

NOTICES OF MEMOIRS.

I.—ON THE ARCTIC SHELL-CLAY OF ELIE AND ERROL, FIFESHIRE, VIEWED IN CONNECTION WITH OUR OTHER GLACIAL AND MORE RECENT DEPOSITS. By the Rev. THOMAS BROWN, F.R.S.E.

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AFTER describing in detail several sections in the two localities, the author, by combining the information derived from them, gives in serial order the various deposits, and examines the evidence they supply as to climate and the relative height of sea and land. In descending series the beds are—

1. *The Blown Sand and Raised Beaches.*—The blown sand is in some places from twenty to thirty feet thick, and contains several beds of peat of various thicknesses, some of them containing large numbers of land and fresh-water shells of species now living in the district. The so-called raised beach consists of shingle, sand, and shells, arranged in a confused manner. It was probably deposited on the shore while the sand was forming beyond high-water-mark. It is occasionally eighteen feet thick. The evidence that it is a true raised sea-beach is not decisive.

2. *Sands and Clays with Scrobicularia.*—This consists partly of about a foot of fine clay with numerous specimens of *Scrobularia piperata* in the position in which they lived. The tide runs further up the stream than where this deposit occurs, but the level of high-water-mark is at least fourteen feet below the clay bed. In the brick clays between Stirling and Bridge of Allan, in which skeletons of whales have been found, Dr. McBain has obtained specimens of *Scrobicularia* and also at Portobello, and both these clay beds are at the same height above the present level of the sea as at the Elie deposit. Below the clay there is about six feet of alternating sandy and clayey layers, containing the same species of mollusca as occur on the shores of the Forth at present, showing the climate to have been the same as now.

3. *The submerged Forest.*—This is seen on the shore passing out into the sea. It is four feet in depth, and consists of a mass of peat, in which willow and hazel, and especially hazel-nuts, were found, with other seeds, mosses, and abundant remains of *Arundo Phragmites*. These plants indicate a climate identical with the present.

4. *High-level Gravel and Sand.*—The beds of this stage occur at considerable heights all over the surface of the country, and are entirely destitute of fossils. In some of the gravels are found angular patches of fine sand, which the author supposes to have been frozen masses of sand transported with the gravel; and, if so, giving the first indication in the descending series of the glacial cold.

In the Fife deposits there is, below this gravel, an unconformity which Mr. Brown believes to represent the period during which were deposited—1st, the beds of Fort William and Caithness, investigated by Mr. Peach; 2nd, the Clyde beds, described by Mr. Smith; and

3rd, those of Aberdeen, to which Mr. Jamieson has devoted his attention. These indicate an increasing degree of cold which reaches its climax in the next stage.

5. *The Arctic Shell-clay*.—This is a fine clay in which the following shells have been found. The names are given on the authority of Dr. Otto Törell.

Buccinum cyaneum.
Natica grænlandica.
Turritella erosa (polaris).
Pecten granlandicus.
Orenella decussata.
C. nigra.
C. lævigata.
Leda truncata.
L. minuta.

Yoldia hyperborea.
 Y., nov. sp.
Astarte compressa.
Nucula inflata.
Dacrydium vitreum.
Thracia myopsis.
 T., nov. sp.
Tellina proxima.
Saxicava rugosa.

Not only are all these species now found in arctic seas, but the size of those species which have a wider distribution southwards corresponds with the specimens of them now living in the seas of Greenland and Spitzbergen. The Clay bed is more than forty feet above high-water-mark; the shells are evidently in the Clay in which they lived; and as they are all deep-water species, the level of the land must have been at least 150 or 200 feet lower than it is now.

6. *The Boulder-clay*.—This well-known deposit, both at Errol and Elie, is beneath the Arctic Shell-clay; but, from an examination of their relations, the author believes that, as a whole, they were deposited simultaneously, and that the fossils enumerated represent the life of the Boulder-clay period.

The author considers that these Fife deposits may form the starting point for a more rigorous classification of the superficial beds throughout Scotland.

W. C.

II.—ON A NEW CEPHALASPID. By E. RAY LANKESTER, Christ Church, Oxford.

[BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. DUNDEE,
 SECTION C. GEOLOGY.]

MR. Lankester exhibited a diagram of the head of a Cephalaspid, fragments of which had been described by Agassiz as *Plectroodus pustuliferus*. It was remarkable for its long cornua, minute pustular ornamentation, and the dentation of its outer margin. It was probably an *Auchenaspis*, but the posterior 'neck-plates' were deficient. Specimens of the head had been obtained by Mr. Lightbody of Ludlow and Dr. Grindrod of Malvern. Mr. Lankester exhibited a diagram of a restored *Cephalaspis*, and noticed the existence of a series of scales forming the broad ventral surface of the body and tail of this genus of fishes. He also noticed the thickening of the margin of the head-shield and the ornamentation of a part of its under surface, showing that this particular part of the concave surface was superficial like the whole of the convex surface, and not covered in by a lower jaw or other plates.