view of a flower, from which all the perianth except the labellum has been removed), *a* represents the anther containing the pollinia, and prolonged above into a long point, *an* the antennæ, which are rigid, curved, hollow horns tapering to a point; but the two differ from one another in this respect, that the apex of the left-hand one bends upwards, while the right-hand one hangs down, and is apparently almost always paralysed and functionless; *l* is the labellum; *d* the disc of the pollinium, which is remarkably large and viscid; *pd* the pedicel of the pollinium; *s* the stigmatic chamber, which is of course functionless in the male flower. The action of the parts is thus described by Mr. Darwin:—When the left-hand antenna is touched, the edges of the upper membrane of the disc, which are continuously united with the surrounding surface, instantly rupture, and the disc is set free. The highly elastic pedicel then instantly flirts the heavy disc out of the stigmatic chamber with such force that the whole pollinium is ejected, bringing away with it the two balls of pollen, and tearing the loosely-attached spike-like anther from the top of the column. The pollinium is always ejected with its viscid disc foremost, and with such force that it is thrown to a distance of two or

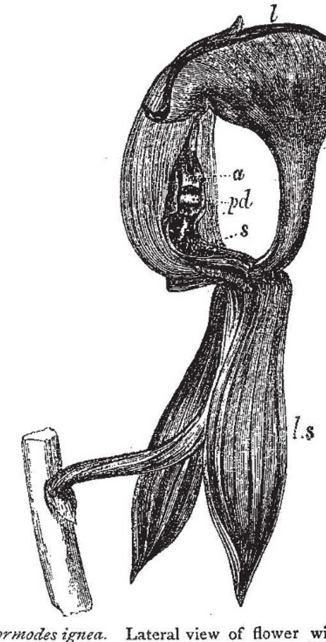


FIG. 4.—*Mormodes ignea*. Lateral view of flower with one of the sepals and one of the petals removed. *a*, anther; *pd*, pedicel of pollinium; *s*, stigma; *l*, labellum; *ls*, lateral sepal.

three feet. On one occasion Mr. Darwin touched the antenna of an allied species, *C. callosum*, while holding the flower at about a yard's distance from the window, when the pollinium hit the glass, and stuck by its adhesive disc to the smooth vertical surface. A series of experiments showed that even violent concussion of any other part of the flower except the antenna produced no effect whatever in disturbing the pollinia.

4. *Mormodes ignea.*—The genus *Mormodes* belongs also to the small family Catasetidæ; the pollinia are again violently ejected, as in *Catasetum;* but the mode in which this is effected is somewhat different, and very curious. The appearance presented by the flower is represented in Fig. 4. The base of the column is bent backwards, at right angles to the ovary, then resumes an upright position, and is finally again bent near the summit. It is also twisted so that the anther, rostellum, and the upper part of the stigma face one side of the flower, to the right or left, according to the position of the flower in the spike. In the drawing, *a* represents the anther, which is elongated and triangular, but does not extend to the apex of the column. A group of spiral vessels runs up the column as far as the summit of the anther; they are then reflexed, and run some way down the anther-case. The point of reflexion forms a short thin hinge, by which the top of the anther-case is articulated to the column beneath its bent surface; and this hinge appears to be the sensitive portion of the structure, conveying any stimulus from a touch to the disc of the pollinia, and causing the ejection of the latter. *pd* is the pedicel of the pollinium, covering the rostellum; *st*, the stigmatic surface, which extends down to the base of the column, and is hollowed out into a deep cavity at its upper end; *l* is the very remarkable labellum, narrowed at the base into a nearly cylindrical foot-stalk, and its sides so much reflexed as almost to meet at the back, forming a folded crest at the summit of the flower. Near the summit it has a slight cavity, into which the summit of the column fits, fixing it in its place. The whole labellum is compared by Mr. Darwin to a cocked hat supported by a foot-stalk, and placed on the head of the column. *ls* are the two lower sepals, which hang down like wings; the upper sepal and one of the lateral petals have been cut off. By a number of experiments Mr. Darwin found that the minute hinge in the anther-case already described is the only portion of the flower that is sensitive to touch. When an insect lights on the folded crest of the labellum, the only convenient landing-place, he will lean over the front of the column in order to gnaw or suck the bases of the petals, which are filled with a sweet fluid. In so doing, he will disturb the summit of the column which fits into the cavity of the labellum; this will press on the hinge in the anther-case; the stimulus will then be conveyed to the pollinium-disc, and the pollinium will be violently ejected. Owing to the peculiar structure of the parts, guided by the hinge, which now serves a second function, the direction in which the pollinium flies is necessarily vertically upwards. If no object is in the way, it is projected perpendicularly up in the air, an inch or two above and close in front of the terminal part of the labellum, and would then alight on the folded crest of the labellum immediately above the column. But if the insect which has caused the disturbance remains in the same position, the pollinium will necessarily alight on his head, and will thus be carried off to fertilise another flower. The pollinium has, however, still the anther-cap attached to it; this drops off, as the pedicel dries on exposure to the air and gradually straightens itself from the almost hoop-shaped form which it bore when ejected; and when this has been done, the pollen-masses attached to the head of the insect are precisely in a position to strike against the stigmatic surface of the next flower visited.

Other instances, almost as extraordinary, could be cited of the special contrivances met with in species belonging to this order, to insure cross-fertilisation rather than self-fertilisation of the flowers. A. W. B.

## THE MOVEMENT OF THE SOIL-CAP

AMID all their general tameness the Falkland Islands boast one natural phenomenon which is certainly exceptional, and at the same time very effective.

In the East Island most of the valleys are occupied by pale-grey glistening masses, from a few hundred yards to a mile or so in width, which look at a distance much like glaciers descending apparently from the adjacent ridges, and gradually increasing in volume, fed by tributary streams, until they reach the sea. Examined a little more closely, these are found to be vast accumulations of blocks of quartzite, irregular in form, but having a tendency to a rude diamond shape, from two to eight or ten or twenty feet long, and perhaps half as much in width, and of a thickness corresponding with that of the quartzite bands in the ridges above. The blocks are angular, like the fragments in a breccia, and they rest irregularly one upon the other, supported in all positions by the angles and edges of those beneath.

They are not weathered to any extent, though the edges and points are in most cases slightly rounded ; and the surface, also perceptibly worn, but only by the action of the atmosphere, is smooth and polished ; and a very thin, extremely hard, white lichen, which spreads over nearly the whole of them, gives them the effect of being covered with a thin layer of ice.

Far down below, under the stones, one can hear the stream of water gurgling which occupies the axis of the valley ; and here and there, where a space between the blocks is unusually large and clear, a quivering reflection is sent back from a stray sunbeam.

At the mouth of the valley the section of the "stone river" exposed by the sea is like that of a stone drain on a huge scale, the stream running in a channel arched over by loose stone blocks, or finding its way through the spaces among them. There is scarcely any higher vegetation on the "stone river ;" the surface of every block is slippery and clear, except where here and there a little peaty soil has lodged in a cranny, and you find a few trailing spikes of *Nassauvia serpens*, or a few heads of the graceful drooping chrysanthemum-like *Chabræa suaveolens*.

These "stone-rivers" are looked upon with great wonder by the shifting population of the Falklands, and they are shown to visitors with many strange speculations as to their mode of formation. Their origin seems, however, to be obvious and simple enough, and on that account their study is all the more instructive ; for they form an extreme case of a phenomenon which is of wide occurrence, and whose consequences are, I believe, very much underrated.

There can be no doubt that the blocks of quartzite in the valleys are derived from the bands of quartzite in the ridges above, for they correspond with them in every respect ; the difficulty is to account for their flowing down the valley, for the slope from the ridge to the valley is often not more than six to eight degrees, and the slope of the valley itself only two or three, in either case much too low to cause blocks of that form either to slide or to roll down.

The process appears to be this. The beds of quartzite are of very different hardness ; some are soft, passing into a crumbling sandstone ; while others are so hard as to yield but little to ordinary weathering. The softer bands are worn away in process of time, and the compact quartzites are left as long projecting ridges along the crests and flanks of the hill-ranges. When the process of the disintegration of the softer layers has gone on for some time the support of their adjacent beds is taken away from the denuded quartzites, and they give way in the direction of the joints, and the fragments fall over upon the gentle slope of the hillside. The vegetation soon covers the fallen fragments and usually near the sloping outcross of the hard quartz, a slight inequality only in the surface of the turf indicates that the loose blocks are embedded beneath it. Once embedded in the vegetable soil a number of causes tend to make the whole soil-cap, heavy blocks included, creep down even the least slope. I will only mention one or two of these. There is constant contraction and expansion of the spongy vegetable mass going on, as it is saturated with water or comparatively dry ; and while with the expansion the blocks slip infinitesimally down, the subsequent contraction cannot pull them up against their weight ; the rain-water trickling down the slope is removing every movable particle from before them ; the vegetable matter on which they are immediately resting is undergoing a perpetual process of interstitial decay and removal. In this way the blocks are gradually borne down the slope in the soil-cap and piled in the valley below. The only other question is how the soil is afterwards removed and the blocks left bare. This, I have no doubt, is effected by the stream in the valley altering its course from time to time, and washing away the soil from beneath.

This is a process which, in some of the great "stone-rivers" in the Falkland Islands, must have taken an enormous length of time. I fear that the extreme glacialists will see in it a danger to the universal application of their beloved theory to all cases of scratching and grooving. I have known too much of the action of ice to have the slightest doubt of its power ; but I say that ice had no hand whatever in the production of these grand "moraines" in the Falkland Islands.

In the West Highlands of Scotland, and in many other parts of the world, I have often noticed that when a hill of such a rock as clay-slate comes down with a gentle slope, the outcrop of the vertical or highly-inclined slates covered with a thick layer of vegetable soil or drift containing imbedded blocks and boulders derived from higher levels, the slates are frequently first slightly bent downwards, then abruptly curved and broken, and frequently the lines of the fragments of the fractured beds of slate can be traced for a yard or two in the soil-cap, gradually becoming parallel with its surface, and passing down in the direction of its line of descent. These movements are probably extremely slow. I well remember many years ago observing a case, somewhere in the west of Scotland, where a stream had exposed a fine section of the soil-cap with the lines of broken-down and crushed slate-beds carried far down the slope. The whole effect was so graphically one of vigorous and irresistible movement that I examined carefully some cottages and old trees in hope of finding some evidence of twisting or other irregular dislocation, but there appeared to be none such. The movement, if it were sufficiently rapid to make a sign during the life-time of a cottage or a tree, evidently pervaded the whole mass uniformly.

It seems to me almost self-evident that wherever there is a slope, be it ever so gentle, the soil-cap must be in motion, be the motion ever so slow ; and that it is dragging over the surface of the rock beneath the blocks and boulders which may be embedded in it, and frequently piling these in moraine-like masses, where the progress of the earth-glacier is partially arrested, as at the contracted mouth of a valley, when the water percolating through among them in time removes the intervening soil. As the avalanche is the catastrophe of ice-movement, so the land-slip is the catastrophe of the movement of the soil-cap.

As I have already said, I should be the last to undervalue the action of ice, or to doubt the abundant evidences of glacial action ; but of this I feel convinced, that too little attention has been hitherto given to this parallel series of phenomena, which in many cases it will be found very difficult to discriminate ; and that these phenomena must be carefully distinguished and eliminated before we can fully accept the grooving of rocks and the accumulation of moraines as complete evidence of a former existence of glacial conditions.

C. WYVILLE THOMSON

## *ON THE INFLUENCE OF GEOLOGICAL CHANGES ON THE EARTH'S AXIS OF ROTATION*[1]

THE subject of the fixity or mobility of the earth's axis of rotation in that body, and the possibility of variations in the obliquity of the ecliptic has of late been attracting much attention. Sir W. Thomson referred shortly to it in his address at Glasgow last September,

[1] An account of a paper by G. H. Darwin, M.A., read before the Royal Society on November 23, 1876.