

species, to which the above name may be given from its most remarkable character.

The true nature of these remains seems still rather uncertain. Schlotheim described them as *Orthoccratites*, and in his figure a central siphon is represented, and the stem seems composed of distinct cups or joints\*. No indication of either of these characters is seen in the most perfect of our specimens, so that we almost doubt whether his fossil belongs to the same class. Other geologists have described them as fucoids. In the 'Silurian System' they are classed as *Polyparia*, which seems now the opinion generally received. Some of our specimens have left merely a dark, perhaps carbonaceous impression on the slate; others show a cartilaginous or horny texture. In several specimens the slate is discoloured for some distance on each side, and shows minute scales of carbonate of lime, as if the more perishable parts of the animal had extended thus far. It is thus doubtful whether these remains have all belonged to animals of one class; and whether some of them may not rather have been internal organs, than the external axis of a variety of polypifer?

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MAY 30, 1849.

P. Martin Duncan, Esq., M.D., and J. Lane Oldham, Esq., were elected Fellows of the Society.

The following communication was then read:—

*On the Distribution of the Superficial Detritus of the ALPS, as compared with that of NORTHERN EUROPE.* By SIR RODERICK IMPEY MURCHISON, F.R.S. G.S. L.S., Hon. Mem. R.S. Ed., R.I. Ac., Mem. Imp. Ac. Sc. St. Pet., Corr. Mem. Ac. France, Berlin, Turin, &c. &c.

[ABSTRACT.]

REFERRING to his previous memoir upon the structure of the Alps and the changes which those mountains underwent, the author calls attention to the fact, that as during the formation of the molasse and nagelflue a warmer climate prevailed, so after the upheaval of those rocks an entire change took place, as proved by the uplifted edges of such tertiary accumulations being surmounted by vast masses of horizontally-stratified alluvia, the forms of whose materials testify that they were deposited under water. The warm period, in short, had passed away and the pine had replaced the palm upon the adjacent lands, before a glacier was formed in the Alps or a single erratic block was translated.

Though awarding great praise to the labours of Venetz, Charpentier and Agassiz, which have shed much light on glaciers, and particularly to the work of Forbes for clearly expounding the laws which

\* *Petrefactenkunde, Nachtrage*, p. 56, tab. 8. fig. 3.



regulate their movement, Sir Roderick conceives, that the physical phænomena of the Alps and Jura compel the geologist to restrict the former extension of the Alpine glaciers within infinitely less bounds than have been assigned to them by those authors.

True old glacier moraines may, he thinks, be always distinguished, on the one hand, from the ancient alluvia, and on the other from tumultuous accumulations of gravel, boulders and far-transported erratic blocks, as well as from all other subsequent detritus resulting from various causes which have affected the surface. He first shows, from the remnants of the old water-worn alluvia which rise to considerable heights on the sides of the valleys, that in the earliest period of the formation of the Alpine glaciers, water, whether salt, brackish or fresh, entered far into the recesses of these mountains, which were then at a considerably lower level, *i. e.* not less, perhaps, than 2500 or 3000 feet below their present altitude.

He next appeals to the existing evidences in the range of Mont Blanc to show, that as each glacier is formed in a *transverse* upper depression, and is separated from its icy neighbour by an intervening ridge, so by their movement such separate glaciers have always protruded their moraines across the adjacent longitudinal valleys into which they descended—and never united to form one grand stream of ice in the valley below. To prove this, it is affirmed that there are no traces of lateral moraines on the sides of the adjacent main valleys, whether on the side of the great ridge from whence the separate glaciers issued or on the opposite side of such main valley, which must have been the case if a large mass of glacier ice had ever descended it. On the contrary, examples of the transport of moraines and blocks *across* such *main* or *longitudinal* depressions are cited from the valley of Chamonix on the one flank and from the Allée Blanche and Val Ferret on the other or south side of the chain of Mont Blanc. Another proof is seen in the ancient moraine of the Glacier Neuva, the uppermost of the valley of the Drance; and a still stronger case is the great chaotic pile of protogine blocks accumulated on the Plan y Bœuf, 5800 French feet above the sea, which have evidently been translated right across the present deep valley of the Drance, from the opposite lofty glacier of Salenon.

Having thus shown that not even the upper longitudinal and flanking valleys around Mont Blanc were ever filled with general ice-streams, the author has no difficulty in demonstrating that all the great trunk or lower valleys of the Arve, the Doire, and the Rhone, offer no vestiges of what he calls a true moraine; since although they contain occasional large erratic blocks, for the most part irregularly dispersed, all the other detritus is more or less water-worn, to great heights above their present bottoms. As Venetz and Charpentier have attached great importance to the original suggestion of an old peasant of the Upper Vallais, that a great former glacier alone could have carried the erratic blocks to the sides of the lower valley of the Rhone, so on the other hand the author, if he had had any doubt himself, would have relied on the practised eye of his intelligent Chamonix guide Auguste Balmat, who never recognized the remains



of "moraines" in that detritus of the larger valleys which has been theoretically referred to old glacier action.

In descending from the higher Alps into the main or trunk valleys, Sir Roderick found many examples of rocks rounded on that side which had been exposed to the passage of boulders and pebbles, with abrupt faces on the side removed from the agent of denudation, all of them reminding him forcibly of the *storm* and *lee* sides of the Swedish rocks over which similar water-worn materials have passed.

Seeing, then, that this coarse drift or water-worn detritus is distributed sometimes on the hard rocks and often on the remnants of the old valley alluvia, he believes that the whole of the phænomena can be explained by supposing that the Alps, Jura, and all the surrounding tracts have undergone great and unequal elevations since the period of the formation of the earliest glaciers—elevations which, dislodging vast portions of those bodies, floated away many huge blocks in ice rafts, down straits then occupied by water, and also hurled on vast turbid accumulations of boulders, sand and gravel. To these operations he attributes the purging of the Alpine valleys of the great mass of their ancient alluvia, and also the conversion of glacier moraines into shingle and boulders. He denies that the famous blocks of Monthey opposite Bex, can ever have been a portion of the left lateral moraine of a glacier which occupied the whole of the deep valley of the Rhine,—as Charpentier has endeavoured to show; and he contends that if such had been the case they would have been associated with numberless smaller and larger fragments of all the rocks which form the sides of the valley through which such glaciers must have passed. They are, however, exclusively composed of the granite of Mont Blanc; and must therefore, he thinks, have been transported by ice rafts,—which, having been forced with great violence through the gorge of St. Maurice, served to produce many of the striæ which are there so visible on the surface of the limestone\*.

Fully admitting that the stones and sand of the moraines of modern glaciers scratch, groove, and polish rocks, Sir Roderick Murchison still adheres to the idea he has long entertained from surveys in Northern Europe†, that other agents more or less subaqueous, including icebergs and heavy masses of drift, have produced precisely similar results. He cites examples in the Alps, where perfectly water-worn or rounded gravel being removed, the subjacent rocks are found to be striated in the directions in which such gravel has been moved; and he quotes a case in the gorge of the Tamina,

\* Mr. Charles Darwin, in a recent letter to the author, adheres to his old opinions on this point, derived from observations in America, and says, "I feel most entirely convinced that *floating ice* and *glaciers* produce effects so similar, that at present there is, in many cases, no means of distinguishing which formerly was the agent in scoring and polishing rocks. This difficulty of distinguishing the two actions struck me much in the *lower parts* of the Welsh valleys."

† See *Silurian System*, pp. 509 to 547; *Russia in Europe and the Ural Mountains*, vol. i. pp. 507 to 559; *Presidential Discourses*, Proc. Geol. Soc. Lond. vol. iii. p. 671, and vol. iv. p. 93; *Journ. of Geol. Soc. Lond.* vol. ii. p. 349; and *Trans. R. Geol. Soc. Cornwall*, vol. vi.



above the Baths of Pfeffers, where this ancient striation, undistinguishable from that caused by existing glaciers, has, by a very recent slide of a heavy mass of gravel from the upper slope of the same rock, been crossed by fresh scorings and striæ, transverse to those of former date, from which the markings made in the preceding year only differ in being less deeply engraved. He also adverts to the choking up of some vallcys, particularly of the Vorder or Upper Rhine below Dissentis, by the fracture, *in situ*, of mountains of limestone, which constitute masses of enormous thickness, made up of innumerable small fragments, all of which have been heaped together since the dispersion of the erratic blocks; and he further indicates the effects of certain great slides or subsidences within the historic æra.

In considering the distribution of the erratic detritus of the Rhone, the author having denied that it can ever have been carried down the chief valley to the Lake of Geneva in a solid glacier, he still more insists on the incredibility of such a vast body of ice having issued from that one narrow valley, as to have spread out over all the low country of the cantons Vaud, Friburg, Berne and Soleure, and to have protruded its erratics to the slopes of the Jura, over a region of about 100 miles in breadth from north-east to south-west, as laid down in the map of Charpentier. He maintains, that in the low and undulating region between the Alps and the Jura, the small debris derived from the former has everywhere been water-worn, and that there is in no place which he saw anything resembling a true moraine; and he therefore believes, that the great granitic blocks of Mont Blanc were translated to the Jura by ice-floats, when the intermediate country was under water. He further appeals to the water-worn condition of all the detritus of the high plateaux around Munich, 1600 and 1700 feet above the sea, to show that a subaqueous condition of things must be assumed, for the whole of the northern flanks of the Alps, when the great erratic blocks were carried to their present positions.

Prof. Guyot of Neufchatel has endeavoured to show, that the detritus of the rocks of the right and left sides of the upper valley of the Rhone have also maintained their original relative positions in the great extra Alpine depression (Lake of Geneva), and that these relations are proofs, that nothing but a solid glacier could have arranged the blocks in such linear directions. But the author meets this objection by suggesting that there are notable examples to the contrary. He also refers to the great *trainées* of similar blocks which preserve linear directions in Sweden and the low countries south of the Baltic, to show that as this phænomenon was certainly there produced by powerful streams of water, so may the Alpine detritus have been arranged by similar agency. In alluding to the drainage of the Isère, he further points to the admission of Prof. Guyot, that nearly all its erratic detritus, both large and small, is rounded and has undergone great attrition; and he quotes a number of cases in which such boulders and gravel, derived from the central ridges of Mont Blanc, have been transported *across* tracts now consisting of lofty ridges of limestone with very deep intervening valleys; and therefore he infers that the whole configuration of these lands has been since much changed, in-



cluding the final excavations of the valleys and the translation of enormous masses of broken materials into the adjacent low countries of France.

In conclusion, it is suggested, that the dispersion of the far-travelle Alpine blocks is a very ancient phenomenon in reference to the historic æra, and must have been coeval with the spread of the northern or Scandinavian erratics, which it has been demonstrated was accomplished chiefly by floating ice, at a time when large portions of the Continent and of the British Isles were under the sea. Viewing it therefore as a subaqueous phenomenon, Sir Roderick is of opinion that the transport of the Alpine blocks to the Jura falls strictly within the dominion of the geologist who treats of far bygone events, and cannot be exclusively reasoned upon by the meteorologist, who invokes a long series of years of sunless and moist summers to account for the production of gigantic glaciers upon land under present terrestrial conditions. This last hypothesis is, it is shown, at variance even with the physical phenomena in and around the Alps, whilst it is in entire antagonism to the much grander and clearly established distribution of the erratics of the North during the glacial period. The effect in each case is commensurate with the cause. The Scandinavian chain, from whence the blocks of northern Europe radiated, is of many times larger area than the Alps, and hence its blocks have spread over a much greater space. All the chief difficulties of the problem vanish when it is admitted, that enormous changes of the level of the land in relation to the waters have taken place since the distribution of large erratics; the great northern glacial continent having subsided, and the bottom of the sea further south having been elevated into dry land, whilst the Alps and Jura, formerly at lower levels, have been considerably and irregularly raised.

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JUNE 13, 1849.

The following communication was read:—

*On the Valley of the ENGLISH CHANNEL.*  
By ROBERT A. C. AUSTEN, Esq., F.R.S., F.G.S.

THE valley of the English Channel presents two points of geological interest which may be considered as new—the one relating to the nature of its bed, as a guide to the conditions of origin of our older marine formations; the other to its age as an area of depression. For the former purpose the area may appear to be too limited; the extent of surface, however, from the Straits of Dover to the outward line of soundings, is more than equal to the whole of the South of England from the Land's End to the Wash, an area which comprises the whole series of English geological formations. Having had frequent opportunities of cruising about this Channel, I have been enabled, at one time or another, to visit nearly every portion of its shores on either side, and to examine its bed with the dredge and sounding-lead.