

THE GEOLOGICAL SOCIETY'S "GLACIAL" DEBATES, 1840-1841

November 4, 1840

Agassiz read a paper on "On Glaciers, and the evidence of their having once existed in Scotland, Ireland, and England [Earlier, in June, he had read "On the polished and striated surfaces of the rocks which form the beds of Glaciers in the Alps."]

Buckland began a reading of "On the Evidences of Glaciers in Scotland and the North of England" (this was completed on December 2).

"The following discussion took place:

"Mr. MURCHISON called upon the mathematicians & physical geographers present to speak of the objections to Dr. Buckland's glacial hypothesis, himself should attend only to the facts of the case. Of the scratches & polish on the surface of certain rocks there is no doubt, & are glaciers the cause is the question. Could they be done by ice alone? If we apply it to any as the necessary cause, the day will come when we shall apply it to all. Highgate Hill will be regarded as the seat of a glacier, & Hyde Park & Belgrave Square will be the scene of its influence. Dr B. has in his paper assumed that all these heaps of diluvium are moraines — but I would rather examine the subject under the old name Diluvium and with our old ideas of diluvial action than by using the term moraines assume the question proved. On Schiehallion there are [?] rocks. If Schiehallion has been covered with glaciers there ought to be some [indications]. If the height be great the result should be proportionate. There ought to be a coordinate relation in the phenomena. But in the Highland mountains not one-third the elevation of the Alps, we have moraines two and three times the magnitude of any known in Switzerland. Formerly, when we found traces of fragmented rocks disposed around a mountain, we attributed it to the successive periods of elevation in that mountain. The Parallel Roads of Glen Roy were compared to sea beaches; now all are attributed to the action of Ice. And not only these but Edinburgh & Stirling, and other places equally out of the reach of such action, did glaciers ever exist in the higher chains, are to be covered with a mass of ice! These grooved & striated surfaces and heaps of boulders are also to be found in Scandinavia, on the east of the gulf of Bothnia, all proceeding from north and northwest. Have these crossed the gulf on ice? In Russia, too, we shall find them where there are no mountains. And if we look to the remains of marine shells found in beds elevated, differing in no respect from those in our present seas except that they are called "Pleistocene" (by James Smith and Lyell), we have proof of a lower elevation at the very time (the period following upon the more tropical epochs), when these glaciers should be introduced. On these accounts I am still contented to retain our old ideas, that when a mountain was elevated, or a body of water passed over a series of elevations, the diluvium would descend with [streams] and be disposed in mounds & terraces according to the direction of currents, &c.

"Professor AGASSIZ.---- Mr. Murchison has objected to the glacial theory in the only way in which it can be objected to — he allows that the whole is granted as soon as you grant a little bit. For here, as in other cases we argue from what is proved, to what is to be proved. In Switzerland the action of glaciers is yearly seen by thousands of foreigners, and of these facts there can be no doubts [nor as to the former] extent of glaciers. In the Glacier de l'Aar, grooves, &c. are to be found in the valley seven leagues (22 m) from the end of the present glaciers. Did we find these surfaces only on the hard rock we might suppose they were merely uncovered by the action of the glaciers. but on the soft limestone rocks these grooves are only to be seen on the surfaces from which the glacier has just retreated. Many glaciers traverse such rocks only (equivalents of our Lias), and there the grooves are annually renewed in winter & removed by the atmospheric action in summer. I have been many hundred feet under the glacier of Monte Rosa, and found the quartzose sand forming a bed beneath, and acting like emery upon the rocks. A moraine may be distinguished by certain characters from any other accumulation of fragmented rocks. From the sides of the glaciers moving faster than the middle there is a continual tendency to throw the fragments into lines at the sides (lateral moraines), and when two glaciers descending from different gorges unite a medial moraine is formed. The [lateral] moraines are exposed to constant friction with the rocks with which they are brought in contact, and their terminations are passed over by the whole mass of the glacier, so that they become rounded and striated, whilst the medial moraines remaining on the surface continue angular. When the glacier retreats in the summer, the medial moraine composed of angular fragments is spread out over the surface of the lateral and the terminal moraines, composed of rounded fragments; and it is by these characteristics that we have proved the existence of moraines in Scotland, Ireland, and the north of England. There are moraines in the Alps 200 feet wide, composed of boulders several feet in diameter.

"Mr. LYELL spoke of the size of moraines and the way in which they might under certain circumstances attain any magnitude. A glacier has been known to retire half a mile in a single summer, [a number of] moraines have been in succession left, and in severe winters all these might be driven successively into one by the downward motion of a glacier.

"Mr. GREENOUGH spoke of the arguments derivable from analogy &c., and objected to the mode in which the Geological Society was in the habit of accounting for phenomena. Instances of accumulations of travelled rocks [occur in] north Germany; from a careful comparison some of these must have crossed the Baltic. In the valleys of Switzerland some deposits must have crossed Lake Geneva, and ascended very high mountains. "Does Prof. Agassiz suppose that the Lake of Geneva was occupied by a glacier 3,000 feet thick?" (Agassiz.--- "At least!") [Mr. Greenough then referred to] changes of climate necessary to account for these phenomena [and to the] objection from the tropical nature of remains in recent deposits. [He considered it to be the] climax of absurdity in geological opinions. In one period, the Crag, we have three opposite conditions blended: corals; tropical; peat; temperate; shells, pronounced by Dr. Beck, arctic!

"Mr. LYELL.--- "Mr. Greenough confuses 4 distinct epochs under the name of Crag. The first comparatively tropical (Coralline Crag), the others Temperate (Red and Norwich Crag), and the period of the Peat bogs (Lacustrine deposits) more recent than any."

"Mr. JOHN EDWARD GRAY. — "The corals of the Crag appear to me as arctic as the shells. I know no reason for making them tropical."

"Mr. GREENOUGH [Remarked] on the size of the blocks on mountains, agency of floating ice, and on mountains as the physical boundaries of different kinds of diluvium.

"Dr. MITCHELL inquired if Dr. Buckland confined the glaciers to the Highlands or whether he made them descend to the Lowlands.

"Dr. BUCKLAND expressed himself ready to answer any questions on the subject under discussion, or any involved in his paper, but considered the present question irrelevant.

"Dr. MITCHELL considered his question relevant to the subject.

"Dr. BUCKLAND rose to reply, but Mr. WHEWELL rose. (Cheers, and "Mr Whewell!").

"Mr. WHEWELL.--- At this late hour it is impossible to go into the question of the physical changes necessary to allow of the existence of glaciers in this country. I shall, therefore, confine my remarks to the subject as discussed this evening, and it does appear to me that the way in which Mr. Lyell has treated it is not the most fair and legitimate. He says: "If we do not allow the action of glaciers, how shall we account for these appearances?" This is not the way in which we should be called upon to receive a theory. Now, it is not within our reach at present to refer each set of phenomena in geology to its adequate cause, but that is no reason why we should receive any theory that is offered to account for it. This glacial theory is brought forward to explain what has hitherto, to a great extent, been found inexplicable — the nature and position of diluvial detritus over considerable areas & in widely different climates. So far it is founded on strict comparison and analogy it is to be received, but we must not overrate its influence; and it appears to me incomplete in 3 important particulars: — Firstly in accounting for such an extent of diluvium over such wide areas, in countries of such opposite physical structure, surface, climate, &c. Secondly [from the] marine remains of glacial period, showing the continents to be submerged. Mr. Darwin has described an Island capped with snow in the equivalent latitude of Yorkshire, and by supposing an equal extent of water in our Polar regions, we might induce a degree of cold sufficient for that; but these glacial phenomena are found over too wide an extent to allow of that. (Mr. LYELL.--- "I have attempted to account for that in my paper --- here interrupted. Dr. BUCKLAND.--- "So have I in a paper — which is not yet written!"). Mr. WHEWELL, continuing --- "Our attention to-night is limited to Dr. Buckland's paper. Thirdly, the physical conditions under which glaciers now exist. We find them universally stretching out from lofty mountain-chains which take their rise in warm climates, so as to allow of the

downward motion and the retiring in summer. Mr. Lyell speaks of the prodigiously rapid retreat of a glacier which amounted to half a mile in a single summer. But where shall we obtain mountains as fulcra for glaciers, stretching many leagues into the plains, producing such results as are ascribed to their action in Scotland.?

"Dr. BUCKLAND resigned the chair to Mr. Greenough, and argued the a priori credit to be attached to his "narrative" from the circumstances of his having been a "sturdy" opponent of Professor Agassiz when he first broached the glacial theory, and having set out from Neuchatel with the determination of confounding & ridiculing the professor. But he went and he saw all these things, and returned converted. And he considered the testimony of four such competent observers as himself, Agassiz, Renouard, and [De Charpentier] who, next to Saussure, had spent more time in the Alps than any other geologist, sufficient to prove to all the truth of their observations and the correctness of their inferences. He referred to Professor Agassiz's book, and condemned the tone in which Mr. Murchison had spoken of the "beautiful" terms employed by the Professor to designate the glacial phenomena. That highly expressive phrase "roches moutonnees," which he had done so well to revive, and that other "beautiful designation" the glacier remanie! "remanie!" "remanie!" continued the doctor most impressively amidst the cheers of the delighted assembly, who were by this time elevated by the hopes of soon getting some tea (it was a quarter to twelve pm) and excited by the critical acumen and antiquarian allusions and philological lore poured fourth by the learned doctor, who, after a lengthened and fearful exposition of the doctrines and discipline of the glacial theory, concluded — not, as we expected, by lowering his voice to a well-bred whisper "Now to — &c." — but with a look and tone of triumph he pronounced upon his opponents who dared to question the orthodoxy of the scratches and grooves, and polished surfaces of the glacial mountains (when they should come to be d---d) the pains of eternal itch without the privilege of scratching!"

November 18, 1840

Lyell began a paper, "On the Geological Evidence of the former existence of Glaciers in Forfarshire."

December 2, 1840,

Lyell concluded "On the Geological Evidence of the former existence of Glaciers in Forfarshire.

Buckland concluded "On the Evidences of Glaciers in Scotland and the North of England."

"Mr. JAMES SMITH referred to the evidence of the upper and lower marine beds along the coast of Scotland, and to the arctic character of the marine shells.

"Mr. WHEWELL felt in a dilemma owing to the difficulties in accounting for the glaciers. Either a decrease of central heat, which has since returned—a supposition at variance with all the known laws of physics— or a different distribution of land and water in the northern hemisphere [must be supposed]. Granting the change of climate, where would be the Alps from which to suspend the glaciers of Scotland ? They could not have descended from such isolated peaks as Schiehallion or Ben Nevis.

"Mr. DE LA BECHE spoke of the changes of conditions necessary for the existence of glaciers in Scotland, and of the recent date of elevatory movements.

"Mr. LYELL explained the distribution of superficial debris in a portion of Scotland. Three distinct covers: (1) universal, composed of fragments of the subjacent rocks with a slight admixture of foreign matter ; (2) Till, unstratified drift clay, with boulders, covered by (3) stratified gravel. The first, supposed to have been distributed by sheets of ice spreading all over the country; the second by glaciers; and the third *remanie*, by melting of glaciers &c.

"Mr. JOHN PHILLIPS examined the question of the Shap Fell granite boulders and their distribution over Stainmoor, across a valley twelve or fourteen miles wide, to Darlington &c.

"M. AGASSIZ advocated the origin of gravel from glacial action and not from marine currents, from the fact of the numerous lakes of Scotland in which there was no gravel. Had marine currents formed the Till it would have filled all these hollows. On the glacial hypothesis they would be filled with ice and thus preserved. Recommended the same caution to his opponents in making objections as had been so strongly urged upon himself in generalising.

"Dr. DAUBENY referred to the wide extent over which the grooved surfaces are found in America &c., and to the difficulties attending the degree of cold necessary.

"Mr. GREENOUGH argued against the recent elevatory movements. The decreasing level of the Baltic he attributed to the clearing of the forests and consequent smaller supply of water, and to the widening of the entrance which promoted its escape .

"Mr. MURCHISON spoke of the universality of the cause which produced the Till &c. of Scotland, its operation over Russia &c., and referred to the agency of drift and floating ice.

"Dr. BUCKLAND did not explain all diluvial phenomena by the operation of glaciers; he allowed the existence of raised bars and beaches, of currents, of floating and drift-ice, but contended that glaciers alone would account for many phenomena observable in Scotland, &c. He discussed the possibility of a glacier descending from Shap Fell, crossing the valley of the Eden, and passing over Stainmoor; and of repeated debacles spreading the detritus still further."

REFERENCES

Woodward, H.B. 1908 The history of the geological society of London (Longmans, Green & Co., London) <http://books.google.com/books?id=cyjAAAAIAAJ&pg=PR3>