

Tyrone and Londonderry, and is found in Mayo and Longford. That it is of the same age as the lower limestone is proved by the alternations, and its often containing similar fossils. In the southern parts of Ireland are many localities of this sandstone. He conceives it proves that there are two distinct limestones of the carboniferous series in Ireland; and that there is a difference in the organic remains, as north of Kinsale the beds contain goniatites, which distinguish the lower limestone. Euomphali are also most generally found in the lower bed. Mr. G. mentioned likewise several newly-discovered localities of Silurian rocks in Ireland, in addition to the one described by Major Portlock, at Pomeroy, in Tyrone. They had been found in the county of Louth; where north of Slane, they contain graptolites. In the county of Kerry they are well developed, especially near Dingle, where they seem to graduate into old red sandstone.

His Grace the DUKE OF ARGYLL mentioned the discovery of copper ore on his estate in Argyllshire in a vein of quartz and clay slate, in a mica slate district, and near granite, and stated his intention of having it worked; and he also mentioned the discovery of copper in the island of Islay. He exhibited several specimens of the ore, also of marble from Tiree and Iona.—Mr. MILNE stated, that on the property of Lord Breadalbane there had been discovered lead, copper, cobalt, arsenical pyrites, sulphuret of molybdena, &c. He mentioned some curious phenomena of the directions of the veins. There are two sets of joints, one N.E. to S.W., containing lead, and the other N. and S., inclosing copper: granite occurs in the vicinity. He mentioned also, as worthy of remark, that in Strath Earn, near the granite of the earthquake district mentioned on the day before, lead was found; likewise near the granite of Loch Dhu.—Mr. DE LA BECHE remarked, that the direction of veins holds good in districts of limited extent, and is useful in exploring them. In Cornwall this is exemplified, although the veins are there in a different direction. A rich copper ore is not sufficient to make a good copper mine, as other conditions are required to render it lucrative. The proximity to granite is a general case with respect to copper mines, although lead is often found at a distance from that rock.

M. AGASSIZ made a communication on the subject of Glaciers and Boulders in Switzerland. He particularly drew attention to facts relative to the manner of the movements of the glaciers, which he attributes to the continual introduction of water into all their minutest fissures, which, in freezing, continually expands the mass. The effects of the movement, produced by this expansion, upon the rocks beneath the ice, are very remarkable. The bases of the glaciers, and the sides of the valleys which contain them, are always polished and scratched. The fragments of the rocks that fall upon the glaciers are accumulated in longitudinal ridges on the sides of the ice, by the effects of the unequal movement of its middle and lateral masses. The result is longitudinal deposits of stony detritus, which are called *morains*; and as the glaciers are continually pressed forwards, and often in hot summers melted back at their lower extremity, it results, that the polished surfaces, occasioned by friction on the bottom and sides, are left uncovered, and that the *morains*, or curvilinear ridges of gravel, remain upon the rocks formerly covered by the ice, so that we can discover, by the polished surfaces and the *morains*, the extent to which the glaciers have heretofore existed, much beyond the limits they now occupy in the Alpine valleys. It even appears to result from the facts mentioned by Prof. Agassiz, that enormous masses of ice have, at a former period, covered the great valley of Switzerland, together with the whole chain of the Jura, the sides of which, facing the Alps, are also polished, and interspersed with angular erratic rocks, resembling the boulders in the *morains*; but so far different, that the masses of ice, not being there confined between two sides of a valley, their movements were in some respects different—the boulders not being connected in continuous ridges, but dispersed singly over the Jura at different levels. Prof. Agassiz conceives that at a certain epoch all the north of Europe, and also the north of Asia and America, were covered with a mass of ice, in which the elephants and other mammalia found in the frozen mud and gravel of the arctic regions, were imbedded at the time of their destruction. The author thinks, that when this

immense mass of ice began quickly to melt, the currents of water that resulted, transported and deposited the masses of irregularly rounded boulders and gravel which fill the bottoms of the valleys; innumerable boulders having at the same time been transported, together with mud and gravel, upon the masses of the glaciers then set afloat. Prof. Agassiz announced, that these facts are explained at length in the work which he has just published, 'Études sur les Glaciers de la Suisse,' illustrated by plates, which was laid before the Section. Prof. Agassiz is also inclined to suppose that glaciers have been spread over Scotland, and have everywhere produced similar results. If we understood him rightly, he means to follow up his valuable researches in the Highlands of Scotland during his stay in this country, and that he confidently expects to find evidence of such glaciers having existed, particularly around Ben Nevis.

MR. LYELL remarked, that the explanation regarding the union of the lateral *morains* into the central, was a complete explanation of the phenomena, but thought the presumed extent of glaciers was doubtful. He stated, that Mr. Darwin observed glaciers in Chili, on mountains not half the elevation of Mont Blanc. The polished surface of rocks may be remarked in many parts of the world. They had been long since noticed in Scotland, and he himself had observed them in Sweden, where perhaps they might be explained by the stranding of icebergs in narrow fiords, where they rubbed against rocks.—MR. MALLET urged, as an objection against the theory, that the motion would be greatest when the alternation was least; and that the opinion, that there was no water beneath the glacier, above the perpetual snow line, was erroneous.—M. AGASSIZ admitted, that the causes which had been assigned by Mr. Mallet [see Report of Brit. Association,] were *veræ causæ*, but, in his judgment, were not the great cause.—Mr. Mallet observed, that he had not said that hydrostatic pressure was the sole cause for the motion of precession, but co-existent with those assigned by Hutton, Playfair, &c., namely, weight, and alternate freezing and thawing.—MR. DE LA BECHE said, there was a difficulty respecting *morains*. In the elevation of land from the sea, there must be lines of gravel, as on beaches, which might be confounded with the other.—MR. MURCHISON alluded to the erratic blocks observed by Buteling in Lapland, originating from a centre, some of them going even towards the north. He alluded to Mr. Agassiz's idea of Europe being at one period encased in ice. This he thinks not borne out, especially in Russia, where the blocks must have been deposited under a sea. In England, we observe in the superficial drift, marine shells of existing species.

MR. SMITH, of Jordan Hill, made some observations on the Geology of Madeira, describing the various kinds of lava, and some deposits, containing shells, which he considered of the newer Pleiocene era.

MR. IBBETSON exhibited a number of drawings of fossils by the Daguerreotype process, in which he had made use of the oxyhydrogen microscope, which had magnified the object in a manner highly advantageous for examination.

'On a Pleistocene Tract in the Isle of Man, and the relations of its Fauna to that of the neighbouring sea,' by Mr. Edward Forbes.

MR. FORBES stated, that he did not appear as a geologist, but as a zoologist, desirous of contributing to the progress of geology. In the course of his investigations, as a member of the Dredging Committee, he was frequently led to compare the present state of the sea with that of the land bordering it, and the results were such as mutually illustrated zoology and geology. The northernmost part of the Isle of Man, coloured white in Mr. Greenough's map, is composed of a great bed of pleistocene sand, and marl, called by the people *red marl*, to distinguish it from the white marl, which fills up basins in the former, and in which the bones of the fossil elk are found. The red marl is marine, the white marl fresh-water. The pleistocene tract so composed, extends from the slate mountains to the sea, terminating in high cliffs of sand and clay. The portion immediately bordering the mountains is composed chiefly of sand, and in it there are no organic remains; that farthest from the mountain is red marl, and the remains of shells are found in beds in it. These shells are associated together exactly as those

are, which at present exist in the neighbouring sea. There is even an exact correspondence between the elevated tertiary tract, and the present sea bottom. The latter, for from two to four miles from the shore, is composed of sand with groups of boulders, to which Laminariae are attached, thinly scattered in places. Beyond the sand, commences a great bed of living shells on a clayey or gravelly bottom, exactly corresponding with the position and nature of that part of the marl in which the shells are found. In the marl, the shells most abundant and characteristic are *Nucula*, so also in the shell bank; but there is this important difference, that the species are not identical. The *Nucula oblonga* characterizes the fossil bed, the *Nucula margaritacea* the recent; but the shells not characteristic are identical as species. The pleistocene bed appears to correspond exactly with that of Cheshire and the Clyde. Near Ramsay it is bordered for about one mile by a triangular tract of gravel and clay. This tract was formed within the memory of man, in consequence of changing the course of Sulby river. It is most interesting in a geological point of view, as it presents all the appearance of a pleistocene clay-bed, containing shells now extinct on the Manx shores, for the diversion of the course of the stream has caused the destruction of *Listera compressa* and *Tellina solidula*, two shells not now found alive on that shore. Mr. Forbes concluded by illustrating the importance of the dredging researches now going on, by the circumstance of that Committee having this summer settled the question of the identity of *Phytocrinus* with *Comatula*; the Sub-committee engaged in dredging on the coast of Ireland, having proved the former animal to be the young of the latter.

MR. JEFFREYS detailed an experiment he had made on a very great scale, to decide the question, whether siliceous matter could be dissolved largely by water, or, what is the same thing, by its vapour. This experiment formed the subject of a paper which was read some months ago before the Royal Society, and by the experiment a solution of more than two hundred weight of silica was effected in steam, at a heat exceeding that of fused cast-iron. The steam was not under pressure, but was conducted into a large kiln used for stone pottery. The silica was not only dissolved, but carried away in the vapour, and some pounds weight of it were deposited, from the vapour, before it issued from the kiln, like a hoar frost, upon some articles in the kiln, where the temperature was not above a red heat.

MR. YATES mentioned that fossil foot-marks had been discovered in the sandstone at Rathbone Street, Liverpool.

MONDAY.

SECTION D.—ZOOLOGY AND BOTANY.

Dr. Fleming in the chair.

A paper 'On the Alpaca,' was read by Mr. W. DANSON.—He observed that since the meeting at Birmingham about twenty of these animals had been imported into Liverpool. The alpaca is remarkable for having extraordinarily long wool, samples of which were shown, the staples measuring from twenty to twenty-four inches in length. This wool is naturally free from grease, in which respect it differs materially from the sheep, attributable to its not perspiring through the skin, and consequently not requiring the artificial protection of smearing with tar and other substances injurious to the wool, as far as the manufacture is concerned, and in shearing, the animal requires no washing preparatory to the operation. Mr. Danson particularly pointed out the hardy character of the alpaca, from the circumstance of its flourishing immediately under the line of perpetual snow, in the mountains of the Andes (Peru); and a not less singular or valuable fact, that of their peculiar coat of silky wool proving a complete protection against an atmosphere at all times excessively humid, and against the deluging rain that continues to fall upwards of four months in the year, rendering them, in his opinion, well suited to the Grampian and other mountainous districts of Scotland. The animal is not only capable of undergoing great fatigue, but likewise lives on mountain herbage, little better than a kind of withered grass, and in times of scarcity has been sustained several days without water, taking only a handful of maize. Their flesh is considered equal to venison, being commonly eaten by the Peruvians, who state the slaughter of them for food to be equal to four millions annually.