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ORIGINAL ARTICLES.

I.—The Elevated Shell-bearing Gravels near Dublin.

By the Rev. Maxwell Close, M.A. F.G.S.[1]

THE elevated Drift deposits near Dublin have been brought under the notice of the Society by other observers. The late Mr. John Kelly has described in our Journal (vol. vi. p. 133) part of the gravels which form the subject of this paper; including the collection at Caldbeck Castle, 1300 feet above the sea. I have already mentioned before the Society (in 1867) the fact of having found marine shells in the Pleistocene gravels near Dublin, at heights of 1000 and 1200 feet above the present sea-level;[2] but I did not wish to offer a paper on the subject until I had collected what might seem sufficient materials for one. These shells are not only in a very fragmentary condition, but also scarce, so that they easily escape notice; and it is necessary to pay several visits, at sufficient intervals, to the few places where the shells are accessible, in order to obtain from thence even a limited collection of determinable species.

The gravels now in question belong to the "limestone gravel" of Ireland, and occur on the sides, or in the immediate vicinity, of the hill mass, the best known of whose prominences is named the Three-Rock Mountain—part of the N.E. end of the Wexford, Wicklow, and Dublin granite range. Ballyedmonduff is on the S.E. side thereof, on the road leading from Stepaside to Glencullen. A little below, and N. of, the highest point of that road, on the E. side of the road, just opposite Ballyedmonduff House, and at the elevation of just 1000 feet, is a gravel-pit which has yielded the shells given below. The distinctly-shaped mound, or mamelon, in which the pit is dug, is chiefly composed of clean stratified gravel and sand; it is part of a great collection of Drift which extends into the S.E., or Ballyedmonduff, bosom of the above-mentioned hill mass, and over the slight *col* at the highest point of the road leading to Glencullen; at which latter place it (the gravel) is of very considerable depth. In the said bosom the gravel maintains, at its upper edge,

[1] Read before the Royal Geological Society of Ireland.

[2] These are noticed in Jukes's "Manual of Geology, edited by Prof. Geikie; by Prof. Harkness in the Geological Magazine. Vol. VI. p. 545; and in Sir C. Lyell's "Student's Elements of Geology," where, however, they are placed in the Co. Wexford, and in the Pliocene formation.

an elevation of about 1100 feet, for some distance; and spreads thinly over the hill-spur, marked on the map 1103 feet.

Shells at Ballyedmonduff, 1000 feet.—*Trophon muricatus* C, *Fusus*? (part of columella), *Turritella communis* CN, *Ostrea edulis* C, *Pecten* (two species), *Cardium edule, C. echinatum, Astarte compressa* CN, *A. elliptica* CN, *A. sulcata* CN, *Cyprina Islandica* CN, *Artemis lincta* CN, *Venus striatula, V. casina* C, *Lutraria elliptica, Mactra stultorum*?, *Tellina*?, *Mya truncata*? CN, *Pholas crispata* C, *Balanus balanoides* CN, *Small shell-boring Annelid* (perforations of).

The species, as also those named below, were determined by Mr. W. H. Baily and Dr. Carte. Those marked C are characteristic of the Celtic province of marine fauna (*Venus casina* is thus marked, although occurring exceptionally in the Mediterranean; as Edward Forbes believed it must have attained access thereto during the Glacial submergence). Those distinguished with CN are characteristic of Celtic and Northern European seas; or of the northern part of the Celtic area.

The remains of the house called Caldbeck Castle stand westward of the Three Rocks, on the *col* above Ticknock, which connects Kilmashogue Mountain with the rest of the said hill mass. About one furlong S. of the ruins is a pit, in clean gravel and sand, at the elevation of a little over 1,200 feet (slightly higher than the shell-bearing gravels near Macclesfield, described by Mr. R. D. Darbishire, F.G.S.,[1] Memoirs of Lit. and Phil. Soc. Manchester, vol. iii. 1868), which has yielded the following species.

Shells near Caldbeck Castle, 1200 feet.—*Fusus*? (part of columella), *Cardium echinatum, Cyprina Islandica* CN, *Venus striatula, V. casina*? C, *Mactra stultorum, Small shell-boring Annelid* (perforations of).

A little below, towards the S.W., in the bosom between the Kilmashogue and Tibradden hill spurs, *Cyprina Islandica* and other shell fragments can be found near the stream, at just 1000 feet. In the Killakee valley running up between Tibradden Hill and Killakee there is an immense irregular accumulation of Drift. In two gravel-pits near the wood where the Ballybrack road enters that valley, and at the height of 850 feet, were found, among other shell fragments, portions of *Cyprina Islandica* and *Cardium echinatum*. And near the head of that valley, beside the road, among some trees, and not far from where the military road passes, at the height of just 1200 feet, there is a pit which yielded a few fragments, of which only *Cyprina Islandica* and *Astarte elliptica* are recognizable. And finally, a little below, and S.E. of, the summit of Montpelier Hill, at the elevation of a little over 1200 feet, there is a long-disused and much grass-grown gravel-pit, in which one indeterminable shell fragment was found. This pit is four and a half miles from that first mentioned.

It is to be observed that, though all the above individual species live now in the neighbouring seas, yet, as a group, they present a rather more boreal *facies* than those of the present coasts, and than

[1] See GEOL. MAG., 1865, Vol. II. p. 293, with table of shells.

those of the low gravels, as a group (see paper by Prof. Oldham, Journ. Geol. Soc. Dublin, vol. iii. p. 131), and a decidedly less northern *facies* than the much larger collection of Drift shells from Moel Tryfaen, at 1360 feet elevation. However, it would be scarcely prudent to found any argument on the limited induction that we have been able to make. Two other points seem worthy of notice, though they may be but accidental: viz. that of *Cardium edule*, which occurs so frequently in the gravels at lower elevations, near Dublin, only one fragment has yet been recognized in the higher accumulations; and also, that but three univalves have been found, although shells of that class must be generally better able, than others, to withstand rough usage, and therefore more capable of handing down determinable fragments. Pieces of *Cyprina Islandica* are the most common, evidently on account of the thickness and strength of that shell.

What then is indicated by the occurrence of marine Drift shells in those elevated situations in our neighbourhood? Not as much as might, perhaps, be supposed on first thoughts. We did not need their presence to assure us that the sorting and stratification of those elevated gravels and sands was effected by the sea; for, as Mr. Kelly has pointed out in his paper, it is utterly impossible to refer that to any other agent. And, moreover, those shells do not give us any information as to the character of the marine fauna of this district when the sea covered it so deeply. The gravel, etc., in which they occur is "limestone gravel" (with a slight sprinkling of granite stones), resting on granite hills; this has been carried thither from elsewhere; and the smashed condition of the shells, and the fact that those fragments, which are large enough to show it, are often well scratched, like many of the pebbles among which they lie, lead to the conclusion that those fragments form, as it were, part of the gravel and have been carried thither along with it, and that, therefore, the animals did not live and die where their remains are now found. (It would seem from the descriptions, especially by Mr. D. Mackintosh, F.G.S., of the Moel Tryfaen gravels and shells, that the same has been the case with the Drift shells of that place.) This conclusion is strengthened by the consideration that, when the sea was up at the level of the site of Caldbeck Castle, the ground would fall steeply down from the very shore-line in all directions to a great depth; and several at least of the above shells would be without sufficient platform, or suitable habitat, for their subsistence.

But how were the limestone gravels and the shells carried to their present positions on the granite hills? Let us note that only a very small proportion of the gravel stones exhibit signs of water-rolling; they are generally subangular; many are greatly scratched (these occur more usually in the upper parts of the gravel), and some are quite angular. Again, at Caldbeck Castle, the nearest part of the limestone ground is $2\frac{3}{4}$ miles distant, and 900 feet lower down; and at Ballyedmonduff pit the nearest part is $4\frac{1}{2}$ miles distant, and 800 feet lower down; yet the proportion of limestone and other foreign pebbles, etc., in the gravel at those places is at least 99 per cent. It

seems utterly impossible that that gravel could have been swept thither by water, along the surface of the ground, for at least those distances, and up-hill too, without having its pebbles nearly all rounded, and without picking up vastly more than one per cent. of granite stones. Again, at Ballyedmonduff pit there is, in one part of the large irregular excavation, and in the upper part of the section, a mass of earthy clay packed with blocks of limestone and grit, some as large as a man's head, and all greatly scratched; this looks almost exactly like true Boulder-clay (it probably belongs to the Upper Boulder-clay), and it overlies fine gravel and sand (all this is now much obscured by some trees having fallen and torn down the pit escarpment). Any rush of water that could have carried those stones along bodily, without rolling them, could not have deposited the fine materials on which they lie, and must have swept away those fine materials, if they had been already there. Since rushing water is out of the question, as the transporting agent, and also, as will be generally conceded, land-ice, for somewhat similar reasons, we seem compelled to believe, as Mr. Kelly did, that the gravels in question have been transported by floating-ice to their present situations (apparently from a north-westerly direction). The blocks of local granite, weighing sometimes up to 20 tons, which usually lie on the top of the (limestone) gravel, in places to which they could not have fallen or rolled, must have been left there by floating-ice; but this may have been local and more immediately connected with the hills.

The upper limits of these gravels are clearly not raised beaches. Yet on the south-east side of the Three-Rock Mountain, in the Ballyedmonduff bosom, there is an approach to a horizontal upper boundary, at the height of about 1100 feet, extending for about a mile; and about Caldbeck Castle and the head of Killakee valley, on the other side of the hill mass, a less near approach to such a boundary, at 1200 to 1300 feet, extending for two or three miles. Of course the upper limit of the gravel, as worthy the title of a deposit, does not necessarily indicate the greatest depth of the submergence in the glacial sea. Above that limit many pieces of foreign material can be found, almost to the summit of the Two-Rock Mountain, at the height of about 1760 feet.

As to the correlation of these high-level gravels with those on the low grounds—it seems impossible, at present, to ascertain their *precise* relations, from direct observation. Speaking roughly, they both evidently belong to the same formation, viz. the Pleistocene "middle sands and gravels," lying below the Upper, and above the true or Lower Boulder-clay. But, considering the most probable mode of transport, and the fact that the submergence of the low grounds must have begun sooner and ended later than that of the high grounds, we may perhaps conclude more definitely that the elevated gravels are contemporaneous with some of the middle parts of the low gravels.

Recapitulation (in different order).—1. The elevated gravels are Pleistocene, and probably contemporaneous with some of the middle parts of the low-level gravels. 2. They have been carried to their

present position by floating-ice. 3. The contained marine shells have been brought along with the gravel. 4. Therefore the animals to which the shells belonged lived and died somewhere else, towards the northwest, and *that* very possibly before the time when the sea was deep enough to deposit the elevated gravels. 5. The shells, as a group, if we may venture to judge from so small a collection, point to rather more boreal marine conditions than now obtain in this region; although they are all to be found now inhabiting the neighbouring seas.

II.—Descriptions of New Fossils from the Devonian Formation of Canada.

By H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E.;
Professor of Natural History in University College, Toronto.

(*Concluded from page* 163.)

(PLATE IX.)

Fenestella magnifica, Nicholson, Pl. IX. Fig. 22.

Polyzoary forming a flattened expansion of unknown but apparently considerable size. Branches almost perfectly straight, bifurcating at intervals of from one quarter of an inch to one inch, nearly parallel, united by straight transverse dissepiments, subangular or obtusely carinated, and closely striated on the non-celluliferous side. About four branches in the space of three lines, measured across the frond. Dissepiments about equalling the branches in diameter, usually placed at intervals of from one line to one-tenth of an inch apart. Fenestrules oblong, rectangular, nearly equal, from one line to one-tenth of an inch in length by two-thirds of a line in width; nine fenestrules in one inch measured vertically, twelve in the same space measured diagonally. The fenestrules of contiguous rows nearly, but not quite, at the same level. Celluliferous face unknown.

This species (Fig. 22) is most nearly allied to *Fenestella laxa*, Phillips, from the Carboniferous and Devonian Rocks of Britain; but it is readily distinguished by the regular dimensions of the fenestrules, their rectangular shape, and their much smaller size. (The fenestrules in *F. laxa* are from two to four times as large as those of *F. magnifica*.) From *Polypora* (*Gorgonia*) *ripisteria*, Goldfuss, the present species is separated by its rectangular, not oval, fenestrules, the much greater proportionate and absolute width of the fenestrules, and the straight, not flexuous, branches.

I have only seen a single specimen of *F. magnifica*, and that only exhibits the reverse side of the cœnœcium; but the general characters of the frond are so distinctive, that I have no hesitation in founding a distinct species for its reception.

Locality and Formation.—Corniferous Limestone, Port Colborne.

Fenestella marginalis, Nicholson, Pl. IX. Fig. 23.

Polyzoary forming a fan-shaped expansion, of unknown dimensions. Branches straight, nearly parallel, about four in the space