

*Note on the motion of the Glacier of the Pindur in Kumaon. By Lieut.  
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In No. 181 (August 1847) of the Asiatic Society's Journal, I gave an account of the Glacier at the head of the Pindur River, in which it was noticed that I had been unsuccessful in an attempt to measure directly the motion of the glacier. In the past month (May 1848), I again visited this glacier, chiefly with the intention of making an accurate measurement of its motion; and the result of my operations I now propose to detail.

About 200 yards below the small tributary that enters the main glacier from the N. W. an old moraine, grown over with grass and bushes, which vouched for its present stability, offered a convenient station from which the motion of the ice could be observed. The moraine is heaped up against an almost perpendicular wall of rock, sufficiently high to command a view of the greater part of the surface of the glacier along the line on which observations were to be made. This line, which is nearly perpendicular to the general direction of the glacier, was marked by two crosses painted white, one on the rock in contact with the old moraine, the other on a cliff on the opposite side of the valley. A stake was driven into the moraine, at its highest point, close to the rock on the line between the two crosses, and a Theodolite was set up over it. Five other marks were also made on the glacier, at intervals along the same line, by fixing stakes in holes driven in the ice with a jumper. These marks, which were all carefully placed on the exact line between the crosses by means of the Theodolite, were completed at about 0h. 30m. P. M. on the 21st May.

On the following day the Theodolite was again set up on the same place as before, and being properly adjusted, the cross-wires of the telescope were directed to the cross on the cliff on the opposite side of the glacier. A stick was then set up near the first of the five marks that had been made the previous day, and was, by means of signals, moved up or down the glacier, till it appeared to coincide exactly with the cross-wires of the Telescope, and consequently to be exactly on the line between the two crosses painted on the cliffs. The distance between the centre of the stick and that of the fixed mark was then measured, which evidently showed the downward progress of the ice at that point

of the glacier since the marks was made the day before. The same process was repeated at each of the other marks.

On the 25th May the progress of the fixed marks was again measured in exactly the same way. The results of these measurements are as follows :

| Time of observa-<br>tion. | Distances of fixed marks from standard line. |                            |                                       |   |                              |
|---------------------------|--|----------------------------|---------------------------------------|---|------------------------------|
|                           | On the west<br>moraine.                      | On the me-<br>dial moraine | At east foot<br>of medial<br>moraine. | Near the<br>middle of<br>the clear ice. | On the east-<br>ern moraine. |
|                           | 0  | 0                          | 0                                     | 0                                       | 0                            |
|                           | ft. in.                                      | ft. in.                    | ft. in.                               | ft. in.                                 | ft. in.                      |
| 21 May, 0 30 p.m.         | 0 5½   | 1 0½                       | 1 0                                   | 1 0½                                    | 0 6½                         |
| 22 May, 1 15 p.m.         | 1 9½   | 2 9½                       | 2 11½                                 | 3 1                                     | 1 5½                         |

The motion in 24 hours of the several marks will also be found to be—

| Date.         | Mean motion of Ice in 24 hours, (in inches.) |                              |                                       |   |                              | Approx.<br>mean Tem-<br>perature. |
|---------------|--|------------------------------|---------------------------------------|---|------------------------------|-----------------------------------|
|               | On the<br>west mo-<br>raine.                 | On the<br>medial<br>moraine. | At east foot<br>of medial<br>moraine. | Near the<br>middle of<br>the clear ice. | On the<br>east mo-<br>raine. |                                   |
| 21 to 22 May, | 5.3  | 11.9                         | 11.6                                  | 11.9                                    | 6.5                          | 43°F.                             |
| 22—25 May,    | 5.7  | 7.6                          | 8.4                                   | 8.8                                     | 3.8                          | 38°F.                             |
| General mean, | 5.5  | 9.7                          | 10.0                                  | 10.3                                    | 5.1                          |                                   |

The progress of the lower extremity of the glacier was likewise approximately measured by observing the apparent angular motion of a pole fixed on the top of the eastern moraine, and of a conspicuous rock lying not far from the middle of the glacier.

The results of these observations are :

| Date.             | Mean motion of Ice in 24 hours, (in inches.) |                         |
|-------------------|--|-------------------------|
|                   | On the moraine.                              | Near middle of Glacier. |
| 19th to 20th May, | 3.0  | ..                      |
| 20th to 23rd May, | 6.2  | 8.1                     |
| 23rd to 25th May, | 5.3  | 10.8                    |
| General mean,     | 4.8  | 9.4                     |

The comparison of the motion of the lower and upper parts of the Glacier is :

|                        | Mean motion of Ice in 24 hours, (in inches.) |                               |
|------------------------|--|-------------------------------|
|                        | On the lateral moraines.                     | On the middle of the Glacier. |
| Lower part of Glacier. | 4.8  | 9.4                           |
| Upper ditto,           | 5.3  | 10.0                          |

At the time of my visit to the glacier hardly any of the last winter's snow remained on its surface. The weather, which was tolerably fine up to the 22nd May, after that day became very bad. Besides a good deal of rain, about 3 inches of snow fell on the 23rd, and as much on the 24th, and on the morning of the 25th, the clearer parts of the upper end of the glacier were still covered with snow, though it had melted on the moraines and open ground near the glacier. This bad weather appears to have had considerable effect in retarding the motion of the ice.

I may as well here mention that the motion of the Mer de Glace, as measured by Prof. Forbes, varied from 27 to 9 inches in 24 hours, in different parts of the glacier, and at different times between the months of June and September. The motion of the middle part of the glacier of the Aar is also stated by M. Martins to be about 71 mètres per annum, which amounts to about  $7\frac{1}{2}$  inches in 24 hours.

The elevation of the foot of the glacier, where the Pindur leaves it, determined by the comparison of corresponding Barometrical observations, made there and at Almora (5586 ft.), is 11,929 feet above the sea. The elevation of the station where the Theodolite was fixed to measure the motion of the glacier, was similarly found to be 12,946 feet; and the elevation of the surface of the glacier near its lower end, at a distance of about 6000 feet from the Theodolite station, being about 12,140 feet; the slope of the surface of the glacier is about  $7\frac{1}{2}$  degrees.