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Baron Von Humboldt
with the authors
regards.
June 22. 1855

39.1

Royal Institution of Great Britain.

WEEKLY EVENING MEETING,

Friday, April 27, 1855.

The Duke of Northumberland, K.G. F.R.S. President,
in the Chair.

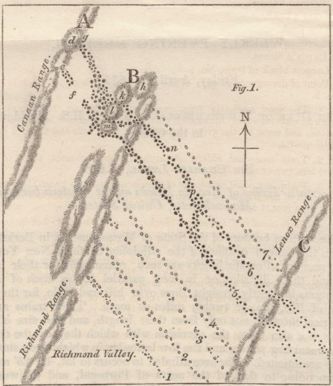
Sir Charles Lyell, F.R.S.

On certain Trains of Erratic Blocks on the Western borders of Massachusetts, United States.

On the western borders of the State of Massachusetts, in Berkshire, and on the eastern confines of the adjoining State of New York, a great number of erratic blocks are seen, remarkable for their large size and their distribution in long parallel trains, each of them continuous in nearly straight lines over hill and dale, for the distance of five, ten, or twenty miles or more. These trains are of geological interest, not only from their length, and the size of the blocks, but also from the precision with which they can be traced to their starting points, and the low latitudes in which these starting points are situated. The area alluded to occurs in lat. 42° 25′ south, corresponding to that of the north of Portugal, and the western borders of Berkshire, where they join the State of New York, are about 130 miles from the Atlantic coast, in a direction due west of the city of Boston, in Massachusetts.

In the accompanying plan, Fig. 1, it will be observed that the mountain ranges A B C run N.N.E. and S.S.W., whereas the trains of erratic blocks (from No. 1 to No. 7 inclusive,) have a direction nearly transverse to these ranges, and consequently to the intervening valleys, their direction being about N.W. and S.E. In one sense we may affirm that the course of the stones has no relation whatever to the present configuration of the country, because the present drainage or flow of the rivers is quite in a different direction, but in another point of view we shall find that a close relation can be made out between the actual inequalities of hill and dale, and the course and mode of dispersion of the erratics; so that there is good reason to infer that the superficial inequalities were very nearly what they are now, before any of the trains originated.

Distance in a straight line between the mountain ranges A and C, about eight miles.



Map, showing the relative position and direction of seven trains of erratic blocks in Berkshire, Massachusetts, and in part of the State of New York.*

A. Canaan range, in the State of New York. The crest consists of green chloritic rock.

B. Richmond range (part of the Taconic range of Hitchcock?) the western division of which consists in Merriman's Mount of the same green rock as A, but in a more schistose form, while the eastern division is composed of slaty limestone.

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* As the description of the trains could not be understood without a ground plan, the above copy of a diagram, exhibited during the lecture, is thought necessary; but it makes no pretensions to geographical accuracy, the speaker and his companion Prof. Hall having been unable to procure a good map of the district, on which to lay down in detail the results of their observations.

C. The Lenox range, consisting in part of mica-schist, and in some districts of crystalline limestone.

d. Knob in the range A, from which most of the train No. 6, is supposed to have been derived.

e. Supposed starting point of the train No. 5, in the range A.

f. Hiatus of 175 yards, or space without blocks.

g. Sherman's House.

h. Perry's Peak.

k. Flat Rock.

l. Merriman's Mount.

m. Dupey's Mount.

n. Largest block of train, No. 6.

p. Point of divergence of part of the train No. 6, where a branch is sent off to No. 5.

No. 1. The most southerly train examined by Messrs. Hall and Lyell, between Stockbridge and Richmond, composed of blocks of black slate, blue limestone, and some of the green Canaan rock, with here and there a boulder of white quartz.

No. 2. Train composed chiefly of large limestone masses, some of them divided into two or more fragments, by natural joints.

No. 3. Train composed of blocks of limestone and the green Canaan rock; passes south of the Richmond Station on the Albany and Boston railway; is less defined than Nos. 1 and 2.

No. 4. Train chiefly of limestone blocks, some of them 30 feet in diameter, running to the north-west of the Richmond Station, and passing south of the Methodist Meeting-house, where it is intersected by a railway cutting.

No. 5. South train of Dr. Reid, composed entirely of large blocks of the green chloritic Canaan rock; passes north of the Old Richmond Meeting-house, and is three-quarters of a mile north of the preceding train (No. 4).

No. 6. The great or principal train (north train of Dr. Reid), composed of very large blocks of the Canaan rock, diverges at *p*, and unites by a branch with train No. 5.

No. 7. A well-defined train of limestone blocks, with a few of the Canaan rock, traced from the Richmond to the slope of the Lenox range.

Dr. Reid, the agriculturist of Berkshire, first called attention in 1842 and 1845 to these phenomena. Professor Hitchcock contributed many valuable observations in 1844, and Professors Henry D. and William B. Rogers treated of the same subject in 1846.* The district was re-examined in October 1852, by Professor J. Hall and Sir Charles Lyell, by whom some of the data referred to in this discourse were ascertained. Within the area particularly referred to, the trains Nos. 5 and 6 are the most conspicuous, by their length and by the magnitude and frequency of the blocks composing them. These fragments consist of a green chloritic rock, remarkably tough, sometimes compact, but occasionally schistose. It is met with in place at *d*, in the highest crest of the Canaan ridge, and reappears in its more slaty form in the

* "Boston Journal of Natural History," for June 1846.

western division of the Richmond ridge B. at *l*, or Merriman's Mount. It passes on the one hand into a quartzose conglomerate, and on the other, when most metamorphic, into a crystalline rock, in which sometimes chlorite, sometimes hornblende and felspar are developed. A large proportion of the green fragments, in trains 5 and 6, have evidently come from the ridge A, and a large proportion of the whole from its highest summit *d*, upon which fragments often 30 feet in length may now be seen, some of them having probably constituted for years the exposed crest of the ridge, and having in that position acquired a smoothed and rounded outline so characteristic of the protuberances of hard rock in regions where erratics and glacial striæ abound. Such dome-shaped masses are called "roches montonnées," on the borders of Swiss glaciers. Several of the fragments having this shape, and lying on the crest of A, have been slightly removed from their original position, as if just ready to set out on their travels. They are angular in their lower parts, where they exhibit such an outline as the jointed rock would possess if a great fragment fell from an undermined cliff.

To the westward of the ridge A no similar green blocks are to be found, not even a small number, such as we might have expected to roll down to the base of a hill having so steep a western declivity. It is evident, therefore, that the propelling power, whatever it was, acted exclusively in a south-easterly direction.

Dr. Reid has traced the train No. 5 for more than ten, and No. 6 for more than twenty miles to the south-east, crossing the Richmond and Lenox mountains B and C, and probably extending beyond the points to which they have already been followed. Messrs. Hall and Lyell found both trains extremely well-defined after they emerge from the Richmond range, but by no means so distinct in their passage over the first valley between A and B. A great number of blocks have collected at the base of *d*, Fig. 1, or the highest knob before alluded to of A, particularly around *g*, or Sherman's House. From this point to the Richmond range, a nearly continuous stream may be traced, and the blocks are seen to pass through a gap or depression, in the eastern division of the ridge B, between Flat Rock and Merriman's Mount, *k* and *l*. But when we attempt to follow the other train, No. 5, from its supposed point of origin *e*, (a spot about half a mile distant from *d* before alluded to,) we find at *f* an hiatus, not less than 175 yards long, where there are no erratics. This break is not caused by the stones having been used up for building, no such materials being observable in the walls enclosing fields, or in the farm-houses in the neighbourhood. A vast number of blocks seem to have crossed the valley in a direct line between A and B, and to have accumulated on the north-western slope of Merriman's Mount *l*, as well as to the south of it, around Dupey's Mount *m*; and they seem to have crossed the Richmond ridge by depressions both to the north and south of Dupey's Mount, those to the north proceeding westward to join the train No. 6. The number of large blocks lying on the west slope of Dupey's Mount, and many of them to the south of the line which would connect the southern train, No. 5, with its supposed starting point *e*, is very great. One of these, 24 feet long, is poised upon another which is about 19 feet in length. The largest of all, composed like the rest of the green Canaan rock, lies on the west flank of Dupey's Mount, and is called "the Alderman." Dr. Reid measured it, and ascertained that it is above 90 feet in diameter, and not much under 300 feet in circumference. At some points about 40 or 50 blocks, the smallest of them larger than a camel, may be seen at once. Among the larger masses the best known, in consequence of its proximity to the Richmond Meeting-house, belongs to train No. 6, and is that marked *n* on the plan, Fig. 1. According to the measurement of Messrs. Hall and Lyell it is 52 feet long, by 40 in width, its height above the drift in which it is partially buried being 15 feet. At the distance of several yards occurs a smaller block, three or four feet in height, 20 feet long, and 14 broad, composed of the same compact chloritic rock, and evidently a detached fragment from the bigger mass, to the lower and angular part of which it would fit on exactly. This erratic (*n*) has a regularly rounded top, worn and smoothed like the roches montonnées before mentioned, but no part of the attrition can have occurred since it left its parent rock, the angles of the lower portion being quite sharp and unblunted.

After the two great trains, Nos. 5 and 6, have crossed the ridge B, and entered the Richmond valley, which is about four miles broad, and about 800 feet deep below the crests of A and B, each train is exceedingly well defined. They are about half a mile apart, the train No. 6 varying in width from 100 to 300 feet, the space intervening between them usually very free from erratics, but here and there a solitary large straggler being visible. At one point *p*, Fig. 1, part of the train No. 6 diverges and forms a branch uniting with No. 5.

The average size of the blocks of all the seven trains laid down on the plan lessens sensibly in proportion as we recede from their point of departure, yet not with any regularity, a huge block recurring here and there in the midst of a train of smaller ones. Many which have wandered farthest from their parent rock retain their angles extremely fresh and sharp. Almost everywhere beneath the trains is a deposit of sand, mud, gravel, and stones, for the most part unstratified, and resembling the "northern drift" of Great Britain and parts of the north of Europe. It varies in thickness from 10 to 50 feet, being of greatest depth in the valleys. The uppermost portion is occasionally, though rarely, stratified; and where stratification occurs, it seems as if the mass first thrown down had been acted upon by currents, and partially rearranged. This drift has been well exposed in some recent railway cuttings, where it is occasionally seen to be 20 or 30 feet thick, immediately under several of the trains before alluded to. The stones in general are more rounded than the erratics already described, occasionally some are seen with one or more flattened, smooth, striated, or furrowed sides. They consist invariably, like the seven trains before mentioned, of kinds of rock only met with in the region lying to the north-west. In one cutting, the drift below the main train No. 6 is 30 feet thick, and contains one or two angular blocks of the green Canaan rock, of considerable, but not of the largest size. There are no appearances here or elsewhere warranting the conclusion that the trains owed their origin to the removal of an upper portion of the covering of drift, the lighter materials having been washed away, and the heavier made to stand out in relief. On the contrary, the erratics of each train, whether large or small, look as if they had dropped down over the linear spaces where they are now strewed, on the surface of hill and valley, equally where the drift is thickest, as where it is very thin or wanting. As a rule, the drift contains no blocks of the first magnitude, although a few occur, and some of the biggest are partially buried in drift, showing that the transport of the heavier, and of a certain portion of the lighter materials, was contemporaneous.

Almost in every place where the removal of the superficial detritus has exposed the underlying rock, a polished, striated, and furrowed surface is seen, like that underneath the modern glaciers of the Alps. The direction of the rectilinear furrows or grooves has been proved by a multitude of observations, made by Professor Hitchcock in this and other adjoining parts of Massachusetts and New York, to be from N.W. to S.E. or similar to the course of the large erratics.* The same geologist has pointed out that such ridges as A B and C are smooth and furrowed, not only on their tops, but sometimes 100 or 200 feet below, on their north-western sides; whereas, on their south-eastern declivities, if steep, there has been no such action, although these also are grooved and polished where their slope is gentle. The furrows, which are from an inch to a foot in depth, usually cross the strike of the highly inclined slates and slaty limestones at a considerable angle, and in such a manner as to demonstrate that the strata of the ridges A B and C, and of the intervening valleys, bent as they are into a series of anticlinal and synclinal folds, were already in their present position, and had even suffered aqueous denudation before the drift was thrown down upon them, and therefore long before the distribution of the erratics above described had taken place.

Although the trains, Nos. 5 and 6, are the most conspicuous, several of the others are well defined, and contain limestone blocks 30 feet in diameter. Thus No. 7 was seen on the western flank of the Lenox range, and followed across the Richmond valley to the eastern side of the ridge B, where the limestone, which has supplied

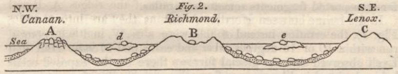
* "Final Report on Geology of Massachusetts," p. 383, *et seq.* 1841.

the travelled masses, is in situ. In like manner, Messrs. Hall and Lyell observed, half a mile south of Pittsfield, enormous blocks of mica-schist, from 30 to 50 feet in their longest diameter, on the south-east side of the Lenox range C ; whereas no similar fragments of mica-schist, whether large or small, are found in any part of the Richmond valley, or on the ridge B, or indeed anywhere between A and the Hudson river.

Some boulders of white quartz rock, two or three feet in diameter, make a part of almost every train, as well as of the subjacent drift, and these may be traced to hills, between the Canaan ridge and the Hudson river, where the Potsdam sandstone has been altered into quartzite.

Sir Charles then proceeded to explain his theory. He believes that all the large erratics have been transported to the places they now occupy by floating ice,—not by icebergs, nor by terrestrial glaciers, but by coast-ice. The hypothesis of glaciers is out of the question, because, even if we could imagine that in lat. 42° 30′ N., the ridges A B C, now only from 1000 to 2000 feet above the sea, once rose, and that at a period, geologically speaking, very modern, to such an elevation as to enable them to generate glaciers, still such glaciers could not have descended from the higher regions in one direction only. They would have radiated from a centre, carrying as many blocks westward as eastward. Their course, moreover, would have been principally S.S.W., or down the valleys now separating the ridges, instead of being south-east, or almost at right angles to the valleys. If, on the other hand, we assume that the country was lower instead of higher, so as to have been submerged beneath the waters of a sea, in which icebergs floated annually from arctic regions, these bergs might bring with them gravel and stones of northern origin, but could not without the aid of coast-ice become freighted with blocks derived from the very region referred to in this discourse, (lat. 42° N.) The northern ice might aid, by chilling the waters of the ocean, and increasing the quantity of coast-ice in a low latitude, but it could do little more.

Fig. 2.



d, e Masses of floating ice carrying fragments of rock.

Suppose the highest peaks of the ridges A B C, in the annexed diagram, to be alone above water, forming islands, and *d e* to be masses of floating ice which drifted across the Canaan and Richmond valleys, at a time when they were marine channels, separating islands, or rather chains of islands, having a N.N.E. and S.S.W. direction.

A fragment of ice, such as *d*, freighted with a block from A, might run aground, and add to the heap of erratics at the N.W. base of the island B, or passing through a sound between B and the next island of the same group, might float on till it reached the channel between B and C. Year after year two such exposed cliffs in the Canaan range as *d* and *e* (Fig. 1), undermined by the waves, might serve as the points of departure of blocks, composing the trains Nos. 5 and 6. It may be objected that oceanic currents could not always have had the same direction; this may be true, but during a short season of the year when the ice was breaking up the prevailing current may have always run S.E.

If it be asked why the blocks of each train are not more scattered, especially when far from their source, it may be observed, that after passing through sounds separating islands, they issued again from a new and narrow starting point; moreover, we must not exaggerate the regularity of the trains, as their width is sometimes twice as great in one place as in another; and No. 6 sends off a branch at *p*, which joins No. 5. There are also stragglers, or large blocks, here and there in the spaces between the two trains. As to the distance to which any given block would be carried, that must have depended on a variety of circumstances; such as the strength of the current, the direction of the wind, the weight of the block, or the quantity and draught of the ice attached to it. The smaller fragments would, on the whole, have the best chance of going farthest; because, in the first place, they were more numerous, and then being lighter, they required less ice to float them, and would not ground so readily on shoals, or if stranded, would be more easily started again on their travels. Many of the blocks, which at first sight seem to consist of single masses, are found, when examined, to be made up of two, three, or more pieces, divided by natural joints. In case of a second removal by ice, one or more portions would become detached and be drifted to different points further on. Whenever this happened the original size would be lessened, and the angularity of the block previously worn by the breakers would be restored, and this tendency to split may explain why some of the far-transported fragments remain so angular.

In the ravine between Merriman's Mount and Flat Rock (*h* and *l*, Fig. 1), the erratics, instead of following a N.W. and S.E. course, run within 10 or 15 degrees west and east; and Messrs. Hall and Lyell observed that the glacial furrows there on the exposed rocks below deviated in like manner from the normal direction, and were directed like the train of erratics nearly west and east. They were told that the like deflection, both of trains and furrows, was observable where Nos. 5 and 6 cross the Lenox range; and this deflection is so represented on the plan (Fig. 1); although the speaker had not an opportunity of verifying the fact. The direction of floating ice, when threading the sounds separating islands, would be governed by the shape of the land and the marine channels, and might be expected to differ from the direction of currents flowing in the open sea between chains of islands.

Sir C. Lyell endeavoured in 1842, when explaining the origin of drift, boulders, and glacial furrows in the neighbourhood of the Falls of Niagara, both in Canada and in the State of New York,* to show that the whole region, with its elevated platforms and its valleys, had first gone down gradually, and had then been re-elevated during the glacial period. All geologists who are acquainted with Berkshire, Massachusetts, are agreed that the position of the erratics cannot be explained by the subsequent unequal elevation of the mountain ranges, as if B, for example, had been uplifted to a greater height than A, after the great boulders had been stranded on B. It is clear that the ridge B has intercepted many erratics on its north-western side, as it would do now, if submerged, and the blocks have chiefly crossed through gaps or depressions in B. The glacial furrows also are such as would be made on the fixed rocks, after they had already assumed their actual position, and when the present hills and valleys existed.

Although the principal mass of drift had accumulated before the trains, yet we see some of the biggest blocks partially buried in drift. This we might have expected, according to the hypothesis above suggested, for coast-ice, such as forms annually in the Gulf of St. Lawrence and along the coast of Labrador, does not merely bear away great stones but also mud, sand, and gravel.

The speaker exhibited a drawing of a large angular block of sandstone, about eight feet in diameter, which he and Mr. J. W. Dawson saw in 1852, stranded on the mud-flats near the mouth of the Petitcodiac estuary, where it joins the Bay of Fundy, and where the water is salt. The ferrymen stated that this block was brought down by ice three years before, from a cliff several miles up the river. About the year 1850 much larger blocks of sandstone were removed by coast-ice from the base of a perpendicular cliff at the South Joggins, in the Bay of Fundy, in salt water, and floated for about half a mile, where they dropped or were grounded on one side of the pier built for loading vessels with coal. The vessels being thereby prevented from nearing the pier it was found necessary to blast these ice-borne rocks, at low tide, with gunpowder. All this occurred in latitude 46° N., corresponding to that of Bordeaux, and when we bear in mind that the Bay of Fundy opens towards the south, and is therefore never invaded by icebergs, such as are stranded occasionally near St. John's, Newfoundland, or such as are annually drifted far to the south of the Bay of Fundy in the open ocean, we may well imagine that, with a different configuration of the land, coast-ice may once have exerted great power as far south as the latitude of Berkshire. The buoyant power of sheets of ice, even of moderate thickness, is so great that the magnitude of

* "Travels in North America," Vol. I., p. 99 ; and Vol. II., p. 48.

erratics depends more on the dimensions of the fragments into which rocks undermined by the sea happen to split, than on the peculiar intensity of the frost in that region.

It has been objected to the theory of submergence that the great train, No. 6, has climbed a part of the ridge B, higher than its supposed starting point in A. But there are no exact barometrical or trigonometrical data for this assertion. Messrs. Hall and Lyell could only estimate roughly the relative heights of the knob *d* in A, and that of the pass between *k* and *l* in B, by means of a spirit-level, as they stood on the Canaan knob. It appeared to them that the gap in B, or the ravine between Merriman's Mount and Flat Rock, is 50 or 100 feet below the highest crest of A, in which case the objection falls to the ground. Some of the erratics of No. 6, in the Richmond valley, have probably come from an elevated point in Merriman's Mount, and therefore present no difficulty, since that mount consists of the green chloritic rock, but others have come from the Canaan ridge, and have crossed the ridge B, as before stated. If it could be shown that some of these stones repose on B, at points actually higher than the crest of A, the fact would be important, but by no means inexplicable by the glacial theory. Mr. C. Darwin has shown, that during the gradual subsidence and submergence of a coast situated in high latitudes, packed ice with stones frozen into it, is continually driven up on the sea-beach above high-water mark, and if the land be going down at the rate of a few inches in a year, the boulders, by being simply kept up to the sea level, will slowly climb up the hills higher and higher, so that a ridge after sinking may, when it re-emerges, have stones lodged upon it at levels above those of the lands from which the same stones were derived.*

The drift of Berkshire and of New England in general has a great resemblance to the terminal moraines of glaciers, being unstratified and containing fragments of rock, some angular, others rounded. But the proportion of rounded boulders is far more considerable in the drift than in an ordinary glacier moraine, in which last, as Mr. D. Sharp has lately shown in reference to some Swiss glaciers, the rounded blocks are quite the exception to the rule. Want of stratification is the natural result of the melting of matter out of stationary ice, the light particles and the heavy stones dropping down together, and no current of water sorting the materials, and carrying those of less specific gravity to greater distances. Stones frozen into coast-ice may have been rounded, some by rivers, others by the waves of the sea. The dearth of marine shells is sometimes urged as an argument against the hypothesis of submergence beneath the sea, and it is certainly strange that marine shells should be so rare in drift. They are, however, extremely scarce in parts of New England, such as Ver-

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* C. Darwin, "Geol. Quart. Journ." Vol. VI., p. 315. 1848.

mont and Maine, where a few, nevertheless, do occasionally occur; and this holds good in Canada, as also in Ireland and other parts of the North of Europe. As we cannot doubt that the formation accumulated in certain cases under water, we are at liberty to assume the same in all others, where such an explanation will best accord with the facts.

The Saxicava rugosa, Mya truncata, Natica clausa, and other recent species of mollusca, are common to the drift of North America and Europe, and constitute part of a fauna, characteristic of a climate somewhat colder than that of the latitudes where the fossils are now met with. The Caplan also, or Mallotus villosus, a fish swarming in the seas of Greenland, Labrador, and wherever ice abounds in the North Atlantic, is found fossil in clayey concretions or claystones, in the drift of Maine and Canada, as well as in Greenland. It appears that in the glacial period, as now, the isothrmal lines, or rather the lines of equal winter temperature bent many degrees farther south on the west than on the east side of the Atlantic, so that the monuments of glacial action extend some eight or ten degrees farther south in North America than they do in Western Europe. Large erratics and glacial furrows are rare south of latitude 48° or 50° in Europe, and are seldom seen south of 40° in North America; but where mountain chains like the Alps or Himalaya have formed independent sources of cold, we find exceptions. In Madeira and the Canary Islands, between latitudes 28° and 33° N., Sir C. Lyell searched in vain for glacial striæ, and other concomitant phenomena, although some of the mountains there are of great height. In the southern hemisphere all the manifestations of the agency of ice, which are wanting in the equatorial zone, reappear in full force, when we reach Chiloe, Patagonia, and Tierra del Fuego.

If ice-islands, running aground on the bed of a sea or on a a coast, can smooth and furrow the subjacent floor of the ocean by pushing before them, or pressing down under them loose sand, pebbles, and stones, the size of such islands is certainly sufficient to afford as much friction and mechanical force as we require. Some of them, measured in the southern hemisphere, exceed 10 miles in diameter, and their height out of the water is from 100 to 200 feet, the mass of ice below being about eight times in volume that rising above the sea-level; if such masses when they run aground are moving only at the rate of one or two miles an hour, their momentum must be enormous.

The area now subject to the action just alluded to in both hemispheres, is many times greater than that over which terrestrial glaciers descend. In like manner, in the period of the "Northern drift," the submarine were far more extensive than the supramarine glacial operations; and since we have evidence of much sea having been converted into land since the glacial period, we must expect to find more space bearing the imprint of subaqueous ice than of space exhibiting evidence of the movement of ice over dry land.

In conclusion, Sir C. Lyell observed, that as the great majority of mankind live now as they have always lived, near the equator, or in countries not more than 25 degrees distant from it, they can never behold ice or snow. We may imagine, therefore, a nation to have made considerable progress in science without knowing anything of the causes appealed to in this discourse. If such a people were told by travellers of the geological appearances above described, how great would be their perplexity! They might at first ascribe the transport of erratics to floods of extraordinary violence, but they would scarcely be able to hazard a reasonable conjecture in regard to the coincidence between the direction of glacial furrows and that of the trains of erratics. A stone, not held fast by ice, but merely pushed along in mud, could not scoop out a long rectilinear furrow, one inch, or sometimes a foot deep, in a hard rock. Still more mysterious would be the discovery of a connection between the former migration southwards of an arctic fauna, and the conveyance of large erratics to the same regions. If the glacial hypothesis afforded no more than a plausible explanation of the association of so many distinct and independent classes of phenomena, it would deserve greater favour than has been shown to it by some modern geologists. The inclination evinced by many to introduce catastrophic action, as peculiarly applicable to the case of drift, arises in a great degree from the absence of stratification in drift. The usual geological proof of successive accumulation, and of the lapse of time, is here wanting; hence the sudden uplifting and sinking of land, the displacement of the sea, and the raising of gigantic waves of translation, rolling over continents at the rate of 50 miles an hour, accompanied by rapid gyrations of the marine fluid, have been imagined. The rate of movement, suggested by the glacial hypothesis, is singularly opposed to these views. Blocks carried by glaciers, travel for centuries at an average rate of less than an inch per hour, and those borne along by floating ice, float a mile or a mile and a half an hour. The observer of icebergs can seldom tell whether their course be north or south, east or west. In like manner the submergence and re-emergence of land will best account for the appearances above described, if the movement were slow, as now in Greenland and Scandinavia; in other words, if it be such as would be insensible to any human inhabitant. Yet the power of the machinery appealed to in both cases is equally vast; for it must be capable of uplifting and depressing continents, and removing from place to place the great volume of superficial materials found in the drift. The real difference of opinion consists in the amount of time during which the force is supposed to have been developed.

[C. L.]

Baron Von Humboldt
with the authors
regards.
June 22. 1855

Royal Institution of Great Britain.

WEEKLY EVENING MEETING,

Friday, April 27, 1855.

THE DUKE OF NORTHUMBERLAND, K.G. F.R.S. President,
in the Chair.