

VORFELD DES UNTEREN GRINDELWALDGLETSCHERS - 1974
(Orthophoto map)

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This map is part of a comprehensive thesis on the history of the glacier from the 12th to the end of the 19th century. The Lower Grindelwald Glacier, a valley glacier in the Bernese Alps exposed to N/NNW (1973 length: 9.0km, surface area 21.7km²; Müller et al., 1976) consists in the higher regions of two main parts, the Fiescher Glacier (SW-part) and the Ischmeer (SE-part). Some important front positions of the glacier from 1600 to 1933 are shown on the map. As the glacier has receded more than 760m since 1933, the front of the ice tongue is today approximately 560m (i.e. about 28cm) off the map in the SSE direction of the gorge.

The time-consuming task of surveying for the orthophoto map (at a scale of 1:2'000 and with contour intervals of 2m) was carried out in 1974 by M. Zurbuchen, Berne, in cooperation with the author. The moraines (mostly covered by vegetation) were mapped by plane-table.

The glacier fluctuations were reconstructed with the help of moraine data and a large number of previously unknown illustrated documents. There are approximately 292 pictures showing the Lower Grindelwald Glacier before 1900 (Zumbühl, 1978). Further results originate from C-14 dating, pollen profiles and pedological analyses of the ditches "Im Aspi" G1 and G2 (Messerli et al., 1976).

The historical sources were found in several libraries, museums of art and private collections, mostly in Switzerland, but occasionally in other countries (Austria, England, Germany, Norway and Poland). Searching for, and analysing, historical source material takes time (7 years so far) but is fortunately often aided by chance discoveries. The quality of the glacier views varies considerably: from landscapes by such masters as C. Wolf, J.A. Koch, J.M.W. Turner down to products for the tourist trade. From 1860 on there are also photographs and topographic maps. For scientific interpretation the pictorial source material must meet at least three conditions:

- The glacier and the topography of its surroundings should be drawn exactly.
- The time of origin of the illustrated document must be precisely known (a lot of problems derive from this point).
- The place where the artist made the picture must be known.

Some of the most important findings are drawn on the orthophoto map:

- In red, the front positions of the glacier which can be identified by moraines and historical sources (moraines originating from the glacier's maximal length in 1600 and 1855/56, but also the ice front of advances in 1893 and 1933).
- In blue, the front positions of the glacier which can be identified only by historical sources. For these positions we have used a maximum and minimum border line (the limits are certain on the Upper- and Lower Schopfrocks, the limits in the lower parts of the valley, originating from the "Schweif", are less reliable).

A summary of the history of the Lower Grindelwald Glacier shows (much simplified) three results (see Fig. 1 in Zumbühl, in: Messerli et al., 1976).

- During the "Little Ice Age" (approximately 1600 to 1860/70) the glacier was for a long time much more extensive than today. Even at its least extensive position, the Lower Glacier still terminated in the region of the Schopfrocks, that means approximately 1200 m beyond its 1976 position (see map: ice border of 1748/49, 1762, 1794, 1813/14, 1868/69).
- Within the comparatively long period of high level growth from 1600 to 1860/70, the glacier shows at least five (to seven) relatively short-term increases with the development of the "Schweif" (amount of advance: 400-600 m). On the map the maximal length of 1600 and of 1855/56, but also the advances of 1768-1778/79 and 1820/22 are shown. The less certain advances of 1669/70, 1719/20 and 1743 are missing.
- Since 1856/57/60, the history of the Lower Glacier is dominated by a shrinking process. Today, the glacier ends in the deep narrow gorge at a distance of more than 1800 m from the moraines marking the maximum

length. There is no historical documentary evidence to show that the Lower Glacier has ever receded as far back as today (at least, during the period 1600-1976).

We can use these findings on the fluctuations of the Lower Glacier for the history of the climate when we take into account some special factors (Messerli et al., 1978). For the period of 1600 to 1900, the combination of the results of an analysis of historical sources with geomorphological evidence seems to be the best method. Before 1600, dendrochronology, C-14 dating and analysis of pollen profiles furnish better results. The historical method, based on a large number of good quality historical views and written sources, can be adapted also for other frequently visited glaciers in the Alps, as for example, for the Upper Grindelwald Glacier (Zumbühl, 1978), the Upper Aare Glacier (Ammann, 1977) or the Lower Aare, Rosenlauri und Rhône Glacier.

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