



*Fig. 1. The Pindar Glacier painted by Adolf Schlagintweit on 30 May 1855 (see p. 687-92)*

## EARLY DISCOVERERS

### XIII

#### THE FIRST GLACIOLOGISTS IN CENTRAL ASIA

according to new studies in the Department of Manuscripts at the Bavarian State Library

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**ABSTRACT.** Contributions to the glaciology of the Himalaya, Karakoram, and Turkestan areas are contained in the hitherto unpublished records of the Schlagintweit brothers. These should be of considerable value for future research since the records include paintings, sketch maps, descriptions, and also measurements of glacier speed, which give details of the state of the glaciers in 1855-56. These records were used recently to great advantage on Nanga Parbat.

**RÉSUMÉ.** Les frères Schlagintweit ont fait des recherches glaciologiques en Himalaya, Karakorum et en Turkestan en 1854-57, qui ne sont pas publiées jusqu'à présent. Après une contribution à l'histoire de la glaciologie il est renvoyé aux matériaux pour des recherches dans ces régions à l'avenir (des peintures des glaciers, cartes esquissées, descriptions, mesures de la vitesse de la glace, indiquant la situation des glaciers de 1855-56). Tels matériaux de Schlagintweit furent profités dans la région de Nanga Parbat avec bons résultats.

**ZUSAMMENFASSUNG.** Aus dem bisher unveröffentlichten Nachlass der Brüder Schlagintweit, die 1854-57 im Himalaya, Karakorum, und in Turkestan u.a. auch gletscherkundlich gearbeitet hatten, werden Beiträge zur Geschichte der Gletscherkunde geliefert und auf Material für zukünftige glaziologische Forschungen in diesen Gebieten hingewiesen (Gletschergemälde, Kartenskizzen, Beschreibungen, Eisgeschwindigkeitsmessungen, die Hinweise auf den Gletscherstand von 1855-56 geben). Zum erstenmal wurde solches Material von Schlagintweit im Gebiet des Nanga Parbat mit gutem Erfolg genützt.

It was fortunate that the same men who had introduced modern glaciological exploration to the Eastern Alps of Europe were able to do the same in the Himalaya. Only a little later than the researches of L. Agassiz and J. Charpentier in the Western Alps, the brothers Hermann and Adolf Schlagintweit began glaciological research in the Alps further east. This was in 1846. They made the first special maps of the glaciers there, measured the velocity of the glaciers, and studied the ogives and other features. They were the first to explain the formation of firn from new snow by frequent changes of melting and freezing.

Because of their meteorological, geological, and botanical-geographical explorations in the Alps they attracted the attention of Alexander von Humboldt. He recommended the two brothers to the East India Company for geomagnetic exploration in India. Thus Hermann and Adolf, and also their youngest brother Robert, went to India in 1854. For three years they collected valuable and abundant scientific material, generally travelling by different routes. With their own glaciological experience and acquaintance with the publications of de Saussure, Agassiz and Forbes they investigated many glaciers in the Himalaya, Karakoram and Kuen-lun during the years 1854 to 1857. This they did in addition to their other activities. Neither von Humboldt nor the East India Company had wanted, or expected, glaciological research. Nevertheless they could not have sent off men better qualified for such work, and this exactly at the time of the glacial maximum in the Alps. Von Humboldt had not, at that time, come to believe in the value of glaciological exploration, nor in the Ice Ages. What he had expected of the Schlagintweits was to clarify certain orographic problems of the mountain ranges of Central Asia, to measure the geomagnetic components, and to study botanical geography. However, all this work was continued and improved upon by others coming after them, and therefore possesses only historic value today. But it is just their surveys and their

painted pictures of glaciers, that are still of real scientific interest. All the more tragic is it that the most successful of the three brothers, Adolf, was murdered in Kashgar in Turkestan in August 1857. A very promising life had ended after only 28 years.

As Adolf did not return, it was the glaciological work which was not elaborated and remained nearly unused and unpublished until today. Thus there remained a gap in our knowledge about the glacier cover of the Himalaya in the nineteenth century. This was all the more serious as the Schlagintweits were the only true glaciologists in these regions during the whole of that century. None of the other explorers reporting on Himalayan glaciers before the present century, i.e. G. T. Vigne, H. Falconer, H. Strachey, H. Godwin-Austen, F. Drew, R. Lydekker, and Martin Conway, had as much experience of and special interest in, glaciers as the Schlagintweits.

After their return the other two brothers, Hermann and Robert, began to list and catalogue the collections of stones, minerals, plants, skulls, historic articles, paintings etc.—nearly 15,000 items—assisted by their fourth brother Emil. They also began to edit their “Results of a scientific mission to India and High Asia” in English, but succeeded only in completing 4 volumes (containing itineraries, positions, heights and meteorology) out of the 15 they had planned.<sup>2</sup> A sixth volume on geology and glaciology was not even begun. Except for one “Atlas of panoramas and views”<sup>2</sup> with coloured lithographs, none of the intended atlas volumes has ever been published.

In the second volume a coloured view of the south side of Nanga Parbat was to be published and this sheet had already been printed. While the original of this painting in water-colour has not yet been found, a nephew of the Schlagintweits was able to give the print to the scientific leader of the Nanga Parbat Expedition of 1934, Professor R. Finsterwalder. As Finsterwalder knew the localities and could compare the painting with his photogrammetric plates and his 1 : 50,000 map of 1934, he learned important facts about the ice cover in 1856. He was certain therefore that the glacierization of the eastern and southern sides of Nanga Parbat was much more extensive in 1856 than in 1934. It must have been very close to the maximum, as is shown today by huge moraines. It is interesting to note, however, that the amount of decrease since that maximum is not as great as on comparable alpine glaciers. These results were elaborated and published by Finsterwalder.<sup>5</sup>

Although the glaciological work of the Schlagintweits was not published, the numerous manuscripts and paintings have almost all been saved. Before going on to Turkestan, where at that time the Turks and Chinese were entangled in military troubles, Adolf had sent most of his companions back to India with the manuscripts, paintings and all collected material. All this came to Europe after some years and at first was taken care of by the brothers. Later it went to different places and for a few decades now has been in the keeping of the Manuscript Department of the Bavarian State Library, although some of it is kept by Dr. E. Schlagintweit, a nephew of the brothers who lives in Bad Wiessee.

Except for the panorama of the south side of Nanga Parbat investigated by Finsterwalder this glaciological work was not used or even noticed for more than a hundred years. It is a fact that not even in German glaciological literature, that is to say in the work of Drygalski and Machatschek (*Gletscherkunde*, Vienna 1942), nor in von Klebelsberg's *Handbuch der Gletscherkunde und Glazialgeologie* (Vienna 1948-49) have the researches of the Schlagintweits in the Himalayas received more than briefest mention. Owing to the murder of Adolf not even the routes taken by him have become properly known. For example, nothing is known about the ascents of the Panmah and Chiring Glaciers in the Karakoram, nor about the ascent to the Western Mustagh La (5,640 m.).<sup>9</sup> More important still is the fact that nothing is really known about the glaciological work done there in 1856. Later explorers of the same glaciers—except H. Godwin-Austen (1861)—namely, A. Desio (1929) and E. Shipton (1939), who went up the same routes along the Panmah and Chiring glaciers to the Western Mustagh La, knew nothing about their predecessors there and could not know.

(Godwin-Austen may have received information from native guides who had accompanied Schlagintweit.) Otherwise they could have compared the pictures and descriptions of 1856 with the present situation and would very probably have got some knowledge about the amount of change. At these same glaciers the Schlagintweits had already measured the velocity of ice, which could have been repeated later for comparison.

The manuscripts are contained in 46 volumes and it is intended to make the glaciological sections, which form only a small part of the whole, available for future research, together with certain paintings. It has proved impossible to compare the pictures with modern photographs not made for this purpose, or to compare them with topographical maps, because nearly all maps of these regions are on too small a scale for such details. Mr. E. Shipton was kind enough to send the writer very good photographs of some parts of the Panmah and Chiring Glaciers, but they were not taken from near enough to the positions used by the Schlagintweits. It was the same with Professor Desio's photographs of 1929. It was much better in the case of the eastern and southern sides of Nanga Parbat. There were two paintings of individual glaciers there, also a sketch map. More important still, there were various descriptions and a measurement of the ice velocity. These were found in 1958; they were all dated 1856—a valuable date for determining the changes of the glaciers within the last hundred years because of the 1850 maximum in the Alps.

For comparison one was able to consult the Nanga Parbat 1 : 50,000 map of 1934, the photogrammetric plates and a velocity profile across the Chungpar Glacier. This profile was measured by photogrammetry in 1934 by Finsterwalder, by accident very near to the same spot on the same glacier where A. Schlagintweit had measured the velocity at two points in 1856. It was not necessary to travel to Nanga Parbat again to compare the conditions of 1856 with those of 1934. The writer's journey in 1958 was for other purposes, namely, for a photogrammetric repeat of the glacier survey of 1934. These results will be published together with A. Schlagintweit's work on Nanga Parbat. His records for this region proved the scientific value of his bequest to posterity, quite apart from their historical interest.

As a contribution to the history of glaciology some remarkable details about the impressions and the work of the Schlagintweits during their journeys in the Himalaya may be cited. They may help us to judge what can be and what cannot be expected from a study of their records.

While the tongues of the valley glaciers, in their alpine counterparts, generally have their origin in a corrie-like *névé*—a *névé*-basin—most of the glaciers of the geologically younger Himalaya and Karakoram lack such *névé*-basins for geomorphological reasons. They get their alimentation chiefly from avalanches off the steep flanks. Therefore among other types the *Firnmulden-Gletscher* (*névé*-basin or alpine-type glacier) is distinguishable from the *Firnkessel* type,\* which is a typical form in the Himalaya and Karakoram, and also in Turkestan. These types were described and were first given their names by K. Oestreich in 1902 in the case of the Chogo-Lungma Glacier in the Karakoram ("Mustagh" type), and in 1913 by R. von Klebelsberg in Turkestan (glacier without *névé* field or "Turkestan" type).

These are the facts and the story of their discovery and description by these authors.

But already half a century earlier, in 1856, A. Schlagintweit had written in his field books for later elaboration the note: " '*Kessel-gletscher*' in the Himalaya, their type and the contrast between them and alpine glaciers". This he had noted as a point for the discussion of his scientific results after his return—the return which never took place. He often added to his descriptions of single Himalayan glaciers: "No '*Firnmeer*' (*névé* field)" or "no '*Firnmulden*' (*névé*-basins) as in the Alps". Then he wrote: "In the case of these '*Kessel-gletscher*' the masses of *névé* suddenly come down from great heights and are changed to ice at the bottom. There-

\* See R. von Klebelsberg, *Handbuch der Gletscherkunde und Glazialgeologie*, p. 198-99. Ed.

fore the line of perpetual snow on the glacier lies lower than on the 'Mulden-gletscher' (glaciers with *névé*-basins) and its position is not so regular." He also realized that

"the individual tributaries of the *Kessel-gletscher* often show much greater changes of volume [*Mächtigkeit*] than in the case of the big glaciers of the alpine type. Also the sudden breakdown of great masses of rock can heap up more material on to the moraines. When large masses of firn suddenly break away they can make a tributary unstable [and powerful] by overweighting it. These influences may cause the alteration in the flow of the main glacier and the local stemming of the flow now on one side and now on another."

These are also quite modern ideas. The exceptional glacier advances, relatively frequent in the Himalaya<sup>7</sup> are caused by these same phenomena, already clearly realized by A. Schlagintweit; they are likewise the reason for the flowing of glacier ice over certain parts of the lateral moraine, sometimes penetrating through what are probably weak spots in the moraines—a phenomenon which can often be observed in the Himalaya. It is remarkable that later on, in our century, the same term "*Kessel*" was independently used by Ph. Visser for the "*Firn-kessel*" of Schlagintweit.<sup>10</sup>

A. Schlagintweit often studied the ogives on Himalaya glacier ice, drawing profiles showing the inclination of these bands into the body of the glacier. He measured the depth of single annual layers of snow. He obviously knew about the importance of this for obtaining dates, so often missing today, for the mass balance of Himalayan glaciers. His measurements of ice velocity are also most important for dating purposes in comparison with present velocities at the same profiles. A. Schlagintweit made these measurements at the Sherpi Gang\* in the Salto Range of the Karakoram, at the Panmah Glacier (Karakoram), and at the Chungpar Glacier.

But he had not thought of his successors and therefore had not fixed marks at the end of the tongues, or surveyed the glacier surface in relation to the unchanging surroundings. This was only done for the first time in the Himalaya half a century later, i.e. in 1902 by K. Oestreich, at the snout of Chogo-Lungma Glacier.<sup>4</sup> Since 1906 it has also been done by officials of the Geological Survey of India, at the suggestion made the year before by Douglas Freshfield on behalf of the *Commission Internationale des Glaciers*.<sup>8</sup> It is interesting that of four glaciers in the Kumaun-Himalaya, the ends of which were marked by the Geological Survey, A. Schlagintweit had painted and described two in 1855, the Pindar and the Milam Glaciers. These descriptions and paintings have also been unknown until now. One of these, that of the Pindar Glacier is shown in Figure 1, p. 686.

The brothers Schlagintweit knew very well about the fluctuation of glaciers. Before their three years' expedition to India they had inquired about certain glaciers in the Alps with respect to their fluctuations and had collected information about former positions of the snouts, glacial lakes, etc.<sup>1</sup> But like their principal and sponsor, A. von Humboldt, they did not believe in an ice age, as had been urged by L. Agassiz since 1837 or 1840.<sup>6</sup> They thought such an enlargement of the glaciers as too fantastic and searched for other explanations for erratics and the glacial striae. They were therefore unable to recognize the Pleistocene moraines in the Himalaya. But they observed the recent moraines very well, described them, measured their heights and believed that everywhere in the Himalaya and the Karakoram there had formerly been a more extended glacierization. A. Schlagintweit tried to find an explanation for the obvious recession of the ice since that former larger glacierization. He connected the recession of the ice with another phenomenon, which possibly also he was the first to conceive and describe.

In the *Journal of the Asiatic Society of Bengal*<sup>3</sup> he wrote:

"... I on several occasions observed gravel and sand beds evidently deposited by these

\* Gang = glacier or ice in Balti-Tibetan.

ivers, and ancient marks produced by the large streams on the rocks, at elevations of 3,000 and 4,000 feet above the present level of the rivers. We have many proofs to show the great depth to which all the valleys of the rivers tributary to the Sutlej and Indus, have been excavated. The decrease of glaciers as observed by us must be due to some general change in the climate of the surrounding country . . . This change of climate is due in a great measure, to the great excavation of the Tibetan and Himalayan valleys by the action of the rivers . . . The sides of these rocky valleys . . . are now heated by the sun to a much greater extent than was the case before the excavation; the warm air, thus produced, ascends the valleys and tends to melt the ice of the glaciers near the origin of the valleys to a greater extent than was the case before the excavation of the valleys had taken place."

Schlagintweit had the conception that was generally common until a few years ago, that the ablation of glacier ice depends directly on the temperature of the air, i.e. by the convection of heat. Had he survived he would have been amused at his earlier idea if he could have experienced the extent of the glacier retreat in the Alps beginning in 1855, which could never have been explained by the excavation of valleys. At the time of his investigations he could not have realized the correct relationship between the velocity of erosion and the periods sufficiently long to account for glacier variations. But it would be wrong to conclude from his hypothesis that Schlagintweit thought of the glacier variations as taking place over geologically long periods. He often noted that many of these fixed moraines, indicating a former bigger glacierization, looked extremely young.

From his descriptions in the Nanga Parbat region one is able to tell whether some of the lateral moraines were formed before or after 1856. One ought to be able to date the same moraines by botanical methods or from the condition of the soil in this arid climate, thus checking these methods.

Unfortunately in those early days photography was still in its infancy. Hermann Schlagintweit had taken a few photographs, i.e. in 1855, of the lake in the Naini valley in Kumaun-Himalaya, but there are no photographs of any glaciers. Somewhat crude field maps were drawn by the Schlagintweits—with reference points surveyed from a base line with a theodolite for later exact mapping. These were done for the Sherpi Gang, the Sospor Glacier, the Panmah Glacier, and the glaciers of the east and south side of Nanga Parbat. Expeditions to all these regions and also the geological surveys of India and Pakistan are advised to try to use the Schlagintweits' data in the same way that they were successfully used on Nanga Parbat.

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## APPENDIX

In 1855-56 paintings were made of the following glaciers, some of them from different viewpoints:

*In the Kumaun Himalaya*

Pindar Glacier (between Nanda Devi and Nanda Kot)	Sersutti Glacier (Kamet group)
Loan Glacier (near Traill's Pass)—official name not known—see note below	Tonse Glacier
Milam Glacier	Glaciers at the Mana Pass
Ibi Gamin Glacier (Kamet group)	Poti Glacier

*In the Karakoram*

Saser Glaciers (between Rimo Mustagh and Saser Mustagh)	Chiring Glacier (Panmah Mustagh)
Mamostong Glacier (near Saser La)	Sarpo Lago Glacier, seen from above (from the Western Mustagh La)
Sherpi Gang (Saltoro Range)	Ste Ste Glacier (at north side of Skoro La, between Koser Gunge and Mango Gusor groups)
A glacier in the Hushe Valley	
Panmah Glacier (Panmah Mustagh)	
(Names and groups according to Karakoram Conference, 1937)	

*In Punjab Himalaya*

Parang Pass and its glaciers	Rupal Valley south of Nanga Parbat
Bhoru Nag Glacier (Lahul)	Sachen Glacier, east of Nanga Parbat
Shingo La Glacier (Nun Kun group)	Bazhin Glacier, south of Nanga Parbat

*In Turkestan*

The 'Bas Névés', near Aksae Chin	The Bushia glaciers (Khotan)
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As far as could be investigated these are the official names of today. As the villagers near the glaciers generally have no names for the single glaciers the Schlagintweits named them according to native names of places (pastures, villages) nearest to the glaciers. Because there are sometimes more than one place near a given glacier and because this rule is not always followed in the official names, the Schlagintweits' names often differ from those cited above.