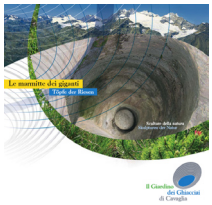

The Cavaglia Glacier Garden

Complete documentation of the website: www.ghiacciai.info

Glaciology

The formation of giants' pots is due to climatic events and related glaciations. This is proven by numerous studies and research activities, which have led to the formulation of theories and hypotheses regarding the processes involved.

Some synthetic notions concerning their geomorphological origin can be found in the following sources :

- Professor Aldo Godenzi, «The Cavaglia Glacier Garden», a paper published on the Almanacco del Grigione Italiano 2005 and based on his 1957 degree dissertation entitled «Research on the glacial morphology and geomorphogenesis in the area between the Bernina Group and the Adda Valley, with special reference to the Poschiavo Valley»;
- Professor Doctor Luca Bonardi, lecturer in Human Geography at the University of Milan, conference held in Poschiavo in June 2004, further to a visit to the Cavaglia Glacier Garden, entitled «The shapes of glacial modelling with particular emphasis on giants' pots.» The text of this conference was recorded on tape and transcribed by Remo Tosio.

An erratic boulder provides evidence of glacial action

Concise texts referring specifically to the Poschiavo Valley have been extracted from the research work of Professor Godenzi while considerations concerning climate changes in general have been based on the conference by Professor Bonardi.

Morphology

«The hinge of the alpine anticlinal is located in the mid part of the Poschiavo valley, where the alpine chain culminated during its last corrugation phases. The waters descended from the area of Pizzo Canciano and Piz Trevisina in a northerly direction.

The ridge that leads from Pizzo Canciano towards the south east and Val Trevisina, which in its topmost part runs in a south westerly direction, is a witness to this ancient hydrography.

At a later stage erosion moved the watershed north by about thirty kilometres. The waters of the Poschiavo valley today flow into the Po, with the exception of those of the Orsera valley, which flow into the Danube.

Valposchiavo: to the left the Trevisina valley and to the right the Vartegna chain

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The Cavaglia basin possesses a typical glacial morphology which manifests itself in several ways. As a result of glacial action the basin was eroded below the top of the Moti da Cavagliola. It is possible that the basin was once occupied by a lake which later emptied due to the formation of the Puntalta gorge. Today instead of a lake we find alluvial terrain, covered in part by morainic terrain. According to C. Burga, geography professor at the University of Zurich, the Cavaglia moraines belong to the "Egesen" stage. A beautiful elevated terrace, about two meters higher than the present level of the river, can be found at the edge of the basin. This terrace provides clear evidence of one of the phases of erosion of the Puntalta gorge».

(Aldo Godenzi)

The basin, the Cavagliasco torrent, the railway station and, in the distance, the Moti da Cavagliola.

Glaciation

«After a long period of subtropical climate, during the Quaternary period temperature dropped by about ten degrees. Four glacial periods, interrupted by interglacial ones, characterized the climate of the alpine region and of many areas of the northern hemisphere. The last glaciation, known as "Wurm", shaped the existing pre-glacial relief of the Poschiavo valley and gave it a new morphology. The glaciers flowing down from the southern slopes of the Alps reached the edges of the Po plain and formed, amongst others, the Garda, Iseo, Como, Maggiore and Lugano lakes.

Palü glacier

Following a change in climatic conditions these glaciers then started to retreat towards the higher regions of the alpine chain. This retreat took place in successive stages, characterized by positive and negative oscillations. The period was studied by C. Burga for the Poschiavo Valley and by L. Huysmans for the Val di Campo. During the phase denominated Valtellina II, the Poschiavo glacier was about 1'200 meters deep, as documented by a moraine situated at 2'230 meters. For the Val di Campo L. Huysmans found, in the Buril area, eight morainic valleys corresponding to the same number of retreat phases.

Important for Cavaglia is the deposit of the "Egesen" stage, which goes back to 11'000 years before our time. At that time the perennial snow level was about 300 meters below the present one. Starting in the "Egesen" stage the climate became warmer and glaciers retreated to the higher regions of the Alps. It is assumed that during the so called "Atlantic" stage vegetation returned to the highest regions of the alpine chain. About 4'000 years ago the climate became more rigid and glaciers once again started to flow downwards. To date sixteen positive oscillations can be counted starting from the "Finiglaciale". In 1850 glaciers reached their greatest expansion after the "Egesen" stage. The Cambrena glacier reached Lago Bianco, the Palü glacier covered the Alpe Palü basin and the edge of the Morteratsch glacier was very close to the present railway station. It should be noted that during the period 1965-1985 the Cambrena and Palü glaciers advanced

The Cambrena glacier and the frozen Lake Bianco

whilst the Corno di Campo one was always in retreat. The Vedreit da Dügüral, which in the Fifties had a surface covered by beautiful crevasses, has today almost disappeared». (Aldo Godenzi)

Potholes

«The glacier, flowing downwards along a steep slope, dug a glacial basin. It then lost its erosive power and left on site a promontory known as a "glacial threshold". Studies conducted in the Fifties have shown that the ice depth at the base of the Morteratsch glacier was about 400 meters and a glacial basin had formed above the Boval hut.

The glacier of the Poschiavo-Palü system flowed down the steep slope of the "Prù dal Vent" and, at the foot of this slope, eroded a glacial basin: that of Cavaglia. Having exhausted its speed the glacier then left in place a glacial threshold: that of the Moti da Cavagliola. Once this obstacle had been overcome the ice flow once again increased its speed and very large transversal crevasses were formed above the glacier. Water flowed in large quantities over the frozen surface and then

The glacial threshold of Cavaglia, were the potholes are located, seen from above

fell into these crevasses, carrying with it stones and debris and reaching the rocky bed of the glacier.

(Aldo Godenzi)

Assuming a height of about 700-800 meters, water pressure at the bottom of the crevasses would have been about 60-80 atmospheres. Some authors assume that as it fell down the crevasses the water reached a speed in excess of 100 kilometres an hour. It should be noted, however, that this erosive phenomenon took place in a closed circuit fashion. The water, in other words, had no exit path at the bottom and was forced to come back up to the surface. Was it therefore its rotational movement that had such a high speed?».

(Aldo Godenzi)

The Cavagliasco with its spectacular glacial «sculptures»

Glacial evolution

«The activity of glaciers is caused by climatic changes. Any history of climate, glaciers, and potholes is a history of Nature reconstructed by man on a theoretical basis, and therefore subject to a margin of error.

Amongst the first and most important scientists to study the role of glaciers in shaping Earth's surface was Switzerland's Jean Louis Rodolphe Agassiz (1807-1873), a man of many talents, in keeping with the style of the period: botanist, glaciologist, geologist and geographer. It is to him we owe the discovery of the climate which prevailed during the great glaciations of the Quaternary period, a climate that created the conditions which made glaciers flow to the bottom of alpine valleys and the surrounding, now densely populated, plains.

To the right the Palü glacier, in retreat since the 19th century

The shaping of Earth by glaciers is mainly due to the climate of the last 1,8 to 2 million years (Pleistocene). This was a period characterized by glacial cycles, separated at intervals by post glacial and inter glacial ones, during which glaciers underwent massive reductions compared to the levels reached during glaciation peaks.

About 10'000 years ago the present geological epoch (Holocene), characterized by a much warmer climate and smaller mountain glaciers, started. Also this phase, however, exhibits irregular cycles of glacier advance and retreat.

According to the theory of Serb scientist M. Milankovich (1879-1958), climate changes are connected with astronomical phenomena which modify the amount of solar energy received by Earth. According to this theory there are three fundamental cycles, lasting respectively 100'000, 43'000, and 24'000+19'000 (the latter connected with each other). Each 100'000, 43'000, 24'000 and 19'000 years, therefore, Earth's climate is subject to change. The Milankovich theory has been confirmed by a completely different research, dealing with marine sediments, carried out by Italian scientist Cesare Emiliani (1922-1995).

The imposing Cavagliasco gorge

About 13'000 years ago the history of glacial periods ended, at least for the time being. One last "backlash" dates back to 11'000 years ago, when, with the reduction phase already in progress, modifications in the North Atlantic current flow led to a new, "brief" (about 1'000 years long) glaciation.

The great shaping of the Earth's surface by glaciers took place, not differently from what is happening today on a very much smaller scale, as a result of two major mechanisms: glacial deposits (moraines, erratic boulders, etc), and erosion (amongst the effects of which, albeit linked with more complex phenomena, are the so called giants' pots). In Cavaglia there are two examples of glacial erosion: the giants' pots and the Cavagliasco gorge. With reference to the pothole phenomenon it should be noted that the direct role of the glaciers in their formation is at times overstated.

In June 2004 Prof. Luca Bonardi of the University of Milan visited the Cavaglia Glacier Garden and was impressed by its beauty

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More precisely, their origin should be attributed to water resulting from the melting of great masses of ice and to materials transported by it. Important roles were played by both hard, medium size boulders and lighter, smaller material. In particular, sand carried at high speed by water, which in turn was subjected to very high pressure in narrow open spaces between ice and rock, acted as a very powerful abrasive. The combined presence of these processes and of the conditions that made them possible are on balance quite rare, as are the pothole locations which can be found in the Alps. This gives the Cavaglia Glacier Garden, where many of these beautiful erosion forms can be admired, a particular significance for scientists and tourists alike».

(Luca Bonardi)

A beautiful and artistic pothole, one of fifteen which can be seen in the Garden