

ON THE RETREAT OF THE SWISS GLACIERS; AND ON
THE LEGAL RIGHTS TO GLACIERS AND TO THE SOIL
BENEATH THEM. By C. MARETT.

I PRESUME that one of the objects of the 'Alpine Journal' must be to contain a record of Alpine changes; and, as no one else has undertaken the task, I have thrown together some details of the very remarkable retreat of the glaciers which has now continued for some years, hoping that in the absence of anything better, this record, though imperfect, may be serviceable hereafter, and may also be not unacceptable to the readers of the 'Alpine Journal.'

Mr. F. F. Tuckett, in the sixth vol. of the 'Alpine Journal,' p. 30, has given an exceedingly interesting account of the retreat of the Lower Grindelwald Glacier, and of the uncovering of ancient marble quarries from beneath it. He also gives reasons for believing that the glaciers were at a minimum about the year 1750; that between that time and 1771 they had rapidly increased, and had not again diminished until after 1850, since which time the retreat has been continuous and very remarkable. Up to about that time the glaciers were no doubt increasing, and the Swiss expressed some anxiety on the subject. Soon afterwards the advance ceased, and in many of them a retreat began; not, however, in all of them, for the Findelen Glacier at Zermatt was in 1859 encroaching on the pastures and turning up old turf like a gigantic ploughshare. The natives give as a reason for the retreat, an unusual number of mild winters, and most old Swiss travellers will say that the summers have on the whole been hotter and finer than they were formerly. The inhabitants of Chamonix declare that their crops ripen a fortnight earlier, and attribute this to the diminution of the glaciers; more, however, is probably due to the warm summers and to improved cultivation.

I have made no actual measurements, but as I was at Chamonix and at Grindelwald in 1830 and 1831, at Grindelwald again in 1852, at Chamonix again in 1854, and at both again in 1875, I am perhaps able to form a tolerable estimate of the vast changes of which the younger generation of tourists can have no notion. I find, moreover, that my rough estimate agrees very exactly with the estimates formed by the Swiss engineers from careful measurements and continued observations.

My recollections of 1830 and 1831 were in 1852 and 1854 tolerably distinct, and I am sure that I saw no remarkable changes when I then visited the glaciers. The change in 1875 was so great that I can best give the younger readers of the Journal a notion by saying that the difference is as much as that between the Thames opposite Greenwich at high water, and the same at low water. I now proceed to details.

1. The *Glacier of Argentière*.—This I did not visit, but from the Tête Noire road I saw clearly that it had sunk and retreated very remarkably, and was much smaller than in 1854 when I had last seen it.

2. The *Mer de Glace* or *Glacier des Bois*.—This glacier I found occupying in width at the foot not above a third of its old width. It

is now entirely on the Chapeau side; but it formerly occupied the whole space between Chapeau and Montanvert, almost protruding into the valley. The red rocks which now (1875) adjoin Montanvert and cover two-thirds of the space between that and Chapeau were formerly buried under ice; and the source of the Arveiron was close to the foot of Montanvert. In fact, as mentioned in the guide books, there was a steep descent from the Montanvert path which led straight down to the Cavern of the Source and was usually taken by tourists.

There is now on each side of the glacier, a moraine of grey rubbish rising some 300 feet above the glacier, up and down which zigzag paths have been made by which to reach the glacier from Montanvert and from the rocks on the Chapeau side. There were in 1854 at many places high moraines, but only the outside slope was to be seen; and my impression is that the ice, instead of being below the moraine, was then in many places above it. The path to the Jardin is now entirely different from that which was formerly taken, as the sinking of the glacier has rendered the old path impracticable.

3. The *Glacier des Bossons* I had not visited in 1854, but it was in 1875 obvious that some 200 feet depth of moraine had been recently exposed, and I was told that the foot had retreated full 200 yards.

4. The *Upper Glacier of Grindelwald*, which formerly filled the whole space between the Wetterhorn and Mettenberg and projected well into the valley, has now retreated a quarter of a mile, and does not occupy above one-fourth of the space between the mountains, being not above 100 yards wide. It is now close to the Mettenberg; and a large mass of glacier-worn rock—a sort of spur from the Wetterhorn—now occupies the rest of the space. The foot of the glacier still (1875) reaches the plain, but at the present rate of decrease it would not long do so. According to the statements of my guide, it had in the last three years retreated about 100 yards from a large mass of polished rocks which he pointed out. All the limestone rocks where the glacier had been were much striated, and the scratches looked white and fresh. The foot of the glacier was steep but smooth and very dirty. About 200 feet above the plain the glacier was deeply crevassed and rose into pinnacles of ice.

5. The *Lower Glacier of Grindelwald*.—This glacier, which formerly projected into the valley, has fallen back at least a quarter of a mile, leaving some bare rocks and a large irregular piece of ground covered with stones and rubbish. The front is now well within the line of the Mettenhorn and Eiger, and the celebrated pinnacles of ice which were formed by the pressure in that narrow space have all vanished. There is now (1875) merely a dirty front, or rather tongue, of smooth ice deeply crevassed coming down to the plain and just filling the narrow space between the mountains. The deep scores in the rocks above show how great the pressure used to be. This glacier has also sunk at least 300 feet. The stream from it is now seen flowing through a deep ravine or cleft in the rocks which was until of late years buried under the glacier and invisible. It is to this glacier that the very interesting paper by Mr. F. F. Tuckett in the 'Alpine Journal,' vol. vi. p. 30, relates.

6. The *Rosenlaui Glacier*, formerly celebrated for its beauty, has, I am told, almost disappeared or retreated into the mountains.

7. *Glacier of the Rhone*.—The Federal Government for two years made careful measurements of this glacier; and they ought to be complete, having cost 800*l*. The result arrived at is that in the nineteen years before 1875 the glacier had retreated about a quarter of a mile, and had sunk 300 feet.

8. The Glaciers at *Zermatt* have, I am told, retreated during the last few years, but up to 1870 or thereabouts, the Gorner glacier steadily advanced while those of North Switzerland were shrinking.

9. *Glacier of Morteratsch* near Pontresina.—This I visited in 1874, but not having then had my attention drawn to the subject I did not make any careful observations on it. I have, however, a distinct recollection of having walked over a considerable space of stones and rubbish before reaching the foot of the glacier; that glacier had therefore retreated, but the retreat has not been nearly so great as at Chamonix and Grindelwald; and altogether the retreat of the Western Glaciers has, as far as I could learn, been much larger than that of the Eastern Glaciers.*

On all the glaciers the ground formerly covered by them was still barren and very plainly marked, though in many places a few stunted shrubs had made their appearance. At the Upper Glacier of Grindelwald, and at the Glacier des Bois at Chamonix, much of the ground left was tolerably level, though, of course, covered with stones and rubbish, and a legal question has been raised as to its ownership.

As a toll is often demanded for leave to go on a glacier or cross a moraine, tourists may like to learn that this is not always a simple extortion, and that glaciers are not a species of no-man's-land as most people even in the country supposed. The laws of Italy and Savoy are contained in codes, and so it seems are the laws in most or all of the Swiss Cantons. When these codes were compiled, glaciers were probably considered as of no value; at all events they are nowhere mentioned or referred to in the codes. Of late years, however, glaciers have become of value both as a source of toll, and for the ice taken from them; besides which, now that the glaciers have retreated, the soil left uncovered is likely to be of some value. The right to the glaciers and their subjacent soil has therefore become a subject of discussion, and seems to be in a state of glorious uncertainty.

M. Cérésolle, in an article *De la propriété des Glaciers* in the Geneva 'Journal des Tribunaux' of September 1865, comes to the conclusion that the glaciers in his country (apparently Savoy) belong to the State; and he declares that the same law prevails in Bern, Vaud, and Valais. As to Bern, however, it is doubtful if he is right, for at

* The Morteratsch Glacier advanced steadily for some years subsequent to 1858. Latterly it has retreated. The Forno Glacier and Roseg Glacier, the two next largest of the Bernina chain, are also retreating. The Adamello Glaciers have retreated immensely in the last twelve years, as has the great Forno Glacier in the Orteler group. See also Von Sonklar on the Eitzthaler Ferner. I am inclined to doubt whether Mr. Maret's belief in the comparatively small retreat of the glaciers of the Eastern Alps is well founded.—Ed.

Grindelwald, in 1875, the inhabitants certainly held that the glaciers, like streams in England, belonged to the owners of the adjacent land, each owner claiming up to the middle line of the glacier opposite his land; and tolls were demanded and taken accordingly. Moreover, Signor A. Grober of Varallo, in an elaborate discussion in the '*Bollettino del Club Alpino Italiano*,' vol. x. p. 1, maintains that in Italy, the Code of which seems very similar to the Swiss codes, the glaciers do not necessarily belong to the State. He says that some Italian jurists are of opinion that glaciers do belong to the State; others consider that they belong to the commune or parish; and others consider that they may be private property. Signor Grober comes to the conclusion that, by analogy to streams of water, large glaciers, like navigable rivers and large lakes, belong to the State; but small glaciers, like rivulets and ponds or small lakes, belong to the owners of the surrounding land. He founds his conclusion on the 427th article of the Civil Code of Italy which declares that rivers and torrents form part of the public domain, but he maintains that this law is not and cannot be applicable to small brooks and ponds.

As to the soil beneath the glaciers. Signor Grober is of opinion that it must follow the law as to rivers, which he states to be—though it does not seem quite certain—that the soil belongs to the owners of the adjoining land, as is the law in England. In France the right seems very doubtful. By Art. 538 of the Code Civil '*les fleuves et rivières navigables ou flottables sont considérés comme des dépendances du domaine public.*' This, I am told, has been held to make the bed of a navigable river the property of the State; but as to smaller streams, the Code being silent, the right has never been determined. The question has usually arisen as to the right to take gravel for the repair of the roads, which is sometimes claimed by the officials of the Government and disputed by the commune or the owners of the adjoining land. Such a dispute was in 1875 going on at the town of Gebweiler in Alsace. Signor Grober further argues that as the adjoining land is subject to be destroyed by the advance of a glacier, it is but fair that the owner should have the benefit of a retreat. He also argues that nothing else can be done with a moraine left by the glaciers and gradually covered with herbage; and he comes to the conclusion that, according to the law of Italy, the bed of the glacier, covered or uncovered, belongs to the owners of the adjoining land.

As the question of ownership has been under discussion for certainly twelve years, it seems odd that it has never been formally raised and decided, or at least had not been raised and decided up to the early part of the year 1876, when Signor Grober wrote on the subject.

ALPINE NOTES.

PRIMIERO.—Mr. A. de Falkner writes, with reference to his recent note (p. 162): 'My authority for writing Comelle instead of Cornelle is simply that of the people of Gares, where the name is so spelt, and is confirmed by Count Manzoni, who possesses some woods leading to the