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EDITORIAL

Since the publication of the last *Newsletter* (No. 59), I have received (and heard indirectly of) several complaints regarding my 'chatty tone' and the use of 'quaint decoration, cartoons and other symbols'! As a direct result of these comments, the matter of my editorial style was discussed at the most recent meetings of the Publications Committee (convened in early December) and the Executive Committee (convened in early January).

Both meetings agreed that while it was *paramount* that the *Newsletter* be viewed as a serious scientific publication, the Editor should be allowed some initiative (within limits) and that he/she should be permitted (also within limits) to place their personal stamp on the publication. So far as I am concerned, I have not strayed beyond those limits in introducing a little 'lightness of touch' but if there are others of you who prefer the more formal approach, do let me know as this is *your* Newsletter, not mine.

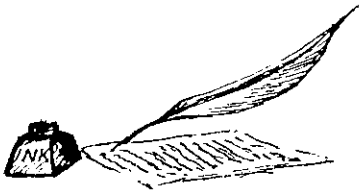
Another matter of serious concern to some of you was the publication, also in *Newsletter* No. 59, of Esmée Webb's letter with regard to the INQUA Conference to be held in China in 1991. Several correspondents deplored the publication of this letter and claimed that this was the first time that any political angle had been introduced to the QRA in this way.

However, in submitting Esmée's letter for publication, I viewed it simply as the expression of a point of view (admittedly related to an emotive issue) that the readership could decide upon for themselves—and I felt that Esmée was fully entitled to air her views, just as Nat Rutter (in this issue) should be free to express his. To me, this is democracy at work—but then, perhaps I have a quaint view of that too!

Finally, may I thank all contributors to this issue for submitting material on time and for the high quality of these contributions—which should make for stimulating reading.

PS. Alas, the 'glossy' and illustrated cover of the Anniversary Series has, by decree, been abandoned in favour of the original (some would say 'ordinary') style adopted in previous issues.

Articles



QUATERNARY DATING BY SEA LEVELS: RISE AND FALL OF THE EUSTATIC THEORY

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The belief that sea levels during the Quaternary were successively lower during each interglacial has been widespread during the present century. This idea originated from the sequence of former shorelines on the Mediterranean coasts, and was encouraged by the sequence of terraces on European rivers such as the Thames and the Somme which appear to get progressively lower and younger. Some workers believed that world-wide correlation of the Quaternary, excluding glaciated areas, was possible if these levels could be identified.

The following is a brief review of the history of this belief which concentrates, perhaps unfairly, on a few famous names. A full history would be a very long and tedious undertaking.

1 Faunal stages in the Pleistocene

Many workers have agreed (e.g. King, 1955) that it would be desirable to subdivide and correlate the Pleistocene on the basis of fossil marine faunas, like the rest of the Phanerozoic column. They have been frustrated by the shortness of the epoch and the consequent small amount of change in many lineages. Many of the faunal distinctions that have been made were on the basis of environmental aspects of faunas ("warm", "cold" etc.) rather than evolutionary ones.

The term *Siciliano* was used by Doderlein in 1872 (references in Trevisan, 1956), for the youngest of four subdivisions of the Italian Pliocene, based on sediments near Palermo. It is characterised by a marine molluscan fauna containing immigrant species from the northern Atlantic. The type area was later studied by Gignoux (1913; and see below) who named the (earlier) Calabrian as distinct from the later Sicilian. The Calabrian is now regarded as the basal stage of the marine Quaternary.

2 France

General Leon De Lamothe (1849–1936), posted to Algeria in the course of his duties, studied the terraces of the River Isser and correlated them with raised coastal platforms which obviously marked higher stands of sea level (De Lamothe, 1899).

The coastal platforms are aggradational features, and their deposits rest on erosional surfaces of the Pliocene "blue marls". Lamothe inferred that there had been several oscillations of relative sea level, "emersions" being each followed by an "immersion" of smaller vertical extent, so that the net effect was of a falling sea level (Fig. 1). He pointed out (p.258, footnote) that he was using the terms "emersion" and "immersion" in a relative sense, and that they did not imply that the land had moved in relation to a fixed sea level. However, he wrote:-

> 'It is difficult not to wonder whether such regular features, affecting stretches of coast several hundred kilometres long, can really be explained by vertical movements of such an extensive zone of the earth's crust, and if it would not, on the contrary, be more logical to attribute them, as Suess has done, to oscillations of the general level of the sea.'

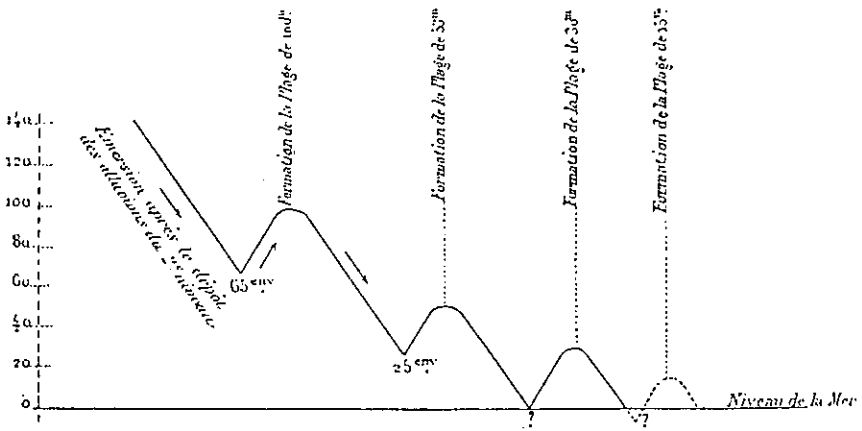

Fig. 1 Diagramme des mouvements relatifs du niveau de la mer pendant le pleistocène.

De Lamothe believed the higher platforms to be of Pliocene (Astian) date, and those with surfaces at 100, 53, 30 and 15 m above sea level to be of Pleistocene age.

On the 10 June 1901 De Lamothe gave a communication to the *Academie des Sciences* of Paris which was boldly entitled "Sur le role des oscillations eustatiques du niveau de base dans la formation des systemes de terrasses de quelques vallees." (De Lamothe, 1901). If the levels that he had observed in Algeria could be matched in other parts of the globe, they could only be explained by eustatic movements of base level. Finding little published evidence, he had investigated the valleys of the Moselle, the Rhine and the Rhone and found remarkable correspondence between the levels of terraces with his Algerian data.

> 'So, this formation must be attributed ... to a succession of eustatic movements, alternately positive and negative, but of which the resultant has been negative, which have progressively lowered base level from the altitude of about 200 m which it possessed during the Upper Pliocene to its present day level.'

Thus, in the first year of the present century, was born the Eustatic Theory.

The man who became particularly associated with the theory was Charles Deperet (1854–1929), who began life as an army doctor at Grenoble where he was a colleague of De Lamothe (Gignoux, 1937, p.205), and became an authority on Cainozoic stratigraphy and palaeontology. His obituarist wrote:

> ... just as, earlier, he had seen in the altitude of the river terraces of the Lyon area a criterion of their relative age, so he was struck by the [idea that the] altitude of former shorelines could supply a guide-line for the chronology of the Mediterranean Quaternary, (Gignoux, 1931, p.1054).

Amid the "chaos and confusion" of marine, fluvial and glacial Quaternary deposits, eustatism could furnish him with "a solid basis and a universal criterion." (ibid).

Deperet became the "general of a peaceful army" (Gignoux, op. cit. p.1055) of researchers who supplied "abundant and highly heterogeneous contributions" (Baulig, 1935, p.6) on the altitudes of beaches and river terraces in many parts of Europe and elsewhere. Later it was alleged (Bourdier, 1959, p.24) that some of these had to cook the results so as to provide the desired altitudinal correlations.

The work of his "peaceful army" was synthesised by Deperet in a note presented to the *Academie des Sciences* on 18 March 1918. He defined the now familiar altitudinal sequence (from above down) of Sicilian, Milazzian, Tyrrhenian and Monastirian, a sequence which has perhaps offered a straitjacket as rigid as Gunz, Mindel, Riss and Wurm. The Sicilian was identified with the 100 m level of Lamothe, although this correlation had already been criticised by Haug (1911, p.1863).

The Tyrrhenian Stage had been differentiated by Issel in 1914 (reference in Trevisan, 1956) on the basis of a "warm" fauna, younger than Sicilian, characterised by several tropical species including the gastropod *Strombus bubonius*. This is probably the youngest marine fauna which can be distinguished in the Mediterranean (Gignoux, 1955, p.620). The type locality is in Sardinia near present sea level, but the fauna was found at about 30 m in southern Italy, and was correlated by Deperet with the 30 m level originally identified in Algeria by De Lamothe.

Deperet had to admit that his new stages Milazzian (for deposits of the 55–60 m level) and Monastirian (18–20 m), did not differ faunally from the Sicilian and Tyrrhenian. Their definition was thus purely altitudinal.

There followed a series of notes (Deperet, 1918–1922) in which he applied his general scheme to various areas, especially the glaciated regions of the Alps and northern Europe. In connection with his work for the geological map of France he had studied the fluvioglacial terraces of the Rhone, which he linked with the moraines marking successive advances of alpine glaciers.

> 'I was thus in possession of a new and precise method of comparative definition of the glacial advances ... by the altitude of the corresponding river terrace, a method which had escaped Messrs Penck and Bruckner' (Deperet, 1919, p.871).

Using Penck and Bruckner's data, he compiled a table (Fig. 2) of heights above the valley floors of terraces corresponding to the four alpine glaciations, and in the following year he explicitly correlated these with the four Mediterranean sea levels (Deperet, 1920, p.159–160). The likelihood that the heights of the terraces above the valley floor, in the headwaters of rivers hundreds of kilometres from the sea, could have accurately reflected corresponding elevations of base level was not discussed.

Later in 1920 correlation with British glacial drifts was proposed (1920, pp.212–218) but to do this Deperet had to discount the possibility of isostatic adjustment, so that he could correlate the 100-foot raised beach in Scotland with his Tyrrhenian sea level.

One of the most able of Deperet's "army" was Maurice Gignoux (1881–1955) (Moret, 1956) who worked on the Pliocene and Quaternary marine formations in southern Italy and Sicily for his doctoral thesis of 1913, and was instrumental in extending Deperet's altitudinal scheme throughout the western Mediterranean (Deperet, 1918, p.482). Later he became well known for his work on alpine geology.

Gignoux wrote a major textbook of stratigraphy, *Geologie stratigraphique*, first published in 1926, in which he embodied "very discreet reservations" (Bourdier, 1959, p.24) as to his old supervisor's concept. He did, however, place Deperet's synthesis (1918–1920) first among the "Traites classiques" which he cited for the Quaternary, and offered (p.558) a correlation table after Deperet in which the four eustatic sea levels were correlated with Gunz, Mindel, Riss and Wurm.

In his obituary of his old master, Gignoux (1931, p.1055) observed that local movements would be found, here and there, to disturb "the marvellous unity of eustatism".

In 1933 Henri Baulig, in a lecture delivered in London (Baulig, 1935, p.7; see below) could say "Deperet's thesis cannot be said to have met with general approval" and that "although Deperet and Lamothe are probably right on the whole, their assumptions and methods call for a thorough critical revision. This we shall attempt ...".

Gignoux also wrote a funeral oration for De Lamothe, but evaded the issue of assessing his contribution, remarking that it would take too long to expound and critically discuss the eustatic theory (Gignoux, 1937, p.206). A note of irony may perhaps be detected in his next sentence: "Let us only say that the whole scientific life of De Lamothe was from then [1899] veritably obsessed by the idea of finding, everywhere and in spite of everything (partout et malgre tout), throughout the entire globe, traces of the marine levels which he had defined with mathematical precision in Algeria."

	Nord de l'Europe (J. Geikie).	Alpes (A. Penck).	Terrasses fluviales équivalentes (C. Depéret).
Quatrième glaciation....	*Mecklenbourgien*	*Würmien*	Terrasse de 18- 20 m m
Troisième »	*Polonien*	*Rissien*	» de 30- 35
Deuxième »	*Saxonien*	*Mindélien*	» de 55- 60
Première »	*Scanien*	*Günzien*	» . de 90-100

Fig. 2

Gignoux abandoned the eustatic theory in the 2nd (1936) edition of his textbook:

> ... as often happens, this very interesting idea was pushed to the extreme, to inadmissible conclusions ... (p.578).

The reference to Deperet's 1918–1822 synthesis was expunged, and the possibility of correlation of the Mediterranean stages with the glaciations, in the current state of knowledge, was denied.

Gignoux was elsewhere more outspoken—"it was sufficient to have an altimeter fixed to the handlebars of one's bicycle in order to become a specialist in one of the most difficult fields of geology." (quoted by Bourdier, 1959, p.24).

In 1960 an American worker, Horace G Richards, was trying to make altitudinal correlations between Europe and the east coast of the USA, but wrote that:

> 'It is generally agreed that the higher shore lines of the Mediterranean area have been considerably uplifted and deformed' (Richards, 1960, p.60).

An entertaining account of the rise and fall of the theory in France was written by the prehistorian Franck Bourdier (1959), who claimed that its partisans were by then "less and less numerous."

3 Britain

By the time that (according to Bourdier, at least) the eustatic theory was being abandoned in France, it was being enthusiastically taken up in Britain. Henri Baulig, professor of Geography at Strasbourg, gave four lectures at the University of London in 1933 (Baulig, 1935) in which he reviewed and embraced the eustatic theory, and summarised his own work, and that of his students, in which he claimed that Pliocene and Quaternary high sea levels could be identified from high level erosion surfaces, at constant altitudes not only in France but also in Algeria and on the shores of the Black Sea. These lectures perhaps gave an impetus to the British work on denudational chronology in the next dacades, much of which was published in the *Proceedings* of the Geologists' Association.

F E Zeuner (1905–1963) came to Britain in 1934 with a wide knowledge of the continental Quaternary and devoted much of his subsequent career to Quaternary chronology. One of his major contributions was to show that astronomical ("Milankovitch") cycles of intensity of solar radiation could provide a basis for subdivision and correlation of Quaternary time.

In 1938 he published a correlation of the Alpine (Penck) sequence with the "observed Mediterranean sea-levels" Calabrian (= Gunz), Sicilian (= Mindel/Riss) and Tyrrhenian (= Riss/Wurm), i.e. those which were defined faunally as well as altitudinally. The actual correlations were later revised and in 1959 (p.304) the Sicilian was regarded as pre-dating the main sequence of Pleistocene glaciations.

Deperet (1919) had correlated the Mediterranean high sea levels with glacial advances, but Zeuner (1945, p.247), more reasonably, regarded them as maxima in a generally falling level with glacioeustatic oscillations superimposed on it. He therefore assumed, throughout his work, that they were interglacial in age, and correlated them with the major interglacials that he had recognised, counting backwards from the present. He did not refer to the difference between his and Deperet's correlation with the glacial sequence.

A J Bull (1876–1950) was a distinguished member of the Geologists' Association with a particular interest in Wealden geomorphology (Kirkaldy and Brown, 1951). In 1941 he read a review paper on the chronology of the Pleistocene of England (Bull, 1942). He wrote on his first page:

> 'I have felt that if only one could trace a single line of successive events related to eustatic changes in sea level to form a coherent story, it should be possible to test this by fitting other observations to it.'

He tabulated former sea levels for south-eastern Britain from over +300 feet (the Caton Terrace) downwards.

Bull's paper was circulated to a number of workers before it was read, and many of them took in the discussion which was printed with the paper. One of these was Zeuner who contributed a world-wide comparative table (Fig. 3) and wrote:

> 'It is evident from this table that the sea-level phases ... apply to the whole world and that Dr Bull is justified in making the eustatic theory the starting point for his chronological scheme of the British Pleistocene (Zeuner, 1942).'

No-one seems to have noticed that the world-wide "correlation" of Zeuner's table depended on the assumption that similar levels in different parts of the world were of the same age, which Zeuner never attempted to prove.

Heights in Metres	Algiers	South France	Jersey	North France	South Engl.	South Africa	Sunda Archip.	South Austral.	North America
Sicilian	103	90–100		103	c.96			(75)	81
Milazzian	c.60	55–60		50–59	c.60	45–75		60 (45)	65 40
Tyrrhenian ..	c.30	28–32	32–34	32–33	(30.5) 33.5			27	29
Main Monastirian ..	18–20	18–20	18	18–19	15–18	18		19.5	20
Late Monastirian ..		7–8	7.5	8	5–8	6		7.5	8
pre-Flandrian regression		min. —92		min —30			—70 to —100		

Fig. 3.

Zeuner went on to use Deperet's scheme in his influential books (1945, 1946 and later editions), reproducing his 1942 table with slight changes (as late as 1959, p.301) till his untimely death in 1963. He was careful to point out (e.g. 1945, p.231, footnote) that "these terms [Sicilian, etc.] are used in the altimetric sense. They must not be confused with the palaeontological terms Sicilian fauna, Tyrrhenian fauna, which have a wider application." Much of the material assembled for *The Pleistocene Period* (1945) was repeated unchanged in the relevant chapters of *Dating the Past* and in the later editions of these works. His commitment to the Eustatic Theory was re-affirmed in a paper in the *Geologische Rundschau* (1952), which included a more elaborate table (re-used in the 2nd ed. of the *Pleistocene Period*, 1959, pp.378–379). On this occasion, however, the *Rundschau* took the unusual step of printing a dissenting note from Cailleux (has he been the referee?) (Cailleux, 1952).

Finally, in the revision of his *Pleistocene Period* published four years before his death, Zeuner (1959, p.356) recognised at least thirteen shoreline altitudes from Calabrian to Postglacial inclusive, with 5 phases of the Sicilian based on the coast west of Alexandria (ibid, p.351).

One of Zeuner's obituarists (Cornwall, 1964) wrote that his "sponsorship of the Theory of Eustasy ... has provided an instrument for world-wide Pleistocene correlations between tectonically undisturbed regions, not, so far, equalled by any other device."

The fourth edition of Gignoux's textbook appeared in 1950, and an English translation in 1955. In this he was even more outspoken than in 1936, writing:

> ... we have no reason to believe that the deformation characteristic of the earth's crust suddenly ceased at the dawn of Quaternary time ... but the altimetric measurements of Deperet and de Lamothe, certainly very meticulous, were conducted with the preconceived idea that the continents had remained stable. ... And such is the power of words, even to scientific minds, that many geologists continue to use these terms [Sicilian, etc.] ... (p.611).

Gignoux's last word was in a paper to the 19th International Geological Congress, 1952 (Gignoux, 1954) in which he criticised Zeuner's position, and wrote that "most modern authors agree in criticising the *theory of levels" (Gignoux's italics)*. To be fair, one must note that he was also sceptical about the use of Milankovitch cycles for correlation and dating, and one must hope that the current interest in these will not turn out to be another will o' the wisp.

British writers, including the present one (ApSimon and Donovan, 1956), referred to the Deperet/-Zeuner sea levels, but generally geologists in Britain were cautious. Fourteen years after Bull's lecture, W B R King, in his Presidential Address to the Geological Society on the subject of the English Pleistocene, mentioned the eustatic theory only briefly at the end, saying that it was "highly controversial" and the "world-wide correlation [by sea levels] appears to be fraught with danger" (King, 1955, p.207).

4 Geological considerations

All authors who supported the Eustatic Theory discussed the problem of a mechanism for progressive lowering of sea level since the end of the Pliocene, on which were evidently superimposed the rises and falls due to the decay and growth of ice sheets which everyone understood. The generally favoured solution was an increase in the capacity of the ocean basins, though the known rates of change appear to be too slow (Donovan and Jones, 1979, p.189).

Zeuner (1945, p.250; reproduced unchanged in 1959, p.303) published a diagram (Fig. 4) purporting to show that Deperet's three lower levels could be plotted on a steadily falling base line representing the interglacial eustatic sea level; backward extrapolation then enabled him to date the Sicilian level. "it is highly probable that the straight line represents a *continuous* drop of the sea-level during the Pleistocene, i.e. that part ... which is due to causes other than glacial eustasy." He estimated this fall of sea level to have been about one-tenth of a millimetre annually (1945, p.250).

On the simple assumption that roughly the same amount of water gets frozen in icecaps during each glaciation, and melts at the next interglacial, one would expect interglacial returns to approximately the same levels. Donn, Farrand and Ewing (1962, p.214), calculated the lowering of sea level expected from the growth of ice sheets during the glaciations, and compared it with actual evidence from submerged shorelines. They concluded that the evidence favoured:

> 'approximate sea-level stability during interglacial in opposition to Zeuner's interpretation of a continuous secular lowering throughout the Pleistocene.'

Bowen (1978, p.158) has argued this from the oxygen isotope record, and Stienstra (1983) has indeed calculated such a curve. A progressive increase in the size of continental icecaps cannot be invoked, as they would have to be much larger than they are, in order to accomodate the supposed fall in sea level of about 200 m since the late Pliocene.

It can be argued that, if river and coastal terrace sequences were primarily a result of crustal movement, that we should indeed infer a generally falling sea level, since regions of uplift would readily come to our notice, while in cases of submergence the evidence is concealed by water.

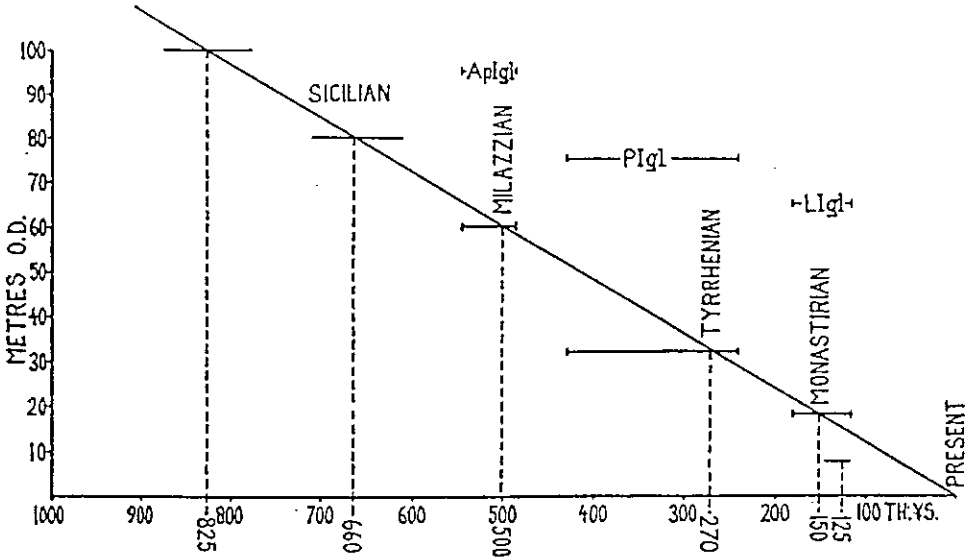

Fig. 4 Diagram showing the relation of altitude to time for the high sea-levels of the Pleistocene. The horizontals representing the Main Monastirian, Tyrrhenian and Milazzian levels have the length of the corresponding interglacials on the time-scale.—From Zeuner (1944).

It can also be argued that the Thames and other rivers give a false impression of former higher sea levels, because at the time when raised terraces were formed the river mouth was farther away than it is now. Because river profiles are concave upwards, cutting-back of the profile and recession of the coast line will produce a height difference in the middle and upper reaches even if there is no change of base level.

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PLEISTOCENE STRATIGRAPHY OF RIVER BASIN SEDIMENTS: A REPLY TO D MADDY AND C P GREEN

D R Bridgland

In the November 1989 edition of QN (No. 59) an article entitled "A unified approach to the stratigraphy of Pleistocene river basin sediments" was published by D Maddy and C P Green, written partly in response to my own paper "Problems in the application of lithostratigraphic classification to Pleistocene terrace deposits" in QN 55. The latter proposed a modification to the use of lithostratigraphic nomenclature for Pleistocene fluvial sediments, in order to comply more fully with the recommendations of the stratigraphic guides. This modification simply sought to change the hierarchical level at which terraces are defined, in recognition of their status as 'primary mappable units'. This suggestion has been generally well received amongst fellow geologists, despite considerable resistance to changing the established scheme.

Maddy and Green expressed misgivings about the application of lithostratigraphy, citing some of the problems with the existing scheme that I had recognised, and proposed an alternative system of nomenclature which is wholly outside accepted stratigraphic practice. A principal factor behind their rejection of standard lithostratigraphy for terrace sediments is that, within a single basin, the deposits of one terrace are frequently indistinguishable from those of another on the basis of lithology. In my opinion this is not a problem, since the deposits of each terrace can be recognised by geological mapping (which can and should include geomorphological mapping); terraces can therefore be defined as basic lithostratigraphic units, or formations. It is not the deposits of other terraces from which these deposits should be differentiated by lithostratigraphy, it is any directly underlying or overlying strata, such as bedrock, till, loess, lacustrine sediments or other fluvial deposits. If the last are interbedded with normal terrace gravels they can be identified as members of beds of the particular formation in which they occur.

The fact that Maddy and Green see the compositional similarity of different gravels within a single terrace system as a major obstacle to lithostratigraphy stems from a fundamental misunderstanding of what lithological properties should be used for such classification, a misunderstanding which is widespread in recent British Pleistocene usage. In recent years lithostratigraphy, as applied to fluvial terrace series, has come to be almost synonymous with clast-lithological analysis (stone counting). This technique was pioneered as a lithostratigraphic method by Gibbard (1985) in the Middle Thames, this usage being extended to the Upper Thames by Hey (1986). The use of clast-lithological analysis as a basis for lithostratigraphy (although without formal nomenclature) was also advocated by McGregor and Green (1986). However, as I pointed out in my article in QN 55, the stratigraphic guides (e.g. Hedberg, 1976) emphasise that laboratory techniques are **not** a valid basis for lithostratigraphic subdivision. This means that, even where there are clast lithological differences between the gravels of different terraces, they should not be used to establish a lithostratigraphic scheme; lithostratigraphy cannot therefore be used to classify terraces at the subdivision level, only at the primary unit level.

Lithostratigraphic **subdivision** should be based on gross lithological properties (e.g. gravel, sand, clay etc.) which can be applied in the field and when mapping. This is exactly the procedure followed when classifying the strata of the 'solid' geological record. Thus within the Purbeck Formation, for example, numerous limestone and shale members are recognised. More subtle lithological characteristics can be used, provided they are obvious in the field: sandy limestone, quartzose conglomerate or laminated clay are good examples.

Adherence to this correct usage also resolves another of the problems that worry Maddy and Green, one which appears to be a principal reason for their advocation of an alternative scheme. This stems from a desire to use a single name for deposits at a particular terrace level throughout a fluvial basin, in order to avoid the proliferation of different names. Since the different rivers in a catchment may deposit gravels containing different clast types, the use of clast lithological analysis as a basis for differentiation means that terraces in tributary valleys, and even in different parts of the same valley, must sometimes be separately defined. According to Maddy and Green (p.8), such sediments do "not readily conform to the basic requirement of internal homogeneity needed for formal lithostratigraphic identification". However, at the level of lithological differentiation which **should** be used by the lithostratigrapher, the fact that all these terraces comprise sand and gravel is amply sufficient, in terms of 'internal homogeneity', for them to be classified by this method as a single unit. They represent the remains of a formerly continuous sediment body which can therefore be defined throughout the basin (by geological mapping) as a formation.

The main reason why separate systems of nomenclature have been used in different parts of valleys and in tributary systems is that reconstruction of such sediment bodies, which have generally been increasingly dissected the older they are, is often problematic. Strictly, the correct way to link the surviving fragments together for the purposes of lithostatigraphic classification is to extrapolate the former three-dimensional extent of the sediment body and, in particular, its linear extent. This can be done by the plotting of long profiles. Useful biostratigraphic and clast-lithological evidence should of course be taken into account when available, but the reconstruction of the former sediment body, actually part of the basic mapping process, is paramount.

Where correlation between isolated remnants of sediments laid down by the same aggradational event is on a sound footing, it is clearly desirable to suppress the use of unnecessary synonyms. There is certainly no overriding reason, as Maddy and Green suggest (p.9), "to name the gravels of each of the [Severn] tributaries as separate Formations/Members". The deposits of the Kidderminster Terrace (Maddy and Green, Fig. 2) and their correlatives in the tributary Avon valley could, in fact, be defined as the Kidderminster Gravel Formation. This term would be quite acceptable, no confusion being likely with the much older (Triassic) Kidderminster Formation. The latter and the Middle Pleistocene Severn/Avon gravels are sufficiently widely separated within the geological record to waive the normal rule that a geographical name should not be duplicated in this way. In any case, there is an important historical precedent for the use of the Kidderminster geographical name for these Pleistocene deposits; it was first used by Wills (1938), long before the definition of the Triassic formation of the same name. The use of the shortened version of the Pleistocene term, i.e. Kidderminster Gravel, further reduces the danger of confusion.

I do not intend to comment at length on the alternative scheme proposed by Maddy and Green. This draws information from morphology, lithology, sedimentology, biology and chronology (presumed to include absolute chronology and/or geochronological techniques independent of biostatigraphy) in a unified approach. This can be highly recommended as a plan of campaign, but as a basis for classification it has many pitfalls. One of the major advances in geology during the post-war years has been the separation of classifications based on rock (lithostratigraphy), fossils (biostratigraphy) and time (chronostratigraphy), which had hitherto frequently been confused. In fact, clarifying the distinction between these types of classification was a principal reason for producing the stratigraphic guides of the late 1970s. It would be most unwise for those working on the deposits of the last 1.6 million years to ignore the example of those who work on the earlier geological record and to erect a separate scheme for the Pleistocene which entails all the confusions that have been avoided in recent classifications of older rocks. Of the various approaches included by Maddy and Green in their Fig. 1, it should be emphasised that **biology**, or rather fossils, is in any case an accepted criterion in lithostratigraphy (Hedberg, 1976, p.31), which is the method used by geologists to classify rock (including, of course, unlithified deposits). It is important, however, not to confuse lithostratigraphy with biostratigraphy. **Sedimen-**

tology and **lithology** are essential and obvious parts of the description of the constituents of the geological record by lithostratigraphy, although classification should not entail genetic interpretations (i.e. terms such as 'fluvial', 'marine', etc. should not appear in the names given to sediment-bodies). It is perfectly permissible, and indeed sensible, for the lithostratigrapher to use his knowledge of the genesis of a sediment body to assist him in mapping it. **Morphology** (geomorphology) is taken into account within the mapping procedure used to define basic lithostratigraphic units (formations). This is part of geological mapping and does not constitute morphostratigraphy, which should be restricted to sequences based purely on landforms. **Chronology** has **no part** in lithostratigraphic classification; time is classified by a quite separate scheme and **should not** be confused with the record provided by rocks, although the two are obviously considered together as part of correlation procedures. To use the system proposed by Maddy and Green for classifying Pleistocene fluvial deposits would be a retrograde step and a recipe for chaos.

In conclusion, I would strongly urge those classifying the sediments which make up the Pleistocene geological record to adhere to established lithostratigraphic procedures. It should always be possible to classify any body of sediment either by basic mapping (formations only) or by subdividing, on the basis or readily observable lithological properties, the formations which have been mapped in this way (members and beds). I leave future workers to decide which they are doing, for it is that which should determine the hierarchical level of a unit, not some preconceived idea of its status based on thickness, amount of time represented or relative importance.

I would like to thank Dr W A Wimbledon for useful discussion of this subject.

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GLACIOLACUSTRINE DEPOSITS IN GLEN NOCHTY, GRAMPIAN REGION, SCOTLAND, UK

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Introduction

The possibility of the former existence of lakes in the Don valley was first recognised by Geikie (1890) and Hinxman (1896). Both Bremner (1921) and Charlesworth (1955) described a suite of Devensian ice dammed lakes in the Don valley on the basis of supposed "overflow channels" and "lake basins". In recent years the criteria for identifying sites of former ice dammed lakes have been re-examined and it is now generally accepted that evidence of strandlines, deltas and/or lacustrine deposits must be presented (Sissons, 1960; 1961).

This paper describes sedimentological evidence for the former existence of an ice dammed lake in a tributary valley of the Don, Glen Nochty, Strathdon (Fig. 1), leading to the development of a preliminary model envisaging a number of lakes dammed in the Don valley towards the end of the Devensian.

Topography and Drift Geology

The River Don is 127 km long, rising in the eastern Cairngorm mountains at an altitude of c.790 m, and flows through a series of basins separated by gorges to reach the North Sea at Aberdeen (Fig. 1). The valley contains an extensive suite of fluvioglacial landforms, including areas of kame-and-kettle topography and eskers; kame terraces up to 10 m above the floodplain, most notably to the north and east of Kintore (Fig. 1); and at least four dissected and discontinuous river terraces. There are numerous meltwater channels and a possible deeply dissected moraine near Kildrummy (Fig. 1).

British Geological Survey shell and auger borehole and trial pit records (Auton and Crofts, 1986; Auton et al., 1988) and a series of electrical resistivity soundings, taken by the author, using the Offset Wenner sounding system in conjunction with the BGS Barker Multicore Cable (Auton et al., 1988; Barker, 1981) have enabled the identification of four main stratigraphic units in the Don valley (Fig. 2). Basal till, comprising three lithologically distinct till types, is locally overlain by laminated silts and clays, up to 20 m thick, which contain isolated clasts. These laminated deposits partially outcrop at the surface but are generally overlain by up to 9 m of coarsening upward fluvioglacial sand and gravel. Glacial sand and gravel is a BGS term for ice-contact deposits and is hence restricted to eskers, kames and kame terraces.

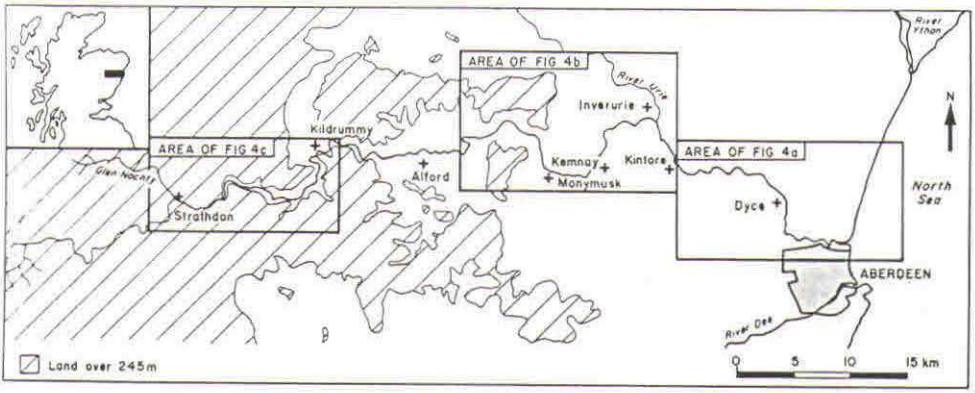

Fig. 1 Locality map of Don basin.

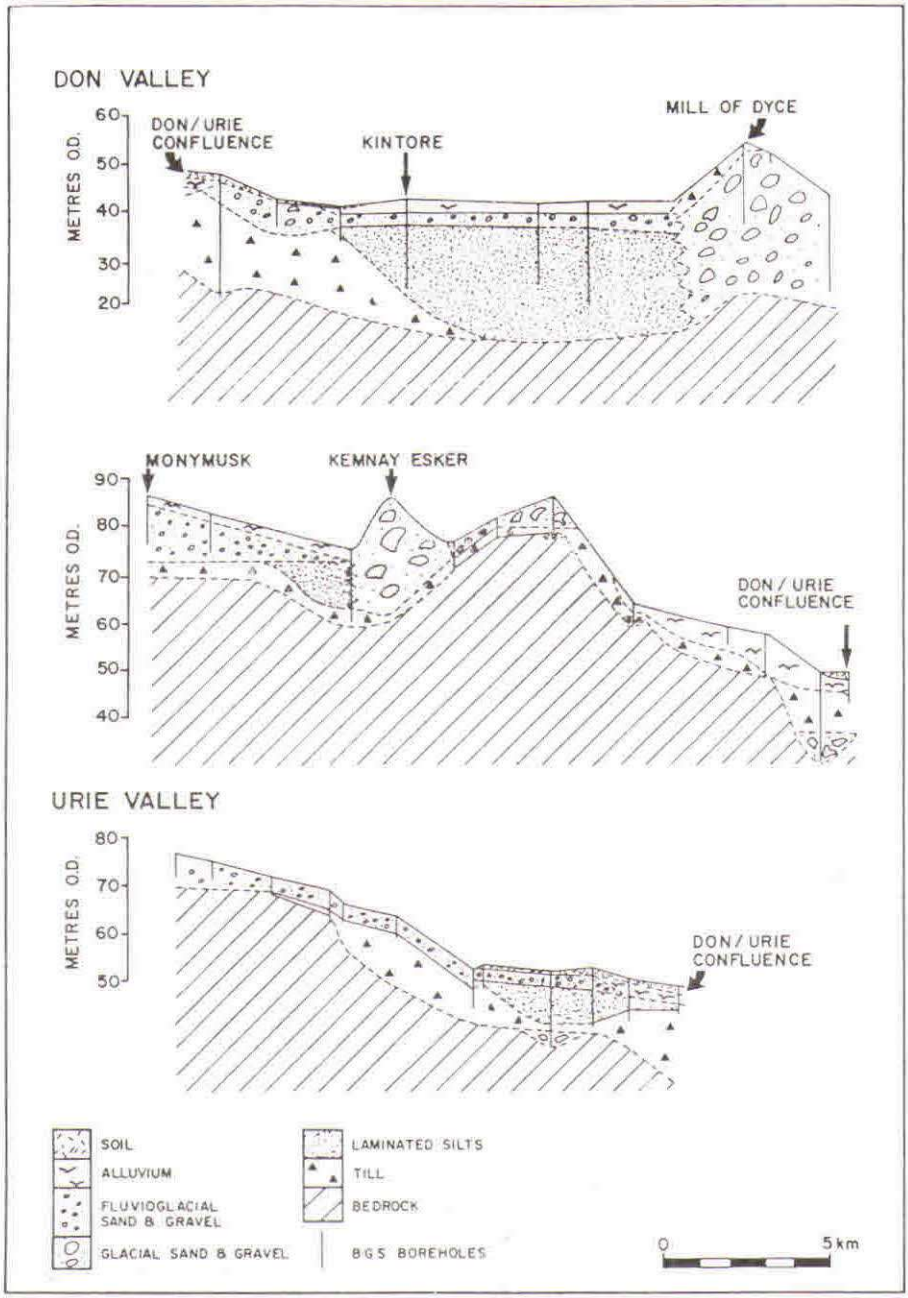

Fig. 2 Fence diagram of the Don valley from Monymusk to Dyce and the lower Urie valley based on BGS boreholes.

The sedimentary sequence in Glen Nochty

Glen Nochty is a north-south orientated tributary valley which meets the main valley at Strathdon (Fig. 1). A deeply incised (c.20 m) mound, called Elrick Hill, occupies the lower reaches of Glen Nochty within 2.5 km of the confluence with the River Don. Transverse ridges run obliquely across the hill to the south, three on the western side and two on the eastern side. Elrick Hill terminates upstream in an abrupt scarp face north of which the glen contains at least one discontinuous low terrace.

Bremner (1921) described sections in Elrick Hill, although he was unable to examine them closely. He noted that the bedding is practically horizontal and that the whole feature is composed of predominantly fine sandy "loam" but with gravel beds, none of which contain boulders. However, he did note that a sheet of coarse gravel extends from the Don and underlies the finer deposits. Bremner suggested that the feature originated as a result of a pause in the retreat of the Nochty and Don ice masses such that debris was washed into a water-filled space between them. Bremner does not explain the formation of the transverse ridges, but simply states that thaw water from snow melt on the slopes of the valley cut into the deposit to form the transverse ridges. "The Nochty barrier is thus partly morainic, partly lacustrine, but wholly glacial in origin" (Bremner, 1921; p.66). Hutchinson (1930) agrees with this explanation for its origin.

There are presently four 15–20 m high exposures within Elrick Hill, three of which are described in this paper (Fig. 3). A brief description of the sediments and their interpretation is given as a basis for testing Bremner's (1921) interpretation and for developing a model of ice dammed lakes in the Don valley system.

The lithofacies scheme used is that of Martin (1981). Nine lithofacies have been identified, comprising six fine- and three coarse-grained sediment types. Their distribution within the sections is shown in Fig. 3. The most abundant lithofacies is laminated sand (Sl), with individual units up to 2 m thick. The sands are predominantly normally graded and occasionally contain small, isolated clasts with downwarped laminae beneath them. The second most frequent lithofacies group, laminated "mud" (Ml), is characterised by interlaminated clay and silt couplets and fining-upward laminated silts, containing numerous isolated clasts and pockets of gravel and clay with disturbance of underlying laminae. Load/dewatering structures are present in the Sl and Ml facies in section II (Fig. 3). Massive sand units (Sm) occur at intervals and are composed of structureless medium and coarse sands. Subordinate units of ripple cross-laminated sands and silts (Sr, Scr and Mdr) and planar cross-bedded sands (Sp) indicate northward (upstream) flow. Section I, lying farthest downstream (Fig. 3), is capped by possible aeolian sand (Sm(e?)). These fines make up c.84% of the total sequence.

The most common coarse facies, making up c.12% of the sections, is horizontally stratified gravel/sand (GSh) composed of fine to medium gravel, interdigitating and interstratified with parallel laminated sands. Massive gravels with a sandy matrix (Gm) occur infrequently. In section I (Fig. 3) massive gravel occurs as a basal unit at least 8 m thick. This basal gravel probably represents Bremner's (1921) spread of "coarse gravel". Where fabric can be discerned, imbrication indicates flow northwards. A few beds of sandy, matrix-rich sub-angular to sub-rounded medium-coarse gravels (Gr) occur sporadically, most frequently in the upstream section III (Fig. 3). There is no discernible pattern to the nature of the boundaries separating different lithofacies from each other.

Interpretation

Both the laminated sand and the silt/clay facies are interpreted as being deposited from suspension in standing water. Silt/clay and sand/silt couplets are commonly deposited by lacustrine turbidity currents (Gustavson, 1975; Sturm and Matter, 1978; Lambert and Hsu, 1979; Benn, 1989). The heterogeneity of these facies suggests that sediment supply may have fluctuated and that the action of discontinuous turbidity currents may have been important (Martin, 1981). The rippled facies confirm the presence of flow within the lake. Isolated clasts and "pockets" of gravel and clay with downwarped underlying laminae were probably dumped from floating ice (cf. Thomas and Connell, 1985). Dewatering structures imply relatively rapid rates of sedimentation to cause loading and the forcing of water from recently buried sediments.

There are a number of possible methods by which the coarse material could have entered the lake. Matrix-supported or matrix-rich (Mr) deposits could be the result of debris flows either from poorly vegetated, till mantled slopes or from an ice mass as a flow till. However, there are no matrix-supported

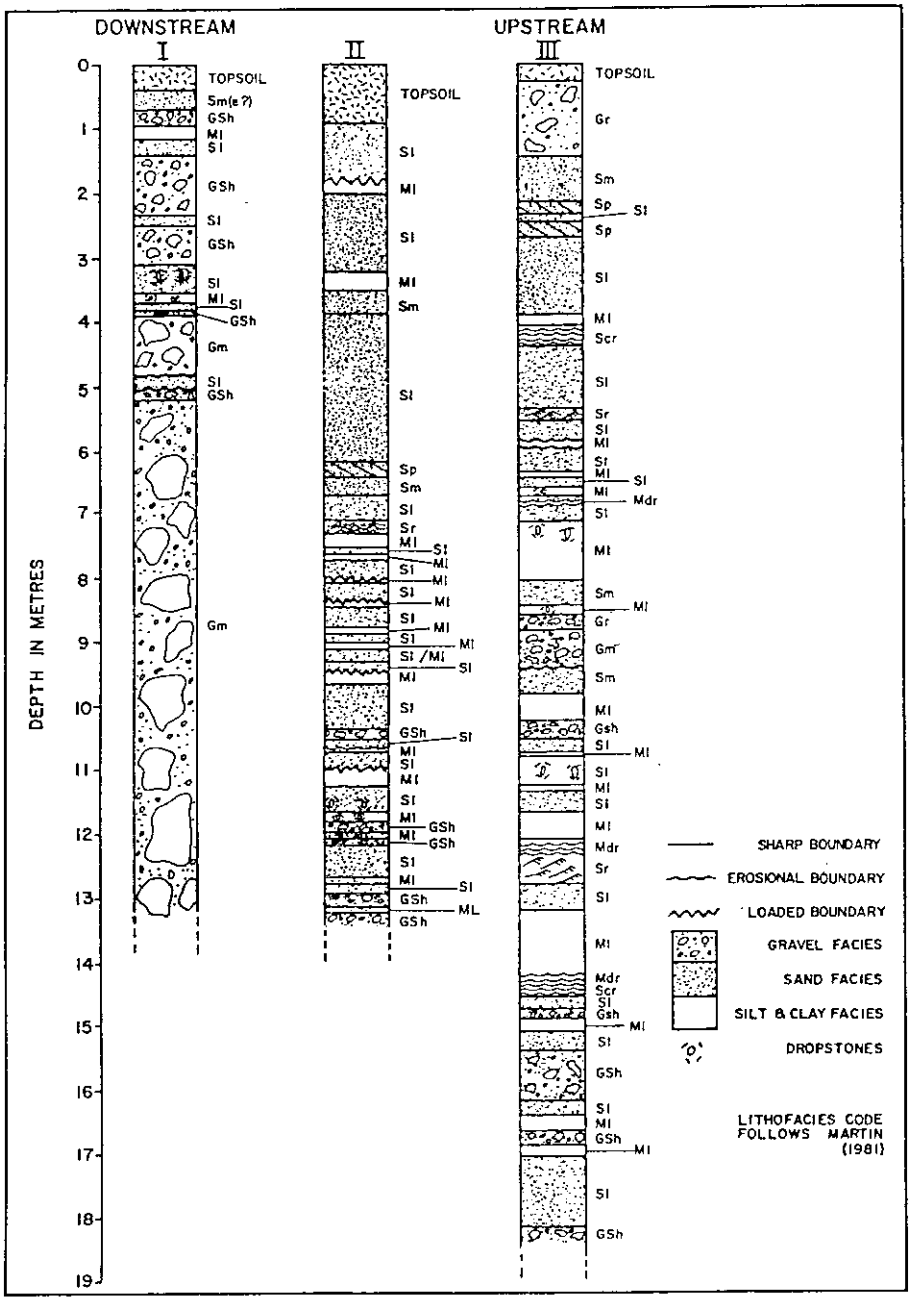

Fig. 3. Generalised stratigraphic logs of the Glen Nochty exposures.

sediments within the exposures and it is possible that the coarse material may have been deposited by sub- or englacial streams entering the lake from tunnels (cf. Thomas, 1984), since such a deposit could be virtually structureless if deposition were rapid and episodic. A final possibility is that the coarse fraction was deposited subaerially as thin outwash deposits on the lake floor after periodic drainage. Sudden drainage of ice dammed lakes has been previously suggested in NE Scotland (Hall, 1984; Maizels and Aitken, in press). The massive basal gravel unit in section I (downstream) (Fig. 3) is not typical of deltaic deposits either in sedimentology or structure (cf. Gustavson et al., 1975). If it is contemporaneous with the lacustrine deposits, rather than pre-dating the lake, then it will have been deposited by one or a combination of the above processes.

The main flow indicators, ripples and imbrication, reveal flow in an northerly direction within all three exposures. Such flows would tend to confirm the position of an ice dam to the south, that is in the Don valley. This suggests that there may have been a period when the Nochty was largely ice free but with ice in the Don valley ponding water in Glen Nochty. In the Don valley at Strathdon, extensive kame and kettle topography is indicative of deposition in association with stagnant ice. The dam may therefore have been of stagnant ice although stagnation could have occurred after ponding. The abruptness with which Elrick Hill terminates upstream and the steepness of the scarp slope (i.e. an ice contact slope), as well as the concentration of coarse facies in section III (Fig. 3), would tend to suggest that there may have been ice upstream of the lake (cf. Bremner, 1921). The transverse ridges on top of the feature may be the remnants of the original lake floor channelised and incised by receding lake waters during drainage. Incision of lake floor sediments during sudden drainage has been observed in Greenland (Russell et al., in press).

At some point during Devensian deglaciation a lake was therefore ponded in the lower part of Glen Nochty (cf. Bremner, 1921). Sedimentation into this lake was rapid and dominated by discontinuous turbidity currents. Floating ice carried coarse sediment in the form of dropstones to the most distal part of the lake (section II, Fig. 3).

Discussion and conclusions

The former existence of a series of lakes (Fig. 4) in the Don valley and its tributaries is indicated by the boreholes which reveal laminated silts and sands containing dropstones overlain by coarsening-upward sand and gravel of possible deltaic origin; the thick units of fine deposits revealed by the resistivity soundings; and the sedimentology of deposits in Glen Nochty. However, it is necessary to determine what might have acted as a dam to cause ponding.

The Ythan and Ugie valleys to the north and the Dee valley to the south do not exhibit such a series of lakes associated with deglaciation. It is probable that topographic controls were at least partly responsible for the ponding of water in the Don. The gorges separating the basins that typify the Don valley could impede flow particularly when large quantities of water are involved, such as during deglaciation. If these gorges also impeded the retreat of ice and/or if they were infilled by sediment, then ponding would be promoted. There is some evidence to support this hypothesis. The lacustrine sediments near Dyce, Kemnay and Alford all lie upstream of gorges which at their downstream ends are typified by hummocky ice contact deposits (Fig. 4). Similarly, the lacustrine deposits in the vicinity of Kildrummy lie upstream of a possible moraine that may have originally blocked the valley (Fig. 4).

There are, however, two exceptions to this pattern: the lake in the Urie valley and the lake at the coast. The lake in the Urie valley could easily have been dammed by ice in the Don valley if the Urie valley was ice free before the Don. Such a hypothesis has already been proposed for the Glen Nochty lake which has been shown to be ice dammed. The lacustrine sedimentary sequence at the coast contains more clay and individual sediment units are generally much thicker than those of the inland deposits. These deposits are probably glaciolacustrine in origin (Thomas 1984; Thomas and Connell, 1985). Perhaps this coastal lake has more in common with the glaciolacustrine deposits at the mouths of the Ythan and Ugie valleys which were dammed by Strathmore ice (Hall, 1984; Connell and Hall, 1987).

It is, therefore, possible to propose a three stage model of ponding in the Don valley. The earliest period may have occurred soon after inland ice had retreated to an unknown position in the west whilst Strathmore ice occupied the coastal zone, damming a large lake at the coast. Pene-contemporaneously,

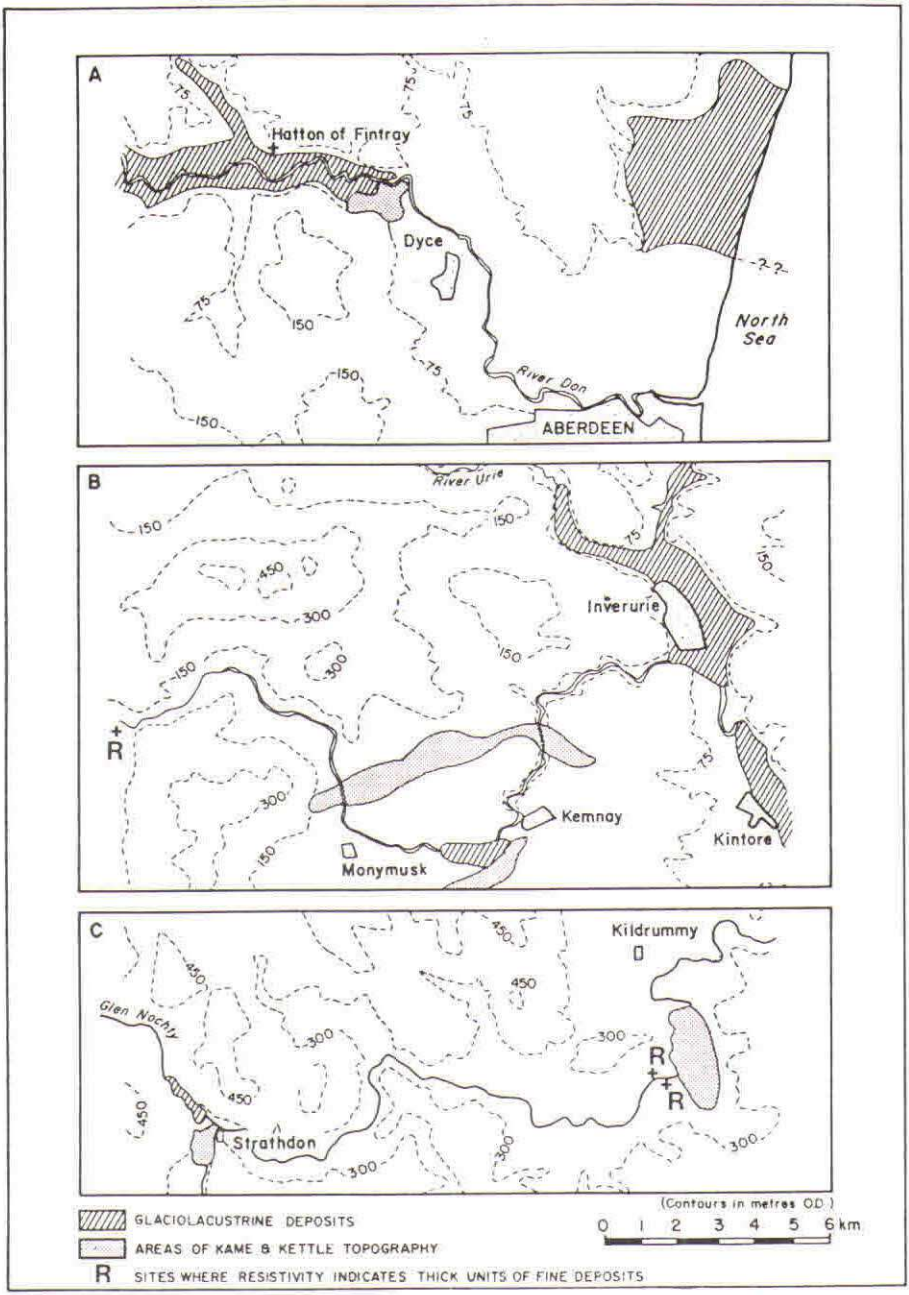

Fig. 4 Distribution of lacustrine deposits and ice stagnation indicators within the Don basin.

during the second stage, lakes may have been dammed in the tributary valleys of the Urie and Nochty by retreating ice in the main valley. Subsequently, once deglaciation was more or less complete, water was ponded behind glacial debris, possibly ice cored.

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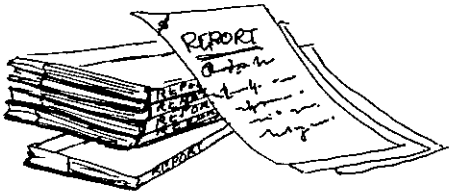

REPORT ON THE ANNUAL MEETING OF IGCP 274 ("COASTAL EVOLUTION IN THE QUATERNARY"), UK WORKING GROUP, HELD AT THE UNIVERSITY OF DURHAM, 12–15 SEPTEMBER 1989

This was the first annual meeting of the Working Group and comprised two days in the field and a day's symposium. The aim of the field meeting was to present work undertaken by research students and research staff of the Geography Department at Durham University, which illustrated a range of aspects of coastal evolution in Northumberland and Cumbria.

The first day of the field meeting took in sites along the coast of Northumberland. Armed with field guides, the participants were shown the Holocene stratigraphic sequence at Elwick, consisting of an interbedded peat between silty-clay and sand, and which fronted an "old cliff line". The site is considered to represent a raised beach, and comparisons with similar features in the Forth Valley were discussed.

The similar sedimentary sequences at Alnmouth and Warkworth were then discussed, a core from the latter site having been taken to illustrate the intercalated peats and clayey-silts, diagnostic of the more landward facies within the Coquet estuary. Discussion centred on the possible provenance of a basal lense of sand (storm surge? tsunami?), and the likely age of the sequence. The results of radiocarbon dating are awaited which allowed for considerable, but confident, speculation. The dating of the overlaps is of considerable interest since the site may be intermediate with respect to crustal movements, between the "subsiding south" and the "uplifting north".

At the mouth of the Coquet lies the town of Amble and Warkworth Harbour, flanked by a sand dune complex. Both the Rivers Aln and Coquet have experienced marked changes to their course during historical times, probably due to storm events, consisting of both sea-level (tidal) surges and increased river discharge. Impacts of future sea-level rise on such communities were discussed, in particular, the cycling of sediment, by both natural and artificial means, and the possible consequences of this for dune systems.

The final visit of the day was to Low Hauxley, to an exposure of peat, overlain by dune sand, within a low cliff section. Debate centred on the possible causes of peat layers within dune sand, and whether it was wise to make inferences about sea-level tendencies from such sequences. The consensus view was one of caution, since such sequences can be formed under a variety of sea-level scenarios, and may simply indicate the position of a topographic low point. A proposed sequence of development for this site can be found in Frank (1982).

The second of the two field days dealt with sites bordering Morecambe Bay. Kirkhead Cavern is a cave cut in Carboniferous Limestone, the floor of which lies at an altitude of c. + 34 m OD. It is believed to be a sea-cave which makes the age of the feature problematic. The floor of the cave is now covered for protection, but has been excavated in the past down to a layer of rounded pebbles and cobbles, ascribed by Ashmead (1974) to be older than 28 000 BP. The marine origin of the cave has been challenged (Gale, 1981), but intriguingly, the floor of the cave is at an almost identical altitude to near-by Edgar's Arch, on Humphrey Head which resembles closely a sea-cave with blowhole.

The final site, Skelwith Pool, contains extensive sequences of biogenic and minerogenic beds, from which eight periods of transgressive and regressive overlap have been identified.

Between the two field days was a one-day seminar meeting, at which four papers were presented, with subsequent discussion. Julian Orford's paper on "Coastal processes, geomorphology and sea-level change" stressed the need to understand gravel beach processes when reconstructing palaeoenvironmental changes from sediments and deposits associated with gravel coasts. In a joint presentation, Ian Bailiff and Romola Parish discussed the potential of luminescence dating, which was followed by a visit to the Luminescence Laboratory at Durham. Callum Firth presented an appraisal of the "Forth

Model" of raised and buried beaches, and its applicability to other areas. Finally, Andy Plater's paper on "The identification of low frequency, extreme water level events during the Quaternary" summarised the methods used to identify such events from the stratigraphic record, with the need to distinguish between storm surge and tsunami deposits being stressed in the subsequent discussion.

The AGM of the Working Group was held during the meeting, which included confirmation of next year's meeting to be held on the south coast between 21–24 September.

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REPORT OF THE WORKSHOP FOR THE CREATION OF A EUROPEAN IGBP POLLEN DATABASE

Frostavallen/Lund, Sweden

24–27 August 1989

Establishment of a Database

Participants of the workshop included representatives of 20 European nations (list attached). Numerous other colleagues, who were unable to attend on these dates, had written supporting the development of the database. All participants agreed upon the importance and urgency of the database enterprise, in particular because of the current planning for research related to global environmental changes. The database should play a critical role in many research projects, ranging from palaeoclimatology to human impacts in Europe. This archive for data is intended to be the IGBP Pollen Database for Europe and to be used for palaeoclimatological and palaeoecological studies.

I *Why should the database be established?*

During the next few years, many nations' palaeoclimate research initiatives will be seeking to understand climate changes and biotic responses at various temporal and spatial scales. The accumulated body of palynological data from the past thirty years in Europe will play a key role in these analyses. As a permanent archive for data generated over the years in European Quaternary palynology, the database will be a resource for a wide variety of applications, some of which are even impossible to foresee at this time.

Several specific reasons for a European database were identified, including the following:

1 its central role in palaeoclimatic reconstructions dealing with continental-scale and eventually hemispheric-scale processes;

2 an urgent need for synoptic palaeoecological analyses that take into account the complexity of Europe with respect to topography, geology, biogeography, ecology, human history and climate;

3 a large number of palynological sites already studied with high temporal and taxonomic resolution;

4 the opportunity to use modern computer-based techniques in studies of prehistoric and historic human impacts on the landscapes — a major source of information about environmental history;

5 increasing attempts to answer a broad range of scientific questions that require comparisons among sites and among regions; and

6 contributing toward the long-term goal of forming a global database for late-Quaternary pollen data.

II *What should the database contain?*

Initially, the database will be for Quaternary pollen data from Europe as far east as the Ural Mountains, all regions surrounding the Mediterranean, and the North Atlantic islands including The Faroe Islands, Svalbard, Iceland, and Greenland. (It is intended that the database design will enable the possibility of extending the database farther east as more data become available.) Priority initially will be given to late-glacial and Holocene data, but older records, especially those that are long and continuous, will also be included.

The database will include primarily all data generated since 1960, after which radiometric chronologies and modern pollen taxonomy have been standard. However, selected data of particular value from earlier work may also be included, especially where possibilities exist for reliable dating by regional correlation.

In addition to complete pollen counts, which will form the core of the compilation, information for each site should also include radiocarbon dates and other chronologic data, site descriptions (location, elevation, size, type of deposit, sediment type, etc.), a listing of other data available for that site (e.g. macrofossils, diatoms, palaeomagnetism, charcoal), bibliographic references to any relevant published work, and the names and addresses of the pollen analyst and authors of primary publications. (Beeane *this list is incomplete*; the formulation of a complete list will be a first priority for the database organisers, in consultation with the Advisory Board—see later—and in due course standard forms or computer software with specific information will be distributed.)

Included in the database would be information from lake sediments, mires, and stratigraphic profiles of soils (e.g. moor humus). A special and important subset should consist of surface samples and the associated data required for climatic and other environmental calibrations. Not included in the database would be isolated pollen samples from buried soils, archaeological materials, cave sediments, and the like.

The completed database would be an important archival resource of two kinds: (1) a directory of sites and the information about them and (2) the data themselves.

III *Data accessibility*

Accessibility to the data stored in the database should be restricted as little as possible, and it is agreed that participation in the database as a contributor would automatically entitle a researcher to receive the compiled database at little or no cost. A protocol for acceptable use of data in the database will be prepared by the organisers, in consultation with the Advisory Board, and will be distributed to all users.

IV *Computer hardware/software and data transfer*

The database will be developed (at least initially) for IBM-compatible microcomputers. Data transfer has two aspects — transfer to the database and transfer from the database. Transfer of data to the

database would ideally be on magnetic media (e.g. diskettes, magnetic tape). However, many potential contributors of data may have neither the time nor the desire to keypunch existing data themselves, although they would be willing to transfer the data on paper. It is highly desirable that most new data be transferred on magnetic media. To encourage this development, user-friendly software for data entry and analysis will be distributed to all pollen labs requesting it. Transfer of data from the database would be on magnetic media, either in ASCII files (the code used by the majority of computer systems) or with software that could produce ASCII files from a more condensed format. In most cases this would mean using discs of the type standard for IBM-compatible personal computers. At least one research group in every country ought to have access to an IBM-PC compatible microcomputer in order to facilitate access to the database. One urgent goal of the database enterprise is to assist with acquisition and use of PC facilities throughout Europe.

Several kinds of portable software have been and are being developed for data entry, analysis and display. Spreadsheet programs of the sort demonstrated at the workshop will be distributed in the very near future for data entry and manipulation. Development of associated programs for database interrogation must be a high priority for the early stages of the database. Longer-term goals are programs for stratigraphic diagrams, synoptic maps and the like. These programs should be user-friendly with menu-driven interfaces.

An important goal associated with the database enterprise is enhancement of computer-related and data-analytic capabilities within the European community of Quaternary palaeoecologists. This will involve initiatives such as educational workshops designed to teach computer-based techniques and efforts to assist in the distribution of computer hardware and software to those laboratories that thus far have been unable to acquire such equipment.

V *Coordination and location of the database*

The workshop participants agreed that the database must be established in one place with appropriate persons responsible for its overall operations. These persons should be familiar with both computing and palynology. The amount of work involved will require that the coordinator have technical assistance in the form of an experienced computer programmer and a person to handle data entry and retrieval. To some extent the programming demands may be reduced by collaborating with other database coordinators (e.g. for the extended COHMAP database in North America) so as to share the task of developing specialised software. Such collaboration would also ensure compatibility between databases, facilitating the later development of a global database.

Participants at the meeting as well as other colleagues emphasised the importance of confidence and scientific/technical capability for the staff actually handling the database. The group nominated an Executive Committee of three persons, chosen especially for their wide expertise in both palynology and fund raising, and an Advisory Board of 10 persons. An important function of the Executive Committee, on behalf of all contributors and users of the database, is to ensure the quality of the staff and the operation.

Several institutional possibilities for coordination were discussed including Marseille (France), Lund (Sweden), Bern (Switzerland), and Durham (England). The workshop participants were greatly impressed with the strength of the proposal from the Marseille group (headed by Professor A Pons), and strongly endorsed that alternative.

VI *Organisational Structure of the Database*

The following nominations were made; the organisers of the workshop have written to the proposed members who were not present, inviting them to serve as indicated. In the meantime, the following lists must be considered provisional.

Coordinating Institution
University of Marseille

Executive Committee
A Pons (France)
W Watts (Ireland)
B Ammann (Switzerland)*

Advisory Board
K-E Behre (West Germany)*
B E Berglund (Sweden)
H J B Birks (Norway)*
E Bozilova (Bulgaria)
M Follieri (Italy)*
G L Jacobson Jr. (USA)
C R Janseen (Netherlands)*
M Kabailiene (Lithuanian SSR)
M Ralska-Jasiewiczowa (Poland)
J Ritchie (Canada)*

* proposed members not present at the workshop.

Regional and National Centers can play an important and useful role in areas where they already exist and have begun to compile databases for the region. It is suggested that the Advisory Board function as an intermediary in cases where it is impractical for the central database coordinator to deal with regional problems of taxonomy and related technical issues.

VII *Schedule of development and funding of the database*

The database is considered to be established as of this date with the concurrence of the workshop participants. Funding is critically needed before activities associated with the database (presumed to be at Marseille) begin. The acquisition of funds is therefore of immediate concern and is to be addressed during the coming few months by the Executive Committee, which is given the responsibility of coordinating requests for funds required to support the establishment of the data centre and its related activities. With the availability of financial support, the initiative can proceed immediately. The funding outlook is optimistic, with possible sources including the European Community, the European Council, and several national research councils. Strong agreement exists that financial support for the establishment and operation of this international database, as well as associated activities (e.g. workshops focused on topics such as computer use and data analysis), should be provided from multiple sources.

Given the technical challenges involved in obtaining funding and organising appropriate physical facilities and personnel, the database will not be completely functional for some time. Nevertheless, certain highly desirable elements of the whole will be available quite soon, in some cases immediately. Some regional centres of research have already compiled palynology databases, which will form a nucleus from which the comprehensive database can expand.

Respectfully submitted,

George L Jacobson Jr. and Björn E Berglund
Lund, Sweden

31 August 1989

LATE GLACIAL IN NORTHWEST EUROPE: THE 1989 OXFORD CONFERENCE

Derek A Roe

Introduction

An international conference was held in Oxford from 19–22 September 1989, to consider recent research relevant to all aspects of the Northwest European Late Glacial period. Some 24 speakers took part over the four days, and the conference was attended by about 80 people, giving excellent representation both geographically over the study area (with a few from beyond) and also as regards their particular interests within Quaternary Research. The meeting was organised by Dr Nicholas Barton and Dr Derek Roe, in conjunction with the Department for External Studies of Oxford University, and enjoyed the excellent facilities at Rewley House, the External Studies Department's headquarters. The organisers gratefully acknowledge financial assistance from the Wenner-Gren Foundation for Anthropological Research Inc (Grant No. 48) and the British Academy.

The conference had the subtitle 'Human adaptations and environmental change at the end of the Ice Age'. There can be no doubt that to tackle such a theme properly does indeed require the participation of archaeologists, physical anthropologists, geologists of several kinds, palynologists, palaeobotanists, and palaeontologists with expertise in large vertebrates, small mammals, insects and molluscs. Between them, they can cope with most of the evidence gathered in the field, but the list does not end there, since physicists are needed to produce chronometric dates and the contribution of ethnologists who have studied modern or recent hunter-gatherers may be of immense importance, when it comes to interpreting the archaeological evidence, the sites and artefacts, in terms of actual human behaviour. The presence of specialists in all the right fields made the Oxford meeting a most productive one, and showed once again that there really is a greater entity, Quaternary Research, which can transcend the disciplines and sub-disciplines that have combined to create it.

Geology, environment, fauna

In his provocative and colourful opening address, Russell Coope (Birmingham University) referred to the growing body of evidence that fauna and flora had not always remained in equilibrium with environmental and climatic change in Northwest Europe during the oscillations of the Late Glacial period. He had found some twenty years ago that, on the evidence of beetle remains, there was a sudden rapid warming within the later part of Zone I, while the interstadial Zone II, Allerød on the Continent and Windermere in Britain, was substantially cooler, whatever the tree pollen diagrams might suggest to the contrary. Open landscapes with really warm temperatures were perfectly possible. Now, other lines of evidence, including the surprisingly late survival of mammoth in Britain, are tending in the same direction: mammoths would have needed a highly productive environment, not a subarctic tundra, to sustain life in the period 13 000 to 12 000 years ago. Are the Zone Ib (Bølling) and Zone II (Allerød) stages really a single 'Bøllerød' interstadial, with no Older Dryas cold snap in Zone Ic to separate them? The record indicates amazingly quick warming of the climate c.12 800 years ago, followed by slow cooling until about 11 000. Shifts in the position of the Gulf Stream would be an important controlling factor in the British Late Glacial climatic sequence; sudden warming or cooling of Atlantic waters to the west could account for the extreme rapidity of some of the changes. Within Northwest Europe, accordingly, Late Glacial sequences are likely to prove of strictly local validity: factors that were of major importance to Britain might have little or no effect on even the westernmost parts of Continental Euorpe.

During the first full day of the conference, support of pleasingly varied kinds came from several speakers for many of the points made by Coope. In some regions, though not all, a single 'Bøllerød' Interstadial could be recognized in place of the classic 'warm-cold-warm' sequence. Richard Preece (Cambridge University) reported on the work at Holywell Combe near Folkestone (Kent), where a valley containing important sediments is being destroyed by work for the Channel Tunnel. Here, good evidence from land mollusca can be added to the beetle and plant information, and there is an almost continuous record over the past 13 000 years, close to the British end of the land-bridge connection to Europe. Here in southern Lowland Britain, two distinct climatic ameliorations do seem to occur within

the Late Glacial. On the other hand, in her review of the palaeoenvironmental succession in Northwest Europe, especially Denmark, Else Kolstrup (Sønderborg) saw no serious climatic setback during the Late Glacial period, other than the sharply cold Zone III. She used pollen evidence and the study of sediments and periglacial features: for example, coversand deposition, interrupted by periods of soil formation, had yielded useful information. The period between Bølling and Allerød was perhaps merely more continental in climate; possibly persistent drought had reduced plant growth, but temperatures had not declined greatly.

Tim Atkinson (University of East Anglia) showed how numerical estimates for 'warmest month' and 'coldest month' temperatures during the Late Glacial period can be derived from several lines of evidence for the Late Glacial period, notably the insect remains. Present day beetle distributions have been superimposed on detailed climatic and environmental maps, on the basis of data supplied by climate stations all over the Old World. As a result, for a Late Glacial assemblage containing several species, the 'mutual range' overlap can be known and a remarkably accurate estimate of prevailing conditions can be reached. Modern observation of glacier behaviour has shown glaciers also to be sensitive indicators of climatic change, and in Britain past positions of corrie glaciers and the 'equilibrium lines' between their accumulation and ablation zones can often be mapped. Knowledge of the Late Glacial climatic sequence in Northwest Europe is benefitting greatly from these fresh approaches.

John Evans (University College, Cardiff) contrasted the 'remote' and 'intimate' approaches to environmental archaeology, and then discussed the nature and information potential of molluscan assemblages. The best results come from autochthonous assemblages from buried soils or land surfaces, but even these give a highly localised picture, precise only for the actual find spot. He used the important Late Glacial sequence from Pitstone, which incorporates a buried land surface with interesting traces of burning, as a case study.

Bernd Becker (University of Hohenheim) caused something of a sensation with his account of dendrochronological work and radiocarbon calibration, based on the large and prolific sub-fossil oak and pine trunks incorporated in Late Glacial fluviatile deposits in south-central Europe. A continuous radiocarbon record based on oaks goes back to more than 9000 years BP, with a patchy record, based on pines, extending further back, towards the start of the Bølling Interstadial, though the pine trunks often show severe damage at some stages, caused by frost and ice. The bad news (though well worth knowing) is that substantial 'plateaux' occur in the radiocarbon dating curve—periods when readings do not change while several centuries pass. There is one such plateau of at least 250 years, starting c.10 000 years ago, and another of some 500 years starting around 9650 years ago. That being so, one can see that a number of dates long cherished by archaeologists may well come under suspicion—and there we were, happily thinking that all that calibration stuff was strictly for the Neolithic.

Problems with radiocarbon dating were also mentioned by Richard Tipping (Edinburgh University), in his study of how the actual record of distinct climatic events in the Late Glacial of Northern Britain matches up to the supposedly 'classic' sequence of the textbooks. Rock flour, highly charged with carbonates, can contaminate radiocarbon samples, giving falsely older readings, and 'hard-water error' can create difficulties in Jurassic limestone areas. He mentioned several other interpretational difficulties, not usually recognised, which can affect our understanding of the ice readvances in Scotland: for example, in some parts of that region, a certain degree of actual ice advance may have coincided with the start of the main climatic amelioration, because an increase in precipitation would have allowed the ice masses to build up at their actual sources. Overall, in Scotland, it seems better at present to abandon the term Older Dryas and to envisage a single Late Glacial Interstadial, sandwiched between 'transitional' stages.

The next few papers turned the audience's attention towards faunal studies. Jean-Marie Cordy (Liège University) discussed faunal assemblages from selected caves and rock-shelters in the Meuse Valley, which are in fact some of the best Upper Palaeolithic sites in Belgium, concentrating particularly on microfauna. Fluctuations in the populations of lemming, and of the tundra and northern voles, enable three distinct cold events, Dryas I, II and III, to be recognised. Allerød, the microfaunal record of which has recently been completed by new finds, shows a major and rapid warming, as does the Late Pre-Boreal, in its turn, after a more gentle start to the Holocene. Large vertebrate remains offer less satisfactory material for study in the Belgian caves than they do at the important Late Glacial open-air hunting sites in northern France and Germany. Andrew Currant (British Museum (Natural History), London), by contrast, discussed mainly the large mammals in his account of recent faunal discoveries in

Britain and the new understanding they have brought to the study of the British Late Glacial. Such animals are clearly able to survive in quite novel environments, and to undergo rapid change, and surprisingly diverse faunal assemblages occur as a result. Sites in the Mendips have recently produced excellent information, notably Gough's Cave and Chelm's Combe. At the former, humans were the main accumulating agents for the faunal remains and butchery marks abound in an assemblage which is clearly of Late Glacial Interstadial age: it includes much horse and red deer and some aurochs, plus one of the rare British occurrences of saiga antelope. Mammoth also survives into this climatic stage. In a good sequence at Chelm's Combe, the fauna of the succeeding stage, Zone III, was well represented, with horse and reindeer dominant. Currant also mentioned the remarkable recent finds of hominid remains and artefacts in a preserved pocket of deposit at Gough's Cave. Adrian Lister (Cambridge University) next described and discussed the evidence for the late survival of mammoth in Britain (for which there are also some parallels in Europe) till later that 12 500 years ago, even if mammoths were much less common then than they had been during the Pleniglacial period. The open but productive conditions of the Late Glacial Interstadial should have well suited creatures that required some 200 kg of food per day. In Britain, the Condover mammoth skeletons had offered the first good evidence for this late survival of mammoth, and confirmation is now available from Robin Hood's Cave, Pin Hole, Gough's Cave and Kents Cavern. The reasons for the subsequent worldwide extinction of mammoth remain obscure, although rather exaggerated views of the human role in it have sometimes been put forward.

Human activities, archaeology, dating

As a curtain-raiser to the second full day of the conference, the exciting Gough's Cave hominid finds were described by Chris Stringer (British Museum (Natural History), London) and Jill Cook (British Museum, London). Over the years, the cave has yielded a very considerable quantity of human remains, cranial and postcranial; some of the material is clearly of Mesolithic age, but there is also a definite and morphologically distinct Late Glacial component. Amongst the recent finds of Late Glacial age, there is considerable evidence of stone tool marks on human bones, including an adult cranium that had been carefully defleshed, and enough other occurrences to make it clear that during this period the careful dismembering of corpses was a regular human activity at the site. The world's press had been predictably delighted to attribute this to cannibalism. Such an explanation is not provable, and not particularly likely, but the real explanation remains obscure, even when ethnographic evidence has been considered.

From cut-marks on human remains to hunting lesions on reindeer bones: Bodil Bratlund (Schloss Gottorp Museum, Schleswig) described her careful study of such evidence in the Ahrensburgian level at Stellmoor, Hamburg. 25 lesions with fragments (often tiny) of flint projectile points had been examined, making possible a fascinating analysis of exactly how the hunting (with bow and arrow) had been carried out—angle to target, range, accuracy and success of each shot, and so forth. The Stellmoor site was evidently planned to ambush reindeer herds moving down a valley, where they had to cross a shallow lake at a bend.

But success in shooting a moving reindeer to obtain meat is only one aspect of hunter-gatherer subsistence strategy, as John Speth (University of Michigan at Ann Arbor) showed next. In dietary terms, too much good lean meat is bad; excess of protein can seriously damage one's health. At least 30% of human calorie intake needs to come from other sources; this is especially crucial in the case of pregnant women and nursing mothers, and is obviously vital to the maintenance, let alone growth, of a population. A proper component of fats and carbohydrate is needed. Accordingly, people who depend on hunting must exercise careful selectivity about the game they hunt, and the seasonally changing condition (fat or lean) of the prey animals, not to mention seeking alternative food sources. All this is highly relevant, when one considers the stressed environments, rapidly changing conditions and unpredictable resources of the Northwest European Late Glacial. *Plus ça change*: was there never a time in all the world, I wonder, when humans could eat whatever they wanted, without being told, even retrospectively, that it was bad for them?

None of that, however, prevented hunters from needing to exploit the Late Glacial reindeer herds, however seasonally and circumspectly, and many speakers were considering from one point of view or another the archaeological evidence left by reindeer hunters. An original and informative approach was that of Bjarne Gronnow (University of Copenhagen), who had studied the excellent ethno-historical

evidence and surviving archaeological traces relating to caribou hunting in West Greenland in the 18th and 19th centuries AD, notably that associated with the dubious career of one Habbakuk, who was not himself so much a hunter-gatherer as an entrepreneurial pseudo-mystic. The whole social and economic system of the West Greenland hunter-gatherers can be followed in detail through its annual cycle, right down to such details as named summer base and activity camps, which were mapped and described by those who saw them in use and survive as identifiable archaeological surface sites today. This study yields a wealth of relevant information for those who seek to understand the Northwest European Late Glacial reindeer hunters in their own environmental setting. Françoise Audouze (CNRS, Paris) has been doing exactly that for several years now in Northern France, studying the superb Late Magdalenian sites of the Paris Basin, of which Pincevent, Verberie, Marsangy and Etiolles are the best known. She showed that there is clearly considerable variety in the ways in which these sites relate to the exploitation of reindeer, from specialised autumn hunting stations to processing and extraction sites. Detailed studies of the lithic assemblages, including microwear work, have helped document the range of human activities, while the variable placing of sites in relation to the river and to the location of flint sources is informative in showing how the whole region was exploited and food sources other than reindeer obtained.

For Stephan Veil (Landesmuseum, Hannover), the detailed study of a flint assemblage was also important: he reported on the open air site of Schweskau in Lower Saxony, discovered in 1986, situated on a peninsula extending into a former lake. In its unusual typological composition, and in details of the technology of blank production (with the distinctive *talon en éperon*), the lithic industry differs from those of both the Hamburgian of northern Germany and the Magdalenian farther south. It may represent an innovatory response by people moving into a new area with unfamiliar resources, during rapidly changing conditions associated with some part of the Bølling—Older Dryas—Allerød succession. Successful human response to the unpredictability of resources, so crucial during the Late Glacial, was considered from a different point of view by Lawrence Keeley (University of Illinois at Chicago). He used data from 99 ethnographically studied hunter-gatherer groups to cast light on their Late Glacial counterparts. One key difference between 'simple' and 'complex' hunter-gatherer societies is the capacity of the latter to operate food storage strategies. This is linked to the degree of sedentism, population density, social organisation and stratification, craft specialisation, elaboration of structures and settlements, and much more. In the archaeological record, some of these features may be actually visible, while others may be able to be deduced, with due care. The Gönnersdorf Late Magdalenian site in West Germany, for example, surely bears the signature of a 'complex' hunter-gatherer society, in these terms.

Rupert Housley (Oxford University) gave an overview of the continuing programme at Oxford of AMS radiocarbon dating of the period considered at the conference. There were now some 300 relevant dates, a substantial increase from the 105 considered in a review article publised in 1986. The laboratory concentrated on obtaining meaningful dates for the presence of humans, or important faunal species, in a given area, by dating actual bones or humanly modified objects, as the new techniques had made possible, rather than trying to get a general reading for a site or a stratigraphic unit. Useful general conclusions were now emerging: for example, that in Britain the earliest Late Glacial human occupation was perhaps as old as 12 800 BP, followed by a large number of slightly younger readings at c.12 400. The British Later Upper Palaeolithic theme was continued by Roger Jacobi (Nottingham University), reporting on some 8 years' work in a long and continuing project designed to examine in detail the archaeology of this period in England, on the basis of the still very incompletely studied extant collections and documentary records, with only minimal and highly selective new fieldwork at this stage. Cooperation with the Oxford AMS radiocarbon laboratory, in the programme just described, had proved extremely fruitful. It was at last becoming possible to define what constituted the 'Creswellian' in Britain, regarded by Dorothy Garrod, with admirable perception, as likely to be an extension of the Continental Magdalenian. Only a few British sites really correspond to Garrod's Creswellian—perhaps they might even represent the wanderings of a single human group over one brief period. Other British Late Glacial material clearly relates to the Continental Tjongerian, and perhaps some to the Ahrensburgian. This study of the range of Late Glacial human populations at the extreme western edge of the Eurasian land-mass will continue for some time yet.

On the final day of the conference, the papers were all concerned with the archaeology of Northwest Europe, including Britain, and the last few speakers crossed the none-too-sharp divide between Pleistocene and Holocene, Late Glacial and Postglacial, Palaeolithic and Mesolithic. First, Anders

Fischer (National Museum, Copenhagen) showed how the virgin landscape of southern Scandinavia, abounding in resources of all kinds, had been populated from the south, where four techno-complexes, Hamburgian, Federmesser, Brommian and Ahrensburgian, acted in that order as sources. Clear continuity links the last three. Moving on to take a single Danish site as a case study, he discribed recent work at Trollesgave, one of the Holmegaard lake margin sites, which was a Brommian base camp in the late Alleröd. Refitting and experimental work had cast good light on the flint industry, in which it was even possible to distinguish the work of one good craftsman and a beginner, perhaps a child under tuition. Typology and technology were so unsophisticated that some might see the lithic assemblage as a low point of Late Palaeolithic achievement. In fact, it was the reverse: sublime simplification, in a situation of abundance without competition. Life at Trollesgave was clearly enviable—though we must hope, remembering Speth's paper, that the inhabitants had good dietary advice available.

Jean-Pierre Fagnart (Direction des Antiquités de Picardie) reported on a very different site, Belloy-sur-Somme in northern France, known since the 19th century but only recently excavated on a large scale to modern standards. Nothing but hard work seems to be represented here: a series of ateliers, where high-quality chalk flint, obtained a few hundred metres away, was systematically worked into large blades, some of them up to 27 cm long. Many refits have helped reveal the technology in detail. There are vast quantities of flaking debris, but virtually no tools; only some 500 *lames et éclats machurés* (blades and flakes with edges bruised by heavy use) were found. They were perhaps employed in robust working of antler or hard wood. The site is associated with a Late Glacial soil horizon, and nearby there is a separate Federmesser occurrence, apparently of closely similar age, but totally different character. Industries from Britain with striking resemblances to Belloy-sur-Somme (including the presence of *lames machurées*) were mentioned by Nicholas Barton (English Heritage, London) in his review of technological continuity and innovation across the Pleistocene–Holocene boundary. Sproughton (Suffolk) and Avington VI (Kennet Valley, Berkshire) are two good examples amongst many now known. Just occasionally, microliths are associated with the characteristic long blades at these sites, but there are also contemporary British industries which more resemble the Ahrensburgian and lack long blades—at Risby Warren (Lincolnshire), for example. Industries of fully Mesolithic aspect do not appear before c.9700 BP, and they include new types of processing tools, even if the hunting equipment is relatively little changed. Perhaps it is mainly the change to a more forested environment that is reflected in the artefact assemblages of the British early Mesolithic.

Martin Street (Römisch-Germanisches Zentralmuseum, Mainz) described a fully Mesolithic site, of middle Pre-Boreal age, at Bedburgh-Königshoven on the River Erft, a Lower Rhine tributary near Cologne. This had been the subject of a recent rescue excavation, which appears to have sampled the site's off-bank disposal area, rather than its main centre, which had previously been destroyed. Finely preserved bones, all of postglacial species, were recovered, giving a clear picture of hunting and butchering, notably of aurochs, red deer and horse, carried out from late spring to late summer. Fish and wildfowl bones were also found, and there is excellent evidence for domestic dog. Flint was obtained from as much as 30 km away, to make an industry not previously seen in the local Mesolithic and earlier than most Mesolithic occurrences in this part of Germany, its nature to some extent recalling the final Palaeolithic. A perforated stag frontlet, somewhat like those of Star Carr and Hohen Viecheln, was an interesting find.

The nature and origin of early Pre-Boreal industries were also considered by André Gob (Liège University), this time with regard to Belgium and the southern margin of the North Sea basin. He advocated a relatively short chronology for the transition phase, and saw the local Beuronian early Mesolithic industries as developing, not gradually from the Federmesser group, as had previously been suggested, but more rapidly from the Ahrensburgian, with continuity provided by an epi-Ahrensburgian phase which was current at the end of Zone III. Ahrensburgian tanged points lost importance as Zonhoven points and microliths of Mesolithic type became dominant. This epi-Ahrensburgian is not found in regions adjacent to Belgium. The whole transition process, and the local variability, may well be linked to the rapid environmental changes of the time and to dispersal and isolation of segments of the population, as the sea level began its postglacial rise in the North Sea basin.

The conference ended with a short account by Paul Mellars (Cambridge University) of a season of excavation, only just concluded, at the famous British Mesolithic site of Star Carr. Work had concentrated on sampling the 'dry land' area behind the reed swamp and lake margin, where it might be possible to locate the main area of the settlement and make a fresh approach to some of the still unanswered

questions about the nature and seasonality of the site. Initial results had been very encouraging: an undisturbed land surface was well preserved under some 30 cm of Boreal peat, with flints and faunal remains in excellent condition. Some wood was also recovered, including what looked like a deliberately split plank. A cubic metre of the deposit had been carefully extracted as a block, and taken back to be minutely 'excavated' in the laboratory.

Conclusion

The foregoing notes on the conference papers merely reflect the impressions received by one particular observer, present throughout, who happened to be an archaeologist, and they pick out only a few of the points made by each speaker. Without exception, the papers contained far more of interest that I have sought to indicate, and the standards of illustration and documentation were impressively high. It is therefore pleasing to be able to report that the contributions will be published as soon as can be achieved. Conference publications come and go, but this volume should be a worthwhile one, by virtue of the wide range of topics and approaches within a single unifying theme, and it will certainly contain plenty of 'hard' information.

One could not fail to be impressed by the way in which research in quite different fields produced consistent and convergent results, whether they cast light on details of the oscillating Late Glacial climatic sequence, or on the date and nature of the human settlement of some particular region of Northwest Europe, or on some hitherto unappreciated factor that offers new perceptions of human adaptive behaviour in the face of environmental stress during this fascinating period of so many dynamic changes. In saying this, I do not have to rely on my own personal impressions, for the discussion sessions were lively and informative, and it is not very difficult to see when a specialist in some particular field or region has perceived unexpected relevance in work done by a colleague operating in quite different territory. That, after all, is why such conferences are held, and why they are worth organising and worth attending.

As for the Late Glacial of Northwest Europe, so many experts are working under this general heading in their own fields and regions that, for many years to come, there will always be a body of new and important information to be shared amongst colleagues in the Quaternary sciences. There can and should be more conferences with this very same title, and at not too long intervals—just as there is a regular and continuing need for international conferences on such major topics as the archaeology of the first human groups, hominid evolution, early food-producing societies, or recent advances in the techniques of chronometric dating. It is not enough in such cases for some editor to commission and publish a series of articles, however well chosen, to be read by those who have the time: an audience of experts and would-be experts must assemble to hear and discuss high-quality presentations by those carrying out the crucial research, for that is how knowledge will advance most rapidly on the basis of cooperation. When the 1989 Oxford conference ended, I myself had no doubt that the Late Glacial Period in Northwest Europe is a major research field of sufficient status to require just such treatment for a long while to come.

Derek A Roe

Announcements & Meetings

CROMER SYMPOSIUM: 2–7 SEPTEMBER 1990

Dr Charles Turner has asked me to remind you all of the 'Cromer Symposium Meeting' which will take place at the University of East Anglia, Norwich, England, between 2–7 September 1990.

Held under the auspices of the INQUA Subcommission on European Quaternary Stratigraphy, the meeting will discuss aspects of the biostratigraphy, lithostratigraphy, chronostratigraphy and correlation of the lower Middle Pleistocene deposits in Europe.

Although details about this symposium have already been widely circulated, anyone still wishing to participate should contact Dr Turner whose address is:

Subdepartment of Quaternary Research
University of Cambridge
The Botany School
Downing Street
Cambridge CV2 3EA
UK

ESTABLISHMENT OF WORKING GROUP ON ARCHAEOLOGICAL SEDIMENTS AND SOILS

Following the 10th Anniversary Conference of the Association of Environmental Archaeologists (AEA), held at the Institute of Archaeology (London), which included a session on "Archaeological Sediments and Soils", it was decided to set-up an informal working group with its organisational base remaining in the AEA.

The aims of the working group are:

1 To promote the study of sediments and soils in archaeological contexts, and the study of sedimentology and stratigraphy more generally as applicable to archaeologically-related paleoenvironmental research.

2 To organise meetings and field venues bringing together workers with a general interest in Geoarchaeology, and in particular generate and foster increased collaboration between researchers in Archaeology and the Earth Sciences, particularly Physical Geography, Quaternary Studies, Geophysics, Sedimentology and Civil Engineering.

3 To raise the profile of stratigraphic and sedimentological research in archaeology in relation to funding research councils (NERC and SERC), Government bodies such as HBMC, County Councils and individual bodies (principally building developers, consultant engineers and aggregate extraction companies) currently funding or sponsoring archaeological research and excavation.

4 To promote an open and informal forum for discussion and training of young researchers, particularly post-graduate students, working on geoarchaeological topics, comparable and complementary to those groupings which already exist in the BGRG and QRA.

5 To liase and foster links between academic institutions and archaeological units in relation to professional training and scientific procedures appropriate to the study of sediments in archaeological contexts.

Interested participants, either from Archaeology, or from cognate disciplines such as Geography, Geology, quaternary Studies and Civil Engineering were encouraged to respond to an initial call for inclusion in the mailing list, sent out in October.

This initial circular went to individuals known to be active in the general area of Geoarchaeology, University Departments of Archaeology in the UK and all UK Archaeological Units. By 24th November over 110 individuals had responded approximately 75% based in the UK, 12% from the USA, 14% from EEC countries other than the UK, and other representatives from Canada, India, Israel, South Africa and Sweden. Given the relatively restricted distribution of the original circular, this was an unexpectedly large and enthusiastic response, and the Working Group is now *de facto* operational.

An initial meeting of the Working Group, coinciding with the "Geoarchaeology — Theory and Practice in European Prehistory" session of the TAG 89 Conference (organised by Mark Macklin, Department of Geography, University of Newcastle), took place at Newcastle on the afternoon of Wednesday 20th December. This meeting considered the organisational arrangements and structure required for the Working Group, within the guideline objectives outlined above and plans for meetings and activities in 1990–91. A report on the outcome of the meeting will appear in the April issue of the AEA Newsletter.

Any individuals wishing to join the Working Group, who missed the circular and/or the TAG meeting, should write to me for further details.

Tony Barham
Department of Human Environment
Institute of Archaeology
University College London
31–34 Gordon Square
LONDON WC1H 0PY
UK

ARCHAEOLOGY UNDER ALLUVIUM
ARCHAEOLOGY AND THE RIVER ENVIRONMENT IN BRITAIN

British Museum, London, 3–5 January 1991

Announcement and call for papers

Dr Stuart Needham and Dr Mark Macklin are jointly convening a conference at the British Museum on the theme of **Archaeology under alluvium: archaeology and the river environment in Britain.** The conference will run from Thursday 3 (pm) to Saturday 5 January 1991 and contributions are welcomed from any archaeologist, geologist, geomorphologist or palaeoecologist working actively in this field. It is intended to address themes such as: origins of alluvial material, causes of alluviation and interactions with human activity, the potential of archaeological data (of any period) and the interpretation of environmental remains. We are interested in innovative approaches and explanations, both the particular and the general. Offers of papers and enquiries should be accompanied by a provisional synopsis and addressed for the attention of Stuart Needham, Department of Prehistoric and Romano-British Antiquities, British Museum, Great Russell Street, London WC1B 3DG, or Mark G Macklin, Department of Geography, University of Newcastle, Newcastle-upon-Tyne NE1 7RU.

Below is the forthcoming programme of The Hutton Club, which incorporates the Scottish regional meeting group of the QRA. As yet, says Ms F S Stewart, the Club has not been approached by the QRA to present any specific lectures (from October onwards) or a combined field trip within Scotland. The Club would clearly welcome any suggestions for future events.

THE HUTTON CLUB

(Quaternary Discussion Group and Scottish QRA Regional Group)

SEMINAR PROGRAMME 1990

February		
16	O Knudsen	Landforms Related to the Retreat of the Vatnaj/kull Ice Cap During the last 100 years
13	C Warren	The Greenland Ice Sheet
20	J Barber	Settlement Changes: Non-Anthropogenic Factors
27	P Bull	Quaternary Clastic Cave Sediments
March		
3*		DATING WORKSHOP (1 DAY MEETING)
6	K Dobbie	Glacially controlled Geotechnical Properties of Sediments
13*		OFFSHORE QUATERNARY RESEARCH FORUM (BGS)
April		
17	M Tooley	Sea-levels: Present, Past and Future
24	D Q Bowen	Amino Acid Geochronology of the Pleistocene of the British Isles
28/29*		TEPHROCHRONOLOGY WORKSHOP (GEOGRAPHY)
May		
1		**AGM**

5.15 for 5.30pm, TUESDAYS, Grant Institute of Geology, Edinburgh

*** Further information will be provided in the future.**
Field excursions will be arranged for the summer, details to follow nearer the time.

The Hutton Club incorporates the Regional Meetings of the QRA.

For further information telephone F Stewart 031 667 1000 extn. 370.

IGCP PROJECT 274 "COASTAL EVOLUTION IN THE QUATERNARY"—UK WORKING GROUP

Annual Meeting, Saturday, 22 September to Monday, 24 September 1990, to the East Sussex and Kent coast.

The meeting will consist of two days of field excursions and a one day symposium, the theme of the meeting being engineering and conservation of the coastal zone.

Provisional programme:

Friday, 21 September	Registration and dinner (6.30–7.30 pm)
Saturday, 22 September	Symposium
Sunday, 23 September	Field excursion to East Sussex
Monday, 24 September	Field excursion to Kent (meeting ends at approximately 5 pm)

The intention of the field excursions is to demonstrate the palaeoenvironmental evolution of the coastline of East Sussex and Kent, and to illustrate the coastal-zone management problems this area is experiencing.

Accommodation has been reserved at Wye College, Ashford, Kent. 30 rooms have been booked. The price of £18.34 per day (£55.02 total) is full board and for single rooms (inclusive of dinner on 21st, but no dinner booked for 24th).

The registration fee covers use of minibus and the cost of the field guide.

BOOKING FORM

IGCP PROJECT 274 "COASTAL EVOLUTION IN THE QUATERNARY"—UK WORKING GROUP

Annual Meeting 22–24 September 1990

Please tick

1 I enclose £5.00 registration fee (non-returnable) ☐

2 Please reserve accommodation (full board) from evening Friday, 21 September to 5 pm Monday, 24 September ☐

Please indicate any special dietary requirements.

Name ..... Signature .....

Address

Date .....

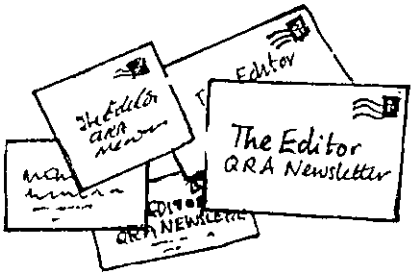
Please send to: Dr Simon Jennings, Department of Geography, The Polytechnic of North London, 383 Holloway Road, London N7 0RN (Tel: 01-607-2789, ext. 2406), before 1 July 1990.

Please make cheques payable to Dr S Jennings IGCP Account.

NCC'S NEW *GEOLOGICAL CONSERVATION REVIEW SERIES*

An arrangement has been agreed with the Nature Conservancy Council whereby their new Geological Conservation Review Series will be available at a discount through the QRA Publications Secretary. The first volume, the 'Quaternary of Wales', is now out. The Publications Secretary will process orders in batches of 16 or more, the first batch being processed two weeks after this Newsletter appears and then monthly thereafter. This enables a discount of approximately 35%, the price for the first volume being £18.00. Look out for future volumes, the next of which will be the 'Quaternary of the Thames', due out this year.

Post Bag



XIII INQUA CONGRESS IN CHINA, 1991

Herewith are the texts of four letters (by Professor E Derbyshire, Zhou Guahgzhao and Nat Rutter) two addressed to me, that refer to the INQUA Congress in China in 1991, together with a record of a meeting of the INQUA Executive (editor)

Dear Editor

I hope you will allow me some space in this Newsletter to express my concern about the potential effect of colleagues' perceptions of the situation in China upon the XIII Congress of the International Union for Quaternary Research (INQUA) to be held in Beijing 2–9 August 1991.

Of course, we have all been appalled and deeply saddened by the events which took place in Tian Anmen Square in Beijing on 4th June 1989. The purpose of this letter is to give my impressions of the situation in China as I experienced it in late September 1989, to express my own view of the situation which, as holder of an EC contract for work in China, is guided by current EC policy, to express to members of the QRA the feelings of our geomorphological colleagues in China, and to extend messages from the President of the Chinese Academy of Sciences and the President of INQUA to the QRA.

I spent the period of 19 September–4 October in China, four days being in Beijing with the remainder in Lanzhou, 1300 km to the west. The situation in Lanzhou is entirely normal and all my colleagues, including the youngest and those most vocal in June, are working normally. A particular friend of mine who is a Professor at Lanzhou University and a member of the Gansu Provincial Government, remains unrepentant about joining the demonstrations in Lanzhou: his work in both University and local government continues without let or hindrance. Beijing is quite different and not surprisingly so, it being the traditional seat of power. When I left, Beijing University was still closed and pedestrians were not allowed in Tian Anmen Square (I tried to cross it but my beard gave me no immunity). Beijing is still tense at its heart, but a few blocks away life continues much as it always has done. If anything, travelling is easier, there being very many fewer tourists.

Prior to my journey to China, I made it quite clear to my hosts that my visit would have to be consistent with current EC policy. In brief this consists of the following: (i) current contracts will be honoured; (ii) there will be no new contracts signed for the present; (iii) there will be no negotiation at the 'institution' level (government or party); but (iv) the EC does not wish to punish Chinese intellectuals (who have suffered enough), and scholarships for Chinese scientists etc. will remain or even be increased, there being a general desire to give every support to individual academics. Following my arrival in Lanzhou, this policy was respected to the letter: there were no banquets or official functions of any kind, and I simply got on with the joint work with my Lanzhou colleagues. My visit was deeply appreciated.

Understandably, the present feelings of our colleagues in China are equivocal. They have entirely lost faith in the government of the day, yet know full well (with characteristic Chinese pragmatism) that, put to the test, guns beat arguments every time. At the same time, they are very anxious that the scientific community in the outside world should not abandon them to another decade or more in the wilderness as happened during the Cultural Revolution, the memories of which still haunt them. They are quietly appealing for moral support of them as individual scientists: in my view, never have they been more in need of such support, for they have been allowed a brief taste of honey only to have had it snatched away in the most violent fashion.

Below is reproduced a letter from the President of the Chinese Academy of Sciences which was delivered to me personally by Professor Liu Tungsheng, President-elect of INQUA and a man known personally to many of us as a scholar of great distinction and a truly gentle man. Also reproduced is a letter from Nat Rutter, and part of the record of a meeting of the INQUA Executive.

May I conclude with a personal appeal to you all as scientists to give the strongest moral support to our Chinese Quaternary colleagues. It will be perfectly possible to avoid official functions, microphones and cameras during the Congress in Beijing if all of us insist on such a policy before arrival, as my recent experience suggests. Our Chinese colleagues, and particularly the young scientists who may never rub shoulders with foreign Quaternary scientists outside the borders of the People's Republic, are looking to us as never before.

Yours sincerely

Professor E Derbyshire

Department of Geography
The University
Leicester LE1 7RH

Dear President i.e. Nat Rutter

I would like to express my sincere thanks for your support in the preparation for the XIII INQUA Congress to be held in Beijing, China, August 2–9 1991. Your support has been and will continue to be very valuable.

Noticing that many colleagues abroad are concerned about the recent situation in China, I think it is appropriate to write you about it. At present, order has been restored in Beijing as well as in other cities in China. Scientific conferences, professional exchanges and tours originally planned are operating on schedule. Our government has repeatedly reiterated that safety of all foreigners in China is guaranteed.

As President of the Chinese Academy of Sciences I would like to reassure you on the following points:

1 China will, as always, adhere to the ICSU principle of free discussion with full participation by scientists from all countries regardless of race, creed or political persuasion.

2 The freedom to participate in this Congress will be particularly ensured for all science students within China who have a special interest or skill in Quaternary science. We particularly wish to use this occasion to encourage free and open exchanges between all scientists who share common interest in the history and welfare of this planet and its inhabitants.

No matter what has happened, I am fully confident of China's goal of realizing the four modernizations and its policy of opening to the outside world. I believe the continuation of scientific exchanges will greatly promote and strengthen the cooperation and friendship between scientists of all countries and benefit all of us.

We look forward to your continued support for the preparation and for the successful convention of the XIII INQUA Congress.

Please accept my best wishes.

Sincerely yours

Zhou Guangzhao
President
Chinese Academy of Sciences

The XIII INQUA Congress in China

The political events of the past months and letters received at INQUA-Secretariat in that matter necessitate a brief statement by the President: INQUA is a non-political Union and would like to ensure for the 1991 Congress in Beijing that:

- Chinese scientists can participate in the Congress
- the Congress itself can take place
- no restrictions be placed on foreign participation
- no financial restrictions be applied in excess to announcement in 1st Circular
- channels of scientific communication be kept open.

Lui Tungsheng confirms commitment by China to host XIIIth Congress and will ask the President of Academia Sinica to issue a letter of confirmation to INQUA-President.

Scientific Congress-activities will be under the main theme of 'Man and Global Change during the Quaternary'. Encouraged are proposals for Symposia/Meetings by INQUA C's, SC's and WG's. Special attention has been given to the organization of sessions: (a) 1st day of Congress with reviews on most important aspects, (b) morning sessions = general, afternoon session = split-up for special Symposia, (c) communications by local scientists may be given during fieldtrips.

The overall programme, including fieldtrips, is welcomed and acknowledged. Organisation follows programme: First circular: April 1989, Second Circular: May 1990.

Finances: Support for Congress sought from IUGS and UNESCO (through INQUA-EXCO), and from CCOP, Third World Academy and Chinese Authorities.

INQUA has agreed to issue 12 scholarships to young scientists for SFr. 1'500.-/each to attend the 1991 Congress (Info see Newsletter).

The INQUA-EXCO extends best wishes for a successful organisation of the XIIIth Congress to the chinese colleagues.

INTERNATIONAL UNION FOR QUATERNARY RESEARCH

Re: XIII INQUA Congress

Thank you for your interest and concern of the recent events in China and their potential affect on the XIII Congress.

At the INQUA Executive meeting on July 18th 1989, in Washington D.C., the Executive unanimously agreed that the Beijing Congress should proceed as scheduled.

This decision was made after careful thought, weighing a number of factors, including assurances by Dr Lui Tungsheng (President of the Organizing Committee and a Vice-President of INQUA) that the Chinese government and Quaternary scientists still welcome and look forward to the Congress. In addition, Dr Lui, in his best judgement, assured us that Chinese students and Quaternarists would not be hindered in participating in the activities of the Congress, that there would be free access for all bonafide scientists and students to China (ICSU regulations) and, that the costs quoted in the latest circular would be adhered to or very close to what was quoted.

Our chinese colleagues are working hard on our behalf. I urge you to attend the Congress.

Sincerely

Nat Rutter
President

Dear Dr Taylor

Esmée Webb's letter suggesting among other things that the QRA should perhaps boycott the next INQUA Congress, that appeared in *Quaternary Newsletter* No. 59 upset me on two accounts—the content, and that the Newsletter printed a 'political' opinion.

INQUA is an affiliate of the IUGS (International Union of Geological Sciences) which is a member of the International Council of Scientific Unions (ICSU). Member societies and countries (of which China is one) adhere to the principles of the ICSU, which among many, include free access of bonafide scientists to their congresses and meetings no matter what their race, nationality or religion. As long as China adheres to these principles, and is in good standing in INQUA, they have the right to hold a congress.

Apart from the rules, I feel that this is no time to abandon our Chinese colleagues. The acts of their government are out of their control. Believe me, they are extremely upset with recent events in their country. However, they are still anxious to have us come. On the contrary, I hope the QRA will encourage its members to attend this important congress in order to benefit from scientific exchange, as well as to strengthen Quaternary science and INQUA.

In any event, it is a personal decision to attend or not, and should be kept at that.

Sincerely

Nat Rutter
President, International Union for Quaternary Research

Dear Dr Taylor

Having just received my copy of *Quaternary Newsletter* 59 (it takes a long time to reach here by sea mail), I was interested to read your editorial concerning a 'News from Overseas' section in the British and Canadian versions of the newsletter. Perhaps you may be interested in taking the idea a little further and including Australasia within the fold? I should be prepared to provide occasional summaries of Quaternary activities here in exchange for similar reviews of British and Canadian reviews for publication in *Quaternary Australasia*.

Please let me know whether you have any success in persuading anyone to review the British field and whether you would be interested in taking up my offer.

I shall look forward to hearing from you.

Yours sincerely

Dr S J Gale
Department of Geography and Planning
The University of New England
Armidale
New South Wales 2351
Australia

QUATERNARY RESEARCH ASSOCIATION

The Quaternary Research Association is an organisation comprising archaeologists, botanists, civil engineers, geographers, geologists, soil scientists, zoologists and others interested in research into the problems of the Quaternary. Most members reside in Great Britain, but membership also extends to most European countries, North America, Africa and Australasia. Current membership stands at c.1000. Membership is open to all interested in the objectives of the Association. The annual subscription for ordinary members is £10.00 and is due on January 1st for each calendar year. Reduced rates apply for student, unwaged and associated members.

The main meetings of the Association are the Annual Field Meeting, usually lasting 3 or 4 days, held in April, and a 1 or 2 day Discussion Meeting held at the beginning of January. Additionally, Short Field Meetings may be held in May or September and occasionally these visit overseas locations. Study Courses on the techniques used in Quaternary work are also occasionally held. The publications of the Association are the *Quaternary Newsletter* issued with the Association's *Circular* in February, June and November, the *Journal of Quaternary Science* published in association with Longmans, and with three issues a year, the Field Guides Series and the Technical Guide Series.

The Association is run by an executive committee elected at an annual general meeting held during the course of the April field meeting. The current officers of the Association are:

President: Professor J Rose, Department of Geography, Royal Holloway and Bedford New College, University of London, Egham Hill, Egham, Surrey TW20 0EX

Vice-President: Professor P Worsley, Postgraduate Research Institute for Sedimentology, University of Reading, Reading RG6 2AB

Secretary: Dr D H Keen, Department of Geography, Coventry Polytechnic, Priory Street, Coventry CV1 5FB

Assistant Secretary (Publications): Dr D R Bridgland, Nature Conservancy Council, Northminster House, Peterborough PE1 1UA

Treasurer: C A Whiteman, Botany School, University of Cambridge, Downing Street, Cambridge CB2 3EA

Editor (*Quaternary Newsletter*): Dr B J Taylor, British Geological Survey, Keyworth, Nottingham NG12 5GG

Editor (*Journal of Quaternary Science*): Dr P L Gibbard, Botany School, University of Cambridge, Downing Street, Cambridge CB2 3EA

All questions regarding membership are dealth with by the Secretary, the Associations publications are sold by the Assistant Secretary (Publications) and all subscription matters are dealt with by the Treasurer.

QUATERNARY
NEWSLETTER

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