

PLEISTOCENE DEPOSITS IN ENGLAND, AND  
THE CONTINENTAL CHRONOLOGY.

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It has been my privilege to work under Prof. Marr at Cambridge, and discuss with him the problems of the relation between Quaternary Man and the Ice Age. His ideas have been ably expressed in the Presidential Address that he gave to the Society. One point, however, it seemed to me was rather passed over lightly, and that is the correlation of the results obtained in England with those found abroad. Dr. Marr suggested in his paper that the time was not yet ripe for such a correlation, and that it was as yet dangerous. Yet the results obtained by Prof. Marr and Mr. Moir are so definite and far-reaching that the writer feels that an attempted correlation is necessary to avoid the danger of a too great insularity of thought. The results obtained abroad may be grouped under two heads ;—

- (1) Those showing positive results
- (2) Those showing negative results

Abroad, and especially in France, not only have there been a number of gifted amateurs engaged in the study of prehistory, but further, owing to the generosity of the Prince of Monaco, there have been a number of distinguished specialists who have been devoting their whole energies to the elucidation of various problems. Many of these have not even been distracted by administrative work, such as comes to those in the position of a Museum Curator, etc.

It seems to the writer that the positive results obtained by these men cannot be lightly treated, and nothing but grave reasons should make us come to opposite conclusions in regard to our own deposits.

In the case of the negative results, the case is different. Here our work may well supplement that of the French. For example, the result of a study of Pliocene man abroad has been negative, while, on the other hand, the results of work in East Anglia at certain places have now appeared to be really positive. Probably most of the foreign "eoliths," as also possibly most of the Early Eolithic finds in Britain, were of natural origin, but the Foxhall finds, etc. (due to the energy of Mr. R. Moir), have supplied positive facts, as to the existence of man in Britain at the end of Pliocene times when the climate was getting colder, just prior to a glaciation.

[The writer would like to add (as a parenthesis) the hope that even if Pliocene man is now proved, the same care will be exercised in the future as in the past in considering whether a specimen is man-made or not.]

Naturally, there are a great many results abroad that are still a matter of dispute; for example, Penck has claimed four glaciations, with warm interglacial times between them, in the Great Ice Age. Boule, on the other hand, claims that there were only three, Penck's first interglacial being denied, it being included with the two first glacials (Gunz and Mindel) under Boule's first (Pliocene) glaciation.

On the other hand, the existence of the two last glaciations is beyond doubt, and the moraines referable to them are clearly seen in the Alps, Pyrenees, and right up in the Baltic areas. Elsewhere, as at Amiens, etc., river terraces are found, these being the remains of gravel sheets deposited when the river was low during the oncoming of glacial times, the following genial climate swelling the river, and thus enabling it to cut its bed down to the level of the next lower terrace. Following the last glaciation there was a recession of the ice, the snow line rising to within 700 metres of its present level to-day. This is known as the Achen Recession. Then followed a return of the ice, the snow level sinking to some 900 metres below its level to-day. This is known as the Bühl period. Even during Achen times the fauna had remained Arctic, consisting of mammoth, reindeer, cave bear, woolly rhinoceros, etc., but now in Bühl times the reindeer spread south as far as Mentone. Following on this the climate slowly and steadily ameliorated, there being merely two moments when, for a time, the snow line ceased rising and remained stationary.

### CHRONOLOGY.

Abroad Magdalenian stations are sometimes found inside the limits of extension of the last glaciation, i.e., they are found on material left by this glaciation when it covered those areas; therefore the Magdalenian period is post-glacial. It was a period of intense cold, when the reindeer abounded, and would seem to correspond to the Bühl period. The slightly less intense cold of Aurignacian times would broadly correspond to the post-glacial stage of Achen. Though the mammoth, etc., roamed over France at this period, in North Spain it was replaced by a short-tusked, not hairy beast, *Elephas Antiquus*. This animal is probably the one depicted in the Cave paintings of N. Spain. The short Solutré period comes, of course, between these.

At the Cave of Cotencher (Neuchâtel) there is a series of stratified deposits; one of these was laid down by the last glaciation, just before its maximum. It contains Mousterian implements. The Cave is inside the limit of the ice of the last glaciation, and

under the final height to which the ice rose. Mousterian man seems to have been living near the ice, as it increased, and his implements were finally "boxed up" in the Cave by the rising ice. Mousterian man here is in association with the last glaciation, and a little before its maximum; Cotencher is being studied by Stehlin of Bâle.

At the Cave of Bouchièta (Ariège) there is a Mousterian deposit resting on material left by the last but one glaciation. Mousterian man is posterior therefore to the last but one glaciation. The fauna is Arctic. The cave was completely filled by the ice of the last but one glaciation, but was not reached by that of the last, the mountain, high up on the side of which the Cave occurs, having been a nunatak. Bouchièta has been studied by Obermaier.

Acheulean implements with a cool fauna are found in a loam that rests on the bottom but one terrace of the Garonne Valley. They are therefore later than the last but one glaciation that laid out the gravels of the bottom but one terrace. No implement has ever been found in the gravels themselves. These results have been demonstrated by Obermaier.

Commont's results at Amiens confirm the above results, the Acheulean occurring in the older loess, while the Chellean is to be found in the gravels of the bottom terrace. Mousterian implements are to be found at the bottom of the younger loess that flows over all the terraces, and is therefore just post-glacial.

A Lower Palæolithic implement has been discovered near Conliège (East France) on deposits left by the Riss glaciation and just beyond the limits reached by the Alpine ice of the last glaciation. Here again, therefore, the Lower Palæolithic is of post Riss Age.

The result of Mr. Moir's work in England has been to demonstrate among other things a glaciation, followed by the Mid-glacial Sands with a warm fauna, and Lower Palæolithic implements; followed by the Chalky Boulder Clay with Mousterian implements (as found by Mr. Moir at Ipswich), indicative of another glaciation, followed by a period when the ice receded north of East Anglia (Aurignacian times); followed by a return of the ice south as far as the North Wales Caves. This return is indicated in the non-glaciated areas of East Anglia, etc., where the ice never reached far enough south to leave its drift, but gravels containing an Arctic flora and fauna, including Reindeer; for example, the Barnwell station gravels and the Ponder's End deposits. Then the climate gradually ameliorated.

Surely this fits in wonderfully with the French classification !

	France.	England.
Post Bühl - Post Magd.	Amelioration after the cold	Amelioration after the cold
Bühl - Magd.	Top of newer loess. Cave deposits	Barnwell station gravel and Ponder's End, etc. Last drift of Welsh coves
Achen - Aurig.	Newer loess. Cave deposits, etc.	Loams just after the C. B. Clay
Würm - Moust.	Moraines of last glaciation. Base of newer loess, etc.	Chalky Boulder Clay
Riss Würm - Lower Pal.	Time when Somme was cutting down to bottom terrace	Derby road and Mid-glacials
Riss - Pre-Chell. times	Last but one glaciation	Cromer Till, etc. Boulders at base of Mid-glacials

The essential thing is to consider the Chalky Boulder Clay as the manifestation of the last glaciation. The Barnwell station and Ponder's End beds being correlated with the cold Bühl times. From their geographical position further north than France they would be even colder than their French equivalents. Note Rindeer bones that are so common in the French Magdalenian of Bühl times are also common in the Barnwell Station gravels, etc.

A succeeding glacier tends to destroy the remains of a previous glaciation. Therefore we should not be surprised to find that the vast expanse of Chalky Boulder Clay remains to us, nothing subsequent, in the way of glaciation, having arrived as far south as East Anglia to disturb it.

As to the existence of a glaciation, or glaciations; previous to the Cromer Till and contorted drift (i.e., to the last but one glaciation), the writer is, for the moment, not concerned. As has been said, the remains of older glaciations are necessarily scanty. Is the contorted drift all of one age ?

It should always be remembered that, England being further north, the mean annual temperature was lower than in France. The glaciations here, therefore, tended to be more intense and longer, while the inter-glacials were shorter and cooler.

The above correlation fits in an extraordinary way, and, at any rate till disproved, forms a useful working hypothesis.