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## EXPLANATION OF PLATE

Phylogenetic tree illustrating the interrelations of the Tetrapods.

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## CORRESPONDENCE

### EAST ANGLIAN DRIFTS

SIR,—Dr. Carruthers' recent letter in the *Geological Magazine* (1948, lxxxv, 367-8) is a stimulating challenge to the orthodox interpretation of the glacial deposits, but his conclusion that the boulder clays of East Anglia were laid down by a single composite ice-sheet does not fit the facts.

In the first place I understand that he considers that uncontorted sands below a boulder clay indicate deposition which accompanies the bottom melt of a stagnant ice-sheet. One place where this interpretation is wrong is at the well-known pit at Chillesford Church, where boulder clay rests on undisturbed Chillesford Beds which are certainly not connected with the bottom melt of any ice-sheet. This and other similar sections prove that it is possible for unconsolidated deposits to remain intact below an ice-sheet.

It is possible that some phenomena, especially within the Cromer Till Series, may exhibit the effects of bottom melt, fallen roof, and other characteristics of melting ice, but there is no reason to enlarge these interpretations into a theory which considers the extremely various boulder clays of East Anglia as overthrust layers in one ice-sheet. Dr. Carruthers admits disturbance of underlying beds by the "Cromer Tills of the Norfolk Coast" and by the "Lowestoft (Chalky-Jurassic) Till around Ipswich", thus confirming some degree of readvance for at least two separate stages in East Anglia, and yet he proceeds to the contrary opinion that the whole East Anglian sequence is monoglacial. That these two tills belong to separate stages is proved by sections at Corton and elsewhere. Incidentally, as Boswell has shown, much of the folding in the Ipswich area was caused by the Gipping ("Upper Chalky") Ice-sheet.

On the glacial evidence alone, therefore, there is no support for the theory that all the boulder clays of Norfolk and Suffolk belong to one glacial episode. The fossil evidence from certain horizons also disproves such an idea. The unique marine fauna of the Corton Beds, as proved long ago by Wood and Harmer, show that these deposits represent a change of facies and climate, as compared with the glacial beds above and below them; and they cannot be explained as an included mass in a single ice-sheet, as they extend over an area of about 1,000 square miles, and in places attain a thickness of 80 feet. As regards Hoxne, Dr. Carruthers questions whether there has been a readvance of the ice in England after the freshwater beds of that site had been laid down. This problem has been debated for many decades, but it

seems to me that the gravel above the temperate deposits at Hoxne can be traced westward into Paterson's "Upper Boulder Clay" in the Breckland (Gipping Glaciation), and this geological evidence is supported by the finding of implements of Hoxne type below that boulder clay at West Stow, Elveden, and other places in the Breckland area.

As to the Hunstanton Boulder Clay, I would add that the old section (now closed down) at the Gasworks Pit at Hunstanton showed most clearly how the March Gravels had been ploughed into and partly incorporated by the overlying Hunstanton Boulder Clay, which is, according to Dr. Carruthers' theory, a proof of readvance. In general, it seems to me that there is abundant proof that the boulder clays of East Anglia were not formed from a single composite ice-sheet.

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#### INDICATION OF GEOLOGICAL SITES

SIR,—Referring to Dr. Rastall's plea for greater accuracy in the use of place names by geologists (*Geol. Mag.*, 1949, lxxxvi, 110), and Mr. Percy Evans's, for full use of the National Grid in Great Britain (*Geol. Mag.*, 1948, lxxxv, 242), may I urge the use of geographical co-ordinates to indicate geological sites throughout the world? The advantages are so great that it is surprising to find this obvious method seldom adopted in the literature.

My experience in the Middle East, the Mediterranean area, French North Africa, and North-East Africa is that place names there are often of very limited value for the purpose. Many names that one learns in the field are not shown on any published map, and conversely, a common name may be found in more than one place on a given map. Neither Arab nor Somali, for example, is by nature imbued with that need for accuracy that is desirable in scientific work, and in their scantily populated countries location on the ground of some of their place names seems to a European, partly from the nature of the case, to be regrettably imprecise.

Grid references are excellent when the appropriate map is available, but obviously useless without it. On different maps of Somaliland, moreover, there are two quite separate grid systems, employed respectively by the War Office; and by East Africa Command during World War II. Such a case is probably not unique.

Geographical co-ordinates are most generally useful, though certain foreign maps printed with co-ordinates in grades, or with a prime meridian of Paris, Rome, Ferro, or other of the couple of dozen that are used in various parts of the world, may give rise to error unless these peculiarities are observed and allowed for. But the latitude and longitude (referred to Greenwich) of any point on the earth's surface can be easily plotted on nearly all maps, to as great an accuracy as required. General use of this method, which I have tried to apply for the past twenty years, would lead to greater accuracy and conciseness of indication, and would often save time and measureless exasperation to all who wish to pin-point a locality from the data of others.

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