NOTICES OF MEMOIRS.

I.—On a Proposed New Classification of the Pliocene Deposits of the East of England. By F. W. Harmer, F.G.S.[1]

THE term Red Crag, including as it does beds differing considerably in age, is vague, and, when we attempt to correlate the East Anglian deposits with those of other countries, inconvenient; the Scaldisien zone of Belgium, with its southern fauna, for example, representing one part of it, and the Amstelien of Holland, in which northern, and even Arctic, mollusca are common, another. It seems desirable, therefore, while retaining it for general use, to adopt for its various horizons some more definite and distinctive names.

The Upper Crag deposits arrange themselves geographically in horizontal rather than in vertical sequence, assuming always a more recent as well as a more boreal character as we trace them from south to north. They are the littoral accumulations of a sea which was from time to time retreating in a northerly direction.

The classification now proposed, which is based on palæontological evidence, is as follows:—

	Older Pliocene.	
Lenhamian	Lenham Beds (Zone of *Arca diluvii*)	Diestien Sands. Waenrode?
	Newer Pliocene.	
Gedgravian	Coralline Crag ...	Zone à *Isocardia cor.*
Waltonian	Essex Crag.	
Walton horizon	... (Zone of *Neptunea contraria*)	Scaldisien.
Oakley horizon	... ,, ,, ,,	Poederlien.
Newbournian ...	Red Crag of Newbourn, Sutton, and Waldringfield	Amstelien.
Butleyan	Red Crag of Butley and Bawdsey (Zone of *Cardium Greenlandicum*)	Amstelien.
Icenian—Lower horizon	... Norwich Crag, Southern part.	
Upper horizon	... ,, ,, Northern part (Zone of *Astarte borealis*)	
Chillesfordian	(Estuarine) Chillesford Clay and Sands.	
Weybournian ...	Crag of Weybourne and Belaugh (Zone of *Tellina balthica*). Forest-bed (so-called) Series.	

An analysis of the characteristic mollusca of the different divisions respectively of the Crag here suggested shows a gradual diminution of the percentages of extinct and southern forms and a gradual increase in northern and recent species. The difference between the Gedgravian (Coralline Crag) and Waltonian is shown to be less than has been supposed, and the former is here grouped as Newer instead of as Older Pliocene, as hitherto.

The Crag of Oakley, near Harwich, from which the author has recently obtained nearly 300 species of mollusca, belongs to an horizon different to anything previously described, and serves to bridge over the interval between the Crag of Walton-on-the-Naze and the Red Crag of Suffolk. Its fauna closely resembles that of

[1] Read before Sect. C (Geology), British Association, Dover Meeting, Sept. 1899.

Walton, but contains some boreal and Arctic species unknown from that place, including *Neptunea antiqua* (dextral), *N. carinata*, and *N. despecta*, and represents the period when northern forms were first beginning to establish themselves in the Crag basin. It is approximately and partly equivalent to the Poederlien zone of Belgian geologists.

The Red Crag beds, the fossils of which are, with few exceptions, the drifted and stratified shells of dead mollusca, seem to have been deposited either against the shore or in shallow water in proximity to it, in land-locked bays or inlets. The position which these inlets successively occupied was from time to time shifted towards the north, in consequence of the upheaval of the southern part of the Crag area described by the author in a former paper.[1] These inlets were silted up, one after another, by masses of shelly sand, but as far as the evidence goes the beds composing the different zones do not overlap. The Waltonian deposits are confined to the county of Essex, the Newbournian occupying the district to the north of the river Stour, and the Butleyan beds occurring along a narrow belt extending northwards from Bawdsey at the mouth of the river Deben. The Icenian deposits which are found to the north of Aldeburgh are shown by their molluscan fauna to belong to a period considerably more recent than any part of the Red Crag. They cover an area 45 miles by 20 in extreme breadth, and in one place are nearly 150 feet in thickness, but they are not anywhere known to be underlain by beds of Red Crag age. In the northern part of the Icenian area *Astarte borealis* occurs, and this species seems to mark a slightly more recent horizon of this zone. The Weybournian Crag, containing *Tellina balthica*, is only known to the north of Norwich, and extends from thence to the Cromer coast. The author now believes that these latter beds are distinct from and of older date than the Westleton Shingle of Prestwich.

II.—On the Origin of Lateral Moraines and Rock Trains.[2]

By J. Lomas, A.R.C.S., F.G.S.

In dealing with the accumulations of fragmentary materials associated with glaciers it is necessary to distinguish between deposits which are stationary and the débris riding on or moving with the ice.

The latter, reviving a term used by Rendu, will be referred to as 'rock trains,' and the meaning of 'moraines' will be restricted to stationary deposits, either lateral or terminal.

Lateral moraines are not necessary adjuncts to glaciers. Their distribution, which appears capricious, really conforms to a well-defined law. In glaciers with a straight course, they are feebly, if at all, developed, whereas those moving through winding channels have lateral moraines developed in their concave bends. The débris carried by a glacier either in the ice or on the surface gradually

[1] Quart. Journ. Geol. Soc., vol. lii (1896), pp. 773.

[2] Abstract of a paper read before Section C (Geology), British Association, Dover Meeting, September, 1899.

works towards the side in such places where motion is retarded and carrying power reduced. In this respect they conform exactly to the action of rivers which deposit material in their inner bends.

Rock trains may appear suddenly in the middle of a glacier or at the junction of two streams. The first are undoubtedly caused by the erosion of subglacial spurs or crags. Those formed at the point of union of two glaciers are usually regarded as being formed by the joining together of two lateral rock trains.

There are cases, however, where rock trains are formed at the junctions of glaciers, and no lateral rock trains fringe the tributary glaciers. In front of the rocky islands or spurs which separate the glaciers at the point of confluence, a hollow is always seen in which a lakelet often exists. This is the counterpart of the hollow on the down-stream side of a river after passing under a bridge supported by piers.

Objects carried by rivers tend to accumulate in this hollow, and may linger there a long time before they join the main current and get carried away.

Thus rock trains may be formed by débris being thrust out of glaciers at similar places where motion is small. In these instances the fragments are probably torn off under the ice from the flanks of the dividing spurs, and they may be compared with those originating in the middle of a glacier.

REVIEWS.

I.—Geological Guides to Pomerania and Bornholm. By W. Deecke. "Geologischer Führer durch Bornholm." 8vo; 130 pp. and map. "Geologischer Führer durch Pommern." 8vo; 131 pp. Nos. 3 and 4 of Sammlung Geologischer Führer. (Berlin, 1899: Gebr. Borntraegger.)

DR. E. GEINITZ'S guide to Mecklenburg and that of Dr. Beck to the section of Saxon Switzerland south of Dresden have already given a favourable introduction to Borntraegger's series of geological guides. The two next volumes in the series are worthy of their predecessors. They are practical in method, clear in style, and while they are written in language sufficiently popular to be understood by any intelligent tourist, the information is sufficiently precise and definite to give a geologist a clear idea of the geological features of the districts described. Both guides are on the same plan. They begin with a brief account of the topography of the districts; this introduction is followed by a longer general sketch of the stratigraphical geology. The reader, having thus been told what there is to be made out in the district, is informed exactly where to find and how to interpret the available evidence. The books close with a list of the more important geological works on each district and with a full index.

The two districts, though not far distant geographically, are very distinct geologically. Bornholm consists of a granite massif,