

“In Madeira and the Canary Islands, streams of lava of sub-aërial origin are divided by bands of red laterite, probably ancient soils formed by the surface-decomposition of lava currents; many of these owe their red colour to atmospheric action on the oxide of iron, but *others are burnt into a red brick by the overflowing of heated lavas.* These red bands are sometimes prismatic, the small prisms being at right angles to the sheets of lava.”

I believe the only plausible alternative to my view is that these red clay bands are either greatly decomposed and rearranged ash or lava accumulations, but if this were the case, should we not expect to find a certain intermixture of organic remains, for corals are found actually projecting into the ashy matter of the first section, and are most plentiful on the same horizon as this cavity and in the beds above the toadstone.

E. WILSON.

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## NOTICES OF MEMOIRS.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. FORTIETH MEETING. LIVERPOOL, 1870. PAPERS READ IN SECTION C. (GEOLOGY.)

*President.*—Sir PHILIP DE MALPAS GREY EGERTON, Bart., M.P., F.R.S., F.G.S.

*G. H. Morton*—On the Glaciated Condition of the Surface of the Triassic Sandstone around Liverpool. (See page 525.)

*Dr. Ricketts*—Section of Strata between Huyton and St. Helens.

*J. Thomson*—Report of Committee for Photographing and preparing sections of the Corals of the Mountain Limestone.

*W. H. Baily*—Report on Fossils of the Kiltorean Quarries.

*W. S. Mitchell*—Fourth Report of the Committee Appointed to Investigate the Leaf-beds of the Lower Bagshot Series of Hampshire.

*G. Maw*—On the Evidences of Recent Changes of Level on the Mediterranean Coast.

*W. C. Williamson*—On the Organization and Affinities of the Calamites of the Coal Measures.

*W. Carruthers*—On the History and Affinities of the British Coniferæ.

*Prof. Duncan*—Report of Committee on British Fossil Corals.

*Dr. Leith Adams* (read by G. Busk)—New Species of Elephants.

*W. Pengelly*—Sixth Report of the Committee for the Exploration of Kent's Cavern, Devonshire.

*Prof. Hull*—On the Extension of the Coal Fields beneath the newer formations of England.

*H. Woodward*—Notes on Fossil Crustacea.

*Dr. Bryce*—Report of Committee on Earthquakes.

*G. A. Lebour*—On the Tertiary Coal Fields of Southern Chile. (See page 499.)

*Prof. Phillips*—Notice of Mammalian Jaw from the Stonesfield Slate.

*Prof. Stokes*—Report of Hæmatite Committee.

*Prof. Harkness* and *H. A. Nicholson*—On the Green Slates and Porphyries of the Lake District.

- C. Lapworth*—On the Discovery of Upper Silurian Rocks in Roxburgh and Dumfriesshire.
- J. W. Judd*—On the Age of the Wealden.
- Rev. W. S. Symonds*—On the Physical Geology of the Bone Caves of the Wye.
- Dr. Moffat*—On Geological Systems and Endemic Diseases. Report of Committee on Sedimentary Deposits of River Onny.
- J. Gwyn Jeffreys*—Remarks on Newer Tertiary Fossils in Sicily and Calabria.
- Prof. Ansted and Prof. King*—Notes of a Recent Visit to the Great Tunnel through the Alps, and of Several Points of Geological Interest, suggested by the condition of the works in the present nearly complete state.
- Prof. King*—On some Points in the Geology of Strath, Isle of Skye.
- W. Pengelly*—The Modern and Ancient Beaches of Portland.
- J. E. Taylor*—On the Occurrence of Seams of Hard Sandstone in Middle Drift of East Anglia.
- F. W. Harmer and Searles Wood*—On the Palæontological Aspects of the Middle Glacial Formation of the East of England, and on their bearing upon the Age of the Middle Sands of Lancashire.
- Rev. H. W. Crosskey*—On Certain Glacial Phenomena in the Central District of England.
- F. W. Harmer and Searles Wood*—On some Thermal Springs in the Fens of Cambridgeshire.
- Dr. Bryce*—On the Matrix of the Gold in the Scottish Gold-fields.
- W. S. Mitchell*—Some Remarks on the Denudation of the Oolites of the Bath District.
- W. Carruthers*—Note on an Antholites Discovered by C. W. Peach.
- W. Carruthers*—On the Sporangia of Ferns from the Coal Measures.
- G. H. Morton*—On the Mountain Limestone of Flintshire and part of Denbighshire. (See page 526.)
- L. C. Miall*—On the Formation of Swallow-Holes, or Pits with Vertical Sides, in Mountain Limestone. (See page 513.)
- A. B. Wallace*—On a Diagram of the Earth's Eccentricity and the Precession of the Equinoxes, illustrating their relation to Geological climates and the rate of organic change.
- J. L. Loblely*—The Stratigraphical distribution of the British fossil Gasteropoda.
- B. Tate*—A Census of the Marine Invertebrate Fauna of the Lias.
- Rev. J. Gunn*—On the formation of Boulder Clays and alternations of level of land and water.
- C. Jecks*—On the Red and Coralline Crags.
- G. J. Stoney*—On some cases of the recent conversion of Glacial Drift into what appears to be Middle Drift.
- H. F. Hall*—On the Glacial and Post-Glacial beds in the neighbourhood of Llandudno. (See page 509).
- J. Thomson*—On the Occurrence of Pebbles and Boulders of Granite in Schistose Rocks in Islay, Scotland.
- Professor Tennant*—Diamonds of South Africa.
- R. A. Peacock*—Changes of Climate.

*Professor C. Malaise*—Sur le terrain Silurien du centre de la Belgique.  
*W. Carruthers*—Remarks on the Fossils from the Railway Section at Huyton.

*T. A. Readwin*—Notes on a Merionethshire gold quartz crystal, and some gold found recently in the river Mawddach.

I.—THE GLACIATED CONDITION OF THE TRIASSIC ROCKS AROUND LIVERPOOL.<sup>1</sup>

By G. H. MORTON, F.G.S., etc.

REFERRING first to the general geology of the neighbourhood of Liverpool, Mr. Morton said that considerable attention had been directed to it since the former meeting of the British Association in the town, in 1854.

At that meeting, Mr. Edward Hull, F.G.S., exhibited the first authentic section of the Triassic strata across the district which he had then just surveyed. The map of the Government Geological Survey, published immediately afterwards, was of great value to local geologists; and although sixteen years of continued observations render a few corrections necessary, they were of a trivial character, and not of sufficient importance to bring before the Section. A deep railway cutting has very recently opened a portion of the Middle (or productive) Coal strata between Rainhill and St. Helen's, and an extraordinary variety of Carboniferous plants and fish remains have been found. The most important progress, however, in local geology, has resulted from the examination of the superficial or Drift deposits which cover the country, and the discovery of the glaciated condition of the surface of the Sandstone beneath.

It was to the latter subject that Mr. Morton now drew special attention. After pointing out the sub-divisions of the Glacial and Post-glacial Deposits, he remarked that it was only when the Boulder-clay has overlain the striated rock, that the scratches were preserved. This Boulder deposit is the dark-red clay so extensively used in the neighbourhood for brick-making. It seldom contains fragments of local origin, but always hard rocks, such as quartzite, granite, greenstone, basalt, and slate.

In 1859, Mr. Morton described, for the first time, to the Literary and Philosophical Society of Liverpool, evidences of the action of ice on the Sandstone in this neighbourhood. Having at that time only found such indications in a single locality, he attributed the striated surface to the grounding of an iceberg in the Glacial sea. In 1866, having found several additional examples of this glaciation on both sides of the river, but at no great distance from it, he began to entertain the opinion that a glacier had descended the valley of the Mersey during the early part of the Glacial Period, and made a communication to that effect to the Liverpool Geological Society. Lately, however, he had discovered similar evidences of ice-action at

<sup>1</sup> Read before the British Association (Section C.) at Liverpool, September, 1870.

greater elevations, several miles from the river, and had consequently been compelled to adopt a new theory, which is, that a great sheet of ice once travelled over this part of the country, from the S.E. towards the N.W. The course of the ice seems to have been only slightly influenced by the inequalities of the ground. It was when the land was higher than it is now, and, consequently, when there was a longer slope towards the Irish Sea.

The localities exhibiting striated surfaces, were indicated on a map, the most distant being about nine miles from Liverpool. They naturally grouped themselves into six areas, each of which Mr. Morton very carefully described, and they occurred indifferently on the Bunter and Keuper divisions of the Trias.

Assuming the glaciation of the surface of the rocks around Liverpool to have occurred before the submergence of the land at the beginning of the Glacial Period, and afterwards covered with Boulder-clay, deposited by icebergs or field-ice, some portions must have been denuded during the subsidence, though the denudation that took place seems to have been inconsiderable. The only alteration in the contour of the land seems to have been the reduced elevation of the low ranges of hills, which traverse the district in the same direction as the ice seems to have done. It is a singular coincidence that the strike of the strata is the same as the supposed course of the ice, and that the form of the ground may be accounted for, either by rain and rivers, or, by the scooping power of ice. The direction of the hard Sandstone ridges, with intervening valleys in the softer strata, would support either conclusion.

Finally, there was little doubt that the country around Liverpool was once covered by a great ice-sheet, at a time when the land was some hundreds of feet higher than it is now, and that it afterwards subsided beneath the sea, when floating ice brought from the hills of the lake district and Scotland débris, which became scattered over the ice-grooved rocks in the form of Boulder-clay.

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## II.—ON THE MOUNTAIN LIMESTONE OF FLINTSHIRE AND PART OF DENBIGHSHIRE.<sup>1</sup>

By G. H. MORTON, F.G.S., etc.

**M**R. Morton pointed out that in Flintshire, within fifteen miles from Liverpool, there is a prominent ridge of Carboniferous or Mountain Limestone. It extends continuously from Prestatyn on the coast of Wales to Llandegla, a few miles north of Llangollen, the distance being twenty-one miles, and the strike of the limestone N. by S.E. and S. Instead of a general description of the formation, he had selected what appeared to be the four most favourable localities as centres of observation: Mold, Holywell, Newmarket (Flintshire), and Llangollen. He alluded to the country around or

<sup>1</sup> Read before the British Association (Section C.) at Liverpool, September, 1870. See also a paper on the Millstone Grit of the North Wales Border, by D. C. Davies, *GEOLOGICAL MAGAZINE*, Vol. VII., 1870, pp. 68, 122.—EDIT.

near these places, for neither Mold nor Holywell are actually upon the Mountain Limestone. Llangollen was included because of the grand section presented by the Eglwyseg rocks, about a mile from the town.

The estimated thickness of the Limestone was 1,200 feet. The Millstone Grit of the Geological Survey succeeds the Limestone, and is about 800 feet thick, coal being worked above it at Tyfynuchaf.

One mile and a half to the west of the town of Mold there is a fine section of the Mountain Limestone. The vertical section of the strata at Newmarket is compiled from three horizontal sections which each show the thickness of a subdivision. The upper, middle, and lower limestones are on the surface disconnected by faults, but the relative geological position of each is obvious. The lower grey and black limestones rest on Silurian strata, and are 750 feet thick at Moel Hiraddug. The white limestone ridge, 350 feet thick, is very different from any of the Hiraddug strata, as it also is from the black and grey limestone and shales, 300 feet thick, which crop out from under the overlying shales and sandstones of the Millstone Grit. Consequently the white limestone of Axton occupies an intermediate position, which was confirmed by the fossils it contained. Appended to Mr. Merton's paper was a list of ninety-four fossils found in the district which he had described, and which showed the range of the species through the three (upper, middle, and lower) divisions of the Carboniferous Limestone. When the number of species is considered, the upper and middle divisions are seen each to have many peculiar fossils, and an undue distinctive character might be supposed to separate them. But when the relative abundance of the species is considered, this distinction is not marked, for the common forms have a considerable range, while the rare ones are more or less restricted.

An analysis of the list showed some interesting results. Excluding a few fish teeth and scales, and plants, all of which occur in the upper limestone, it appeared that the lower limestone does not contain any species peculiar to it, for some of them extend upwards into the white or middle limestone, whilst others pass up to the highest subdivision. The earlier species, principally found at the base of Moel Hiraddug, are *Spirifera lineata* and *Syringopora reticulata*, and they continue upwards through the whole of the Mountain limestone. These two species, with a *Lepidodendron* and another plant, seem to have been the first colonists that settled down in the Carboniferous sea of North Wales. The middle or white limestone presents twenty-eight species which are peculiar to it (of course common species elsewhere), but of these no less than twenty-three have only been found in the limestone ridge at Axton, Newmarket. This assemblage of species in such a limited area was extraordinary. In the upper limestone, twenty-three species have been found to be peculiar to it, but they are all of rare occurrence, only single specimens having been found of about half of them.

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