

Making of Mount Everest Map at swisstopo

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Abstract: The Swiss Federal Office of Topography (swisstopo), along with many other contributors, produced a 1:50,000 Mount Everest map in 1988. This article focuses on the making of this map at swisstopo, which has not been presented in detail up to now. Today's map production is mentioned for comparison. The article finishes off with some personal notes by the article author, a former trainee and later working mate of Francis Comtesse, the team leader of the Mount Everest map project at swisstopo.

Keywords: mountain cartography, Mount Everest map, swisstopo, Francis Comtesse, map production, National Geographic Society

1. Introduction

In 1988, the National Geographic Society published in their monthly *National Geographic* magazine a 1:50,000 scale map of Mount Everest—just in time for the 100th anniversary of the National Geographic Society, and the 150th anniversary of the Swiss Federal Office of Topography (swisstopo; [swisstopo.admin.ch](https://www.swisstopo.admin.ch)). The print run was over 10 million copies!

Over nearly eight years, a large number of contributors from eight countries created this masterpiece in high mountain cartography. The contributors included several

institutions and individuals, including special assistants, consultants, early surveyors and cartographers of Mount Everest (Figure 1). The initiator of this mapping project was Henry Bradford Washburn (1910–2007), a former director of the Boston Museum of Science, and passionate alpinist (Washburn 1988a).

Articles in the *National Geographic* magazine and in other publications covered the making of this extraordinary topographic map in a general sense (Washburn 1988b). However, a detailed description of swisstopo's work and an introduction of the people involved has been missing from the published record as



Figure 1. English: Mount Everest, Nepali: सगरमाथा Sagarmatha, Tibetan: ཇོ་མོ་གླང་མ Chomolungma, Chinese: 珠穆朗玛峰 Zhūmùlǎngmǎ Fēn. 8,848.86 m (29,031.7 ft) above sea level, (27° 59' 9.8340" N, 86° 55' 21.4428" E). Photo by Pixabay user peteranta.

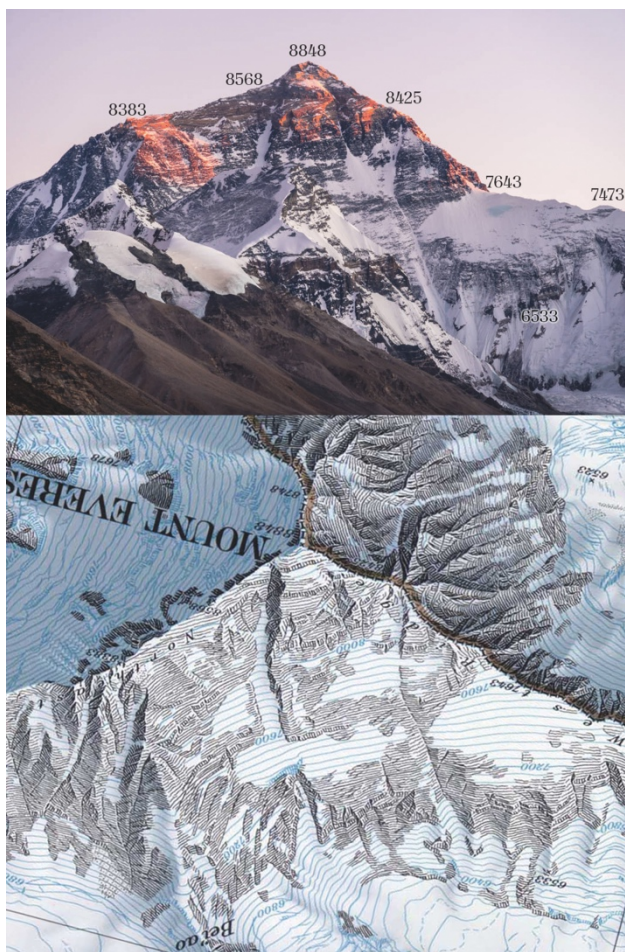


Figure 2. Excerpt of Mount Everest map, 1:50,000, first edition (1988)—center part drawn by Francis Comtesse. Keep in mind while comparing, that there are differences in coverage of snow and ice between the photo (above) and the map (below), because they were recorded at different times. Furthermore, the visual perception differs from the terrestrial side view (photo in frog's eye view) to the aerial, vertical view (map in bird's eye view), with regard to projection distortions and visible and invisible zones, respectively. Notice the well depicted, generalised geomorphology with layers, steps, fractures, and triangular eroded rock features. The terrain depiction, as with all the other map content, was generalised to the scale according to the cartographic principles: emphasising the important, simplifying the complicated, and omitting unnecessary features. The hypsometry (atmospheric perspective) and orography (angles of inclination) were perfectly shown in high contrast. Photo credit: Getty Images, <https://www.travelbook.de/ziele/berge/mythos-mount-everest>, modified by Jürg Gilgen.

far as my research revealed. This article focuses on swisstopo's experts and their work on the Mount Everest mapping project, depicting the roof of the world in the highest quality of Swiss mapping design (swisstopo 2017).

At swisstopo, the threads for the completion of the Mount Everest map came together through the efforts of the following team: five cartographers, two composite printers, and a typesetter, all of whom worked on the map in Wabern, a suburb of the Swiss capital Bern.



Figure 3. An enlarged extract of the National Geographic map of Mount Everest, 1:50,000, second edition (1991), published by the Boston Museum of Science and the Swiss Foundation for Alpine Research.

2. Workflow

The Mount Everest map was created using similar techniques to the Swiss national maps, at a time when cartography was just beginning to undergo a transition to digital production. It was a team effort involving experts in remote sensing, photo-repro, and cartography.

2.1 Photogrammetry and Remote Sensing

Franz Infanger (1943–2017), senior photogrammetrist at Swissair Photo+Surveys Ltd., Zürich, produced the detailed photogrammetric plot at a scale of 1:10,000 with 20-meter contours, using a Wild A-8 combined with AVIOPLOT RAP system. Franz Infanger later worked at swisstopo from 1995–2005.

2.2 Photo-Repro

Rinaldo Colombo (1940–2013), and Viktor Humbel (1940–2022), composite printers from the photo-repro team, were in charge of the engraving glass plates.

They copied the blueprints of the photogrammetric plot content (contour lines, hydrography, route network, settlements, and other features), and the cartographic editing onto photosensitive layers on separate glass plates. Finally, they coated them with a very thin, red engraving layer, a swisstopo in-house development. Glass as the basis for the photosensitive layers and the red engraving coating had the advantage of being dimensionally more stable than foils, which would have been an alternative at that time.

They also produced glass plates for masking the lake and forest tones. Additionally, they produced a glass plate for masking out the yellow colour of the shaded relief in rock, scree, and glacier areas.

Furthermore, they copied the blueprint onto a paper that was mounted on aluminum for airbrushing the shaded

relief (Keates [1989] describes the analogue technology in detail).

2.3 Phototypesetting

Edith Steiner (1950–), typesetter, typed the lettering in a digital text production system (a tps 6200 photosetting system), which was photographically exposed on a stripping film for the cartographers. The lettering was set in swisstopo's own fonts: LK Kursiv and LK Roemisch (Figures 2 and 3).

2.4 Cartography

Francis Comtesse (1925–2020; Figure 4), cartographer from 1941–1989 at the Swiss Federal Office of Topography, headed the production team of four cartographers specialised in terrain representation (swisstopo 1968–2015).

Kurt Maire (1921–2003) and Francis Comtesse edited the map content and drew the partly generalised blueprint for the map. Four cartographers simultaneously mapped the rock, glacier, and scree representation in four working units, performing their work according to the design principles for Swiss-style rock drawing (Gilgen 2015; Imhof 1982; Jenny et al. 2014). Francis Comtesse scribed these details for the center part of the map, with the summit of Mount Everest, into the coated glass plates. Friedrich (Fritz) Siegfried (1940–), was in charge of the southern part of the map, Rudolf (Ruedi) Signer (1954–) the northwest, and Jürg Gilgen (1963–; the author of this article) the northeast. The cartographers scribed the terrain depiction negative and true-sided in the red

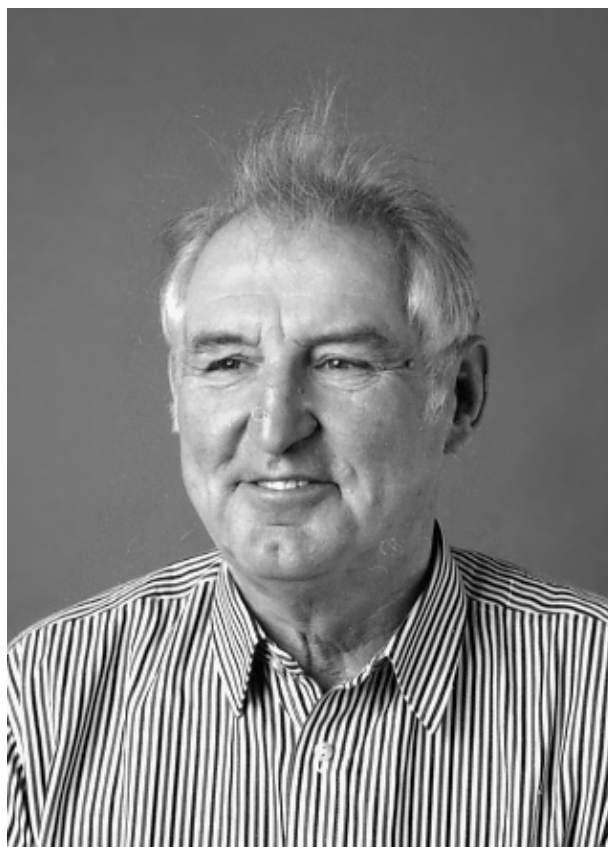


Figure 4. Francis Comtesse. Credit: swisstopo.



Figure 5. In the foreground, left, is a rock scribing tool (German: Dreikantnadel, a triangular ground steel needle in a wooden peg), and right, is Francis Comtesse's hand magnifier. In the background is a red, coated scribing glass plate with rock, scree and contour line scribing (negative and true-sided, drawn to the scale), which were in use at swisstopo until the year 2000. Credit: Jürg Gilgen.

coating. As a basis for their work, each had a blueprint with the detailed photogrammetric plot, a range of overlapping, stereoscopic aerial orthophotos in colour and black & white, and numerous oblique photographs.

The cartographers then engraved other map content, such as linear (e.g., contour lines, routes) and areal (e.g., buildings) features, at the original map scale, on the colour-separated glass plates (black, blue, brown, and green). They drew it with engraving needles and worked with a hand magnifier (Figure 5). They corrected errors with black ink and pen and, if necessary, engraved in the ink again.

The cartographers were also responsible for mounting the names and figures on stripping film in position and into their relevant colour foil, as well as drawing a forest tone mask with black ink and pen, positive and true-sided, on a glass plate. A cartographer also drew the lake tone and the deletion mask for the yellow shaded relief.

Paul Ehrlich (1949–) finally airbrushed the shaded relief with black ink. He also applied pen and ink, and sometimes a scraping knife to sharpen the ridges.

2.5 Photo-Repro

The composite printers turned the negative, true-sided glass plates to positive, reversed photographic films, and assembled the four work units into one whole map. They also produced exemption masks for the lettering. Thereafter, they combined the lettering and the exemption mask with the respective colour-separated films.

Additionally, they photographically applied a pattern to the forest areas masked out by the cartographers, and added it to the green photographic film. They also produced a tinted halftone with the optical lithography method for the lake tone.

Next, they photographed the shaded relief and photographically produced, with halftone screening, a tinted continuous-tone image of it. They also produced an inverse negative, applying a gradation curve, for the yellow, sunny tone. They finally combined all the photographic films according to the CMYK colour model for the offset print.

2.6 Proofreading and Corrections

A proofreader closely checked the map content and the graphic quality. The cartographers finally corrected the map according to the proof plot, and the Mount Everest map was ready for printing.

3. After the Publication

The first edition of the Mount Everest map was published by the National Geographic Society in November 1988 (Figure 4). Bradford Washburn called it “a masterpiece that shows the beauty of nature and scientific information in the most vivid way” Washburn (1988). Every contributor received a copy of the map signed by Sir Edmund Percival Hillary (1919–2008). Hillary and sherpa Tenzing Norgay (1914–1986) have been

the first climbers to reach the summit of Mount Everest, on May 29, 1953.

In 1991, the Boston Museum of Science and the Swiss Foundation for Alpine Research published a second edition. The national border was changed to a brown band. Additionally, the description of the first ascents from 1953–1986 appears on the backside (Figure 3).

In 1993, at the 16th International Cartographic Conference in Cologne, Germany, the map was awarded first prize.

4. Today's Map Production

The Swiss Federal Office of Topography introduced computer-aided map production in 1996. By 2000, it had displaced analogue map production completely. At the beginning, the digital cartography software LORIK by Lorient was in use. Since 2011, swisstopo produces its maps in Esri's ArcGIS.

Alongside this change to GIS, swisstopo's map styles were slightly adapted to the new needs of its customers. The typeface Frutiger, named after its Swiss designer, Adrian Frutiger (1928–2015), is now in use. It is a humanist sans-serif typeface, intended to be clear and highly legible at a distance or at small text sizes and, additionally, is less spacious in comparison to swisstopo's own former serif typefaces LK Kursiv and LK Roemisch.

Today, Scree Painter
(terrainscartography.com/screepainter), a free open-source software by Bernhard Jenny (1974–) of Monash University, Melbourne, is used to automatically generate the scree representation. Meanwhile the cartographers, specialists in terrain representation, update the raster data (rock, glacial features, and shaded relief) more efficiently than the old analogue techniques, by using Adobe Photoshop with a Wacom pen and tablet (Gilgen 2007).

5. Personal Notes

Thanks to Francis Comtesse, the senior cartographer and team leader of this project at swisstopo, the Mount Everest map set the standard of excellence for mapping that mountain. It was due not only to his great cartographic expertise, but also to his great human leadership that the Mount Everest map was a huge success.

He led the team with the charm of a “Suisse romand,” the French speaking Swiss people. He praised good work, helped to solve problems, and ensured the team's good mood. For special occasions, he brought a bottle of white wine from the French-speaking part of Switzerland and we had an aperitif after work. This good working atmosphere, supported by Francis Comtesse, motivated us all to do an excellent job.

After Francis Comtesse's retirement in January 1989, we kept up our good habits. He visited us occasionally at work with a bottle of white Swiss wine as long as he was in good shape. I, on the other

hand, took a bottle of white Swiss wine to his house on his birthday, which was about 15 minutes away by bicycle. He had a nice house built on the Gurten, the local home mountain of Bern, overlooking the Gürbetal valley.

Meeting him and his wife Käthy (1923–)—parents of Anne, Frédéric and Philippe—at his home in Kehrsatz (Bern canton) gave me a more personal, inside view of my admired trainer in cartographic terrain representation. Being born before the Second World War, he had endured the hardship of postwar life as a young employee, even though Switzerland was not directly war wounded. He told me, for example, that they worked six days a week at swisstopo, when he was young.

Being born in La-Chaux-de-Fonds (Neuchâtel canton) in the Swiss Jura mountains bordering France, and raised in nearby St-Imier (Bern canton), a small city in the French speaking north-western Switzerland, in a valley devoted to manufacturing watches, he already learnt there to work precisely and in small dimensions, I guess. Furthermore, I learned that he was a very good joiner, and why he had a fingertip missing. Yes, he lost a fingertip while working on his sawing machine fabricating wooden boards for his home. He showed me his well-equipped work shop, where he also built pieces of furniture for archiving maps and related materials.

He not only collected maps, but he also had a nice collection of fine art prints (copper engravings and lithographs) and paintings at home. His affinity for the fine arts was awakened in his youth, as I saw in his early drawings. He honed his skills at the [School of Applied Arts in Bern](#) during his four-and-a-half-year apprenticeship, where copper engravers—a forerunner profession of the cartographers—attended lessons. Francis Comtesse's year of apprenticeship was the last one to be taught copperplate engraving at swisstopo. Afterwards, the cartography apprentices were trained in the scribing of coated glass plates and other production techniques of that time.

Seeing the Le Corbusier LC3 sofa—a design classic from 1928, still available at Cassina—in his living room, I realised that he was inspired and influenced by Bauhaus, a German school of crafts and fine arts, having the principles *form follows function* and *reduce to the max*—also important in cartographic generalisation. I learnt from him that *dimensions follow visual perception* (average of seven strokes per 2 millimetres in rock drawing) and that I should *generalise to the scale* (emphasizing the important, simplifying the complicated, and omitting unnecessary features while also applying general design principles).

By the way, Charles-Édouard Jeanneret (1887–1965), the Swiss-French architect, designer, painter and writer known as Le Corbusier, was born in La-Chaux-de-Fonds, just as Francis Comtesse.

For Francis Comtesse, the Mount Everest map was the crowning achievement of his 48-year career as a cartographer specialised in the field of Swiss-style rock drawing, a design classic based on the provisions of

legislation dating from 1935. For me, Jürg Gilgen, it was an extraordinary start to a fulfilling and meaningful working life.

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