Mrs. Fleming upon a photographic plate taken in July. The telegram has been communicated to the observatories in the southern hemisphere.

"ASTRONOMICAL JOURNAL" PRIZE.—Owing to the fact that during the past six months only one comet has been discovered, and that its period of visibility was unusually short, and also to the probable prevalence of a bad time of observing weather during the winter, the period specified in the offer of this prize for observation of comets has been extended by six months. The closing time for this prize will now take place September 30, 1894.

COMET BROOKS (OCTOBER 16).—Last week we gave Bidschof's elements and ephemeris for this comet. This week, for the sake of comparison (*Astronomischen Nachrichten*, No. 3194), we give the elements of the comet as obtained from the observations made at Hamburg, October 17; Greenwich, October 18; Pola, October 19; Strassburg, October 23, and Vienna, October 24. They are as follows:—

Elements.

T = 1893 September 19·209 M.T. Berlin.

$$\left.\begin{aligned} \omega &= 347^\circ\ 20'\!\cdot\!50 \\ \Omega &= 174\ 53\!\cdot\!20 \\ i &= 129\ 45\!\cdot\!77 \end{aligned}\right\} 1893\!\cdot\!0$$

$$\log q = 9\!\cdot\!90992$$

The current ephemeris is for 12h. Berlin mean time.

1893.	α App. h. m. s.	δ App. ° ′	Br.
Nov. 9	12 58 50	+30 27·2	0·82
10	13 0 53	31 20·6	...
11	2 59	32 14·8	...
12	5 9	33 9·9	...
13	7 22	34 5·8	...
14	9 39	35 2·6	0·80
15	12 0	36 0·4	...
16	13 14 25	36 59·1	...

Unit of brightness occurred on October 17.

MOON PICTURES.—In an article on the "Origin of the Lunar Craters," which has appeared in the last two numbers of *Prometheus* (Nos. 212, 213), the writer has been able to secure some excellent illustrations. These pictures are copies from photographs taken at Paris by the Brothers Paul and Prosper Henry, and illustrate regions near the South Pole. The current number of *Knowledge* also contains two fine reproductions of lunar photographs obtained by MM. Henry, illustrating an article by Mr. A. C. Ranyard, on the tints of the lunar plains.

METEOR SHOWERS DURING NOVEMBER.—During this month, in addition to some minor showers, Mr. Denning's table informs us that there are two which are above the usual brilliancy. The positions of the radiant points are as follows, the two most brilliant being printed in heavier type:—

Date.	Radiant. α	δ	Meteors.
Nov. 13	**150**	**+22**	Swift; streaks
16	154	+ 41	Swift; streaks
17	53	+ 71	Slowish
20	62	+ 23	Slow; bright
27	**25**	**+44**	Very slow; trains
30	190	+ 58	Swift; streaks

GEOGRAPHICAL NOTES.

SOME anxiety may have been caused amongst Dr. Nansen's friends by reports published in an evening paper from the slender testimony of some Samoyedes, that the Kara Sea was unusually hampered by ice this season. The *Nouvelles Géographiques*, it is satisfactory to see, reports on the authority of the captains of the Russian vessels carrying railway material to the Yenesei, and of Captain Wiggins, that the navigation of the Kara Sea was particularly easy this summer, the ice being thin and not compact. The Hammerfest whalers also reported that never within human memory has the sea been so free from ice. At the end of December one vessel saw not a single iceberg between Nova Zemlya and Franz Josef Land. In the Kara Sea the current, which is usually westerly at that season, was this year running north-north-west, at the rate of a mile an hour. The note indicates that Captain Wiggins entertained no doubt of Dr. Nansen having easily reached the New Siberian Islands, which were to be his real starting-point.

IN continuation of the soundings of the English lakes recorded in this column from time to time during the summer, Mr. E. Heawood, assisted by Mr. Shields, has last week made bathymetrical surveys of Ennerdale, Buttermere, and Crummock Waters.

THE annual report of the Tyneside Geographical Society shows that there is now a membership of 1011, and the society generally in a flourishing state. From its headquarters in Newcastle the Tyneside Society extends its operations over a considerable area, and has established a regular branch in the city of Durham.

DR. JOHN MURRAY, of the *Challenger*, has written an elaborate paper on the first voyage of Columbus in relation to the development of oceanography. It is published in the current number of the *Scottish Geographical Magazine*, illustrated by reproductions of a number of ancient maps. Dr. Murray deals incidentally with the origin of the name America, rejecting Horsford's fantastic guess that it came from the name of the Norse explorer Erik the Red, and inclining towards Marcou's theory of its native origin from the Amerrique tribe of Indians in South America. As to Amerigo Vespucci's connection with the name, the author views it as a playful nickname given to him on account of the similarity of his Christian name, which was superseded by *America*, just as he himself is frequently called "Challenger Murray" for the sake of distinction.

THE EROSION OF ROCK-BASINS.

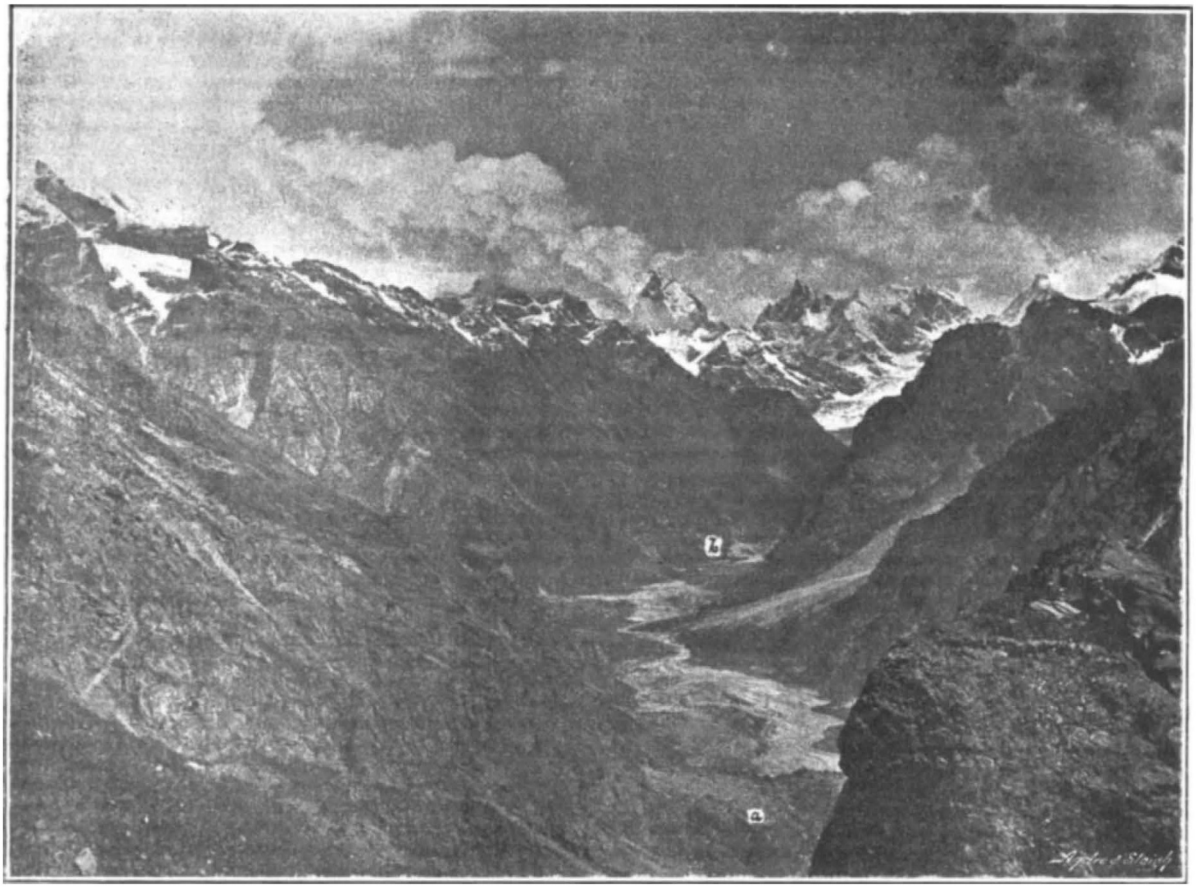
IN a recent letter to NATURE (vol. xlviii. p. 247, July 13, 1893), Sir H. Howorth attacks the views of those extreme glacialists who hold that a glacier is able, by means of the fragments of rock frozen into its under surface, to excavate rock basins: and with justice, so far as the larger basins, such as those of the great Swiss and Italian lakes are concerned, for it has been frequently shown, especially by Prof. Bonney, that such a cause is quite inadequate to account for the excavation of those basins. It seems inconceivable that a glacier which is barely able to move the loose *débris* lying in its path, should be able to plough out hard rocks to any depth whatever below the general valley level. On the other hand, the frequent occurrence of rock basins in regions which are now, or were in former times, subjected to glaciation, is so remarkable, that it appears as though there must be some connection between the two sets of phenomena.

Sir H. Howorth says that, "so far as we know, the mechanical work done by ice is limited to one process. The ice of which glaciers are formed is shod with boulders and with pieces of rock which have fallen down their crevasses. These pieces of rock abrade and polish and scratch the rocky bed in which they lie when they are dragged over it by the moving ice. Without this motion they can of course effect nothing either as burnishers or excavators." But there is another agent of erosion which is only called into play under the peculiar circumstances afforded by glaciers, and one which, I venture to think, is sufficient to account for the formation of these hollows. This is briefly, the action of the water, derived from the melting of the surface of the glacier. It is now some five years since I had the good fortune to be able to explore some of the large glaciers in the higher regions of the Himalayas, and formed the conclusions which I am now about to put forward; but it seemed to me so likely that they had occurred to others, and probably been dismissed as unsatisfactory—though of this I could not assure myself, as it is long since I have had access to any library in which papers relating to such questions might be found—that I hesitated to publish them. It seems, however, from the remark in Sir H. Howorth's letter, quoted above, that no weight has hitherto been attached to this cause of erosion, however slight it may be, and therefore my observations may possibly be of some value.

Before going into details, I wish to draw attention to one or two facts which have been overlooked by Sir H. Howorth, and which have an important bearing on the discussion. In the first place, whatever be the cause of motion, it is an undoubted fact that the lower portions of large glaciers do move over level or nearly level ground, and that for considerable distances. Whether the bottom layers of the glacier move at all under such circumstances does not matter much, but that the surface layers move is proved by the manner in which stones are carried down and deposited in a moraine often several miles distant from the foot of the steep slopes at the head of the valley. I am inclined to think that the amount of plasticity attributed to ice, founded on laboratory experiments, has been considerably underrated, and that under the conditions in which it exists in a large glacier it does actually flow, though very slowly, like a viscous body. Why gravity should cease to do any work on the ice, when it rests on a level surface, as Sir H. Howorth states, I cannot see, and when we consider the enormous thickness and weight of ice in a large glacier, there seems nothing strange in its spreading out or flowing in the only direction in which motion is possible, if we allow any degree of plasticity whatever. In the second place, that erosion of some kind, and that to a large amount, does go on beneath a glacier is proved by the turbid state of the water which issues from the end of it, and it must be remembered that this turbidity of the water is not occasional like that of a river in flood, but is continuous, or at least is recurrent every twenty-four hours, throughout a great portion of the year.

In ascending one of the larger Himalayan glaciers we notice at least three well-defined stages. First, at the foot of the glacier, and for a considerable distance up, perhaps a mile or more, the ice is almost completely concealed by the burden of moraine stuff brought down from above, which, as the ice melts away, is continually being deposited on the floor of the valley. As a result of the continued renewal of these loose deposits, the stream which rushes out from beneath the glacier is unable to cut down into the solid rock. Therefore, supposing the end of the glacier to remain at or about the same position for a long period, and allowing for a moment that there is *any* erosion whatever going on beneath the glacier higher up, there is undoubtedly a tendency towards the formation of a hollow, closed at its lower end by a rock barrier.

Having clambered over the masses of moraine matter which conceal the lower end of the glacier, we enter upon a broad expanse of ice comparatively free from boulders. Here the surface of the ice usually lies at a very gentle inclination, and may continue in this manner for several miles, until the foot of the steep snow-covered slopes, riddled with crevasses, forming the third stage alluded to above, is reached. It is to this middle, gently sloping portion of the glacier that I wish especially to draw attention, as it is here that the agent of erosion, to which I refer the digging out of the hollows, is alone effective. And it is in such positions—that is, immediately below a point where the inclination of the valley decreases more or less abruptly—that in a formerly glaciated region rock-basins are most commonly found.



Glacier at head of Bhutna Valley Zanskar Rang, Kashmir. *a* Old Moraine; *b*, present termination of glacier.

The ice in this portion of the glacier is traversed by occasional narrow crevasses, into which the streams, often of considerable size, arising from the melting of the surface ice under a hot Indian sun, plunge sooner or later, carrying down numerous pieces of rock with them. Even if the crevasse does not originally extend to the bottom of the glacier, a shaft must quickly be worn out, so that the falling water is enabled to exert the whole of its force directly on the solid floor of rock. These waterfalls are, of course, well known under the name of "moulin," but I do not think that sufficient weight has been attached to them as an agent of erosion. They must act like so many gigantic drills upon the rock surface, and dig out hollows similar to those found at the foot of an ordinary waterfall. It may be objected that, when the glacier has retreated, we ought to find, instead of one large hollow, a series of pits corresponding to the position of each moulin; but here the peculiar conditions afforded by the presence of the ice come into play. Any particular moulin never keeps the same position for any length of time, not only because a new crevasse may open at any point in the course of the stream, but also because the water is continually cutting back the edge of the fall, as in an ordinary waterfall, but much more quickly. Thus the drills, in course of time, work backwards and forwards over the whole of the area occupied by this portion of the glacier. Indeed, their action may be compared to that of a rapidly revolving drill moved slowly over the surface of a piece of wood, which would ultimately be cut out to any desired depth, or to the action of a sand-blast directed on a piece of plate-glass.

It may be noted that none of the streams find their way down the glacier as far as the mass of moraine matter near its lower end, so that they can have no effect on the rock barrier, which, as I have pointed out, has a tendency to form beneath that portion of the glacier. Moreover, the majority are swallowed up before they reach the lower third or so of this middle portion of the glacier, and thus the well-known section of the bed of those rock basins which have been attributed to glacial action, deepest near their upper ends, and gradually shallowing lower down, is simply and easily accounted for.

It is a curious fact that, in the Himalayas, true rock basins are of very rare occurrence, although the conditions for their formation on the above hypothesis are conspicuously present. It is not, however, difficult to account for their absence if we consider the enormous amount of *débris* carried down by the Himalayan glaciers as compared with that borne by most European glaciers, to judge from pictures and photographs of the latter. It is only the lower portion of the Himalayan glaciers that is so entirely covered by *débris*, and the difference may be partly due to the fact that the hill-sides above this portion of the glacier are much less protected by ice and snow than in the case of the northern glaciers. On the retreat of the glacier this burden of moraine stuff would be quite sufficient to fill up any hollow that may have been formed beneath it. This is well shown in the accompanying illustration, where there is a well-defined old moraine at *a*, the present termination of the glacier being at *b*. Between these two points stretches an almost level plain, some four or five miles long, in which we should have expected to find a lake, supposing a hollow had been worked out beneath the glacier; but in place of it we find this broad stony plain covered with *débris*, evidently derived from the main glacier and from the side valleys. But suppose the glacier were to advance again, all this loose material would in course of time become frozen into the bottom of it, and carried out. Then if a rapid retreat of the glacier were to occur, leaving no time for the hollow—if any exists—to be filled up again, we might have a lake where the plain now is. Or, the contrast may perhaps be accounted for by a difference in the rate of change of climate since the glacial period, which may have been more slow in these southern latitudes than further north, so that the northern glaciers had not sufficient time during their retreat to fill up the hollows formed beneath them. If, as has been supposed, the extension of the European glaciers was partly due to a diversion of the Gulf Stream, might not the rapid breaking down of the barrier which caused that diversion have given rise to the rapid amelioration of climate required?

It would not, I think, be difficult to carry out a few measurements of the erosion that goes on beneath a glacier, which might throw much light on the question. If one visits the mouth of one of these glaciers early in the morning, the stream which issues from it is seen to be nearly, but never quite, free from sediment. This amount of sediment might, I think, be taken as that due to the rasping action of the ice itself, aided by the rocks frozen into its under surface. As the day proceeds, and the surface of the glacier begins to melt, the volume of water issuing at its foot quickly increases, and at the same time it becomes thick with mud. It would be easy to measure the velocity of the stream, and the amount of sediment at intervals during the day, and from this, knowing the area of the glacier, we could estimate the erosion due respectively to the rasping action of the ice and to the drilling action of the moulins. That the latter would be enormously in excess of the former I have no doubt whatever, and I think that it is worth considering whether this may not be an adequate cause of those hollows which do undoubtedly occur in positions that seem to connect them with a former extension of glaciers.

T. D. LATOUCHE.

CHRONO-PHOTOGRAPHIC STUDY OF THE LOCOMOTION OF ANIMALS.[1]

THE chief interest in the study of organised beings is to look for the similarity which exists between the special conformation of each species, and the particular characters of the functions in this species.

The union of comparative anatomy and physiology is becoming more and more close, and will, without doubt, lead to the discovery of the fundamental laws of morphology—laws by means of which the inspection of an organ will permit us to foresee the particularity of its function.

These relations begin to be comprehensible in the case of the organs of locomotion of vertebrates. The size and length of the muscles, the relative dimensions and form of the bony supports of the members, the extent and the form of the articulating surfaces enable us to infer the character of the movements of mammals; and, on the other hand, the accuracy of these deductions can be proved by controlling them by chrono-photography, which gives the geometrical character of these movements.

Attempts have been made to extend this method of analysing the movements of a number of different animal species by chrono-photography, and they have been successful not only with mammals, but also with birds, reptiles, fishes, molluscs, and arthropods.

It will no doubt be a lengthy enterprise to collect the numerous series of pictures necessary for this comparison, but we have been able to assure ourselves that it is nearly always possible to obtain such pictures by varying the conditions according to the kind of animal studied.

Reptiles, for example, must be put in a kind of circular canal, where they can run at their ease; the chrono-photographic apparatus is placed above the path in which the animal runs, and thus photographs the successive attitudes during the course.

The fish swim in similar troughs filled with clear water, and illuminated underneath, in order that their silhouettes should appear on a clear background. At other times the animal is lighted from above, and thus appears light on a dark background. Similar arrangements are employed for insects. It is not necessary to have here the dark background which served for the study of mammals and birds. The principal difficulty is to ascertain whether the animal under experiment is moving in its normal fashion. With the domestic and tame kinds this is not considerable, but with wild species it requires much patience and many attempts to secure the natural movement.

On comparing some of the types of which chrono-photographic images have been obtained, very interesting analogies are found. Thus, for locomotion on land, as well as in water, it is possible to follow the gradual transitions between simple reptation and the more complicated kinds of locomotion. An eel and an adder put in water, progress in the same way; a wave of lateral inflexion runs continually from the head to the tail of the animal, and the velocity of the retrograde progression of this wave is slightly greater than the rate of movement of the animal itself.

If an eel and an adder are placed on the ground, the manner of reptation is modified in the same way with both species. The undulatory movement has here and there a greater amplitude, and this amplitude increases with the smoothness of the surface on which the animal moves.

With fish, provided they have fins, and with reptiles which have feet, there remains, in general, a more or less pronounced indication of the undulating movements of reptation.

With the dog-fish, for instance, the retrograde wave which goes the length of the body is very pronounced; it is much less with salmon, and exists hardly at all, except at the end of the tail, with fish with thicker bodies.

The retrograde wave during the terrestrial movements of the Gecko is plainly visible, but is less pronounced with the grey lizard and green lizard.

The batrachians present, during the successive phases of

[1] Translation of a communication by M. Marey to the Paris Academy of Sciences.