NOTE *on the SHELLS from the LOWER BOULDER-CLAY of DAWPOOL.*

By SEARLES V. WOOD, jun., Esq., F.G.S.

The shells are far less fossilized than those from our East-Anglian glacial beds and those from the Bridlington bed, and are all common shells of the British littoral region*. The Lower Boulder-clay from which they come I regard as belonging to the latest part of the Glacial sequence—later, that is, than the newest of our East-Anglian beds. The *upper* clay of Dawpool cliff (which is the same as the apparently uniform deposit of Upper Boulder-clay which extends through the lower grounds of North Wales, Cheshire, and Lancashire) seems to me not improbably the same as the Hesse clay of Yorkshire, which is obviously a deposit due to a postglacial (partial) resubmergence subsequently to the general emergence of the country from the glacial sea, and its reoccupation by the great mammalia.

DISCUSSION.

Prof. RAMSAY remarked, with regard to the Bridlington beds which had been cited, that they were probably preglacial, and not glacial. He thought that eventually it would be proved that during the Glacial Period there had been several oscillations in this country both in level and in temperature. With respect to temperature, the calculations of Mr. Croll showed the extreme probability of such variations being due to astronomical causes; and these were best illustrated by reproducing his figures in the form of a diagram showing the curves and oscillations of temperature.

4. *On MODERN GLACIAL ACTION in CANADA.*

By the Rev. WILLIAM BLEASDELL, M.A.

(Communicated by Principal Dawson, F.R.S., F.G.S.)

SECOND ARTICLE.

FURTHER inquiry into the action of ice in Canada furnishes new facts illustrating the powerful effects of this agent in changing or modifying the Boulder-drift surfaces of the country lying over the Silurian strata, even during the period of human observation; and if so, how much more of change must have been effected in this way during that comparatively long period which, as far as Canada is concerned, may be designated prehistoric, when it lacked observers to note, and a written language to record, those changes which must have occurred in the bygone centuries of its existence in its present form, and subject to the same powerful glacial agencies and climate? In addition to the facts furnished to the Geological Society, and kindly received by it, in my previous paper †, I am now in a position to lay before the Society further evidence of this nature.

At the head of that arm of Lake Ontario named the Bay of

* [The species of shells I sent to Mr. S. V. Wood, jun., did not include all those above named by Mr. Gwyn Jeffreys.—D. M.]

† See Quart. Journ. Geol. Soc. vol. xxvi. p. 669.

Quinte, the Canadian river Trent discharges its waters at the village of Trenton; and a mile above the latter the lower or Frankford Rapids terminate. These rapids extend for about nine miles up the river, from this point to a mile above the village of Frankford, where there is again deep and navigable water. Between these two points the river runs over a limestone bed of the upper Trenton series of the Lower Silurian rocks, and the rapids are thus formed. At intervals small islands exist in what are sometimes designated as the Nine-mile Rapids. These tend consequently to increase the force of the stream by the impediments they present to its course. The islands are thinly strewn with a gravelly soil, and are mostly covered with trees, of a similar character to those on the river's banks, and with low brushwood, in which the Canadian wild grape (*Vitis vulpina*) luxuriates in particular spots.

About six miles from Trenton there was an island known by the name of Fidler's Island; and here the effects of glacial action in the shape of ground-, anchor-, or pack-ice have recently become conspicuous. This island, once nearly sixty feet in length, has disappeared within the last eighteen months. All these islands lie, for obvious reasons, lengthwise in the stream; and the widest portion of the island in question may have been twenty-five or thirty feet in width. In the winter of 1869-70 the anchor-ice had so acted upon the surface of Fidler's Island, and on its former site, as entirely to remove it and leave the subjacent rock entirely bare. And in the month of April 1870, when the waters of the Trent were unusually high from the melting snows of the region which it drains (at least, with its tributaries, 150 miles in extent), a large portion of the upper surface of this island came floating down on the face of the stream, and was seen at the village of Trenton below, with the trees and bushes on it in the upright position in which they grew.

Recently some observations on Ground-Ice and its Results, by Henry Landor, Esq., M.D., Superintendent of the Malden Asylum in this province, and communicated to the Entomological Society, London, Ontario, have been kindly laid before me by the Rev. C. J. Bethune, M.A., Principal of Trinity College School, and our most distinguished Provincial entomologist. This essay contains some most valuable and, I believe, philosophical remarks on the formation of ground- or anchor-ice in the rivers and streams of Canada. I insert the remarks of Dr. Landor, as published in a local organ, and issued by the Entomological Society, in illustration of the phenomenon under consideration:—"When the thermometer falls to 10° of Fahrenheit, ground-ice begins to form, but it is not at that temperature long adherent to the bottom. As soon as the sun rises, it rises and floats away in great abundance of small light porous portions of ice, covering, for the most part, the centre of the stream. But when the thermometer is at zero, the ice adheres to the bottom, and it is most apparent where the stream is most rapid. It is then most abundant where there is no surface-ice; there is none where the surface is frozen over. Depth of the stream, at any rate to six feet,

does not prevent the formation of ground-ice; for it is seen abundantly on the bottom of the St.-Lawrence Rapids, and at the Tubular Bridge, Montreal, which affords a favourable point for observation, before the surface is frozen over. As the frost continues, the ice at the bottom thickens. It is tubular, or honeycombed, in the direction of the current; and the water pours through the tubes. It is rarely solid, but is so after long continuance of hard frost. It adheres to the stones at the bottom, or to the ground itself, and it remains anchored until its power of flotation enables it to rise to the surface and carry its anchor with it. It comes to the surface with stones attached to it. These stones, of course, bear a proportion to the mass of ice. When the mass is small, the stones it raises are small, and are only pebbles; but when the mass is large) and it is often a large mass that rises to the surface) it brings adherent to it large stones, deserving to be called small boulders. The mass floats away down the stream to the next part of the river that is frozen over at the surface. There it becomes frozen in with the mass of surface-ice, and in a very few hours loses its porous condition altogether." Such is the valuable testimony of a close observer in these matters, showing how this powerful agent is now acting from year to year in producing such changes on the surface of the earth as those of Crab Island adduced in my former paper, and Fidler's Island in the present one. Dr. Landor also speaks of having seen in the small rivers that form the Canadian river Thames "a vast number of pebbles and stones, as big as a foot in diameter, carried away by ground-ice," and also of observing "the ice rise with stones attached." I might add to what has been already advanced from this valuable essay on this head; but I trust that at some subsequent period the author may lay the results of his observations on these matters before the Geological Society; for I believe them well worthy of its attention.

A visit just made (at the time I write) to the locality of Fidler's Island reveals a rapid, surging up with white foam, and the water thus bounding over its site, whilst between it and Flat Creek Island, about 200 yards lower down the stream, a new shoal has been formed, probably by a portion of the *débris* of the former island. A mile lower down the river is Patrick's Island, which furnishes evidence that the same causes are operating extensively there, as it is greatly reduced in size, and glacial action has almost deprived its surface of soil—two detached groups of trees being all that now remains of it. Before long a shoal or a rapid will be all that remains to mark the site of Patrick's Island.

Another remarkable example of glacial action in Canada is the removal of Salmon Island, the history of which has but recently come under my notice. At the junction of the Bay of Quinte with Lake Ontario there is an island of some magnitude and well settled with inhabitants, formerly named Isle de Jonti by the early French explorers, from Chevalier de Jonti, an associate of the enterprising explorer La Salle, but now known as Amherst Island. Off the eastern extremity of this island there was formerly a small

one, named Salmon Island. Judge Fairfield, who was brought up from childhood in this locality, tells me that when a boy, some fifty years ago, he was on it, and it was then, he supposes, over an acre in extent. Within the last twenty years I remember this island, having seen it in the distance from the bay and main shore opposite; and it was then conspicuous by a large elm tree growing upon it. Now Salmon Island has entirely disappeared, and a shoal, with four feet of water over it, alone marks its former site. North of this, and near the main shore of the Bay of Quinte, separated by narrow channels, are three small islands, side by side, and hence named the Brothers. These islands also are under a process of disintegration; and the western one has almost disappeared. On one of these a recluse formerly resided, and supported himself by fishing &c.; but he left the locality some time ago.

The cause of these changes is confessedly of a glacial character. These islands are low, and little above the level of the waters of Lake Ontario and the Bay of Quinte. They are so situated, in a range with the Lower Gap (the lower outlet of the bay to the lake), that the prevailing south or S.S.E. wind blows the drift-ice, which is apt to pile up on such spots, to a great height; and loading itself with a cargo of earthy material, gravel, stones or boulders, it acts upon such exposed spots and carries them away piecemeal. As an evidence of this disintegrating action, I may mention that last winter, on a low rocky limestone point about $4\frac{1}{2}$ feet above the level of the water, in the range of the Lower Gap and on the opposite shore of the mainland, a large mass of drift ice was piled to such a height, on a spot between Perrot's Bay and Collins Bay, as to obstruct the high road that passed by it. This spring there were left on the point some large heavy boulders and other *débris*, which were not there previously, and which had evidently been brought by this glacial agency from the direction of the lake and the islands already named; and this may be deemed the chief cause of the disappearance of Salmon Island and the disintegration of the group of the Brothers. Further eastward, and opposite the village of Bath, tradition states that in the days of the early settlers, about A.D. 1786, there was a small island a short distance from the shore; and a shoal now marks the spot. Drift-ice from the direction of the Upper Gap may similarly have effected this.

Two or three typographical errors have crept into my former article as printed in No. 105, for November 1870, which I here correct. For "Barnhast's Island," &c., read "Barnhart's Island;" for "immature ice-bergs," read "miniature ice-bergs;" for *Saricava vagosa*, read *rugosa*; and for "chalky sandstone," read "gritty limestone."

DISCUSSION.

Prof. RAMSAY mentioned that Sir William Logan had informed him that shore-ice in Canada, charged with boulders, had been

known to produce grooves on the face of cliffs as well marked as those of glacial times. He had also mentioned the case of a boulder transported by ice which was of such a size as to have occasioned the wreck of a vessel which had struck upon it.

MAY 22, 1872.

John Arthur Phillips, Esq., of Cressington Park, Aigburth, Liverpool; George Fergie, Esq., Conduit Colliery, Brownhills, Walsall; and Arthur William Lawder, Esq., C.E., Almora, India, were elected Fellows of the Society.

The following communications were read:—

1. *A Communication from the Right Hon. EARL GRANVILLE, enclosing a Report from H.M. Minister at Rome relating to the recent ERUPTION of VESUVIUS.*

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2. *On the PHOSPHATIC NODULES of the CRETACEOUS ROCK of CAMBRIDGESHIRE.* By the Rev. O. FISHER, F.G.S.

(The publication of this paper is deferred.)

[Abstract.]

THIS paper contained an attempt to explain the origin of the phosphatic nodules which lie in a thin bed at the base of the Chalk in Cambridgeshire and are largely extracted, by washing the stratum, for the purpose of making superphosphate of lime. Two hundred and seventy tons per acre, at the rate of fifty shillings a ton, represents the valuable yield of the deposit, which is followed to the depth of about 18 feet. The nodules and other fossils of the bed are chiefly derivative, forming a concentrated accumulation from a deposit belonging to the Lower Cretaceous period. Some of the fossils, however, are believed to be indigenous to the deposit. *Plicatulae* are attached to all the derivative fossils and nodules; and the sharp broken surfaces of the latter, with *Plicatulae* on them, show that they were mineralized before they were deposited in their present *gisement*. The green grains of chlorite have been drifted into patches. Certain calcareous organisms are preserved; but many genera of mollusks only occur as casts in phosphate of lime. The deposition of the phosphatic matter has been determined by *animal* substances. There are two chief varieties of the "ordinary" nodules. The first are amorphous, or else finger-shaped; the second formed like a long cake rolled, partially or wholly, upon a stick. The surface of these two kinds of nodules is coriaceous and wrinkled; and they usually show marks of attachment to some foreign body. Certain species, clearly zoophytes, are converted into phosphatic