

# HANDMADE RELIEF MODELS

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## INTRODUCTION

A relief model is a sculptural, three-dimensional representation of a landscape section. It is a very graphic way to depict mountains. Models serve schools, communities, exhibitions, museums, travel agencies, visitor centres, publicly accessible buildings and the military as a realistic copy of the earth's surface. Some occupational groups, e.g., geologists, use such models to investigate and examine the morphology of landscapes. Many of the handmade relief models are, in the end, works of art and are therefore outstandingly precious and of great value. Often, the locations of the original models are unknown. Some are identified as cultural assets and stored in shelters, some are in private possession while others have simply disappeared.

In contrast to handmade relief models, private companies today commercially produce computer-generated relief models by applying different techniques. These models, however, do not achieve the quality of the professional handmade relief models. It is the author's hope that the knowledge and ability to handcraft a relief model will be preserved.

## HISTORY

The construction of relief models has a long tradition in Switzerland. A pioneer in relief modelling was Hans-Ludwig Pfyffer (1716-1802). His 26m<sup>2</sup> relief of Central Switzerland was finished in 1786 after many years of field work, surveying and relief modelling. Another relief constructor living at that time was Joachim Eugen Müller (1752-1833). Napoleon's Council of War bought one of Müller masterpieces, a large area relief of the Swiss Alps, scale 1:60,000.

The culmination of relief modelling was reached between 1870 and 1914, just after Switzerland was completely surveyed and mapped by the Swiss National Survey. Masters of the construction of alpine relief models were, among others, Charles Eugène Perron (1837-1919), Albert Heim (1849-1937), Xaver Imfeld (1853-1909), Fridolin Becker (1854-1923), Simon Simon (1857-1925), Carl Meili (1871-1919), Christoph Reichlin (1872-1927) and Leo Aegerter (1875-1953). Eduard Imhof (1895-1986), a student of Fridolin Becker, built three reliefs. The Windgällen and the Bietschhorn reliefs, each in a scale of 1:2,000, attracted attention at the Swiss National Exhibition in Zurich in 1939 because of their dimensions and level of detail.

Today, Toni Mair is the only remaining professional in the domain of handmade relief models in Switzerland (see box: Toni Mair, relief maker).



Fig.: Matterhorn relief made by Xaver Imfeld, 1896.

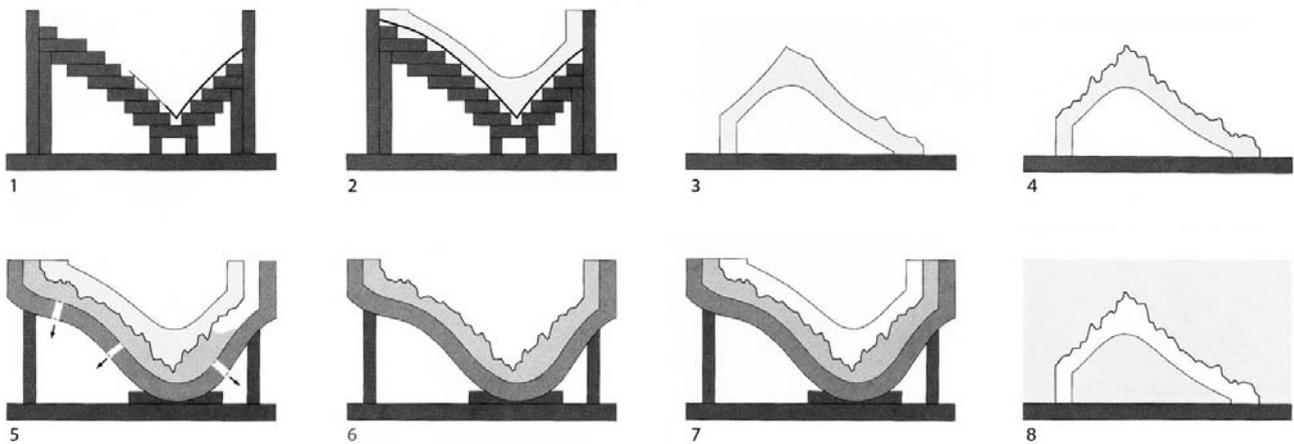


Fig.: Säntis relief (section) made by Carl Meili, 1899.

## CONSTRUCTION

Reliefs are not to be exaggerated. Eduard Imhof noted: "All vertical exaggerations are a falsification and create unreal and unnatural scarps. Exaggeration is not at all necessary to represent alpine morphologies. A scarp, viewed head-on, appears steeper in nature than when viewed laterally. On the relief, most of the slopes and rock faces are looked at nearly frontal. They thus appear relatively steep and do not require enhancement from exaggeration."

There are different ways of building a handmade relief model. The following description of a one method, based on Imhof, results in an unpainted model:



Transference of the map's contour lines to wallboard plates. Sawing the wallboard plates following the contour lines, then accurately positioning and fixing the wallboards to a frame to obtain a rough approximation of a negative terrain model. Smoothing the model by filling it with plaster to give it a basic form (use of lubricant) (Fig. 1). Casting plaster in a 3–5 cm thick layer (Fig. 2). The wooden parts are removed from the hardened plaster.

The positive mould forms the blank shape of the model (Fig. 3). The next step is accurate modelling, for which a relief constructor uses aerial photos, pictures, drawings and sketches as an aid. Shaping the plaster model requires a lot of experience and manual skill; the original model is the result (Fig. 4). Construction of a cover cap perforated with air pipes with a 2–4 cm distance to the original model. Filling the hollow space with a gelatinous compound (Fig. 5). After the compound has solidified, the original model is lifted out (Fig. 6). Plaster is poured into the gelatine form. After a few minutes, the plaster has solidified (Fig. 7). The plaster mould is removed, and with careful handling, then other moulds can be made (Fig. 8).

Usually, reliefs are made of plaster. Plaster has some advantages over plasticine and other materials. Hard plaster, when treated skilfully, cracks just like stone so the 'rock' adopts the desired similarity to nature. Missing or broken parts may be remodelled by affixing new plaster.

A slightly different workflow in pictures, based on Toni Mair's method, e.g., Aegerital:



Fig. 1: Step model made of wood.



Fig. 2: Negative step model covered by red caoutchouc.



Fig. 3: Positive mould made of plaster.



Fig. 4: The original carved model

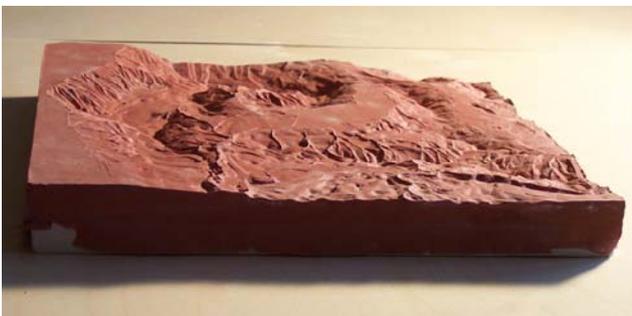


Fig. 5: Negative mould covered with caoutchouc.



Fig.6: Final relief, designed and painted.

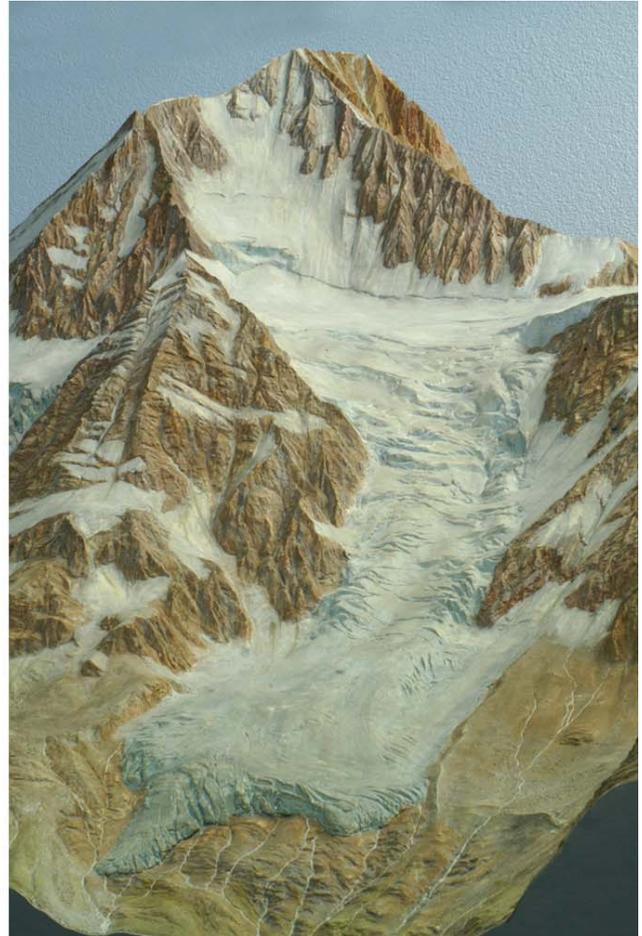
## THE BIETSCHHORN RELIEF MODEL

The cartographer and artist Eduard Imhof not only drew and mapped mountains, he also modelled them. In 1938/39, the Bietschhorn relief was created with a scale of 1: 2,000 for the National Exhibition in Zurich. Beside the unpainted original, which is stored in an air raid shelter at ETH, four other moulds were made. These were painted and now stand in the Institute of Cartography ETH Zurich, in the Scientific Collections of the Museum of Nature in Winterthur, in the Swiss Alpine Museum in Berne as well as a high school in Solothurn. The Bietschhorn is an outstandingly beautiful example of a relief model.

The Bietschhorn relief is composed of three main blocks, all made of plaster. It is 137 x 170 cm and weighs more than 50 kg. The height from the plaster base to the modelled summit is 95 cm. In nature, the modelled area is 9.4km<sup>2</sup>. As the areas represented are located above the timber line, only rocks, scree and glaciers are presented. In a corner of the model, the Bietschhorn cabana is recognizable – to scale as a 2.5 mm building. Seen from the Lötschen Valley, the Bietschhorn relief is very impressive. The Nest, Birch and Uistre Stampbach glaciers plunge down and come into their full glory. Nowadays, the relief serves as contemporary witness to climate changes. At the time of its creation, ice masses were more voluminous and ice areas were greater in size. They have retreated, considerably since then.



Bietschhorn north face with Nest glacier in 2005.



Relief: Nest glacier expansion around 1938.

## THE RESTORATION OF THE BIETSCHHORN RELIEF

In November 2005, Toni Mair restored the Bietschhorn relief modelled by Eduard Imhof for the Swiss National Exhibition of 1939. There, it was exhibited in the Swiss Alpine Club (SAC) pavilion. Today, the restored relief of the Bietschhorn looks as good as new at the Institute of Cartography at ETH Zurich.

At 70 years of age, the Bietschhorn relief was in a bad state. Damages from transport, exhibitions and storage had all left their mark. Colours were yellowed or cracking and parts of the rocks were truncated, especially on the ridges. This situation led to the decision to restore the relief at the Institute of Cartography, ETH Zurich. Toni Mair, relief maker from Unterägeri, carried out the restoration.

To start, the relief was thoroughly cleaned. Dust and dirt were removed by means of brushes. Particularly polluted spots (crevasses, couloirs) were cleaned with wet cloths. Inevitably, the water-soluble colours smeared.

In 1939, the relief had to be moulded into three different blocks due to its size and weight. During the restoration process, these three parts were reassembled into one single block. In order to assemble the three plaster blocks, they had to be newly set and levelled and then affixed on a base by means of silicone glue. The splices were extended as way of eliminating fragile edges, so entire rock parts and glacier areas had to be removed. Using glue and spackel material and plaster combined with retarder, the splices were closed.



Figure: In 2005 Toni Mair restored the Bietschhorn relief.

## CARVING ALPINE MORPHOLOGIES

Imhof's rock and glacier structures were reconstituted through precise carving using knives and potter's tools. On plain, smooth areas, such as the Baltschieder glacier, the work had to be performed with particular care so as to not leave the cutting edges visible.

The scree in the zone of the splices had to be reconstructed. For this purpose, fine grains of light-coloured sand were sieved onto the area which had been brushed with glue. The grains fell downhill along couloirs and steep acclivities. The smallest grains remained further uphill while the coarsest grains rolled down to the end of the run-out area, just as in nature.

The fragile side-walls of the relief were repaired and smoothed. To stabilize the walls, they were covered with fleece wallpaper which was painted a neutral grey.

## PAINTING WITH COLOURS SIMILAR TO NATURE

Painting a relief greatly influences its appearance. When the weather is nice, a mountain appears very bright and well-balanced. That is why mainly bright hues are used for painting a relief. Glacier tongues on the Bietschhorn relief are represented free of snow and, accordingly, shown in a bright grey-blue. The colour should not gleam and should be laid on as sparsely as possible in order to not smooth out the smallest mouldings such as scree and rocks. Water soluble gouache colours are well-suited to this task; Imhof was already using them.

For the Bietschhorn relief, the repaired and newly carved mouldings (ridges, rocks and filled splices) were primed. After another cleaning for dust, the model was painted with a water-soluble background colour, analogous to Imhof's treatment. Special care was taken that no differences arose between the old and new painting.

Streams were not painted on the relief. Using photographs and maps from the 1930s, these were scratched into the surface colours. Thus, the coruscant white of the plaster body simulates the spumous mountain torrent.

## "PUT IN THE RIGHT LIGHT"

Big reliefs such as that of the Bietschhorn are shown even more to their advantage when properly illuminated. The light source, be it daylight or artificial light, should come from one direction, preferably from a top angle. In this way, the relief obtains a natural shading. Rock flanks, glacier break-offs and narrow couloirs also feature the necessary contrasts. The sculptural, three-dimensional impression is intensified by the illumination.

The Bietschhorn relief was placed on a stand so that the overall height of the summit is 2 m. The observer sees the model frontal and sideways. It therefore appears much more impressive than seen from the top.

To protect it against dust or damage caused by viewers, the Bietschhorn relief is covered with a glass display case. After 80 hours of labour, the relief now shines with a new brilliance. It can be seen at the Institute of Cartography, ETH Zurich. The building is open to the public and attendance is free.



Figure: Renovated Bietschhorn relief.

### **TONI MAIR, RELIEF MAKER**

Toni Mair is the only relief maker in Switzerland today who crafts and restores landscape models. The geographer and former high school teacher in Zug passionately models alpine landscapes in the manner of Imfeld, Meili, Simon, Reichlin and Imhof. In his studio in Unterägeri, several mountain models like the Bernina and the Masoala reliefs came into existence. The latter stands in the entrance of the Masoala Rain Forest exhibit at the Zurich Zoo. Mair built his largest relief for the museum Naturama in Aarau. This relief, assembled from 53 components, represents the Canton of Aargau on a scale of 1:10,000 and is 23m<sup>2</sup>. More information about Toni Mair and his work can be found at:

[www.mair-relief.ch](http://www.mair-relief.ch)

## Biography of Author



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**SWITZERLAND**

Stefan Raeber is a cartographer at the Institute of Cartography of ETH Zurich. From 1984 to 1993, he was employed at Swissair Photo+Survey Ltd., and from 1994 to 1995 at Hallwag AG in cartography and pre-press. Since 1995, he is employed at ETH Zurich as a collaborator of the Atlas of Switzerland, lecturer in cartography, web-master, working in map production and visualization, as well as relief presentation. He is a member of the Swiss cartography examination board, and a committee member and web-master of the Swiss Society of Cartography.