changes indicate the positions of likely geological boundaries (Zalasiewicz and others, in press). The field observations on soils, topography and sections, which were recorded at the same time as the conductivity data, provided some basic lithological information. More precise information was obtained using an extendable auger, and the holes were sited to calibrate the conductivity readings. The auger holes largely eliminated the need for trial excavations, which are slower and more costly.

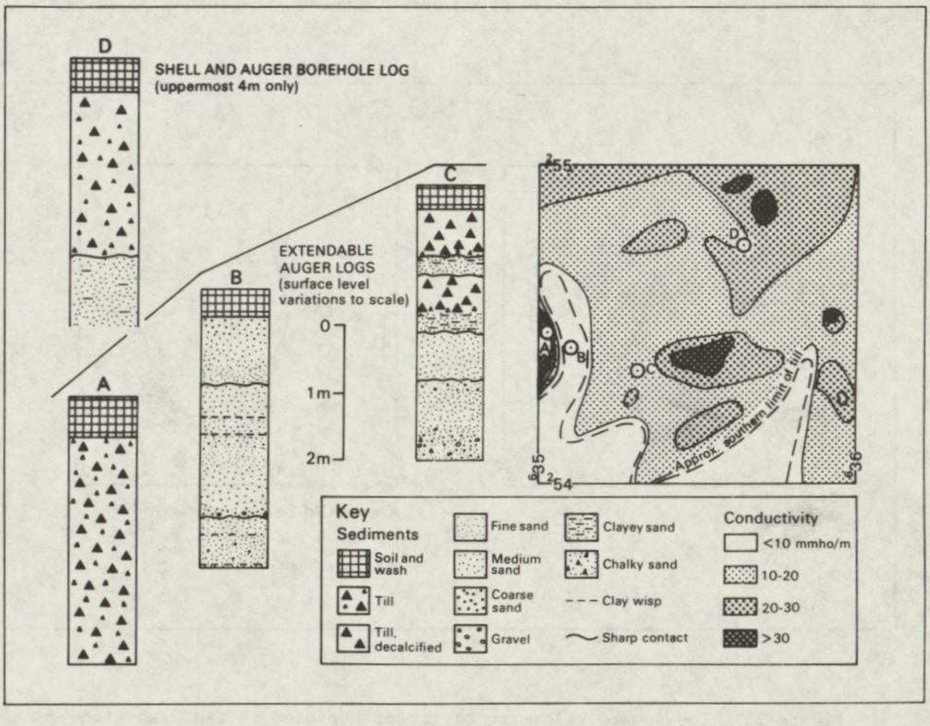

Figure 2. Conductivity contour map of a square kilometre of ground near Woodbridge, Suffolk, with simplified logs of extendable auger holes and a shell and auger borehole

The combination of techniques outlined above produces drift maps that are considerably more detailed and accurate than those produced by conventional techniques and take no longer to complete. Above all, this approach produces an accurate factual framework into which new information can readily be incorporated, thus reducing the subjective element in drift mapping.

Example

A fairly typical kilometre^2 of glacial deposits near the edge of the Anglian till sheet (chalky boulder clay) is depicted in Figure 2. In this area the till overlies and also interdigitates with glacial outwash sands and gravels. The conductivity contour map was constructed from a network of traverses with an average spacing of 200-300m; readings were taken every 25m along each traverse line (Fig. 3a). The

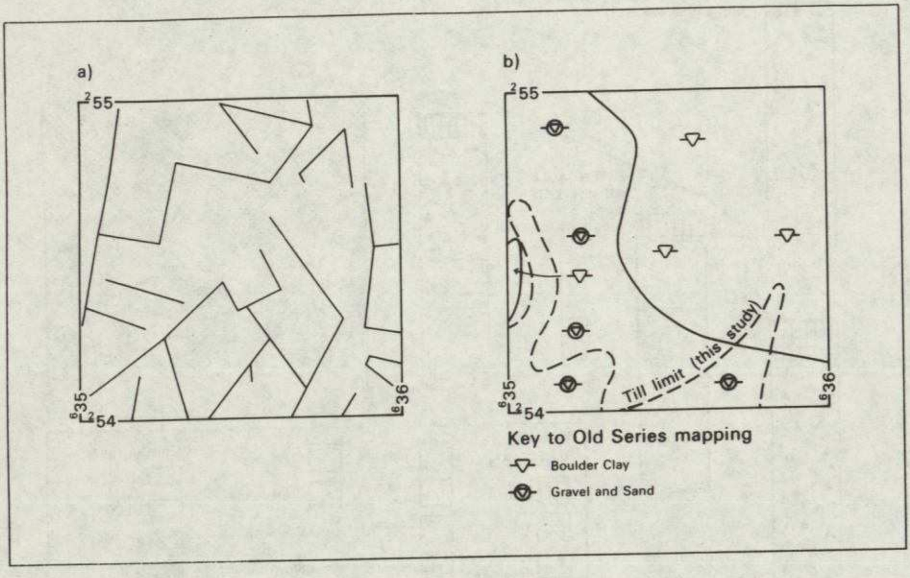

Figure 3. The square kilometre of ground depicted in Fig.2 showing:

a) location of conductivity traverses (readings taken at 25m intervals along each traverse).

b) linework from Geological Survey Old Series One-Inch map (solid line, ornament) compared with linework obtained in this study (pecked line).

auger-hole logs, together with the log of a shell-and-auger borehole, confirm that an irregular till sheet underlies the area of high conductivity and that its thickness is roughly proportional to the magnitude of the ground conductivity readings. Auger holes and mapping observations over a wider area have shown that, in general, till underlies ground with a conductivity of about 7 mmhos/m or more (the precise figure varies depending on the particular conductivity meter used). The results so obtained are a marked improvement on earlier mapping of the area (Fig. 3b). The auger-hole logs reveal the complexity of these sediments, showing, for example, graded units within the sand. Further examples of the mapping of the glacial deposits in this area are given in Zalasiewicz and others (in preparation).

Acknowledgements

We would like to thank Mr. R.D. Lake, Dr. E.R. Shephard-Thorn, Dr. F.C. Cox, Dr. W.A. Read, Mr. E.G. Smith and Mr. W.B. Evans for critically reviewing earlier drafts of this paper. This paper is published with the permission of the Director, British Geological Survey.

S.J. Mathers and J.A. Zalasiewicz,
British Geological Survey,
Keyworth,
Nottinghamshire
NG12 5GG.

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20th ANNIVERSARY MEETING: 24th MARCH 1984

The following are transcripts of lectures given at the 20th Anniversary Meeting of the Q.R.A. held in The Botany School, University of Cambridge on the 24th March 1984. The chair was taken by Dr. E.A. Francis and the meeting was followed by the Anniversary Dinner at St. John's College.

HISTORY OF THE QUATERNARY RESEARCH ASSOCIATION

By R.W. Hey

From time to time during the 1960s I used to boast, to anyone who would listen, that a suggestion of mine had led to the foundation of the Quaternary Field Studies Group, later to become the Quaternary Research Association. The response was usually sceptical, if not ribald, and after a while I concluded that I must have been mistaken. Then, only a few years ago, I was told that documents had been found which seemed to support my claim. Now that I have been invited to tell the story, or my version of the story, to the Q.R.A. itself, I feel not only reassured but vindicated.

The story begins in September, 1962, when I took part in an excursion to north Lincolnshire, organised by the Yorkshire Geological Society. Our main purpose was to examine the Jurassic and Cretaceous, but the advance publicity had mentioned a visit to the interglacial site at Kirmington, and had also told us that A. Straw would demonstrate various glacial and geomorphological features of the Wolds. This was perhaps the reason why the party included an unusually large number of people interested in the Quaternary, some from universities but the majority, as I remember, from the Geological Survey office in Leeds.

Most of us, indeed, would have been quite unaware of this, as we assembled at our hotel in Caistor on the Friday evening: in those days there were still relatively few people in this country with a special interest in the Quaternary, and contacts between them were still relatively limited. By a happy chance, this particular excursion entailed a good deal of walking. As we walked, those of us with Quaternary interests soon found that we were surrounded by other enthusiasts, and discussions began which continued throughout the weekend. We may even have overdone it, for one of the leaders of the excursion, an eminent Mesozoic geologist, was heard to express mild but unmistakeable impatience over his lunchtime sandwiches.

On the Sunday afternoon, as we sat in the coach on the way back to Caistor, I can remember thinking that I had learnt almost as much during those 48 hours as during either of the two INQUA Congresses I had attended. Then another thought crossed my mind: what an excellent thing it would be if a series of field-meetings could be started which would be run on similar lines to those of the Yorkshire Geological Society but concerned only with the Quaternary.

Having returned to Cambridge I discussed the idea with R.G. West, who was enthusiastic. We then composed a letter suggesting the possibility of holding short and informal meetings, devoted to Quaternary studies, in different parts of the British Isles and at intervals of perhaps two years. This was sent out in January, 1963, over our two signatures, to anyone of our acquaintance who seemed likely to be interested. With it was a questionnaire, asking for opinions and further suggestions.

The response was large and encouraging. F.W. Shotton was then approached, and on April 13th, 1964, a party gathered at the Geology Department of Birmingham University for the inaugural meeting of the Quaternary Field Studies Group.

The meeting, with G.R. Coope as Local Secretary, was an immense success. It included three magnificent days in the field, setting an example which has been followed by the organisers of all subsequent Annual General Meetings. On the evening of the 15th there was a general business meeting, with T.H. Whitehead in the chair. Despite much talk of the importance of informality, a Committee was nevertheless appointed, with instructions to determine the date and place of the next meeting and to provide continuity meanwhile. In addition, L.F. Penny was appointed Secretary, but it was decided that for the time being the Group should have no other officers, not even a President. Dr. Penny reminds me that the first meeting of the Committee took place in the open air, on the Main Terrace of the Severn at Eardington, near Bridgnorth. Its minutes have survived as pencilled notes on a page torn from Dr. Penny's field notebook.

A year later the Group held its second meeting at Durham, once again spending three days in the field. At the business meeting there was some discussion of constitutional matters. I cannot myself remember the outcome, if any, but Dr. Penny again reminds me that this was the occasion when he persuaded the Group to relax its unworldly principles to the extent of acquiring money for postage etc. As a result there was a silver collection at the door, and Dr. Penny became Treasurer as well as Secretary.

At the A.G.M. of 1968, E.A. Francis relieved Dr. Penny of both offices. Soon afterwards it was suggested that the title of the Group should be altered to include the word 'Research', since it was thought that this would make it easier for both the Group itself and its individual members to obtain financial support. Another Circular was sent round, including a statement of the function of the Group, as agreed by the Committee, and a list of ten suggested titles. Members were asked to vote for one of the ten, it being made clear to them that the Committee favoured the title Quaternary Research Association. This was duly adopted, and in 1969 Professor R.G. West became the first President of the Q.R.A., Dr. Francis its first Secretary and D.Q. Bowen its first Treasurer.

In the fifteen years of its official existence, the Q.R.A. has had a history that any organisation might envy, a history of steady growth and development uninterrupted by serious crises. Meetings held under its auspices, both outdoor and indoor, have steadily increased in number; some have been held overseas, at locations ranging from Iceland to Majorca (where it snowed), and in 1982 the A.G.M. itself took place in the Netherlands. Our Excursion Guides are now often quoted as primary references, and some are said to change hands for high prices. The Newsletter was started in 1970 by W.G. Jardine; originally intended as a means of internal communication, it now has a worldwide circulation and reputation.

Most striking of all is the growth of our membership. In April, 1965, the Q.F.S.G. had 165 members. The Q.R.A. list for November, 1983, includes 807 Ordinary Members, of whom no fewer than 105 are resident overseas, in 27 different countries. The largest overseas contingent is in Canada, with 16 members, followed by that in the Netherlands, with 15. We are represented in almost every European country, western and eastern; we are also represented, if only by single members, in countries as distant as Kuwait, Sierra Leone, Singapore and the Solomon Islands. Nor must we forget our 37 Institutional Members, 12 of them overseas and two of those 12 in the People's Republic of China.

With all this growth and development our administrative arrangements have necessarily become more elaborate: for example, we now have five officers (President, Vice-President, Secretary, Treasurer, Newsletter Editor) as compared with one in the innocent days of the Q.F.S.G. But in view of the fact that they receive no help in running what is now a large organisation, other than that provided by a small number of additional Committee members, they could hardly be described as a topheavy bureaucracy.

What is more important, the increase of numbers seems to have had no adverse effects on the relations between our members, which remain as friendly and informal as ever, so much so that many of us look forward to our meetings as enjoyable social occasions. This, I believe, is the main reason why the Q.R.A. has become so outstandingly effective as a means of communicating information and ideas about the Quaternary.

THE ADVANCE OF QUATERNARY STUDIES DURING THE LAST TWENTY YEARS

By F.W. Shotton

This talk of mine will try to give my impressions, inevitably somewhat subjective, of the progress of Quaternary Science since the first multi-disciplinary meeting of interested people gathered in Birmingham 20 years ago. I have deliberately introduced the term multi-disciplinary at this early stage because one of the most striking aspects of modern work, certainly in the U.K., has been the way in which partitions between university departments have disappeared. Geography must be my first example. Geographers have long lived with the expressed opinion that Geography is not a subject in itself, but the skilful welding into coherence of other disciplines. For no subject could this be more true than for Quaternary Science. From self-styled geographers has come splendid work in geomorphology, palynology, malacology, stratigraphy and heavy mineralogy. U.E.A. (cleverly disguising the question of its identity with either Geology, Geography or Ecology by choosing the label of Environmental Sciences), now practises U/Th dating and palaeometeorology alongside its more traditional activities, whilst Geography at Aberystwyth pioneers Amino acid ratio measurements.

Several Departments of Botany have applied Palynology to Quaternary Studies, and Cambridge in particular, impressed by the promise which this discipline offered long ago set up a sub-department of Quaternary Research, from which has developed the Godwin Laboratory. Under one or other of these labels may still come researches on pollen or macro-plants, or on animals such as foraminifera, but most will think of the Godwin Laboratory in terms of Oxygen isotope ratios on marine foraminifera, of T/L dating on speleothems, silts and loess, and micro-organisms, or of the long-established centre of radiocarbon dating.

Academic geologists have produced some excellent exercises in stratigraphy (but not as many as I would have hoped for). Some are prepared to practice palaeontology (e.g. at Imperial College) to interpret palaeoenvironments and the most significant of these studies has been the development of palaeoentomology at Birmingham. The use of this discipline and the environmental conclusions which arise from it are now spreading widely - in the U.S.A. and Canada, Scandinavia, Western Europe, Eastern Europe, Russia and New Zealand.

Petrology as practised by geologists, is a continued tool in sourcing stone implements and what is more important to Pleistocene studies, in recognising the identity and source of glacial erratics. Birmingham University also set up one of the earlier radiocarbon laboratories in the country and one which it still claims gives reliable dates older than 40,000 years.

Help from other departmental disciplines must not be forgotten. There are university departments of Zoology, Physics, Chemistry and Archeology all contributint to knowledge of the Quaternary. Several Polytechnics have made very significant contributions and I can think in particular of Portsmouth, Coventry (Lanchester), City of London, North London, Trent and Newcastle and I have doubtless omitted some which I should have included.

Government Institutions are strongly involved in elucidating Quaternary problems. The Natural History Museum, in its Department of Palaeontology, has a wealth of stored knowledge within its collection of Pleistocene vertebrates. It sponsors and takes a prominent part in critical excavations and in the Sub-Department of Anthropology gained notable distinction under the late Kenneth Oakley with Swanscombe Man and the Boyn Hill Terrace, Galley Hill Man and that composite anthropoid from Piltdown. The other half of the British Museum at Bloomsbury continues to good purpose with its radiocarbon laboratory.

The Atomic Energy Authority at Harwell has developed several physical methods of absolute dating to the extent that it now provides a widely varied public service.

The British Geological Survey now recognises the great importance of Quaternary deposits from their stratigraphical and economic aspects and is in a special position to contribute because of the involvement of numbers of personnel in field mapping, in having money for boreholes and in now having staff trained in palynology and palaeoentomology. If there is a limit to its potential, it is the obligation to map within sheet boundaries and specific Quaternary problems often extend beyond those limits. To complete such studies may involve considerable sacrifice of personal leisure time.

Finally, in this citation of credits, I must mention the growth of international co-operation, evidenced by I.G.C.P. Project 24, Glaciations of the Northern Hemisphere and the free exchange of ideas and techniques on such matters as Deep Sea Oxygen isotope cycles, Climap, Amino-acid ratios and U/Th dating.

What, then, are the achievements of the last two decades, not necessarily emanating from this country? First I would mention that criticised Special Report No.4 of the Geological Society, Classification of the Quaternary. There was no attempt then made to correlate British stages with the deep sea isotope record - how could there be twelve years ago - and in attempting correlation between different British areas, the committee had to work with what evidence it had of a continental sequence which must inevitably be fragmentary. So it is no surprise to find evidence accumulating for additional climatic cycles of cold to warm within the larger climatic oscillations, for this must inevitably follow. Nevertheless the basic situation of three post-Cromerian glaciation episodes, each one complex, has not been superseded. At least one pre-Cromerian glaciation (Plateau Drift) appears to have affected Britain, and this is something that was not recognised in the Quaternary Special Report. Above all, the report provided the basis for constructive criticism.

2. The oxygen isotope record of the deep sea cores. This has so strikingly been replicated in several deep-sea cores, that it is now accepted as gospel evidence, not only of the variation of the relative proportions of the two major isotopes of oxygen, but of the interpretation of these variations in terms of world wide changes of climate, basically between warmer and colder. Considerable progress has been made in putting absolute dates on to some of these oscillations. We are well on the way to correlating Britain's known cycles to many of the isotope stages. However this is done, it becomes clear that some of the stages are as yet unrecognised - or perhaps it would be truer to speak of some of them as in process of being defined - not without generating discussion and argument.

3. The recognition of a complex succession of warm climate periods evidenced by soils. In this country we have made progress in the last few years but we may never find such full sequences as to allow us to emulate the mid-Europeans with their great thicknesses of loess in the country between the North Europe Glaciers and those of the Alps and Carpathians. One thinks particularly of Czechoslovakia, where Kukla has demonstrated a succession which, if one accepts the tying-in of the Brunhes Matuyama transition, has a remarkable correspondence with the deep-sea isotope record.

4. Worthy of mention is the shattering of the four major glacial episodes in the Pleistocene - the inevitable Wurm, Riss, Mindel and Gunz with possibly a still earlier Donau. Nowhere was this classification more rampant than in the U.S.A. where for a long time, they had the four major stadials of Wisconsinan, Illinoian, Kansan and Nebraskan with major separating interglacials. Now it is known that the U.S.A. with its large geographic spread and great altitude variations, experienced glaciations from well before the start of the Pleistocene. The number of cycles is much more than four, and the type stages of Kansan and Nebraskan do not correlate with claimed paratypes. This has been demonstrated by Easterbrook and his colleagues. Fortunately in their mountain ranges the tills intercalate with tephra which can be dated by conventional techniques such as K/Ar or fission track. We here are not so fortunate in that we have no recent volcanic action, not even in Ireland.

5. Brief mention can only be made of the exciting discoveries that have been made in the last two decades of our human precursors. We tend to forget when we are considering Pleistocene vertebrates that *Homo* and its precursors should be the most interesting fossils to us. Finds from East Africa, Abyssinia, India, China and Vertesszollus in Hungary have amplified our knowledge of mankind's complex family tree and I would again pay tribute to Kenneth Oakley, who died 2½ years ago. With his *Catalogue of fossil hominids* (with collaborators), his *Framework for dating Fossil Man* , and his use of the fluorine relative dating method for validating or otherwise the antiquity of hominid discoveries, K.P.O. did a great service to British Quaternary research.

6. My sixth accolade must go to the art of dating. Correlation has always been one of the main aims of Quaternary research and what could be better for this purpose than to put exact dates in years on deposits. So it is not surprising that the last two decades have experienced a determined quest to find new methods of dating and to give old practices greater precision. In 1966 I gave a presidential address to the Geological Society of London on the subject of "The problems and contributions of methods of absolute dating within the Pleistocene period". At that time Radiocarbon dating by proportional counting was well established but people were arguing about the relative effects of hard water error, isotope replacement, contamination by ancient carbon, and modern contamination. Such sources of error are at least better understood now. K-Ar dating and fission track dating were proving useful for the older Pleistocene in regions where suitable rocks associated with Pleistocene activity were available, but still had large margins for experimental error. Dating by means of the Uranium decay series was by this time known, but under the shadow of grave doubts about its reliability and limits. Of TL I was able to write that "it had not reached the stage of positive results". I made no mention at all of Beryllium nor of amino-acids.

The availability of exact dating methods is now greatly widened. "Old method" radiocarbon determinations are now much improved, particularly with the development of scintillation counting, and for the first time the "accelerator" at Oxford holds promise, if not of reaching back to dates far older than the conventional method can attain, at least of being able to date very small samples, such as a single seed or a beetle's elytron, or the amino-acid extracted from a bone. U/Th dating is now a routine laboratory practice covering about the last 300,000 years, although it still has problems of contamination and loss of daughter elements which lead to the discarding of some 'results'. Amino-acids are experiencing a surge of interest which is encouraging, though it must always be remembered that its ratios permit correlation or differentiation between samples, but to convert the figures into absolute time requires co-operation with an 'exact' method such as U/Th or for more recent examples, ^{14}C, on at least a few of those being compared, or on correlation of deposits from their faunal and floral content, with the age of at least one of these deposits being known.

7. Very briefly, I would like to mention how the study of more and more divisions of the animal and vegetable kingdom as fossils has enhanced the interpretation of the environment - its climate and its ecology - at different times.

The two subjects that spring first to my mind are (a) insects, especially beetles, providing the possibility of thousands of species whose present-day habitat requirements are often well known: and (b) the capability which the scanning electron microscope has given us to identify pollen grains to the specific, rather than generic level. Progress in the study of other organisms has been considerable, but perhaps not so spectacular.

8. And finally I must refer to magnetostratigraphy. In Britain we cannot claim much credit for any progress, and elsewhere there is the possibility that the minor, short-lived reversals, the 'events', may be wrongly identified because some may be unrecognised or indeed not represented by sediments. However, in Europe and in America there are now many sequences where the change from reversed Matuyama to normal Brunhes can be recognised. This provides a world wide division of time unparalleled by any striking and universally recognisable biotal change, so that there is now a strong case for using the Brunhes/Matuyama transition as the divide between Middle and Lower Pleistocene.

I conclude by looking back to the meeting in Birmingham in 1964, when the Quaternary Field Studies Group was brought into existence. It was not long before it changed its name. What is remarkable to me is the way it has fostered the co-operation and exchange of ideas between exponents of so many disciplines, has enabled them to meet together in fruitful discussions or field work, and has reached the astonishing membership total of about 800. I venture to think that the growth of our Association may also rank as one of the achievements of the last 20 years.

DEVELOPMENT OF QUATERNARY PALAEOBOTANY

By G.F. Mitchell

Introduction

These remarks must be regarded as carrying, like the invoice of trade, the magic letters E & O E, errors and omissions excepted. I recently wrote an account of archaeology in the Royal Irish Academy, and I omitted all reference to living persons. This I cannot do today, but to do otherwise is, I know, the quickest way to lose friends. Also I am aware that my account is very much slanted to the British Isles, with but occasional side-glances to the continents of Europe and North America. This I regret, but it is difficult to avoid on what is essentially a domestic occasion, the celebration of our founding twenty years ago.

Part I Microfossils

We can take the opening of the twentieth century as the departure point for our review. Like a zoologist trying to track down the ever-receding name first given to an organism, we could grub about in the late 19th century, but our story really begins with Lagerheim, Professor of Botany in Stockholm from 1895-1925. By 1900 Lagerheim was already referring to pollen-counting 'as a reliable method with which to follow step by step from one layer to another the immigration of all plants whose pollen or spores are preserved as well as the relative frequency of these species. When the rate of formation of all the different layers can be determined, it will also be possible to calculate the speed with which the plants in question immigrated.' Fifty years later radiocarbon made it possible to ascertain the rate of formation, and after another thirty years an atlas of immigration rates has appeared.

In 1910 Weber of Hamburg (the first to describe the *Grenzhorizont* of raised-bogs which flashed across our view about fifty years ago) was also counting pollen-percentages, but von Post was the first really to develop the full potentialities of the method. By 1916 he was already producing important papers; in 1924 he wrote of forest history in south Sweden; in 1937 he produced the splendid English word *'paludification'*, meaning 'the process of things getting damp', a word which can be found in use in the most recent issue of the *Proceedings of the Prehistoric Society*. In 1946, after a visit to his former pupil Lucy Cranwell in New Zealand, he wrote of '*revertance*' in woodlands as the postglacial proceeded, a concept very similar to that of "*telocratic phases*." He also drew a picture of world-wide parallel forest development.

Several people here will know that I stood in a very special personal relationship to Knud Jessen, first, like von Post, in the Geological Survey and later Professor of Botany in Copenhagen, but setting that aside I claim that he was the first to produce a full and rounded work. His thesis of 1920 on *Bog-investigations of northeast Zealand*, dealing in 240 pages with vegetation-history, sea level changes and archaeology, using bog-survey, pollen-counts, seed identifications, cryptogam identifications, algae, bones, rhizopods, stands as a milestone on the road. He expresses his thanks for help to Weber, Lagerheim and von Post, in that order. My impression is that he was never very close to von Post.

By 1928, in collaboration with Milthers, Jessen had solved the Eemian problem, almost for all time, and in 1934 he proceeded to make Ireland his own.

1921, only one year after Jessen, Gunnar Erdtman's pollen-analysis thesis appeared, and Erdtman remained a pollen man till his death. His thesis secure, he then toured the world, the British Isles, Australia, Kamchatka, publishing in English and putting pollen-analysis (and also

Erdtman, but not von Post) on the map. This may be the cause of the hatred that he engendered on the part of von Post. Matters were not improved when his very useful book *An Introduction to Pollen Analysis* was published in 1943. In the introduction R.P. Wodehouse (an American principally interested in modern pollen) wrote that Erdtman 'standing on the shoulders of his predecessors, has reached into the realms far beyond'. I am sure von Post objected to anyone standing on his shoulders, but he could not abide Erdtman in that position. However, Wodehouse gave all pollen counters a nice pat on the back; he writes 'Mostly they have been men and women strongly individualistic and characterised by an independence of thought'.

Ten years previously Erdtman has introduced that daring thing a centrifuge into his pollen work; he had also developed with the aid of his brother who was a chemist, the acetolysis method. This aroused von Post's rage, and in a paper in 1933 he denounced these "improvements" as unnecessary - heating on a microscope slide was good enough for him. A centrifuge, even a hand-driven one, was an unnecessary luxury. But at the same time he was arguing vagaries of nature were more important than working methods. He referred to pollen-production rates, pollen flying capacity, pollen from near or distant sources. He said that only after these matters were solved, could we go on to absolute pollen frequencies.

It seems incredible that he should be so hostile to technical advance, when at the same time he had a brilliant group of students with him, Mrs Maj-Britt and Sten Florin, Knut Faegri, Johannes Iversen, and others from Baltic countries. The Florins worked on sea-level changes and diatoms, Faegri tackled the NAP jungle, while Iversen was coming to the forefront. In 1936 we had his paper on *Secondary Pollen*, and in 1941 the epoch-making *Landnam i Danmarks Stenalder*.

About the same time papers from Margaret and Harry Godwin were beginning to appear in England, while the Fenland Research Committee had Grahame Clark and Godwin excavating at Peacock's Farm, with its superimposed archaeological horizons. Jessen was starting his Irish campaign, Firbas was at work in Gottingen, and in Poland,Szafer was drawing his isopoll maps.

The disastrous and isolating war-years then intervened, but progress was soon as the march once again. Out of the war appeared C-14 dating, and by 1951 Willard Libby was able to produce the first book of dates.

I have already acknowledged my debt to Knud Jessen; this is perhaps the point at which to acknowledge my continuing debt to Sir Harry Godwin for much assistance and many kindnesses. When he was told in the late forties that fifteen specimens would be dated for him, he generously passed three of these datings on to me. Throughout his career in Quaternary matters Harry has taken a broad synoptic view of the whole field and given particular areas gentle nudges when these were needed.

If 1933 was good in Scandinavia, then 1955 was good in Cambridge, when the three W's, Walker, West and Willis arrived. After establishing his capabilities in Cambridge, Donald Walker went on to Canberra where he has given such a lead in southern hemisphere Quaternary studies; after Waldo Zagwijn had captured *Azolla* with a sieve with smaller holes, Richard West and I changed ours. Soon he had *Azolla* in East Anglia, and from there he went on to build up the whole history of the pre-glacial Pleistocene. He showed that vegetation did not repeat itself in a parrot-like manner in successive interglacials; that species-associations differ; while some forms like *Corylus* behave in a manner that is hard to understand. Eric Willis organised the Cambridge radiocarbon laboratory and then moved on to America, first to a commercial laboratory and then to the Army.

Meanwhile that sleeping giant, north America, began to bestir itself, largely due to the indefatigable efforts of Herb Wright in Minnesota (and anyone who has driven across the American continent non-stop with him will know what I mean by *indefatigable)*. He introduced the splendid practice of importing promising European colts and letting them develop their staying powers in the States. Magnus Fries must have been among the first to go (a list of all who went sounds like a Roll of Honour), and he raised American standards of pollen-counting to a new height.

1964 was the American year. Ed Cushing's thesis with its emphasis on local pollen-assemblage-zones rather than regional zones put the final nails in the Blytt-Sernander coffin. Margaret Davis and Ed Deevey brought absolute pollen-frequencies to their study of Rogers Lake, both its palaeoecology and its limnology; both I am sure would acknowledge the help they received from Evelyn Hutchinson in Yale.

But Europe was holding its own; Henrik Tauber was trying to bring precision to pollen transport, Judy Turner was beginning to try to pin down where people farmed, rather than just that they farmed; Winnifred Pennington, making a most welcome return to the fray, by adding sedimentology to limnology and palaeoecology, was throwing light on the difficult problem of pollen recruitment in lake basins.

Life was getting more complicated. By 1949 we had C-14, but only nine years later Hans Suess was drawing attention to tree-ring discrepancy. Are we to calibrate or not to calibrate? Absolute values had arrived, but Webb was muttering that 'Influx data merely replace one source of uncertainty in a data set by another source'. 1962 brought us principal component analysis, 1968 the scanning-electron-microscope. von Post was quite happy with 11 pollen types. The recently published Brian Huntley/ John Birks *Atlas* requires 55 major pollen and spore types. Fungal debris is studied more and more keenly.

The volume, *Quaternary Plant Ecology*, the account of a 1972 symposium, shows the trend of events. Of 18 contributions, Pollen dispersal and sedimentation, Pollen representation and Vegetational History and Community Development each had four contributions, Limnological History had 3, Methodological Problems had 2, but there was only one on Plant macrofossil assemblages.

Where do we go next? Our preparation methods are good but time-consuming, our microscopes, both optical and electron, are superb, the computer will both analyse our data and print our diagrams. Can we develop Fourier holograms to identify our pollen? If so, we can put our lake-mud in at one end, and pull the finished diagram out at the other? Our medical colleagues have gone a long way in this direction; why not us?

Part II Macrofossils

Here again we start with 1900 and the publication by Clement Reid of the *Origin of the British Flora*. Some 270 Quaternary identifications are made. Previous work by A.G. Nathorst and Gunnar Andersen is acknowledged. Bennie's work at Corstorphine is noted; here the sediments yielded *Apus glacialis* to what is described as the "ingenious manipulation" of the searcher. I am glad to say the same deposits have since yielded beetles to the ingenious manipulation of Russell Coope, and I have also used the method to find *Apus* in lateglacial Ireland. Lewis (1905-11) described plant remains in Scottish bogs, and Hartz (1902) was finding arctic plants at the bottom of Danish bogs.

Jessen's 1920 thesis not only had pollen, but also seeds, mosses and diatoms. Jumping ahead to the 1933 mark, it was in the following year that Jessen started his work at Ballybetagh, where in addition to the *Salix herbacea* noted by Stelfox and Erdtman, he added many other northern plants to the list. Since then Wes Scyner has returned there and has brought the list of species identified to 60. Last year Tony Barnoski went to Ballybetagh to study the Giant Deer remains, in particular why male skulls were far more numerous than female. He had observed that in the autumn many forms of deer divide into male and female groups occupying different territories, the female often on upper more open areas. He pictures the males assembling on the sheltered slope of the overflow channel, shedding their antlers, tramping on them and chewing them up, and so littering the ground with the antler fragments that he found during his excavation; a few died, and their skulls were added to those already entombed.

In 1944 Jessen carried seed studies still further, in a classical paper with Helbaek on impressions of seeds in prehistoric pottery. Helbaek then made this type of work a subject of his own, working intensively in the Middle East. His personality was not of the happiest; he was on the technical staff of the Copenhagen museum, but as he had no university degree he could not rise to the scientific staff, although he had a world-wide reputation. Tom Harris and Reading University tried to rectify this by giving him a well-deserved honorary degree. But this was not good enough for the museum regulations, and the chip on his shoulder grew even larger. General psychological and matrimonial problems did not help and it became difficult to ensure his co-operation.

1956 saw the publication of Harry Godwin's monumental *History of the British Flora*, and it became possible really to assess the vast strides that had been made since the beginning of the century. The following year saw the appearance of Jessen's paper (with Farrington and Andersen) on the still controversial interglacial deposit at Gort, and this was hotly followed by Bill Watts's paper on Kilbeg. Some time later Watts was able to show that Jessen's micro-*Menyanthes* from Gort was in fact *Nymphoides*, probably *cordata*, another American plant now disappeared from Europe.

Watts proceeded to demonstrate his interest in macrofossils in a paper with Winters on Kirschner Marsh, and then went on with papers on south-east United States to throw much light on plant movements there during the Quaternary. Specially interested in species migration, he insists on the building-up of good data-bases. Following Bill Watts on the Herb Wright Minnesota circuit, Hilary Birks took up the problem of modern macrofossil assemblages, from the comparative point of view.

I had a call-over of the subject of this talk with Bill Watts and Richard Bradshaw, and we asked questions such as 'What paper, not one of your own, would you like to have written?' and 'Which do you think was your best paper?'. Afterwards I asked myself 'Which do you consider your least-read paper?', and the answer has to be Goodland, Co. Antrim. This is the only place in Ireland with chalk downland, now largely buried by blanket-bog; it had extensive Neolithic occupation, extensive medieval occupation, and is still in agricultural use. Many cooks came and looked at it, but nobody served the meal. When I was in Cambridge in 1968, I tried to draw some of it together. Amongst other things I made a seed-count in the base of the blanket-peat, and noted in one small sample over 2,000 seeds of *Juncus conglomeratus/effusus*. But not one single grain of *Juncus* pollen was noted in the pollen-counts. I introduce this as an awful warning. Juncus is very common in Ireland today and was probably equally prominent throughout the Quaternary. Any attempt to recreate past vegetation in Ireland must lie in the shadow of the question 'What was *Juncus* doing then?'

Although Clement Reid included Roman material in his studies, there has been an enormous expansion of interest in the macroscopic fossils in the archaeological deposits of this millenium, most notably from the medieval period. This can be well seen by comparing the bibliographies in the first (1956) edition of Harry Godwin's book and the second (1975). Single sites produce lists of up to 150 identifications, with parasitic eggs, fleas and rat faeces thrown in for good value. Interpretation can be difficult, given that the material is an agglomeration from various sources, but one thing is quite clear - life in a medieval town was cramped and smelly.

There is no doubt that in the prehistoric period also such seed studies will get more and more important, especially as archaeologists swing away from their museum shelves to landscape archaeology. As Judy Turner has shown, pollen studies also will be more and more pressed into service. Dendrochronology, as it gets more and more sophisticated, will also have a very important role.

A parting-shot - what about the Elm-decline? There is a good record for absolute dating in Trinity College, Dublin, even though its radiocarbon laboratory is no more. Almost 400 years ago its Chancellor, Archbishop Ussher, said that the world was created in 4004 BC; its current Provost, Bill Watts has said that the Elm-fall was caused by disease in 3150 BC. A recent Irish newspaper records 'Flint knife found in Kerry dated 3200 BC' (by the BM Laboratory).

Hitherto we have always said 'No limestone, no elm, no Neolithic farmers in Kerry'. What are we to say now, 'Disease or Man'?

THE FUTURE OF QUATERNARY RESEARCH

By R.G. West

I am at a bit of a disadvantage here because our previous three speakers have been talking about the past twenty years while I have to look ahead and make a few comments on the next twenty years. Naturally, I shall be talking from the point of view of somebody within a University, but there are those here from other types of institution and perhaps they could make their own comments at the end of my talk.

There is one point to begin with concerning tradition. In the past there have been a certain number of professors of geology who have taken a serious interest in Quaternary research. This was a band of people which included O.T. Jones, S.E. Hollingworth, W.B.R. King and F.W. Shotton amongst others. They combined, for example, an interest in Palaeozoic research with research on the Quaternary. This tradition seems to be failing. Of course, a number of earlier workers were officers of the Geological Survey, Clement Reid for example, and we can also note that Edward Forbes contributed a paper in 1846 to Volume One of the Memoirs of the Geological Survey, in which he discussed how the past physical conditions in the British Isles in the period of the northern drift affected the nature of the present fauna and flora. Incidentally, there is also in this volume an article on the denudation of south Wales.

Nowadays I get the impression that the geological establishment does not consider the Quaternary to be an important part of its responsibilities. This viewpoint is not, however, a new one. Here is a quotation, part of a letter for one geologist to another. "The antiquity of man question... is doomed to be damaged by bad evidence and worse reasoning. I have long seen what the fate of the geologist would be from the time that he allied himself with the anthropologist and antiquarian. The only thing that can save us is to restrict us to the Silurian System for a year or so." (Prestwich 1899; from Godwin Austin to Prestwich in 1859).

We can compare this situation with that in other countries, where the Quaternary occupies a much more solid position in Universities and geological surveys, e.g. in the United States, Canada, the Scandinavian countries, the Netherlands, Germany, Poland, U.S.S.R. and so on.

It is about time that there was a clear recognition that Quaternary research supplies the all-important baseline of environmental knowledge against which we must consider all the problems we have today about the future of our environment. The key to the future is in the past, particularly in the knowledge of conditions and processes characteristic of our recent past. Wherever we look matters of climatic change, pollution, acid rain, greenhouse effects, conservation and ecosystem response are constantly presenting problems which will have to be solved. I have this strong feeling that while astronomers are peering into black holes, while physiologists are investigating the molecular basis of neurobiology and geneticists are busy manipulating genes, a very large surging ice sheet will come and prod them in the backside.

The apparent imbalance of scientific endeavour follows from historical development and inertia in the system, which of course has its advantages. But perhaps we should be stating more clearly that Quaternary research is a fundamental discipline for providing a baseline and background for studies for our environment, its past evolution, its present state and future development.

With these remarks made, I now want to go on to ask four questions. These are as follows. What has to be done? Where will it best be done? Who will do it? Who will pay for it?

Starting with the first one - what is to be done? - Fred Shotton has already outlined very clearly the important developments of the next ten or twenty years. I might just underline one or two important themes. I think that much more detail of stratigraphy is required and more detailed mapping. There is a deficiency of strong stratigraphy. We also need to know much more about the relation between the marine and continental facies of the Pleistocene. This is a very important subject, which will bring together two fundamental but complementary areas or research now rather segregated. For example, investigations on the taphonomy of marine pollen assemblages are badly needed. The third subject to mention is climatic change, the identification of the nature of climatic change and the complications of climatic change. We tend to use the phrase climatic change in a very broad sense. What we need to know, for example, are changes in seasonal temperatures, and changes in seasonal precipitation, maxima and minima, as well as means. The fourth subject is new dating methods. Their application and development must clearly rest on very secure stratigraphy before reliability is proven.

Where will this work be done? As Fred Shotton has pointed out Quaternary research is essentially multi-disciplinary. Now the structure of departments and universities often, if not always, militates against Quaternary research, especially at a time like the present when there is a lack of posts for new developments. In fact, there have been restrictions and losses by retirement. The best way forward is by informal collaboration, constructive collaboration with well-intentioned colleagues. Such cannot necessarily be organised on an institutional basis; organised collaboration is often very testing in my experience and sometimes not conducive to the best science. We also need equipment and here is the problem that we are in competition naturally with popular but very expensive activities in biology and earth sciences, such as genetic manipulation, crustal investigations and so on. The most satisfactory way to go forward may be to group people interested in Quaternary research into departmental or interdepartmental groups in universities and elsewhere. The problem here is that any such grouping needs the support of heads of departments in universities and directors of institutes. It seems to me that there are few cases of such support for the prosecution of multidisciplinary research. The importance of multidisciplinary research was stressed by the 1983 Morris Report on "The support given by Research Councils for in-house and university research", an investigation set up by the ABRC. pp. 38-39 deals with the need for the stimulation of multidisciplinary research activities at universities. Perhaps you should all go back to your universities and draw their attention to this point. If anyone is in a position to give support to the recommendation I hope they will for the benefit of our subject. An interesting point also made in the Report is that multidisciplinary co-operation is far more satisfactory in institutes; perhaps Douglas Peacock can comment on that.

My third question is - who will do the work? I was discussing this point with Phil Gibbard and Paul Ventris and they suggested it might be useful to look at the subject allegiances of QRA members, as indicated in the address list. This is not really satisfactory because there are many private and other addresses. But the results do give some indication of allegiances, as follows: geology 136, geography 209, Quaternary 19, archaeology 18, earth science 7, botany 14, zoology 5, biology 2, environmental 25, soil 3. The multidisciplinary nature of our subject is well shown by these crude figures.

Now let me look at the situation from the students point of view. Last January I gave a lecture on the Quaternary to the students' annual geological conference at the University of Aston. There were 200 students present. I asked the audience to hold up their hands if they had received more than one lecture on the Quaternary. Three put up their hands. This reveals a most important point, if not the most important point in my talk. This is the problem of putting more Quaternary teaching into earth sciences. This brings us to the question of training to enter Quaternary research. Most of us have taken degrees in one of the subjects contributory to Quaternary research, and we later specialised in post-graduate degree courses of training, at the same time attempting to widen our background so that we could understand the relevance of our own speciality to the Quaternary as a whole. A problem comes at the present time with the employment of post-graduates who have undergone this sort of training. When there are these very rigid departmental structures priority is always given to applicants who are in the main line of business of the department. You won't find that a zoology department, for example, will like to employ a Quaternary zoologist; and the same with botany and earth sciences. This is perhaps not always true in geography departments, because geography has often maintained a broadness of approach which has resulted in the employment of Quaternary post-graduates. A similar problem arises in employment in institutes. Those qualified in Quaternary research are not so acceptable as those qualified in earth sciences as a whole, with little experience of the Quaternary. On the other hand, many continental surveys employ well-qualified Quaternary scientists. Combined with this is the effect of the Rothschild arrangements for research support, which has meant the replacement of long term mapping projects by short term surveys such as those of the mineral assessment teams, where full advantage cannot be taken of all the most useful data obtained. This seems very short-sighted in view of the needs I have mentioned already.

My final question is - who will pay for it? In the dual support system universities should provide the baseline equipment for research.

Apart from apparatus for radiocarbon dating, palaeotemperature research etc., equipment needs are not as heavy as in some other subjects, but with the competition for equipment funds I mentioned before, it is still a difficult matter to obtain equipment for multidisciplinary areas. In the matter of funds from research councils, here again we come to the size of the slice of cake, in the form of grants and studentships, allotted to Quaternary research. Being multidisciplinary, the subject may fall into cracks between the formal committee subjects of the research councils. There is also the historical inertia in the allocations to different subjects in the earth and life sciences. I believe there may be too much accent on new developments in deciding funding. What needs to be supported is good long term research into fundamental stratigraphical matters, using new techniques where possible. There should be a balance between the demand for new developments and the need to accumulate stratigraphical and palaeontological knowledge on classical lines. The three-year grant system works against long term aims for improvement of our stratigraphical knowledge. Only those in post can consider such long term objectives, and there are not many of these.

With these remarks I have tried to draw together some thoughts about the future of Quaternary research. I have not said anything about what I think will be discovered in the next twenty years, because that will be the result of your individual initiatives, and not the result of some committee, grant or policy. Which way the subject goes depends on yourselves.

What we have to do is, I think, quite clear. We must take every opportunity to make the relevance of Quaternary research known at large. We must demonstrate that Quaternary research is an integral part of earth sciences and should be taught as such. We must develop interdepartmental teaching programmes for properly qualified students and also for generalists. A knowledge of our environment and its history is perhaps the one compulsory subject which should be taught in schools. That is how I regard the importance of Quaternary research.

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PROSPECTING IN AREAS OF GLACIATED TERRAIN

UNIVERSITY OF STRATHCLYDE, 17-18TH MAY, 1984.

by D.G. Sutherland

Quaternary studies have much to offer the mining community both in terms of understanding the genesis of surface mineral accumulations and in explaining the dispersion of eroded mineral fragments or chemical elements away from ore bodies. Equally the quantity and quality of the data gathered by mineral exploration companies would be invaluable to Quaternary scientists in helping to generate and test theoretical models of dispersion patterns resulting from ice-sheet glaciation or drainage basin evolution. The meeting at Strathclyde was the sixth biennial conference on 'Prospecting in Areas of Glaciated Terrain' organised by the Institution of Mining and Metallurgy in the hope that the presumed mutual interest would be promoted. Out of a total of over 100 participants (from 14 countries) the attendance at this year's conference of only a handful of Quaternary specialists suggests that they are either unaware of the opportunities or unwilling to get involved. One result of this low level of interest by glacial geologists was that a high proportion of the papers presented would best come under the title 'Prospecting in-spite of glaciated terrain'.

28 papers were given of which a number were of wider interest to glacial geologists and geomorphologists. John Miller (Anaconda Co.) presented an interesting model of the down-ice displacement of geochemical anomalies away from ore bodies in Northern Canada and Ireland. Miller demonstrated that the surface geochemical anomaly was displaced by up to several hundred metres down-ice. This highlighted a difference of approach with a number of other geochemical papers in which the expectation was expressed that the geochemical anomaly was most probably over the ore body. Such a fundamental and potentially important difference was reflected in the discussion as to the relative roles of clastic as distinct from groundwater geochemical dispersion within tills.

A strong contingent from the Finnish Geological Survey headed by L.K. Kauranne was present. S. Rossi emphasised the limited erosion and accompanying preservation of deeply weathered bedrock in the ice shed area of the Scandinavian ice sheet in Lappland. B. Saltikoff detailed the computerised data bank established for over 7,500 ore-bearing erratics in Finland and its utility in cross-correlating known outcrops with erratics and building up a picture of ice transport, and K. Nenonen emphasised the need to consider till stratigraphies and multiple glaciation in any overall understanding of erratic dispersal. In their papers and in discussion the Finns argued strongly for only very limited transport of erratics by the last ice sheet.

A valuable theoretical counterpoint was provided by Geoff Boulton (UEA) who presented an ice sheet model that as yet cannot predict to where erratics will be carried,but can at least define zones in which they may be found given a particular source, or vice versa. Brian Horsfield (Monopros Ltd) provided a complementary paper on the mode a glaciation and ice flow directions in the western Grampians which was, to the present writer at least, a touch controversial.

In many of the other papers glacial deposits, where mentioned, were described as 'overburden' or simply as 'till' with an occasional 'ablation-lodgement' couplet thrown in. In an appropriate impromptu address L.K. Kauranne made a plea for people to stop treating till as a homogeneous material or, for that matter, one that is best ignored. There is clearly an opportunity for glacial geologists and geomorphologists to demonstrate the relevance of even relatively simple concepts and techniques in this field but to do so they must be outward looking and present their work appropriately. As most geomorphologists should realise, the mountain is unlikely to come to Mohammed.

Donald G. Sutherland
Placer Analysis Ltd.,
2, London Street,
Edinburgh
EH3 6NA.

ABSTRACTS OF RECENT Ph.D. THESES

THE TERRACES OF THE RIVER THAMES IN CENTRAL LONDON

P.D. Nunn

Ph.D. Thesis, University of London 1983

The geomorphology of central London has not been investigated significantly since the 1880s. In view of the complexity demonstrated in the river terrace sequence elsewhere in the Thames valley since that time, a reappraisal of that in central London is considered long overdue. The data used consist of large amounts of well and borehole log information which is contour mapped by computer and morphological maps of the sub-drift surface derived. These maps demonstrate the existence of a succession of planar benches cut in the bedrock clays. The discrete nature of each surface was confirmed as far as possible by fieldwork and the overlying sediments sampled and analysed.

There are seventeen, altitudinally and morphologically discrete benches flanking the valley of the Thames in London, from -4.5m to 130.0m above sea level, of which at least ten are paired across the valley. Benches are named A-O, including three altitudinally discrete facets of bench E, which underlies much of what has been mapped as Taplow Terrace in the area. Bench G underlies the Boyn Hill Terrace of earlier writers and bench D can be linked with the Upper Flood-Plain Terrace. All benches demonstrate reasonable downvalley continuity within the area. Drifts resting on the lower seven benches can be separated statistically using petrological criteria, such as grain size, pebble type and heavy mineral proportions.

A model for the development of the river Thames during the Flandrian is proposed (see also, *Transactions of the Institute of British Geographers, N.S. 8*, p 187-213) and the process environments under which (presumed) older benches probably formed and the aggradation of the drift occurred are described. Major bench-cutting is reasoned to have occurred under periglacial conditions with possible (major?) extension during Pleistocene interglacials. There is no evidence to show that the present fluvial (-glacial) drifts resting on benches in London were even approximately contemporary with the time of bench-cutting, although such a relationship is favoured for the three lowest.

FLANDRIAN VEGETATIONAL HISTORY AND SEA-LEVEL CHANGE OF THE WAVENEY VALLEY

A.M. Alderton

Ph.D. Thesis, University of Cambridge, 1983

The stratigraphy of the Waveney Valley marshland between Beccles (Suffolk) and Great Yarmouth is constructed from a network of 120 boreholes, together with about 250 previously recorded bores, mainly commercial. The data are synthesised into 22 cross-valley sections and a longitudinal section.

Up to 5 Flandrian lithostratigraphic units are recognised upstream from Yarmouth, from the base upwards:- Barnby Peat Bed, Oulton Bed (estuarine), Burgh Peat Bed, Breydon Bed (estuarine) and Stanley Carrs Peat Bed. These were defined at two type sites, Boundary Dyke (TM 48909258) and Stanley Carrs (TM 44049298).

The Oulton Bed generally floors the sequence inland from Yarmouth, but is restricted upstream of Burgh St. Peter to a narrow channel incised into the valley floor. The Barnby Peat Bed is common only in the vicinity of this incised channel. Contour maps of the underlying sand and gravel surface, which were constructed from the borehole data, show the channel precisely underlies the present course of the R. Waveney. The Burgh Peat Bed is variable in composition and shows that while alder fenwood dominated upstream from St. Olaves there were areas of open water, sedge and moss peat here too. Downstream a raised bog developed and extended part way up the tributary Fritton Valley. At Yarmouth the stratigraphy is more complex, although generally the same 5 units can be recognised, interdigitated by spit deposits. The Breydon Bed is more extensive, but thinner, and penetrated further inland than the Oulton Bed which was confined by the pre-Flandrian valley topography.

Six representative sites were subjected to environmental analyses and radiocarbon dating. This showed that peat formation began before 8500 b.p. near Caldecott Hall, but was interrupted by estuarine conditions at 7500 b.p. However, the Oulton Bed did not reach its inland limit until c.6300 b.p. and Fritton Valley until 5650 b.p. Peat growth recommenced at 4900-4700 b.p. and was followed by the incursion depositing the Breydon Bed at 2200 b.p., reaching inland to Aldeby by 1990 b.p. The regressive overlap is dated 1750 b.p. here. A sea-level band and partial chronology of positive and negative tendencies of sea-level is developed for Broadland. These are compared with changes recorded in other regions in Britain and the Netherlands.

THE QUATERNARY FLUVIAL DEPOSITS OF NORTH KENT AND EASTERN ESSEX

D.R. Bridgland

Ph.D. Thesis, C.N.A.A. (City of London Polytechnic)
1983

A lithostratigraphic and morphostratigraphic study has been made of Pleistocene fluvial deposits in north Kent and bordering the Essex coast. The principal method of investigation has been lithological analysis of gravel sized material, samples from the various aggradations in the research area having been subjected to stone-counting. By this method, essentially a study of provenance, it was possible to distinguish between gravels laid down by the various rivers in the district, in particular the Thames, the Medway and the combined Thames-Medway. Gravels of Medway origin were found to comprise mainly southern and local rock types, while those deposited by the Thames contain both southern and 'exotic' material in small but consistent quantities. The different characteristics of the gravels of these two fluvial systems were established in north Kent and the Lower Thames Valley respectively. In eastern Essex, south of the Blackwater, the gravels can be separated, on the basis of lithology, into higher and lower subdivisions. The higher deposits are of Medway affinities, whereas the lower gravels contain the 'Thames

exotic suite', although retaining a fairly large southern component. The latter are interpreted as Thames-Medway deposits. North of the Blackwater, only the highest (and oldest) of these Thames-Medway deposits was recognised, where it represents the youngest aggradation of the Clacton area. The older gravels of the Clacton area were also found to include Thames-Medway deposits, but these contained considerably more exotics than those from south of the Blackwater. They have been interpreted as equivalents of the Kesgrave Gravels of southern East Anglia, which are Thames deposits, laid down prior to the diversion of that river (by Anglian ice) from a more northerly route than at present, which carried it across northern Essex. This diversion provides an explanation for the change from Medway to Thames-Medway deposition south of the Blackwater. The higher (Medway) gravels in this area are thought to have been deposited prior to the Anglian glaciation, when the Thames flowed across southern East Anglia. During this glaciation the old Thames route was blocked by ice and the river diverted into its modern valley through London, thereby appearing in eastern Essex, in Thames-Medway form. It is apparent that the newly diverted Thames flowed across eastern Essex by way of the old Medway valley, rejoining its pre-diversion route in the Clacton area.

REVIEWS

The Mountains of Northeastern Tasmania. By N. Caine 1983 Balkema, Rotterdam, viii and 200pp. Price £16.00 (hard cover) ISBN 90 6191289X.

This book is, in essence, a research monograph of a kind not seen too often. It is well illustrated and closely written with a good bibliographical context serving to place this apparently parochial study into a wide geomorphological and process framework.

The author's aim is "to examine the landscapes of northeastern Tasmania with respect to the material and environmental properties that have contributed to their present form." To achieve this he adopts the debris cascade as a general model but takes into account lithological, temporal and palaeoclimatic factors. The work is thus both a contribution to the geomorphology of a small but interesting region and an interesting exercise in deducing past process from present form. In that the temporal framework is predominantly that of the Quaternary, this book will interest Quaternary scientists with strong geomorphological leanings, especially towards glacial and periglacial processes.

Following a succinct introduction, Caine provides a background chapter which places the northeastern Tasmanian mountains in their regional, geological, morphological, climatic, vegetal and pedological contexts. Bedrock weathering and landforms are discussed and a six-fold hierarchy of forms is presented, all but one being relict. Consideration of Pleistocene glaciation is followed by chapters on the alpine cliffs, and mass wasting deposits and mechanisms. The cliffs have developed mainly by small-scale rockfall and, on Ben Lomond, by large scale cliff failure leading to toppling.

The longest chapter (62 pp.) considers the size, form, distribution and modification of talus accumulations, alpine blockfields and mass wasting mantles. The blockfields are believed to have been emplaced by mass wasting, most of the movement occurring by sliding failure in remoulded clays underlying the blocks when pore water pressures were high at times of freezing of the upper surface layer. Frost creep is also suggested. A solifluction origin may apply to many of the debris mantles. A chapter on the mountain landscape emphasises the influence of the structure of this dolerite-dominated area on the mountain form and considers erosion rates, process models, sediment budget models and the climatic-geomorphic factor. Quaternary scientists will be most interested in the relatively brief chapter (29 pp.) on the glaciation of the Ben Lomond plateau. Glacier models are derived from the distribution of glacial erosional and depositional features, suggesting two very small ice caps with an E.L.A. of 1400 m. and a mean temperature below the present of perhaps 10°C. Earlier ideas on the low energy of these ice caps are confirmed.

The most fascinating, and potentially controversial, part of the book is the relative chronology of glaciation, cliff recession and mass wasting derived from the mapping of weathering rinds and weathering pans on bedrock and diamict mantles, rock pedestals, and lichenometry. Two glaciations, ice-cap and cirque, are dated thus at about 100,000 yr and (with the aid of ^{14}C) 20,000 - 10,000 yr respectively. The rockfall process may go back more than 250,000 yr and large-scale toppling on Ben Lomond may have prevailed from 100,000 - 18,000 yr B.P. The raw material of the blockfields was prepared by Tertiary weathering (weathering rinds thicker than 50 mm may be older than 0.5 m yr), much was transported by the ice caps on Ben Lomond in the plateau glaciation, and freeze-indiced mass wasting emplaced blockfields 75,000 - 12,000 yr ago which then became stabilized and weathered.

This book is a fascinating combination of the closely argued and the adventurous. It deserves to be seen as of wider systematic interest than its narrow geographical context might suggest.

Edward Derbyshire
Department of Geography
University of Keele.

Pontnewydd Cave - A Lower Palaeolithic Hominid Site in Wales. The First Report, Ed. H.S. Green 1984. National Museum of Wales, Cardiff. 234 pp. 39 plates, 69 figures, 34 tables. Price £19.95 (hard cover). ISBN 0 7200 02826.

This volume is the first detailed report on the excavation carried out in Pontnewydd Cave between 1978-81 with additional material from excavations in 1982-3. The archaeological significance of the site can be immediately gauged by consideration of Figure 1.2 where its isolation by C. 150 km from the next nearest Palaeolithic find site can be seen. But the finds in the cave of the remains of 3-6 individuals most probably referable to *Homo sapiens neanderthalensis*, and the general dated context in which these finds were made further enhances the sites' importance.

The initial reports on the current excavations were made in 1981 in short papers in *Nature* and *Antiquity*. The purpose of the current volume is to provide a detailed, but interim, report to give a more detailed account of the present knowledge of the site in advance of the final volume to be produced at the end of the excavation. With this aim the editor and his fifteen co-authors have succeeded well, although as is the nature of interim reports, some chapters have little to add to the original papers on the site, while others are at such comprehensive length to leave the reviewer to consider what extra they might find to put in the final description of the site.

The volume contains seven chapters of description together with an introduction and conclusion by the editor. The major part of the text is preceded by well arranged tables of contents with lists of all illustrations, and perhaps most important of all, abstracts for each chapter or sub-section.

The first descriptive chapter (Chapter II) by C. Embleton, deals with the geomorphological context of the site. This brings out the lack of information on the geomorphology and Quaternary stratigraphy of the Elwy Valley area and the pivotal position Pontnewydd and its dated horizons holds for the sequence outside the cave.

Chapter III is subdivided into two, a forty-five page section on the cave sediments by S.N. Collcutt, and a shorter (twelve pages) section by P.A. Bull on his SEM work on the quartz grains in the cave sediments. Both these sections are well illustrated by diagrams and photomicrographs. In view of the complexity of Collcutt's section his "introductory" summary is especially helpful to the reader in identifying the major sedimentary units in the cave without traversing, in the author's words, "the monotonous, dense presentation" which is necessary to describe such complicated and variable sequences of sediments characteristic of most caves.

Chapter IV reports the varied means used to date the sediments and artefacts in the cave. H.P. Schwarz and M. Ivanovich, A.M.B. Rae and M.A. Wilkins describe their U series and stable isotope work; N.C. Debenham, M.J. Aitken, A.J. Walton and M. Winter describe additional U series determinations and TL dates on calcite stalagmite; J. Huxtable TL dates on burnt flint and stones, and T.I. Molleson her work on uranium and flourine trace element analysis. The main conclusions of the efforts at dating the Pontnewydd deposits is that the occupation of the cave probably took place around 225ka, and thus in isotopic stage 7 of the oceanic sequence.

Chapter V, by the book's editor describes the archaeological industry, and M.H. Newcomer, some flaking experiments on Pontnewydd raw materials. The industry described is an Upper Acheulian one made largely on volcanic pebbles but also with a few flints. This is another measure of the importance of Pontnewydd in that it shows the clear association of such an industry with Neanderthal fossils in a dated context. This chapter is well illustrated with twenty-five pages of drawings of the stone artefacts, although in the review copy some of these figures are rather lightly printed so that some of the fine detail of the drawings is lost.

Chapters VI and VII are concerned with the bone remains found in the cave. In Chapter VI C.B. Stringer describes the hominid finds and compares them to Neanderthalers from European sites. In Chapter VII A.P. Currant reviews the mammalian remains and uses the preservation of the various bones to separate the fauna into three units irrespective of derived components in the upper layers. The lower of these units, also containing the remains of the hominids, appears to be related to an open woodland environment thus underlining the probable interglacial conditions at c.225 ka. The other two faunas are continental and tundra in type and represent more rigorous climatic conditions, and fit well with their inclusion into breccia units in the cave succession.

Chapter VIII is divided into three to describe the mineralogy and petrology of the sand and clay of the cave sediments (D.A. Jenkins); the provenance of the flints (C. Clayton) and the petrology of artefacts and erratics in the cave (R.E. Bevins). All three authors conclude that exotic material from northern or Irish sea sources is present suggesting both a source for the raw material for the artefacts in glacial deposits outside the cave, but also the glaciation of the area of the cave entrance after occupation by the hominids.

The final Chapter IX is the editor's summary and discussion which ends with a strategy for future work in which it is hoped that this very important and interesting site may yield more hominid remains and contribute even further to the adding of detail to regional Quaternary chronologies.

As a whole this volume is an excellent production. The authors and especially the editor Stephen Green, are to be congratulated on such a well produced report on a complicated site. It is especially pleasing to see such a volume produced so rapidly when Quaternary scientists commonly wait for years for the publication of reports on Quaternary sites of no less complexity and with similar teams of authors involved. It must be considered a well-nigh unsurpassable feat to get a book such as this published in so short a time.

D.H. Keen
Department of Geography
Coventry (Lanchester) Polytechnic

Glacial Deposits in North-West Europe. Edited by J. Ehlers, 1983. Published by A.A. Balkema, Postbus 1675, NL-3000 Rotterdam, Netherlands. 476 pp. Price £29.00 (hard cover). ISBN 90 6191 2237.

With recent developments in the study of tills, glacigenic sediments and Quaternary stratigraphy, 'Glacial Deposits in North-west Europe' edited by Jurgen Ehlers of the Hamburg State Geological Survey, provides a timely review of the history and effects of Quaternary glaciation in the south and south-west parts of the Scandinavian ice-sheet. The book is massive; consisting of 476 pages of almost A4-size paper, by 46 different authors contributing to 52 different chapters. Without exception, the text is brief, relevant and explanatory. Illustrations are prolific; with 409 figures including black and white photographs, maps and diagrams, 18 tables, and 95 striking colour photographs. The landforms, tills, sands and gravels, erratics and palaeosols shown on the colour plates are a luxury only rarely offered by books these days, and the information they record is immense. All the text is in English, and all the chapters are informative. In terms of quantity alone £29.00 is a reasonable price. For an excursion around the Quaternary of central and southern Norway and Sweden, the whole of Denmark, northern West Germany and most of the Netherlands it is a bargain. Because of the size of this book this review comprises a description of the contents in addition to an assessment of its contribution.

The book is divided into five sections covering each of the countries concerned. Each section includes a review of the glacial history of the region, a summary of the glacial deposits and their lithological properties, and a series of case studies concerned either with critical regions or significant thematic topics. The content of each section is illuminating, not only in terms of the direct information imparted, but also in the way it illustrates the different approaches adopted in different areas. A range of approaches exist, depending on the types of evidence available, and these reflect the importance of the behaviour of the glaciers within a region, the age of the glacial episodes, the interaction between glaciers and other processes, and the interaction between the geomorphic processes and the antecedent relief.

For Norway, the glacial history and character of the deposits are reviewed by Mangerud and Haldorsen, and evidence from the Oslofjord, western-central, and central Norway is outlined, respectively, by Sørensen, Bergeson and Garnes, and Sollid and Reite. Inevitably, these chapters are concerned particularly with the Late Weichselian glaciation. Evidence for earlier parts of the Middle Weichselian Gudbrandsdalen Interstadial, and Fjorsangerian Interglacial being fragmentary and rare. Particular attention is given to tills, glacial and glacifluvial landforms, and glacimarine sediments. The final chapter by Vorren, Hald, Edvardsen and Ling-Hansen reviews the evidence from the Norwegian Shelf, and provides a very clear example of the techniques available for such studies and a model of offshore environmental changes to complement that for the Late Weichselian that has been developed on land.

The background to the Quaternary history and glacial deposits of Sweden is given in three chapters by Jan Lundqvist. Stromberg reviews the varve chronology giving particular attention to the history of research and the methods of data collection and analysis. Johansson, Persson, Ringberg, and Largerlund consider, respectively, the landforms, sediments and stratigraphy of northern, central and eastern, southern and Skane districts of Sweden, while Hillefors describes the stratigraphy of two complex sections from streamlined landforms north of Gothenburg, giving an insight into a more complex glacial history than is indicated by the bulk of the evidence. In this section also, attention is given to practical applications of glacial deposits and chapters by Eriksson and Johansson consider, respectively, their relevance to mineral prospecting and road construction. Like Norway the evidence of landforms and inorganic sediments dominate in the reconstruction of the Quaternary environments, and in these two sections it is particularly pleasing to see such excellent colour photographs from classical areas of rogen moraine, kalix till, sveg till and jokulhlaup deposits.

The glacial history of Denmark is reviewed by Sjørring, and the characteristics of glacial landforms and sediments are summarized by Kruger. Rassmussen briefly outlines the methods of mapping glacial deposits employed by the Danish Geological Survey. Because of the importance of sedimentary evidence chapters by Nielsen, Houmark-Nielsen, and Petersen, consider till lithology, fabric, texture and derived biological content. Finally, Baelthav and Ristinge Klint in the Danish archaepelago are discussed, respectively, by Houmark-Nielsen and Sjørring, because of the detailed evidence available for Weichselian glacial stratigraphy and glacitectonics.

The section on north-west Germany is the longest, reflecting the importance of the subject, the complex history of glaciation, and the amount of work carried out, largely by officers of the Geological Surveys of Lower Saxony, Hamburg and Schleswig-Holstein. This section has four main topics. An introductory review of the glacial history is provided by Ehlers. Sedimentology, fabric, carbonate content, and indicator lithologies are considered by Ehlers, Stephan, Grube, Baermann, Iwanoff, Wilke, Meyer and Prange. Lithological and landform stratigraphic evidence for Elsterian, Saalian, and Weichselian glaciations is given by brief studies of critical regions by Ehlers, Stephan, Grube, Kabel, Schluter, Wilke, Hofle and Lade. Finally the topics of palaeosols, periglacial phenomena, and offshore evidence are considered, respectively, by Felix-Henningsen, Hofle, and Figge. Some of these chapters are very short, such as that on periglacial phenomena, giving only a brief indication of the nature of the evidence, while others such as those on the glacial history, palaeosols or the stratigraphy of Schleswig-Holstein are comprehensive, and provide important reviews of the topics. From the evidence reviewed in this section it is clear that the Elster Glaciation is represented by overdeepened valleys and glacial and glacilacustrine sediments, and that this evidence was subsequently buried by Saalian glacial deposits, from which they can be distinguished by intervening Holsteinian marine deposits and distinctive till lithologies. The evidence for the Saalian Glaciation indicates Older, Middle and Younger glacial episodes, each with distinctive till units, separated by glacifluvial and glacilacustrine sediments, but an absence of biological remains. Each of the Saalian glacial events can be associated with large, subdued moraine ridges, but these do not coincide with the lithostratigraphy. The Saalian Glaciation is separated from the Weichselian by Eemian soils and organic deposits, and the evidence for the last Glaciation consists of distinctive constructional topography and till lithologies. Within this pattern emerges the problem of the Treene Palaeosol and the so-called 'Treene Interglacial'. Whether this is an interglacial soil developed between the Saale and Warte Glaciations or an interstadial soil between the Middle and Younger Saalian is still a matter of debate.

The glacial history of the Netherlands is reviewed by de Jong and Maarleveld, and the type and lithology of the glacial deposits is considered in chapters by Schuddebeurs and Zandstra, Zandstra, Ruegg and Riezebos. Maarleveld outlines the form and genesis of ice-pushed ridges in the Central Netherlands and ter Wee contributes chapters on the Elster and Saalian Glaciations. As with the other sections the type of work done clearly reflects the evidence available, with particular attention being given to lithological properties of the glacial deposits and glacitectonic structures. It is of interest to compare the evidence from the Netherlands with that from Germany and note equivalent Elsterian lacustrine deposits. However, in contrast with Germany, detailed biological evidence exists for the non-glacial parts of the Saalian. Perhaps the most striking element of the Quaternary of the Netherlands is the ability to place the glacial episodes within a well documented stratigraphy and to observe their insignificance.

Without doubt, 'Glacial Deposits in North-west Europe' paints a vivid picture of the glacial history of the south-east part of the Scandinavian ice-sheet. In so doing it gives us insight into the variety of approaches adopted within each of the countries, indicating methods which may in the future contribute to our own investigation of the glacial history of the British Isles. It sheds light on problems that are currently of relevance in Britain such as the status and extent of the penultimate glaciation, the likelihood of an interglacial between the Hoxnian and the Ipswichian, and the role of palaeosols in stratigraphic interpretation. Detailed descriptions of tills and sedimentary structures broadens our experience and makes us see that others have similar problems in recognizing complex sediments such as melt-out tills. It could be improved in certain ways, such as by the addition of specific location maps in certain cases, but in general it succeeds remarkably well as an easily readable, highly informative review. All that is needed now is the hope that Balkema will support sister books on the topics of 'Glacial Deposits of the British Isles' and 'Glacial Deposits of Finland, the Baltic States and Poland'.

J. Rose,
Department of Geography,
Birkbeck College,
University of London.

(The above volume may be purchased at the special price for QRA members of £23.00. An order form accompanies this *Newsletter*).

NOTICES

POLLEN DIAGRAMS, PUBLICATION AND THE RAPID DISSEMINATION OF PALYNOLOGICAL DATA

by R.H.W. Bradshaw and K.J. Edwards

Pollen data are the life-blood of Quaternary palynology, yet much potentially valuable data lie unseen in desk drawers awaiting the extra work required to turn a series of pollen counts into a full scientific paper. We propose the creation of a different type of outlet for pollen data enabling the analyst to rapidly claim credit for his or her work and allowing other scientists to examine and take account of the data in their own studies. We are especially concerned with making generally available the unpublished pollen diagrams which exist in every pollen laboratory. A publication format consisting of full pollen diagrams with essential supporting information would enable the rapid and hopefully inexpensive dissemination of data to all palynologists. Such a publication would have certain defined standards and we put forward one suggestion for the form these might take (Table 1). A similar idea was proposed and implemented by the editors of *The New Phytologist* in a series named "Data for the Study of Post-glacial History" (Clapham et al, 1938). The series ran intermittently until 1955 totalling seventeen contributions. The papers were short, but perhaps not of sufficiently uniform format or subject matter to fulfil the role we now propose.

It would be desirable for the pollen data to be included in a publication created specifically for the purpose and based on camera-ready material, inexpensive enough to appear on the bookshelf of every active palynologist. Alternatively, production could take the form of Appendices to frequently-published journals. Some geographical restrictions would be necessary with, for example, American data appearing in *Quaternary Research*, Scandinavian data in *Boreas* and British data in *The New Phytologist* or *Journal of Biogeography*. Continuity and international uniformity (if considered appropriate) could be maintained by publishing all data under a constant head such as "Archive for Quaternary palynology".

A computerised data-bank might be an alternative to the suggested publication, but such repositories are expensive and time-consuming to maintain and difficult to make available conveniently to all scientists. There may also be an understandable reluctance shown by an analyst in providing unpublished data to a bank when there is no formal recognition of the work such as would be conferred by a published paper. The proposed publication would be a data-bank available to all and where due credit is given to the contributing palynologist. We are not suggesting that this format would replace all existing 'orthodox' pollen publications. It would be desirable to see plain, single profile site reports or arrays of surface samples appearing in this outlet. Full papers comprehensively describing large projects or addressing specific ecological problems would continue to appear in the standard journals, possibly freed from the need to present all the data which must appear unpalatable to the non-specialist reader.

TABLE 1 Format of pollen data publication

Type of data	Standards
Site description	Latitude and longitude site type (lake, bog, humus, soil) site size; water catchment size
Sediment description	Lake, mud, peat, clay etc. Organic content or other geochemical information (if available)
Pollen data	Pollen diagrams with each taxon shown in a separate column and a bar for each level. As far as possible the minimum pollen sum should be 250 total terrestrial grains (this may not be possible for certain sites, e.g. late-glacial, mineral soil or in treeless environments in high latitudes)
Macrofossils	
Dating	^{14}C; palaeomagnetism; regional chronozones
Discussion	500 words outlining important features of data

Do other palynologists feel that there is a need for the type of publication outlined here? Is there a publisher out there willing to take the scheme on?

Reference Clapham, A.R., Godwin, H. and James, W.O. (Eds.) (1938) Notice, Data for the study of post-glacial history. *New Phytol.* *37*, 329-332.

Richard H.W. Bradshaw,
School of Botany,
Trinity College,
Dublin 2,
Ireland.

Kevin J. Edwards,
Department of Geography,
University of Birmingham,
Birmingham, B15 2TT.
England.

XII INQUA Congress

Dr. J. Clague (XII INQUA Congress Programme Committee) would welcome ideas or opinions on the type of programme to be provided for the XII INQUA to be held in Ottawa in 1987. He is particularly interested to obtain views on topics or titles for symposia, format of sessions and whether proceedings should be of invited or unsolicited contributions. Comments of a specific or general nature are welcome. They should be sent to Dr. J. Clague, Geological Survey of Canada, 100 West Pender, Vancouver, Canada V6B 1R8.

X INQUA Congress Fund

British subjects normally resident in the UK having a major active interest in Quaternary Studies are invited to apply for grants from the Xth INQUA Congress Fund. Grants from this Fund are awarded annually to applicants who are judged capable of furthering the international repute of British Quaternary studies, and are normally awarded to facilitate attendance at international meetings.

Application forms may be obtained at any time from the Executive Secretary, The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG (attn. CRA) and should be returned after completion to the Royal Society by 1 October 1984. Results of applications will be advised around the end of the year.

AMQUA

Eighth biennial meeting 13th-15th August 1984, University of Colorado, Boulder.

The theme of this meeting is "Seasonal climatic responses in the Quaternary". The meeting in Boulder is preceded and succeeded by field trips in the Rocky Mountain area. For a full programme and second circular write to: Office of Conference Services, Box 153, University of Colorado, Boulder, 80310 Colorado, U.S.A. (telephone (303) 492-5151).

AQQUA

Fifth annual congress 4th-7th October 1984, Université de Sherbrooke, Québec

The theme of the meeting is "Pleistocene and Holocene stratigraphy and Palaeoenvironments of Québec and adjacent regions". The meeting is preceded by the 1st Symposium on Holocene Climates and trends in North America and Greenland (see Newsletter 42 for details of this meeting). Further details and the Second Circular for the Congress may be obtained from Hugh Gwyn, Département de géographie, Université de Sherbrooke, Sherbrooke, Québec, Canada J1K 2R1 (telephone (819) 565-4695 or 4521).

Weekend Workshop on Sea-Level Changes - University of Durham, Department of Geography, 5-7 October, 1984.

The objectives of the workshop are to describe and to instruct in the laboratory and in the field, techniques that are relevant to sea-level studies. The following techniques will be demonstrated:

stratigraphic analysis
pollen analysis
diatom analysis
foraminiferal analysis
plant macro-fossil analysis
morphological mapping and surveying
computer storage and retrieval systems:
including a SWAPSHOP of programs

Examples will be taken from the Durham coast, the Wash coast, the coast of south-west Lancashire, the coast of East Anglia, the coast of Rio de Janeiro and the North and Irish seas.

The sessions will be led by:

Professor B.M. Funnell
Dr. P.A. Greatrex
Mr. S. Ireland
Dr. I. Shennan
Dr. D.E. Smith
Dr. M.J. Tooley

The workshop is relevant to the aims and objectives of I.G.C.P. Project 200 Late Quaternary Sea-level changes: measurement, correlation and future applications and is supported by The Royal Society British National Committee for the I.G.C.P.

Lectures and demonstrations will be in the Department of Geography, University of Durham.

Accommodation and all meals will be in Trevelyan College, University of Durham.

The total cost (from dinner on Friday 5 October 1984 until lunch on Sunday 7 October 1984) will be £20.00.

Further information and booking forms from

Dr. M.J. Tooley,
Department of Geography
University of Durham
South Road,
Durham, DH1 3LE

or

Dr. I. Shennan,
Department of Geography,
University of Durham,
South Road,
Durham, DH1 3LE

Conceptual Issues in Environmental Archaeology

This international symposium will be held at Oxford from 22nd-24th February 1985. The meeting is arranged around four discussion themes as follows

1) Conceptual issues at the site scale;
2) Conceptual issues at the microregion scale;
3) Conceptual issues at the macroregion scale;

and

4) Conceptual issues associated with cultural, spatial and environmental change.

Further details and the first circular for the meeting may be obtained from

Conceptual Issues in Environmental Archaeology,
Department of Geography,
University of Strathclyde,
Livingstone Tower,
26, Richmond Street,
Glasgow, G1 1XH.

SASQUA biennial conference 1985

This meeting will be from 29th March to 3rd April 1985 and will be held at the University of Stellenbosch. The first circular has been issued and may be obtained, together with other details, from The Secretary, Department of Archaeology, University of Stellenbosch 7600 Stellenbosch, Cape Province, South Africa.

In association with the conference, and before it, there will be a ten day field excursion to the Quaternary shorelines of Natal and the South Cape. Details of this excursion may be obtained from Dr. O. Davies, Natal Museum, 3201 Pietermaritzburg, Natal, South Africa.

MSc in Quaternary Studies

The two-year, part-time evening course in Quaternary Studies taught jointly by the City of London Polytechnic and the Polytechnic of North London has now been running successfully for seven years and has recently been granted extended approval by the Council for National Academic Awards. This is a Master's course, predominantly based on a taught syllabus but also including an assessed thesis. Laboratory techniques and practical instruction in the field form major elements of the taught course. In the first year, the syllabus consists of the following main components:

(a) morphological investigations
(b) analysis of sediments
(c) biological investigations
(d) dating techniques
(e) palaeoclimatic reconstruction.

There are residential field courses based on East Anglia and Scotland. In the second year of the course broader aspects of Quaternary environmental change are examined, integrating principles and concepts covered in the first year. There is a week-long residential field course in an area outside the British Isles. This enables the study of Quaternary problems not easily exemplified in the local region. Currently this excursion is based on Sicily. Members of staff in the departments of Geography and Geology of each Polytechnic contribute to the main teaching on the course, but there are specialised aspects that are taught by invited lecturers from other institutions. The current External Examiner for the course is Professor F.W. Shotton, Emeritus Professor of Geology, University of Birmingham.

The course has a biennial intake, the next being in October, 1984. A number of applications have already been received and intake is restricted to 18 students. Applications should, therefore, be sent as soon as possible, and no later than 31st July, 1984 to Dr. J.J. Lowe (Course Tutor - MSc Quaternary Studies), Geography, City of London Polytechnic, Calcutta House, Old Castle Street, London E1 7NT. The minimum entrance requirement is a Class II Honours degree in an appropriate subject (Geology, Geography, Biology, Archaeology, for example). Further information (course brochure) and application forms can be obtained from the Course Tutor or from the Admissions office of either Polytechnic. Fees for the course are currently £78.00 per annum.

Exhibition at the Castle Museum, Norwich
July - September 1984

The exhibition is planned to show details of environments of the Ice Age in East Anglia. Vertebrate remains from the Cromerian and later glacials and Interglacials will be on display together with specimens of erratic boulders and invertebrate remains.

Glacial Lake Agassiz edited by J.T. Teller and L. Clayton, Geological Association of Canada, special paper No.26.

A compilation on the largest glacial lake in North America reviewing the development of the lake, aspects of its biota, hydrology, geomorphology and archaeology. Obtainable from Geological Association of Canada Publications, Business and Economic Service Ltd., 111 Peter Street, Suite 509, Toronto, Ontario, Canada M5V 2H1.

A full review of this volume will appear in *Newsletter* 44.

York University, Ontario, Quaternary Symposia

Publications resulting from the 6th Quaternary Symposia (1974-1983) are listed below. Copies may be ordered from the publishers or from W.C. Mahaney, Quaternary Symposia, Geography Department, 4700 Keele Street, Downsview, Ontario, M3J 2R7.

1974	Quaternary Environments Geographical Monographs No. 5, 318 p.	$10.00
1975	Quaternary Stratigraphy of North America, Hutchinson and Ross, Stroudsburg, Pa., 512 p. Abstracts and Field Guide	 $60.00 4.00
1976	Quaternary Soils, Geoabstracts Ltd., Norwich, U.K., 508 p. Abstracts and Field Guide	$30.00 4.00
1979	Quaternary Paleoclimate, Geoabstracts Ltd. Norwich, U.K. 464 p. Abstracts and Field Guide	$35.00 4.00
1981	Quaternary Dating Methods, A.M. Dowden, Stroudsburg, Pa., 431 p. Due for publication, Sept., 1983 Abstracts and Field Guide	 $50.00 (estimated price) 4.00
1983	Quaternary Chronologies, Geoabstracts Ltd., Norwich, U.K. 500 p. Due for Publication, Spring, 1984	$50.00 (estimated price)

Cheques payable to Quaternary Symposia.

New Journals

The editor has received notice of the publication of the following new journals:

Geoarchaeology
A Van Nostrand Reinhold Scientific Publication
commencing publication in 1984

Geoarchaeology is a quarterly international journal committed to exploring the methodological and theoretical interface between archaeology and geology. The journal publishes papers integrating material from both of these fields to promote interdisciplinary understanding. Submission of general syntheses, research manuscripts, methodological or technique papers and book reviews is encouraged. Announcements of conferences, professional meetings and new publications are a vital part of the journal.

The editors are now soliciting manuscripts in all aspects of geology, paleontology, climatology, oceanography and geochronology which either include archaeolcgical data or can be applied to archaeological studies.

The Editor-in-Chief is Dr. J. Donahue, Department of Geology and Planetary Sciences, University of Pittsburgh, Pittsburgh, P.A. 15260 U.S.A. The Series Editor is Dr. R.W. Fairbridge, Department of Geological Sciences, Columbia University, New York, NY 10027, U.S.A. Further details and instructions for authors may be obtained from the above.

Litoralia: An International Journal of Coastal Sciences.
Commencing publication May 1984

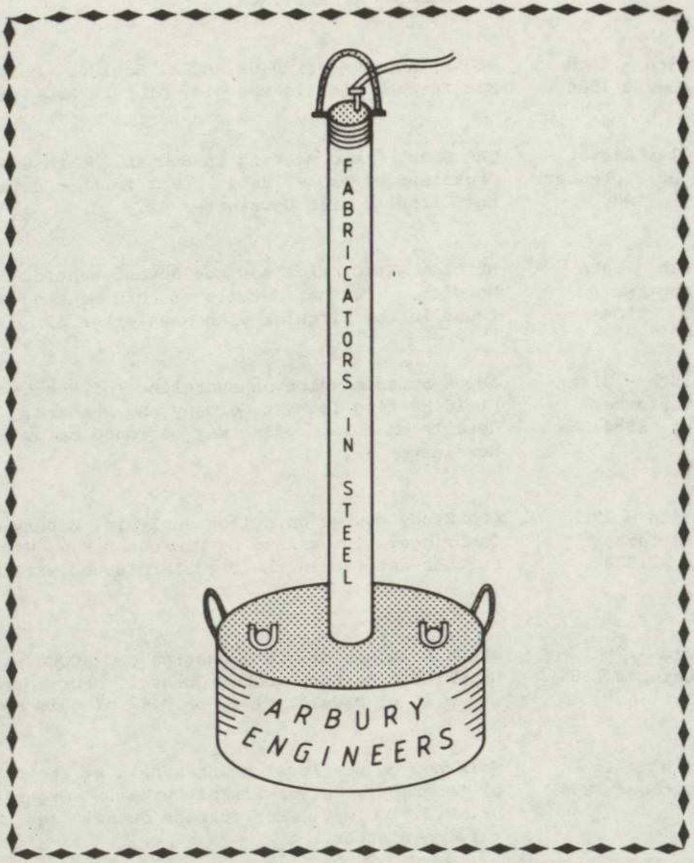
Litoralia will enhance and foster the understanding of the coastal zone by exploring the common ground between different disciplines in this area. Litoralia will probe the fields that overlap marine physical science and biological science - fields such as: oceanography, geology, biology, marine science, ecology, climatology, soil science, geomorphology, mineralogy, coastal engineering and more.

Litoralia will provide basic, original research, theoretical papers and applied science articles. It will present traditional applications along with the most modern, up-to-date, developments in the areas of coastal science. Litoralia will supply professional reports, correspondence, literary reviews, abstracts, schedules of events, calendars of meetings, and recent research bibliographies. All this will combine to make Litoralia one of the newest, most comprehensive journals in coastal science research.

Editor-in-Chief: is Charles W. Finkl, Ph.D., Center for Coastal Research, P.O.B. 2473, Colee Station, Fort Lauderdale, Florida 33303, 305/564-5049. Further details and instructions to authors may be obtained from him.

CALENDAR OF MEETINGS

13th - 15th August 1984	8th Biennial Meeting of AMQUA, Boulder, Colorado. For further details see p.47 of this Newsletter.
31st August - 2nd September 1984	QRA Short Field Meeting in Buchan, North-east Scotland. Organised by Dr. M. Hall. For further details see the Circular with Newsletter 42.
9th - 14th September 1984	British Association for the Advancement of Science, Norwich. Further details of this meeting may be found in the Circular with Newsletter 42.
15th - 21st September 1984	INQUA Subcommission on shorelines of North-west Europe - Field Meeting in West Germany and Denmark. Further details on this meeting may be found on p.47 of Newsletter 42.
24th - 27th September 1984	QRA Study course on pollen analysis, Botany School, Cambridge. Organised by Professor R.G. West. Further details in the Circular issued with Newsletter 42.
3rd - 7th October 1984	INQUA Holocene of North America and AQQUA meeting. Université de Sherbrooke, Québec. For further details see p.46 of Newsletter 42 or p.47 of this Newsletter.
5th - 7th October 1984	Workshop on sea-level changes held at the Department of Geography, University of Durham. Organiser Dr. M.J. Tooley. For further details see p.48 of this Newsletter.
22nd - 24th February 1985	Conceptual Issues in Environmental Archaeology meeting at Oxford. For further details see p.49 of this Newsletter.
29th March - 3rd April 1985	SASQUA meeting University of Stellenbosch, South Africa. For further details see p.49 of this Newsletter.



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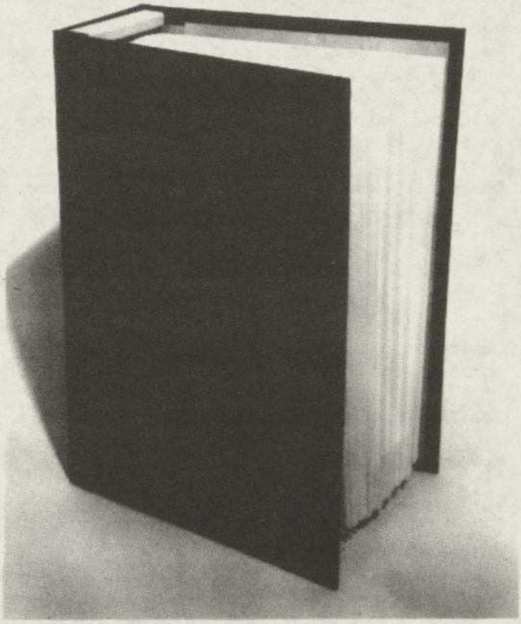
Considerable stocks of binders for the *Quaternary Newsletter* are still available. The binder is a dark blue 'Easibinder' with silver printing of *Quaternary Newsletter* on the spine. Single binders will hold up to eighteen copies of the *Newsletter*. The current price inclusive of postage and packing is £4.25.



Binders may be purchased from the Secretary, Dr. P.L. Gibbard, Botany School, University of Cambridge, Downing Street, Cambridge CB2 3EA to whom cheques made payable to the Quaternary Research Association should be sent.

QUATERNARY NEWSLETTER

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