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

A NOTE ON THE PALAEOECOLOGY OF THE RED CRAG (LOWER PLEISTOCENE)

By R.G. Dixon

The main problem in attempting a study of either the palaeoecology or stratigraphy of the Red Crag is to distinguish between derived and non-derived faunas. The method used in the present study is primarily based on Norton's (1967) method of obtaining species percentage frequencies by counting gastropod apices and bivalve hinges, and the interpretation of those frequencies. Traditional interpretive methods, such as counts of valve and articulation ratios, were found not to be useful because of the nature of the sedimentary environment. Instead :-

(1) The fauna was divided into groups of ecologically similar species, and the relative frequency of each group was studied.

(2) A comparison was made between a faunal interpretation and a sedimentological interpretation, and between the fauna expected to be found in a given sedimentary environment and the fauna actually found.

The study therefore evolved into the recognition of biofacies, linking sedimentary type and structure, trace fossils, exotic and indigenous shells, faunal frequencies and ecologies, and depositional environment.

Because the study was based on many different assemblages collected from different horizons and localities and comprised varying frequencies of numerous species, a computer cluster analysis suitable for multivariate data (Davies, 1973) was used. This compared the species frequencies in each assemblage with those of other assemblages to find a 'degree of similarity' (or 'correlation') between assemblages. The program was run using five different sets of input data (frequencies of dominant extant species, extant and extinct species, ecological groups; two were run using frequencies of different extinct species). The results from the different computer runs were remarkably similar, and demonstrated a statistically viable method of assisting interpretation .

On a lithostratigraphic basis the Red Crag can be divided into Upper and Lower units; this has been recognised by many workers, e.g. Wood, Harmer and Prestwich.

(1) The Lower Red Crag

The Lower Red Crag comprises the well exposed, strongly false bedded megaripples found over the whole Red Crag area. The ripple bottomsets and foresets are well preserved, and the upper surfaces are truncated; they vary from 1 m to 5 m in height, but are usually 2 m-3 m high. The sediment is dominantly coarse shell sand and gravel. Complex detailed sedimentary processes are reflected in imbrication, shell avalanche, winnow, lag and other deposits. The ripples indicate maximum water depths of c. 25 m, but an average of 15 m-20 m; common superimposed trough bedding in the central and northern parts of the basin show that the sea floor was within reach of wavebase, which is c. 20 m in the North Sea today. Current directions were towards the south-west, but there was some influence by tidal streams in the central part of the basin. Velocities were variable, with deposition of coarse laminae during storms and other periods of high current activity (up to 0.6 m/sec), but with the deposition of mud laminae and partings during quiet periods (less than 0.1 m/sec), when animal communities were able to develop (exogenetic bioturbation structures are commonly found in the finer grained laminae).

The faunal interpretation corresponds very closely. For example, at Walton-on-Naze two types of assemblage are found :

(a) Glycimeris variabilis/ Spisula arcuata / Venerupis spp. assemblages with Cardium parkinsoni, Turritella triplicata and Nassa granulata occurring in high frequencies, and abundant Echinocyamus pusillus. This assemblage is typical of open marine, sublittoral shell gravel in normal salinities, and is found in lag, foreset and shell avalanche deposits. Articulated shells of Glycimeris variabilis, Cardita corbis and Aloidis gibba are fairly common.

(b) Abra alba, Thracia phaseolina, Mysella bidentata assemblages with Echinocardium cordatum found in poorly stratified muddy fine sand bottomsets. Many of the molluscs are articulated and many juveniles are present.

It is suggested that the shell gravel fauna colonised the megaripple crests, which were open to maximum current influence, and were periodically swept into troughs as shell avalanches. The mud tolerant fauna colonised the troughs, which were sheltered in the lee of the megaripple and where sediment was much finer. This relationship is seen throughout the Lower Red Crag, but is often less readily apparent than at Walton.

However, the nature of the shell gravel fauna changes as dominant species become less frequent and are replaced by others. At Walton-on-Naze a Glycimeris dominant shell gravel fauna is present, where 'shell gravel' species contribute $>30\%$ of the assemblages, 'clean sand' species $<10\%$, 'muddy sand' species $<15\%$, 'mud tolerant' species $<15\%$ and extinct species c. 35%. At Brightwell the fauna changes to a Venerupis dominant shell gravel, and at Stratton Hall a Mytilus dominant shell gravel fauna is present, where species seen in the Glycimeris and Venerupis shell gravels contribute $<10\%$ of the assemblages, 'sandy shore' species $<5\%$, but 'rocky shore' species $>35\%$ and extinct species are c. 40%. All assemblages contain abundant Echinocyamus pusillus.

Because the shell gravel faunas are demonstrably superimposed, with the Mytilus faunas overlying Venerupis faunas, which in turn overlie Glycimeris faunas, the changes reflect :-

(a) environmental changes, especially of water depth (from c. 25 m at Walton to 5-10 m at Stratton Hall) and ecologic succession; and
(b) temporal or stratigraphic changes indicated by the oncoming of new species which eventually dominate assemblages.

This sequence in the Lower Red Crag is partly masked by two factors :-

(a) The influence of the Aldeburgh/Gedgrave Coralline Crag ridge. The ridge had the effect of influencing current directions and sheltering the Butley district to the west. This is reflected in the median and modal grain-size values, which are significantly lower in the lee of the ridge and also in a corresponding increase in diversity of mud-tolerant species, e.g. Nucula nucleus, Phacoides borealis, Astarte montagui and Trophon muricatum. The littoral deposits forming around the ridge were also reworked to contribute shells to offshore sediments.
(b) Basal deposits. These vary from pebble beds to shallow water sands and muds. The pebble beds rest directly on the London Clay surface and resulted from marine scouring; they often contain abundant reworked shells and are typified by considerable epifaunal growths on pebbles. The shallow water deposits are found flanking ridges in the London Clay surface e.g. at Trimley or around Coralline Crag inliers e.g. at Tattingstone. The sediments and faunas are very similar to the Upper Red Crag and point to a similar environment of deposition. However, the assemblages do vary in accordance with the temporal/stratigraphic controls seen in the Lower Red Crag and can be shown to be diachronous. Thus, marginal, littoral deposits were formed as the Red Crag marine trangression took place, and, as water deepened, megaripples swept into and across the basin. The deposition of the Upper Red Crag occurred as the basin was becoming choked with sediment.

(2) The Upper Red Crag

The Upper Red Crag occurs widely in the northern part of the basin, north of the River Orwell, and attains a maximum thickness of 5.5 m in the Butley district. The sediments change from trough bedded and medium scale rippled sands, and tidal channel and lag deposits in the lower part of the unit, to flaser bedded fine sands and silts with small scale and climbing ripples in the upper part of the unit. Tidal influence is readily apparent from bipolar structures showing northwest and southeast current directions, normal or oblique to the Coralline Crag ridge and western shoreline, and southwesterly directions parallel to the shore. Current velocities were variable, but show a general decrease in the upper part of the unit.

The change from Lower to Upper Red Crag is either by a transitional decrease in ripple size, or by a marked break when local wave action and erosion were dominant. The sediments thus indicate a complex sequence of microfacies in vertical succession, with a general shallowing of water to low shore conditions at the top of the sequence.

The fauna of the Upper Red Crag agrees with this interpretation. There are large frequencies of Mya arenaria and other littoral species

(> 10%), and extinct species, such as Spisula ovalis, S. obtruncata, Macoma obliqua, M. praeteninuis and Cardium angustatum, form up to 50% of assemblages. Shell gravel species occur in very low frequencies (<10%). Near the Aldeburgh/Gedgrave Coralline Crag ridge, which afforded a 'rocky shore', Mytilus edulis becomes dominant, and other similarly grouped species, e.g. Nucella lapillus, increase in diversity. Two types of trace fossil also occur commonly :

(a) Large 30 cm vertical, mucus agglutinated tubes in sediments where mud and fine sand form more than 10% of the sediment. These occur in the upper part of the unit, and have tentatively been identified as Arenicola.
(b) Small, thin 50 mm tubes always found in fine sand in the lower part of the unit or sometimes in association with Arenicola; these tubes may belong to Corophium or a small worm.

The final silting up of the Red Crag basin is thus represented by nearshore and onshore sediments and faunas.

The Palaeoclimate

The palaeoclimate is not accurately determinable by molluscs, but two lines of evidence may be used as indicators.

(a) Throughout the Red Crag there is the overlap of a high Boreal epifauna, such as Admete viridula, Buccinum undatum and Modiola modiolus, and a low Boreal epifauna, such as Balcis alba, Gibbula tumida and Philbertia linearis. This overlap occurs today around the Northern Ireland coast, where summer water temperatures are 13-15°C, and winter water temperatures 6-8°C. Sublittoral species are replaced in the Upper Red Crag by infralittoral species. There is also an increase in Buccinum undatum, which may suggest climatic cooling.
(b) Supporting evidence is gained by the mollusc correlation of the oldest Red Crag with the Netherlands' mollusc biozone Mol. C (Spaink, 1975) and the youngest Red Crag with mollusc biozone Mol. B. This correlation provides a link with pollen based palaeotemperature interpretation.

Conclusions

(1) There is good correlation between interpretations based on sediments and faunas.
(2) Assemblages occur in the types of sediment they would be expected to colonise in life.
(3) On the whole, faunas are local, even though transported.
(4) The ecological control upon faunas is evident, hence a progressive change in assemblage-types.
(5) The progression of assemblages also reflects a stratigraphic succession alternative to Harmer's.

References

Davies, J.C. 1973 : Statistics and data analysis in geology. John Wiley and Sons.

Norton, P.E.P. 1967 : Marine Mollusca in the early Pleistocene of Sidestrand, Bramerton and the Royal Society borehole at Ludham, Norfolk. Phil. Trans. R. Soc. Lond. B., 253, 161-200.

Spaink, G. 1975 : Zonering van het mariene onder-Pleistocene en Plioceen op grond van Mollusken-faunas. In : Toelichtingen bij de Geologische Overzichtskaart 1 : 60000.000 van Nederland, Rijks Geol. Dienst, Haarlem, 118-122.

RADIOCARBON ASSAY OF DUCK BONES FROM LATE DEVENSIAN RAISED MARINE DEPOSITS NEAR MONTROSE, ANGUS

by D.E. Smith, R.A. Cullingford and R.L. Jones

In 1975 the authors had the opportunity of examining a collection of organic remains made during the nineteenth century in the Montrose area by J. C. Howden and subsequently housed in the town museum. Attached documentary evidence and a paper by Howden (1868) indicated their provenance as a marine deposit bearing a cold climate fauna, exposed in two brick pits at Puggieston (NO 692 598) and Dryleys (NO 708 604). These pits, now derelict and flooded, occur in the sides of gullies which intensively dissect the surfaces of two otherwise uniform terraces that run for about 3 km along the shore of the Montrose Basin with breaks of slope at the rear lying at 11 m O.D. (Puggieston) and 13 m O.D. (Dryleys) respectively. Present day exposures in the pits consist of layers of fine sand, silt and clay, becoming finer with depth. Exposures in the front of the higher terrace exhibit fossil cryoturbation structures. The terraces are thought to be the lowest members of a suite of eight late Devensian raised shorelines in the area (Cullingford and Smith, in preparation).

Howden (1868) recorded the following, taken from the lower parts of the deposits in the pits :- Phoca vitellinus, Cythere sp., Ophiolepis gracilis, Cyprina islandica, Pecten groenlandicus, Saxicava sulcata, Nucula tenuis, Leda arctica, Yoldia pygmoea. These were verified present in the museum collection, together with skeletal remains of what Howden considered eider, some still embedded in a reddish-brown silty clay. Detailed examination of the bones by D. Bramwell showed that one group of leg and wing bones belonged to one individual, a female eider (Somateria mollissima) and that the other two groups (leg and wing bones and a rib cage) belonged to another individual, either an eider or a scoter (Melanitta sp.).

The silty clay in which some of the bones were embedded was low in pollen content which also had a restricted taxal range. However, the analysis of several samples yielded consistent finds of Gramineae, Cyperaceae, Empetrum, Artemisia and Rosaceae. Identical sediment with a comparable pollen flora has been recorded in a similar stratigraphic context at other locations in the Montrose Basin, being overlain by radiocarbon dated Flandrian deposits at one site (Morrison, personal communication). While it would be unwise to infer a late-glacial age from such impoverished spectra, the taxa indicate open conditions and frequently occur in association in late Devensian deposits (Godwin 1975).

Radiocarbon assay of collagen from the bones (Williams and Johnson 1976) gave :-

Birm 660 10 610± 220 BP (Somateria mollissima)
Birm 661 , 11 110± 210 BP (Somateria or Melanitta sp.).

confirming their age as late Devensian.

The combined sedimentological, geomorphological and palynological evidence, supported by the radiocarbon dates, suggests a late Devensian age for the deposits. However, the dates infer that raised shorelines now lying at 11-13 m O.D. were formed during or shortly after the period 10,500-11,200 BP in the Montrose Basin. The implication of existing evidence on the sequence of relative sea-level changes in the Tay and Forth areas (Sissons, Smith and Cullingford, 1966; Smith, Sissons and Cullingford, 1969; Sissons, 1974a; Cullingford, 1972, 1977) and on the height of the Main Lateglacial Shoreline (Sissons, 1969, 1974b, 1976) is that relative sea-level in the Montrose area was much lower than 11 m at the time in question. Assays of circa 13,000 BP would be more consonant with such an elevation, and rather than suggest that sea-level attained an anomalous height during the latest part of the Devensian, we feel that it is more likely the bones came from reworked sediment on the sides of the gullies in which the pits were situated.

References

Cullingford, R.A. 1972 : Lateglacial and postglacial shoreline displacement in the Earn-Tay area and eastern Fife. Univ. Edinb. Ph.D. dissertation (unpubl.).

Cullingford, R.A. 1974 : Lateglacial raised shorelines and deglaciation in the Earn-Tay area. In J.M. Gray and J.J. Lowe (eds.) : Studies in the Scottish Lateglacial environment, Pergamon, pp. 15-32.

Godwin, H. 1975 : The History of the British Flora (Second Edition), Cambridge University Press.

Howden, J.C. 1868 : On the superficial deposits of the estuary of the South Esk. Trans. Edinb. geol. Soc., 1, 138-50.

Williams, R.E.G., and Johnson, A.S. 1976 : Birmingham University Radiocarbon Dates X. Radiocarbon, 18(3), 249-67.

Sissons, J.B. 1969 : Drift stratigraphy and buried morphological features in the Grangemouth-Falkirk-Airth area, central Scotland. Trans. Inst. Br. Geogr., 48, 19-50.

Sissons, J.B. 1974a : The Quaternary in Scotland : A review. Scott. J. Geol., 10, 311-37.

Sissons, J.B. 1974b : Lateglacial marine erosion in Scotland. Boreas, 3, 41-8.

Sissons, J.B. 1976 : Lateglacial marine erosion in south east Scotland. Scott. Geogr. Mag., 92, 17-29.

Sissons, J.B., Smith, D.E., and Cullingford, R.A. 1966 : Lateglacial and postglacial shorelines in south-east Scotland. Trans. Inst. Br. Geogr. 39, 9-18.

Smith, D.E., Sissons, J.B. and Cullingford, R.A. 1969 : Isobases for the Main Perth Raised Shoreline in south-east Scotland as determined by trend surface analysis. Trans. Inst. Br. Geogr., 46, 46-52.

STONE AXES AND QUATERNARY GLACIATION

by A. M. ApSimon

In the comment by C. S. Briggs "Economy and erratics in stone age Britain" (Quaternary Newsletter No. 23) on a previous note by Professor Shotton, great play is made of our relative ignorance of the organisation of Neolithic stone axe workshop sites in Britain, with the conclusion that "geological and archaeological investigations have adequately tested neither of the opposing views" - that the recorded distributions of axes are to be explained either by quarrying and "factory" production followed by humanly mediated dispersion, or by local production from erratics.

In the present writer's view, available evidence suggests that the first, Prof. Shotton's view, is more likely to be the substantially correct one. As it happens, there is very good evidence for this from Brittany, from the site of Plussulien in Côtes du Nord, where extensive excavations over a period of years have produced a great deal of information about a quarry and workshop site where Neolithic stone axes were made (Le Roux, 1975). In this case an extensive dolerite sill was being quarried and the actual worked faces have been exposed, together with evidence for the changing methods used to quarry the rock. Immediately adjacent areas of outcrops show batter marks due to use as anvils, with smoothed areas resulting from the grinding of axes into final shape. The stratified waste heaps which abut the outcrop provide a well-dated sequence of activity, beginning at least as early as 3200 BC. The spoiled axes in these heaps were all discarded during the roughing out phase, evidently because this was the stage at which flaws in the rock would be discovered (Le Roux, 1975, 50).

Petrological examination has shown that 40% of all polished axes in "hard rocks" in Brittany derive from this site, which was only discovered in 1964, while outside this region, departments from Seine Maritime to the Charentes show varying percentages of finds, reaching 45% in the nearer departments. Beyond this zone scattered finds extend to the lower Rhone valley to Alsace, to Belgium and even to southern England. This activity is broadly contemporary with British Neolithic axe "factories", the level of "cultural sophistication" involved is clearly very much the same and there are indeed signs of relationships between the two areas during the Neolithic. Plussulien provides a model against which to test our observations, a model which evidence from elsewhere in Europe suggests is in no way unique (a good example is the westward dispersion as far as Belgium of Middle Neolithic handled wedges made from amphibolite from Sobotka in Silesia - Van der Waals, 1972). In particular, Plussulien suggests that even though it is likely that polished axes were normally finished on site, we should not expect unfinished polished specimens on quarry sites.

The scale of exploitation indicated by Neolithic flint quarry sites is such as to indicate that erratic sources, except when very close to the parent source, or in the case of the exceptional giant erratic, are always likely to have been totally inadequate. The notion of the specialist axe maker, for so they are likely to have been, searching the still largely wooded Neolithic landscape for the one stone in 10,000 which might make a usable axe is surely too ridiculous for further consideration. Archaeologists have still to elucidate the social mechanisms which made possible large-scale exploitation of raw materials and the dissemination of the products, but there can be little doubt, meanwhile, of the high level of organisation reached by Neolithic societies.

To invoke a glacial hypothesis for dispersion in the case of Plussulien would presumably require a Holocene glaciation of most of France. Perhaps even Mr. Briggs would shrink from this, though I should be interested to hear whether he suggests a hitherto undocumented extension of Alpine glaciation to account for the presence of jadeite axes in the British Isles. It seems unsafe in principle, and in practice, to use the distribution of artifacts, whether polished stone axes or even Stonehenge "bluestones" as a substitute for geological evidence for glaciation.

A recent general reference to Plussulien and other sites is given below. Earlier notes will be found in numbers of Gallia Prehistoire (10, 1967, 334; 12, 1969, 440; 14, 1971, 342-5).

References

Le Roux, Ch.-T. 1975 : Fabrication et commerce des haches en pierre polie. Les Dossiers de L'Archeologie, 11, July-August 1975, 42-55.

Van der Waals, J.D. 1972 : Die durchlochten Rossener Keile und das fruhe Neolithikum in Belgien und in der Niederlanden. Fundamenta, A 3/Va, 153-184.

A NOTE ON PICEA IN THE CHELFORDIAN INTERSTADIAL ORGANIC DEPOSIT AT CHELFORD, CHESHIRE

by P. F. Whitehead

An organic horizon in the Congleton Sands (Evans et al, 1968) contains trunks and stumps of large trees in growth positions, together with an invertebrate fauna (Coope 1959). A radiocarbon date of approximately 61,000 years B.P. (Groningen) points to a Lower Devensian interstadial (Mitchell et al, 1973), and at the present moment (October, 1977) an extensive section is still producing wood and macroscopic plant remains from the dated peat bed. The site is near Chelford (SJ 822717).

Field identifications made by the writer during a recent examination of plant debris from the peat suggested that Pinus sylvestris Linnaeus, Betula pubescens Ehrhart, and Picea abies (Linnaeus) Karsten are the important large woody plants, whereas the peat contains remains of Sphagnum (within which the metallic elytra of the coleopteran Plateumaris sericea (Linnaeus) were conspicuous), compressed leaves, stems of Phragmites and seeds of Menyanthes.

Presumably, these peats were oligotrophic, a tendency which the large gymnosperms would accentuate. More detailed examination of the cones of Picea revealed characters not convincingly those of Picea abies sensu stricto. Not surprisingly for a tree whose presence in Britain today is from plantings of wide provenance, cones of modern P. abies vary. On the other hand the Chelford cones, including a good complete specimen now in the Department of Geological Sciences at Birmingham University, are all alike, particularly with regard to the shape of cone-scale.

The cone-scales of P. abies are generally described as being rhomboidal in shape, with truncate, erose, or toothed apices (Dallimore and Jackson, 1966;

Den Ouden & Boom, 1965; Gilbert-Carter, 1936). In modern P. abies there is slight variation in the shape and size of cone-scales in any one cone, but the broad shape is rhomboidal. Bean (1916) has called them "bluntly triangular as if having been bitten off".

These descriptions could not be applied to the five Picea cones from the Devensian peats at Chelford. Of these, which I have examined, the largest and most complete was 90 mm long. The cone-scales are broadly rounded and sub-entire, with many minute incisions hardly visible to the naked eye. They are, particularly in the case of the basal ones, fan-shaped and slightly broader than long.

In Pleistocene interglacials Picea is of regular occurrence in sub-climax vegetation, and P. abies has been recognised in the Cromerian (Sparks & West, 1972). At present Picea pollen is unknown in Britain in primary contexts between the Hoxnian interglacial (say 350,000 years B.P.) and the Chelfordian interstadial (61,000 years B.P.) which is its latest occurrence. However, in what is now mainland Europe it figures prominently in the Ipswichian (Eemian) interglacial (say 120,000 years B.P., using generally accepted chronology).

If, as seems probable, the Chelford spruce is not P. abies, then what is it? The seed wings of both are similar and the variation within those of a single cone of each is such that modern and Chelford spruce overlap. Several species of Picea demonstrate cone-scale morphology similar to the Chelford material, but many are Himalayan, American or Japanese, and it would not be easy in a population only 61,000 years old, to infer the presence of these species. Even if it were, such disjunct distributions would be more easily explained as reactions to differences which distinguish the Tertiary from the Quaternary instead of the Devensian from the Flandrian.

However, in the north of its modern range P. abies is replaced by a species having identical cone-scale morphology to the Chelford spruce, Picea obovata Ledebour (Gilbert-Carter, 1936). More to the point, there is a western population of P. obovata in North Scandinavia known as var. fennica (Regel) Henry, which interconnects P. abies and P. obovata (Den Ouden & Boom, 1965). P. obovata, therefore appears to be acting more as a cold stenotherm than P. abies sensu stricto, and as the Devensian climate at Chelford was more continental than at present (Coope, op. cit.), the existence of a form of P. obovata preserved in the interstadial peats seems highly probable.

References

Bean, W.J. 1916 : Trees and shrubs hardy in the British Isles. Vol. II, Murray.

Coope, G.R. 1959 : A late Pleistocene insect fauna from Chelford, Cheshire. Proc. Roy. Soc. Lond., B151, 70-86.

Dallimore, W., Jackson, R.B. 1966 : A Handbook of Coniferae and Ginkgoaceae 4th ed., Arnold.

Den Ouden, P., Boom, B.K. 1965 : Manual of cult. conifers, Nijhoff.

Evans, W.B., Wilson, A.A., Taylor, B.J. and Price, D. 1968 : Geology of the Country around Macclesfield, Congleton, Crewe and Middlewich. Mem. Geol. Surv. Eng. and Wales.

Gilbert-Carter, H. 1936 : British Trees and Shrubs, Clarendon.

Mitchell, G.F., Penny, L.F., Shotton, F.W. and West, R.G. 1973 : A correlation of Quaternary deposits in the British Isles. Geol. Soc. Lond. Special report No. 4.

Sparks, B.W., West, R.G. 1972 : The Ice Age in Britain. Methuen.

W.W. BISHOP - AN APPRECIATION OF HIS WORK AS AN EARTH SCIENTIST

by P.H. Banham

The sudden death of Walter William (Bill) Bishop on 20th February this year at the age of 45, left a great gap in the lives of his family, friends and colleagues. Bill was above all a warmhearted man who inspired those around him to live more abundantly. Thus, it is only after a time that we come fully to realise the loss that has also been suffered by science.

Bill's eminence as a scholar is apparent from his activities while he was Professor and Head of the Department of Geology at Queen Mary College, London (1974-77). At this time, among other things, he was directing and taking an active part in major field-based projects in East Africa and Pakistan; editing a symposium volume for which he had also written two papers; collaborating with others in the writing of two further papers for other volumes; playing a major part in the organisation of the 10th INQUA meeting at Birmingham, as Chairman of the Programme and Publications Committee, and continuing his close association with the London Geological Society, in the recent re-organisation of which he had been a prime mover as, successively, Editor and Secretary. Shortly before he died he had been appointed as Director of the Peabody Museum and Professor of Geology at the University of Yale, and would have taken up his duties there this autumn.

As a scientist, Bill had the advantages of an open mind and breadth of vision. Wherever his career took him he was thus able to make significant advances in knowledge, mainly in the fields of Quaternary stratigraphy and geomorphology and hominid ecology and evolution.

While graduating (1952) in Geography at Birmingham and characteristically, simultaneously holding the demanding position of President of the Students' Union, Bill first became interested in Quaternary matters through his tutor Dr. Gordon Warwick. After spending one year training as a teacher he joined Professor Fred Shotton in the Department of Geology at Birmingham supported by bursaries from the William Piddock Foundation and the Charles Henry Foyle Trust.

His now standard work on the relationships between the Quaternary sequences and landforms of the South Midlands and the Thames Basin was read to the Royal Society by Professor Shotton and published in 1958.

Subsequently, Bill spent two three-year periods in East Africa. The first (1956-59) with the Geological Survey of Uganda and the second (1962-65) as Curator of the National Museum of Uganda at Kampala. During these years Bill made many significant contributions to the study of the Cenozoic deposits and landforms of the East African Rift. Refusing to accept the orthodox generalisations of "climatic stratigraphy", he made important regional correlations between local successions established only after detailed mapping. In this work, Bill often spoke of the benefit of fieldwork and discussions with Professor Richard Flint during his tour of Africa in 1957.

Also while in Africa Bill was inspired by Dr. and Mrs. Louis Leakey and their pioneer work on the Olduvai hominids. Subsequently, he became a hominid authority himself, concentrating on hominid ecology, stratigraphy and absolute chronology. At the time of his death he was collaborating with Dr. Richard Leakey and others in an international team working on the hominid-bearing Mio-Pliocene deposits near Lake Turkana (Rudolf) in Kenya. Also, in an effort to close the gap in the more recent record, Bill and his assistant, Dr. Martin Pickford, were engaged in further international team work on younger deposits in Pakistan. His many publications, especially his editorships, clearly show Bill Bishop's contribution in this field of study. In 1976 he was awarded the Prestwich Medal of the Geological Society of London in recognition of his work.

Between his tours of duty in Africa, Bill spent a few years (1959-62) at the Hunterian Museum, Glasgow. Once again, he became involved in solving problems concerning the Late Glacial in this region, assisted at times in the field by members of the Lockerbie extra-mural class that he taught with much enthusiasm.

Despite his massive commitment to hominid work, Bill never lost his interest or authority in the British Quaternary. On his return to Britain, after his capture for Bedford College by Professor Basil King, Bill's experience as a stratigrapher was of great value to those attempting to formalise our Pleistocene succession. More recently, Professor Shotton and I have benefitted from his knowledge and grasp of essentials in our joint attempt with Bill to present a unified account of the Quaternary stratigraphy of Midland England. Again, recent collaboration between Bill and Dr. Russell Coope has led to an original and penetrating account of Late and Post Glacial environments in S.W. Scotland. It is therefore sad, but fitting, that the recent book, British Quaternary Studies, is dedicated to the memory of Bill Bishop.

The foregoing has merely scratched the surface of one part of Bill's life and work. His stimulating contributions to the life of Bedford College, for example, in the Students' Union, of which he was elected an Honorary Life Member, and in the Light Opera Group, which he founded, and to the learned societies, especially the Geological and Zoological Societies, each merit separate treatment. The continuing connection with and loyalty to his own University is also clear. Bill made every effort to attend the annual dinners of the Lapworth Society at Birmingham, which, by his own account, he greatly enjoyed.

On the death of Bill Bishop, Earth Science lost one who had already made contributions of the first order and who undoubtedly would have continued to make them himself and to encourage good work from others. Although our sense of loss cannot compare with that felt by his wife, Sheila, and his sons, Richard and Charles, nevertheless we shall sorely miss Bill's friendship and unselfish work for others and for our subject.

(A Memorial Fund in honour of Bill Bishop is to be set up to provide grants for students who wish to work in the fields that Bill himself found so rewarding. Details will be available shortly).

The Published Works of W.W. Bishop

1958 The Pleistocene geology and geomorphology of three gaps in the Midland Jurassic escarpment. Roy. Soc. Lond. Phil. Trans., No. 682, Vol. 241B, pp. 255-306.

Miocene mammalia from the Napak Volcanics, Karamoga, Uganda. Nature, Lond., Vol. 182, pp. 1480-1482.

Fossil apes and ivory. The Uganda Bulletin, pp. 127-129.

Raised swamps of Lake Victoria. Geol. Surv. Uganda, Records, 1955-56, pp. 1-10.

1959 Kafu stratigraphy and Kafuan artifacts. South African Journ. Sci., Vol. 55, No. 5, pp. 117-121.

1960 A review of the Pleistocene stratigraphy of the Uganda Protectorate. Joint Meeting Reg. Coms. Geol. (Leopoldville 1958), C. C. T. A., pp. 91-105.

Pleistocene environments and Early Man in Uganda. Uganda Journal, Vol. 24, pp. 44-61, (with M. Posnansky).

1962 Pleistocene correlation in the Uganda section of the Albert-Edward rift valley. Proceedings 4th Pan African Congress on Prehistory (Leopoldville 1959) pp. 245-253.

A summary of the present position regarding Quaternary stratigraphical research in Uganda. Proceedings 4th Pan African Congress on Prehistory (Leopoldville 1959) pp. 209-217.

The mammalian fauna and geomorphological relations of the Napak volcanics, Karamoja, Geol. Surv. Uganda, Records 1957-58, pp. 1-18.

Pleistocene chronology in East Africa. Advancement of Science, pp. 491-494.

Tertiary mammalian faunas and sediments in Karamjoa and Kavirondo, East Africa. Nature, Lond. Vol. 196, No. 4861, pp. 1283-1287, (with F. Whyte).

1963 Gully erosion in the Queen Elizabeth National Park. Uganda Journal, Vol. 26, 2, pp. 161-165.

New fossil hominoid material from Uganda. Nature, Lond. Vol. 197, No. 4873, pp. 1187-1190 (with D.B. Allbrook).

The later Tertiary and Pleistocene in eastern equatorial Africa, pp. 246-275, in African Ecology and Human Evolution, F. C. Howell and F. Bourliere Eds., Chicago, Aldine Publishing Co.

Uganda's animal ancestors. Uganda Wild Life and Sport, Vol. 3, No. 3, pp. 1-7.

Fossils from Karamoja, in Report on Brathay Exploration Group's Expedition to Uganda, Uganda Journal, Vol. 27, 1, pp. 109-114, (with

B.J.K. Tricker and W.H. Taylor).

Late-Glacial deposits near Lockerbie, Dumfriesshire. Dumf. and Gall. Nat. Hist. and Antiquarian Soc. Trans., Vol. XL, pp. 117-132.

1964 More fossil Primates and other Miocene mammals from North-East Uganda. Nature, Lond., Vol. 203, No. 4952, pp. 1327-1331.

1965 Quaternary geology and geomorphology in the Albertine rift valley, Uganda, pp. 293-321, in International Studies of the Quarternary, H.E. Wright & D.G. Frey, Eds., Geol. Soc. Am., Special Paper 84.

1966 The prelude to early toolmakers in Uganda, pp. 13-17, in Prelude to East African History, M. Posnansky, Ed. Oxford University Press, London, p. 186.

Stratigraphical geomorphology, pp. 139-176 in Essays in Geomorphology, G.H. Dury, Ed., Heinemann, London.

1967 Erosion-surfaces, tectonics and volcanic activity in Uganda, Geol. Soc. London Quart. Journal, Vol. 122, pp. 385-420 (with A.F. Trendall).

The Later Tertiary in East Africa - Volcanics, sediments and faunal inventory, pp. 31-56, in Background to Evolution in Africa, W.W. Bishop & J.D. Clark, Eds., Chicago University Press, 935 pp.

Annotated lexicon of Quaternary stratigraphical nomenclature in East Africa, pp. 375-395, in Background to Evolution in Africa -W.W. Bishop & J.D. Clark, Eds., Chicago University Press, 935 pp.

Earlier, Middle and Later Pleistocene faunal distribution, pp. 11-13 and 22-28 plus 3 maps, in Atlas of African Prehistory - J.D. Clark, Ed., Chicago University Press.

The Lake Albert Basin - An Account of the Uganda Museum Baker Centenary expedition. Geographical Journal, Vol. 133, pp. 469-480.

1968 The evolution of fossil environments in East Africa. Sixth Bennet Lecture of the University of Leicester (1966) Transactions Leicester Literary and Philosophical Society, Vol. 62, pp. 2-44.

Means of correlation of Quaternary successions in East Africa, pp. 161-172 in R.B. Morrison and H.E. Wright, Eds., Proceedings VII INQUA Congress, Vol. 8, Univ. Utah Press.

1969 New potassium-argon age determinations relevant to the Miocene fossil mammal sequence in East Africa. Am Journ.Sci., Vol. 267, pp. 669-699. (with J.A. Miller & F.J. Fitch)

Pleistocene stratigraphy in Uganda. Memoir No. 10, Geol. Surv. of Uganda, Government Printer Entebbe, 128 pp.

1970 Early Pliocene sediments and fossils from the Northern Kenya Rift Valley. Nature, Lond., Vol. 226, pp. 914-918 (with G. Chapman)

Radiocarbon dates related to the Late Glacial Sea in the Firth of Clyde, Scotland. Nature, Lond., Vol. 227, pp. 480-482 (with J. Dickson).

1971 Late Cenozoic History of East Africa in relation to Hominoid Evolution, pp. 493-527, in The Late Cenozoic Glacial Ages, K.K. Turekian, Ed., Yale University Press, 606 pp.

Succession of Cainozoic vertebrate assemblages from the Northern Kenya rift valley, Nature, Lond. Vol. 233, pp. 389-394, (with G.R. Chapman, A.P. Hill and J.A. Miller).

1972 Stratigraphic succession 'versus' calibration in East Africa, pp. 219-246, in Calibration of Hominoid Evolution, W.W. Bishop & J.A. Miller, Eds., Scottish Academic Press, 1972, 487 pp.

Post-conference commentary, pp. 455-477 in Calibration of Hominoid Evolution, W.W. Bishop & J.A. Miller, Eds., Scottish Academic Press, 487 pp.

1973 The tempo of human evolution, Nature, Lond. Vol. 244, pp. 405-409.

Stratigraphical nomenclature in the Baringo area of the northern Kenya Rift Valley. Proc. Pan Afr. Congr. on Prehist., Dakar, 1967, pp. 332-333.

1974 Fossil bear (Agriotherium Wagner 1837) from Langebaanweg, Cape Province, South Africa, Quaternaria (with R.G. Wolff and R. Singer).

1975 Geology, fauna and palaeoenvironments of the Ngorora Formation, Kenya Rift Valley. Nature, Lond., Vol. 254, No. 2497, pp. 185-192 (with M. Pickford).

New evidence regarding the Quaternary geology, archaeology and hominids of Chesowanja, Kenya. Nature, Lond., Vol. 258, No. 5532, pp. 204-208. (with A. Hill and M. Pickford)

1976 Pliocene problems relating to human evolution, in G. Isaac & E.R. McCown, Eds., Perspectives on Human Evolution, III, L.S.B. Leakey Memorial Volume, Staples Press, California.

Thoughts on the workshop - 'Stratigraphy, palaeoecology and evolution in the Lake Rudolf Basin' in Y. Coppens, F.C. Howell, G.L. Isaac and R.E.F. Leakey, Eds., Earliest Man and Environments in the Lake Rudolf Basin : Stratigraphy, Palaeo-ecology and evolution, University of Chicago Press, Chicago.

Geochronological framework for the African Plio-Pleistocene Hominidae : As Cerberus sees it. In C. Jolly, Ed., African Hominidae of the Plio-Pleistocene : evidence, problems and strategies. Butterworths, London.

Comparison of Australopithecine-bearing deposits in eastern and southern Africa - a new look at a 16 year old problem. Annals of the South African Museum, 71, 225-237.

1977 Stratigraphical and faunal evidence for Lateglacial and Early Flandrian environments in south-west Scotland. In J.M. Gray and J.J. Lowe, Eds., Studies in the Scottish Late-glacial environment. Pergamon Press, London, pp. 197 (with G.R. Coope).

Glacial-interglacial stratigraphy of the Quaternary in Midland and eastern England. In F.W. Shotton, Ed., British Quaternary Studies - Recent Advances. Oxford University Press, pp. 267-286 (with F.W. Shotton and P.H. Banham).

in press The geological framework of the Kolombe Acheulian Archeological site, Kenya. In Bishop W.W., Ed., Geological Background to fossil man. Scottish Academic Press. Edinburgh.

Editor of :

1967 Background to Evolution in Africa. Chicago University Press. 935 pp. (with J.D. Clark).

1972 Calibration of Hominoid Evolution. Scottish Academic Press. 487 pp. (with J.A. Miller)

1969-1972	Scientific Editor Journal, Geological Society of London.
in press	Geological background to fossil man - recent research in the Gregory Rift Valley. Geological Society of London - Scottish Academic Press. Edinburgh.

THE INSTITUTION OF GEOLOGISTS

The Institution of Geologists is incorporated through the signatures of the 23-member committee of an Association for the Promotion of an Institution of Professional Geologists (APIPG). Its creation thus represents the combined wishes of the 1000 or so members of that Association - perhaps a quarter of all professional geologists in the U.K. All professional geologists may apply for membership of the new Institution, which can anticipate a rapid build up in numbers.

The Institution will build on the external relations of APIPG. Increasingly close association will be sought, through the Council of Science and Technology Institutes and the Council of Engineering Institutions, with sister Institutes in science and engineering, and a special relationship will develop with the Geological Society of London - as the premier learned society for geology in the U.K. - with which the Institution will be lodged in Burlington House.

Geologists locate and help exploit the materials upon which our civilization depends. Fossil fuels, metal ores, bulk building materials and water resources are today crucial factors in global politics, multinational business strategy and not least in the living standards of ordinary men and women. The geologist is also involved in planning and policy decisions on the use of the environment, the safety of dam sites, tunnels and motorways, and the disposal of toxic and radioactive wastes. In presenting the concerted views of professional geologists the Institution hopes to influence thinking on these issues in the way, for example, that the Association of Engineering Geologists in the U.S.A. has recently done regarding the safe construction of a dam in California.

The founder members of the Institution are drawn from a wide range of organisations : the National Coal Board; the extractive, mining, oil and civil engineering industries; universities; Government departments and Research Councils, and water authorities.

The Institution's first President will be Dr. R.H. Cummings, OBE, Chairman of Robertson Research International Ltd.

Among the founder members is the first Secretary, Professor J.L. Knill. He has been the moving spirit in the five years it has taken to structure and create the Institution and to ensure that from the outset it reflects the wishes of professional geologists as a whole. With Professor W.S. Pitcher (President of the Geological Society), Mr. J.K. Shanklin and Mr. M.J. Barefoot, Professor Knill was involved in the first formal study group on professionalism and stays the course to see his labours bear fruit.

Other officers, until the first AGM and inauguration in February, 1978, are Mr. C.M. Bristow, Chief Geologist, English China Clays, Lovering and Pochin (Chairman); Mr. C.J. Dixon, Senior Lecturer in Mining Geology at Imperial College (Treasurer) and Dr. R.C.L. Wilson, Senior Lecturer in Earth Sciences at the Open University (Editor).

For further information contact J.L. Knill 01-589-5111 Ext. 1638 or P.T. Warren 01-660-4087 (evenings only).

NEW PUBLICATIONS

The Ice Age in Yorkshire and Humberside, by P.J. Boylan, 1977. Published by, and available from, The Yorkshire Museum, Museum Gardens, York. YO1 2DR. 32 pp. Price 50p plus 10p postage.

During the summer of 1977, many visitors have been attracted to the Yorkshire Museum by a special display of Quaternary sites in Yorkshire, organised by Miss B.J. Pyrah, entitled "A Mammoth Display - The Ice Age in Yorkshire". Patrick Boylan's booklet, produced in conjunction with the exhibit, is designed mainly for museum visitors and gives a broadly based account of most important Quaternary features in Yorkshire. The introduction gives an interesting account of the early historical development of Quaternary studies in Yorkshire, and subsequent sections deal with various divisions of the Quaternary in chronological order. The illustrations include museum specimens from Bielsbeck and Kirkdale Cave, and representations by Barbara Pyrah of the more important Quaternary mammals.

The Quaternary Deposits of the Mendip, Bath and Bristol areas, by A.B. Hawkins and E.K. Tratman, 1977. Proc. Univ. Bristol Spelaeol Soc., 14, 197-232. Available from the Librarian of the University of Bristol Spelaeological Society, University Road. BRISTOL BS8 1SS. Price 60p including postage; a discount of 20% is allowable on 10 or more copies.

This paper summarises present knowledge of the important Quaternary sites of the area in the form of a table giving principal references and brief notes on stratigraphy, palaeontology, archaeology and dating. The sites are arranged in approximate chronological order from the Flandrian to "Wolstonian and Older" Stages. Donovan's annotated bibliographies of Palaeolithic and Pleistocene sites (1954, 1964) are reprinted, and principal references since 1964 are given as a supplement. All the main Quaternary references to the area are therefore included.

CALENDAR OF MEETINGS

January 6th-7th, 1978	Quaternary Research Association Discussion Meeting on Quaternary Mammals, Cambridge. Further details and booking form included with this Newsletter.
March 11th, 1978	William Pengelly Cave Studies Trust Ltd. Deposits in Sea Caves. Further details given in Quaternary Newsletter No. 22.
April 7th-11th, 1978	Quaternary Research Association annual field meeting, Keele. Further details and booking form included with this Newsletter.
May 19th-21st, 1978	Quaternary Research Association Field Meeting, Hertfordshire. Further details are given in the circular included with this Newsletter.
September 25th-29th, 1978	Quaternary Research Association Field Meeting, Oban. Further details are given in the circular included with this Newsletter.

Typed in the Department of Geography, Birkbeck College, University of London, by Kath Beech, October, 1977.