IV.—*Two Glens and the Agency of Glaciation.* By HIS GRACE
THE DUKE OF ARGYLL, K.G., K.T. (With a Map.)

(Read 1st April 1895.)

The group of questions which are connected with the Glacial Age seem to me to be among the most interesting and the most difficult in the whole science of geology. They include the question of Time—since, perhaps, the only hope we have of even reaching any unit of time in geological changes lies in the phenomena of the Glacial Age. The question of the comparative slowness or suddenness of great physical changes is not less directly involved. Bound up with this again is the question of the sudden or slow destruction of the extinct forms of life, and the introduction of new forms to replace them. The connection between Cosmical and Terrestrial causes of change comes directly into our view, and then the nature and operation of the terrestrial forces which were brought into play. I am very sceptical as to many of the solutions which have been proposed for most of these questions, and still more for the theories which profess to answer them as a whole. There is nothing to be done but to accumulate evidence in detail—to observe facts well, that is, completely—and avoid looking only at such of them as tell in favour of some preconceived hypothesis.

It is one of the great delights of the physical sciences that the questions they concern are inexhaustible. I do not mean only that each one of those questions always leads on to some other. I mean that even each question in itself is always turning up in some new light, or new aspect, even when we may have been long familiar with the phenomena which suggests it. The truth is that the very fact of such familiarity is perpetually the cause of some fresh departure, because it extinguishes that sense of surprise, and puts even that natural curiosity to sleep, out of which all intelligent questioning of Nature comes. Things which we see every day are precisely those which are most apt to conceal their lessons from us—and it is only, perhaps, some accidental suggestion that awakes us to obvious interpretations which we had never thought of before. Such, I confess, is the experience I have lately had concerning a question in geology which I have long regarded as of the highest scientific interest. I refer to the physical agency, and the physical conditions under which what is known as the glaciation of our West Highlands was effected. The science of geology presents no more perplexing problem. Living, as I do, in a country where the marks of glaciation are abundant, but at the same time far from universal over the whole surface, I have long come to the conclusion that one agency widely believed in cannot possibly have been the producing cause. It cannot have been what is called an Ice Sheet, or an Ice Cap, or ice in any form, under whatever name it is

called, which moved upon, and moved over all the hills, in enormous masses, and therefore with an enormous pressure universally applied. The marks appear to me to be incompatible with any such supposition. They are essentially partial, local, and what may be called selective. We cannot attribute this partiality to the disturbing effects of subsequent obliteration; because the same rock in the same place which is highly glaciated on some one part of its surface is wholly untouched upon other parts. Some rock surfaces, indeed, do exist, which have been evidently wholly covered by, and ground down under enormous and continuous moving pressure into one smoothed and polished floor or dome, and these rocks are of the greatest interest in showing to us what the characteristic effects of such an agency must always be. But though they exist, they are comparatively rare. For every one specimen of this kind of glaciation there are hundreds of thousands in which the smoothing, abrading, or scratching agency has acted on some one side of a rocky surface and has left the other side rough and untouched. There is, however, one general rule or law which can be clearly traced. The direction from which the agency came, and the direction towards which it moved, is almost always determined by the existing configuration of the land,—that is to say, rocks on the sea-shore have been smoothed by some body which must have moved along the coast from the higher hills towards the lower ranges, or towards the outlets of the arms of the sea on which they are abundant. In like manner, in the glens not occupied by water, they follow the lines of the glen from its head towards its opening. So far, this is easily intelligible, because, if the configuration of the country was substantially what it is now, ice moving in the form of ordinary glaciers, such as those of Switzerland, would, and must, be guided in their course by the direction of the hollows in which they lie, or, if moving in the form of floating or floe-ice, would equally be guided by currents similarly determined. But there is this difference to be noted, that even small glaciers, such as those which we now have on the Alps, do produce surfaces wholly polished upon those particular rocks over which they actually move in a solid mass. Very partial glaciation, therefore, such as leaves large parts of a rock wholly untouched, cannot indicate the passage of ice in this particular form, whilst it is not only consistent with, but characteristic of ice floating in water, and made by currents to impinge upon rocks which interrupt its passage. The floating masses grate along the shores, or the rocks which constitute a shore for the time being—catching the projecting surfaces as they pass, and necessarily leaving untouched the retired or sheltered surfaces, which do not obstruct the way. Then there is one phenomenon, which clearly indicates the same agency—although under the same conditions, which startle us not a little—and that is the glaciation of rock surfaces which constitute the summits of high hills, far above the general level of the whole country, and not situated in any glen or hollow which could possibly have guided either a solid glacier or a mere shore current. These glaciated tops are often smoothed or striated on one surface only—with a sheltered side as rough and as well-marked as any similar rock upon the existing shores. This is quite inconsistent with the passage of that enormous kind of glacier which is denoted under the name of an Ice Sheet or an Ice

Cap. Such a body could not have failed, by its vast pressure, to have ground down all the surfaces on which it rested, or over which it passed; and the appearances actually presented are generally quite distinctive of an agency much lighter and more passing in its work. The same lesson is taught by another phenomenon very common on our hills; and that is the position of enormous boulders and masses of rock left poised or "perched" upon the very tops of ridges, isolated hills, in such a manner that no conceivable agency but that of floating ice-floes could have placed them and left them where we now see them. Nor are these blocks deposited only on the tops of conspicuous hills, but also on knolls and elevations of every sort and kind, just as would naturally happen on shoals and banks in a rising or falling sea. Moreover, it is to be observed that many of these stones are not rounded, as they must have been if they had been rolled under water, or dragged along in the lower layers of a moving glacier. Many of them are rough, and even angular in a high degree—just as they might have fallen from some overhanging cliff, or have been torn off by the splitting power of frost. These are all arguments to show that even if an ice sheet had ever existed as a moving mass, it could not have produced the phenomena which we actually see. But besides these arguments, there are others which condemn the supposed ice sheet as a physical impossibility—inasmuch as no adequate cause of motion has ever been made out for such an assumed "flow" of such ice-masses.

Putting all these considerations together, I had long come to the conclusion that our glaciation has been effected mainly by ice-floes and occasional icebergs in a glacial sea, which rose at least some 2000 feet above the level of our present ocean, and in which powerful currents were running in a general direction from N.E. to S.W. There is a natural and legitimate aversion to such an explanation. It defies altogether that impression of the stability of the relative position and levels of sea and land, which is one of the strongest preconceptions we derive from our own uniform experience. Forgetting how very short that experience is, and how inadequate to justify any conclusions as to an unknown past, our preconception is farther helped by the extreme difficulty of even imagining any physical cause for a submergence of the land, which would seem to have been so recent and so passing. These are excellent reasons for reserve and caution in our reasoning, but they are no excuses for reluctance in admitting the evidence of obvious facts, or for carelessness in making closer and closer observation as to facts which may not be equally apparent at first sight. After all, we must remember that geology has made us familiar with the idea of the interchangeability of sea and land, almost everywhere over the globe, as one of its most certain facts; and the assumptions, so often tacitly made, that all those changes must have been always infinitesimally slow, are assumptions in the highest degree precarious, and founded on theories for which there is really no adequate foundation. We must remember also that the movements which are suggested, although they startle us by their evident recency in point of time, and by our conception of their magnitude in elevation and depression, are, after all, movements of infinitesimal smallness when considered with reference to the size of the globe, and with

reference to such forces as we know to have worked, and to be still working in its interior. A movement of elevation or of depression in any part of our terrestrial surface, to the extent of 2000 feet, would be quite invisible to a spectator standing at the distance of a few hundred miles, and might easily be produced by the operation of such causes as we see must have been concerned in a thousand cases of geological change. In this, as in all other cases of reasoning on physical phenomena of this class, what we have to look for, above all things, is not merely simple effects, which may plausibly be accounted for by invoking some one supposed cause; but for those complicated and complementary effects which, in great variety and number, are sure to accompany the operation of such great physical forces as those which we may invoke. The evidence which we should seek is essentially cumulative—full of incidental and subsidiary testimony arising out of a thousand facts, which, at first sight, may not seem to have any bearing upon each other, or upon any common explanation. And this is precisely the kind of evidence which only comes to us gradually—as the result of long and continuous observation illuminated by equally continuous thought. Suggestions, indeed, may arise in our minds quite suddenly, and may be of such a character as to be of the highest value, throwing a flood of light on conclusions which had before seemed to rest on a basis hardly adequate to support them, but which now seem very largely confirmed if not actually established.

A suggestion of this kind has lately occurred to me in respect to the agent of glaciation in the Inveraray district, from certain facts with which I had, indeed, been long familiar, but which I had never before put together in connection with this particular problem. This suggestion it is my object in the present paper to explain.

The parish of Inveraray occupies some ten or eleven miles of the north-western shore of Loch Fyne, and reaches to within three or four miles of the extreme end or head of that long and very deep arm of the sea. The large fresh-water lake of Loch Awe lies in another deep depression, which, roughly speaking, lies parallel to this upper reach of Loch Fyne; and the two sheets of water are separated from each other by a range of hills from six to seven miles across from shore to shore “as the crow flies.” The trend of Loch Fyne is in that general direction of N.E. and S.W. which is so conspicuous a feature in the physical geography of the West Highlands. The parish is deeply trenched by two great leading glens which join the main valley of Loch Fyne at an acute angle—running pretty nearly north and south, but with some deviation towards the prevalent N.E. and S.W. These two glens, named respectively Glenaray and Glenshira, are nearly parallel, separated by a range of hills and moors hardly exceeding two miles in breadth. This range terminates abruptly in the curious conical hill of Dunicoich, which rises immediately above the town and castle of Inveraray. As the whole country is occupied by one great geological formation, these two glens, which traverse it in such close proximity to each other, might well be expected to present a close resemblance. It is true, indeed, that the rocks of the district have a certain variety, which is quite competent to produce in close proximity considerable varieties of aspect. They consist of the whole series comprehended in the general name of the Mica Schists, together with great masses of

intrusive material, these for the most part being a porphyritic granite. As the Mica Schists include not merely beds of mica slate but beds also of quartzite and of limestone and of a material which has been suspected to be stratified volcanic ash, there is ample room for the agencies of denudation to do a good deal of differential work—quite capable of accounting for many different aspects of the surface. Moreover, as the sedimentary beds are all more or less inclined at a high angle, glens cutting through them are liable to have sides or walls, some of which present the slope, and others the escarpment sides of the strata, according to the direction in which these are traversed. But if due attention be paid to those causes of a certain amount of difference in the scenery, we can easily separate them from other causes which have operated in other ways. In the case of these two glens there are some special differences which are very striking. The separating wall of mountain is common, of course, to both glens, and the two other, containing ridges to the west and east respectively, rise to about the same elevation, and consist very much of a repetition of the same, or closely similar beds. Yet, in spite of their close structural resemblance, the two glens present a violent and curious contrast to each other. The mountain slopes on either side are as steep in the one glen as in the other. But in Glen-shira they are comparatively smooth and regular in surface, showing the slopes and escarpments on either side clearly, and unencumbered by rough knolls or lower ranges of hill. The bed or bottom of the glen is still more remarkable in the same way. It is a smooth and level valley, occupied by a rich alluvial soil, and running about four miles from the sea before its river reaches the elevation of 100 feet. Its placid, peaceful, and rich pastoral character is very beautiful—but singularly unlike most other highland glens, and reminding us more of the glens and valleys in Westmoreland. Glenaray, on the contrary, on the other side of the same dividing ridge, is in every respect different—it is a typical highland glen, occupied by a rapid brawling river, which plunges over three successive waterfalls and runs the rest of its course down a bed encumbered with stones and rocks. The whole surface of the glen partakes of the same rough and irregular aspect. Along the lower slopes near the river, it is encumbered with enormous quantities of loose stones of every size and shape—some of them of gigantic proportions, and most of them quite unworn and unrounded,—presenting, on the contrary, many sharp angular surfaces. Farther up the glen its floor is largely occupied by great conical mounds of clay, sand and gravel, with a multitude of included stones. They represent typically the boulder clay. Through many of these the line of the public road to Dalmally, on Loch Awe, has been cut—showing sections which prove that these mounds have generally not even a nucleus of solid rock, but are composed entirely of transported materials from the grinding down of the rocks around. The included stones are strongly smoothed and striated—very fine specimens of polishing and striation being common in the sections. In short, the whole course of Glenaray is a conspicuous example of the most characteristic glacial action—of a very marked and violent kind. One side of it—the eastern side—presents a surface of moor full of knolls and mounds all covered with loose transported stones, and rocks of every size and shape. The escarpment to the

west, which is extremely steep—much of it almost precipitous—is, however, free, or almost free, from similar appearances—as if the agency, whatever it may have been, had been deflected to the eastern side, and had scoured out the faces opposite.

Here, then, we have a whole series of contrasted conditions in two closely contiguous glens, which suggest some curious questions. How can we account for the almost complete exemption of the one glen from glacial work, when that work is so evident and so predominant in the other? What is there in the physical configuration, or in the geographical position of the one as compared with the other, which can be rationally connected with this great difference? The moment we ask this question, if we are fully awake to its significance, there is at least one negative answer which is certain. No cause operating over the whole area of the country can possibly be the agency which has thus discriminated so immensely between these two glens. This conclusion seems absolutely to exclude the agency of some universal “ice-sheet” higher than all the mountains, and “flowing” from some gigantic confluent glacier-mass which moved from the German Ocean over the whole Western Highlands. Yet this has been the dream of many writers of the extreme glacial school. Any such agency must, in this particular case, be put out of count—quite apart from the many physical objections which lie against it as applicable anywhere or at any time.

But there is another agency much less theoretical, and much more probable, as applicable to similar phenomena elsewhere—and that is the action of comparatively small local glaciers formed upon the containing hills of all our deeper glens, and taking the usual and natural course of such bodies down the slopes, and passing down the valleys into which they fall. If there has ever been any glacial age at all in Scotland, and if the mountains which we now see were ever at any time during that age above the surface of the sea, and exposed to the usual atmospheric conditions of an arctic climate, the snow must have gathered and consolidated on all the higher elevations into true glacier ice, and small local glaciers must have been formed upon them—just as they are now formed on the higher hills in Norway and elsewhere in Northern Europe and America. That such glaciers must have existed in the Highlands, during the glacial age, is practically certain, and there are abundant evidences of their action in many of our glens. But the curious thing in respect to the cases of Glenaray and Glenshira is that it is impossible to account for the difference between them by supposing that a local glacier had existed in Glenaray and none in Glenshira. This impossibility lies in the fact that, of the two glens, the mountain ranges which fall into the unglaciated Glenshira are far higher, and far more certain to have gathered glacial snows, than those which fall into the highly-glaciated Glenaray. It is true that the more immediate containing walls of both glens are very nearly of the same altitude. But in the case of Glenaray, these nearer ridges and summits lead to no contiguous mountains beyond which are still more elevated, but, on the contrary, fall off at once on every side—towards Loch Fyne, in one direction, and to Loch Awe upon the other. On the other hand, the containing walls of Glenshira, at its head, do lead up to contiguous mountain surfaces of much higher elevation, and

especially to the peaks, corries, and precipices of Ben Buie, which rises to the height of 3100 feet. If local glaciers had been formed anywhere in the whole district, they must have been formed on the tops and flanks of this mountain—and they must have moved down Glenshira if they had acted as all such bodies do elsewhere. Two very deep and long ravines, each of them draining large surfaces of mountainous slopes and moors, fall into the head of Glenshira : and it is quite impossible that, if local glaciers were ever formed in Glenarary, they should not have been also formed, and in much greater volume, at the top of Glenshira. There is, indeed, no comparison between the extent and elevation of the gathering ground at the head of Glenshira and the comparatively trifling area capable of serving the same purpose in the case of Glenarary. The conclusion is inevitable that the agency which seems to have been present in great force in Glenarary, and to have been either wholly absent or else very subordinate in Glenshira, must have been something entirely different from a local glacier—something to which Glenarary was much exposed, and from which Glenshira, on the contrary, was much sheltered.

The question is then forced upon us—whether there is any distinctive feature in the physical geography of the two glens which can afford any explanation to this apparent mystery. But the moment this question is asked, we are guided to a most significant reply. There is one, and only one, great distinction between the two glens—namely, this : that Glenarary terminates in a low pass or watershed only 480 feet above the level of the sea, over which the road passes from Loch Fyne to Loch Awe, and that it gapes as with a bell-mouthed opening to the valley of Loch Awe in the directions of N. to N.E. Glenshira, on the other hand, is a glen completely closed in that direction by successive ridges of mountains, which rise from 1800 and 1600 to at least 2000 feet above the same level, and present no pass at all from the valley of Loch Fyne to the valley of Loch Awe. Looking up Glenarary from the town of Inveraray, we see a low horizon and the peaks of Ben Cruachan, on the other side of Loch Awe, fully exposed to view. Looking up Glenshira from a corresponding point at its mouth, our view is bounded by steep mountainous ridges, which close it completely, and behind these ridges by a high screen of elevated moorland, which constitutes an horizon line of at least 1500 feet high. In short, the one circumstance in which the two glens differ is this—that the one is completely open and unprotected to an agency moving from beyond it in a north-easterly direction, whilst the other glen is completely protected from any such agency by a lofty protecting wall of mountains. Of course, the significance of this great difference is immense the moment we connect it with the idea that the glaciating agency was floe ice floating in a sea which at one time rolled over all our hills up to the level of from 1500 to 2000 feet, and which, in both its rising and in its falling stages, must, of course, have been deflected in its currents by many lower elevations, which would afford complete shelter to some glens from the scour to which others, with a lower watershed, were exposed. It seems to me that all the differences and peculiarities of these two glens, with reference to the marks left by the glacial ages in the one, as compared with the other, are explained by the corresponding distinction between them with reference to the physical geography

of each as now described. And the completeness of the explanation is in no way lessened by the fact that the sides, and walls, and floor, of Glenshira are not absolutely devoid of marks which have been left by the glacial conditions to which the whole country was at one time exposed. Quite near the head of the glen a few mounds of transported blocks do appear on the floor of the glen, and the high slopes on each side are thinly sprinkled with transported boulders—not, indeed, with such large and angular masses as encumber, in immense profusion, the floor and sides of Glenaray; but with rounded boulders scattered here and there over a wide surface,—as if they had been dropped by flocs, perhaps gradually melting at great heights overhead, which was then the surface of the glacial sea.

When we stand on the low summit of the road which runs up Glenaray, and try to imagine the scene in front of us when the great hollow of Loch Awe was a deep arm of the sea, it is not difficult to understand how there must have been a tremendous scouring current setting down Glenaray towards Loch Fyne. Immediately opposite to us, on the other side of Loch Awe, is the mountain wall of Ben Cruachan, with its subsidiary ranges stretching to the N.E. and E. Westward and north-westward there is no such barrier—the country is much lower, and a comparatively open sea must have existed in those directions. The distant mountains of Morven and Ardnamurchan rise high over a series of lower elevations, and those mountains might then have been islands, as the Hebridean hills, beyond, are now. To the north-eastward, the mountainous region, which so completely protects Glenshira, is traversed by a deep glen, which opens over a low pass right across to the eastern side of Scotland—leading first to Loch Tay, and beyond that hollow to the continuous valley of the river Tay. Along this deep glen, the engineers have constructed the line of railway from Oban to Callander; and every passenger who has an eye to geology must have observed how the line cuts through immense accumulations of sand and gravel, with boulder stones profusely scattered over all the surfaces of the country. In trying to follow in thought the causes which would operate in any submerged area, we must recollect that such conditions involve the double operation of a time of sinking or submergence, and a later time of rising, or emergence. During both those times, all the natural glens, which cut deeply through the country, must have been the seat of powerful currents guided by the containing walls. Thus, the low pass, which breaks the wall between Loch Awe and Loch Fyne, would at both epochs be a line of scour, and as the emergent movement has been, of course, the latest, its marks would be those with which we should expect to meet especially. Accordingly, all the facts point to this solution of the appearances presented by Glenaray, which are in such remarkable contrast with those of the parallel and adjacent valley of Glenshira.

There are two other valleys, or shallower glens, in the parish of Inveraray, which strongly corroborate the same conclusion as to the glaciating agency which has been at work. These are both glens which run parallel to the bed of Loch Fyne, and are parts of the series of parallel ridges and hollows of which the whole mountain mass consists that separates Loch Fyne from Loch Awe. Along the last and lowest of these hollows,

the road from Inveraray to Lochgilphead has been made, in order to avoid ground which is too precipitous at some places on the shores of Loch Fyne. The summit level of the easier gradients afforded by this glen is only 300 feet above the sea, and along its floor there are stretches of land which lie very low. These are generally occupied by mosses, and they are almost entirely free from boulder-stones. But the top and sides of the somewhat sudden rise, which conducts us to the summit level, are, on the contrary, loaded with transported blocks of stone—some of them more or less rounded, but many others presenting rough and angular outlines. The accumulations of these which have been left on the more prominent knolls and elevations have all the appearance of having been stranded where they now lie by floating ice, which came from the N.E., and, in passing, grounded on the first obstructing rocks and shoals which arrested their progress through the straits. The same explanation, and no other, is suggested by a series of similar blocks which lie on a hill some 500 feet above the same glen. That hill happens to be so situated as to break and obstruct a parallel hollow behind the first ridge to the north, and it raises its steep front exactly in such a position as to front and arrest any agency, whether water or ice, which could have moved south-westward along the hollow. Accordingly, this obstructing hill is covered with great angular blocks of stone, just as it would naturally be if it stood directly in the way of a current from the N.E., which carried along with it floe-ice laden with stones from the N.E. Many years ago I took the late Sir David Milne Home to see this remarkable example of the transported boulders, to which he devoted so much attention, and he was much struck by its significance and its only possible interpretation.

But even more decisive than all other facts, in my opinion, of the nature of the agency which carried the blocks, are the cases of what are called "perched boulders," on the very tops of many of the lower ridges, and even of the highest ridge between Loch Fyne and Loch Awe. Some of those are very remarkable, both as to great size, as to angularity, and as to position. They are so situated that it is impossible to conceive how any other agency than floating ice can have placed them where they are. They cannot have rolled down from higher ridges behind—because their material is generally different, and also because they would have had to roll up steep slopes, and the impetus which would be required for this cannot be supposed to have stopped exactly at the top. Moreover, many of them are not rolled at all, and some are conspicuously angular. On the other hand, such situations are precisely such as would be the natural places, or points, of deposit by ice floating on a sea over an emerging land. Every prominence which is now a ridge must have been a shoal, or ledge of reef, in such a sea at some given time in the process of emergence. Floes, or bergs, stranded on such reefs would necessarily drop their burdens upon these when they melted, and such deposit would always be upon the very top, or close to it.

There is yet another very clear indication of the nature of the glaciating agency in the appearance presented by the hills on the tops of which these perched blocks are situated. In one conspicuous instance, not far from the town of Inveraray, a hill which is crowned

by a large number of perched blocks, is a granitic ridge, 700 feet above the level of the sea, with a steep and partially precipitous face, facing S. and S.E. This face is quite untouched, and rough—showing no trace whatever of any rounding or smoothing, agency having passed along it or down it. But the back of the same hill, facing to the N. and N.E., is on the contrary well smoothed and glaciated. Behind and above this hill there is another and a much higher ridge, also granitic, which rises to the elevation of 1000 feet, and presents, like the lower one, a precipitous face, quite untouched by glaciation, towards the S. and S.E. Between the two hills there is a deep hollow, over which, in some parts, many huge blocks of transported stones are scattered. These blocks also are often very angular and unrolled. It is impossible to reconcile any of these facts with the agency of any body of ice large enough to rest upon, and to move along, the whole surfaces of the country. They are essentially connected with the passage of ice in some form which was partial and selective, impinging on all surfaces which were exposed to its movement from the N. and N.E., but which admitted of its passing entirely over, without any contact, all other surfaces which were not so exposed.

The evidence, therefore, in favour of the action of floating ice in a glacial sea grounding upon and grinding over the rocks and shoals of a rising and emerging land, is accumulative evidence, including a great variety of corroborating details. Moreover, it is evidence which, so far as I can see, is of such a nature as to exclude the possibility of the action of other forms of ice, such as have been suggested in either local glaciers or in an ice sheet.

I do not deny, nor do I seek to minimise, the great difficulties presented by this explanation of a very peculiar set of facts. It involves the idea of a submergence of the land, and a re-emergence of it, at some time so recent that in all its main contours or outlines the country was very much as we see it now. But the difficulty of conceiving such an operation, or rather the difficulty of accounting for it by any known physical causes, must not lead us to hesitate in accepting evidence which in itself admits of no other explanation. We have to recollect, too, that at least one other explanation, namely, that of an ice sheet moving over the whole country, besides failing to account for the facts, involves physical difficulties of a much more formidable nature. The supposed cause of motion in such a body of ice has never been explained. I believe it to be a physical impossibility. This cannot be said of the forces which we must believe have acted on the elevation of our existing islands and continents. They have been undoubtedly such as are capable of reproducing like effects at any time. We are, no doubt, accustomed to assume that these earth-movements have been sleeping for a far longer time, and that, when they did act, they always acted with infinitesimal slowness in time and in effects. But this is an assumption in which, very possibly, we may be entirely mistaken; and we have to consider the significant fact that one of the most experienced and most cautious of our eminent geologists, Professor Prestwich, has very recently been led to the opinion that some comparatively sudden submergence, and some correspondingly rapid re-elevation of the land, has left clear evidence of its occurrence all over the south of Europe, at a date quite recent in geological time.

THE DUKE OF ARGYLL ON TWO GLENS (GLEN ARAY & GLEN SHIRA) AND THE AGENCY OF GLACIATION.