

Science in free sphere – 100 years of research on the Jungfraujoch

A brief history of a national project that has grown into a sustainable international adventure



Presented with a special
«MAP» conform Introduction

Silvio Decurtins
Universität Bern

Hungarian Pavilion EXPO 2010 Shanghai

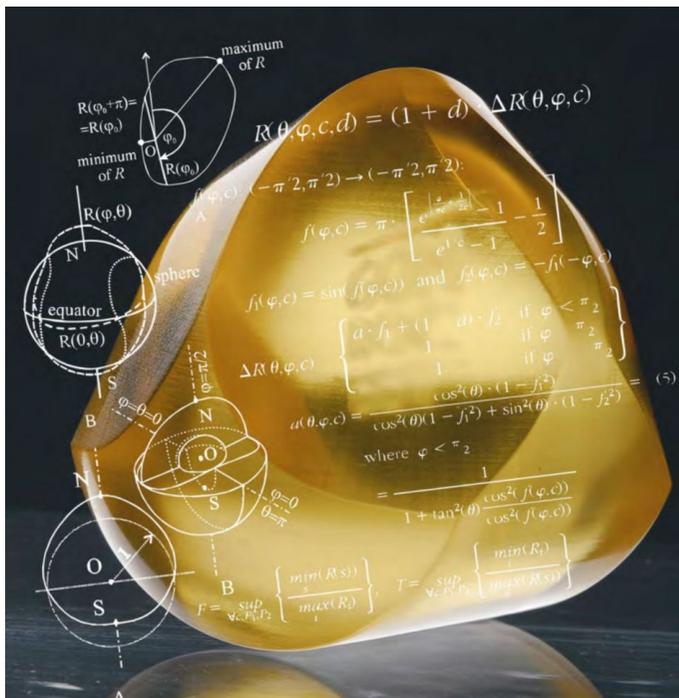
The Gömböc, a Hungarian invention based on a mathematical model, is a body that rises from any position determined by its shape; the movements are always uniform and balanced.



The Gömböc is the first known mono-monostatic object (to have just one stable and one unstable equilibrium point) - the existence of objects in every equilibrium class can be deduced from the existence of the Gömböc.

The Gömböc is the first known convex, homogeneous object with just two static equilibrium points. Its existence was conjectured in 1995 by V. I. Arnold, one of the most influential mathematical minds of the 20th century.

This was contradicting common belief among scientists that such an object cannot exist.



Gabor with «his» Gömböc in Budapest

However, its existence was proven in 2006 by Hungarians Gabor Domokos and Péter Varkonyi by providing a constructive mathematical proof; they also designed a corresponding shape.

Selected examples of worldwide exhibitions for the Gömböc



G 1854 is part of the collection of scientific instruments and teaching aids at ETHZ.



G 1928 at the Institute Henri Poincaré, Paris, Cedric Villani regards the Gömböc as a mythical object.



Sir Roger Penrose receives the Gömböc G 1466 in 2021 on the occasion of the Award of the Erasmus Medal, the highest recognition of Academia Europaea; 1466 was the year of birth of Erasmus.



G 1935, the year of the founding of the Courant Institute at New York University, is on permanent display in the Library.



What about BEG / Basel University ?

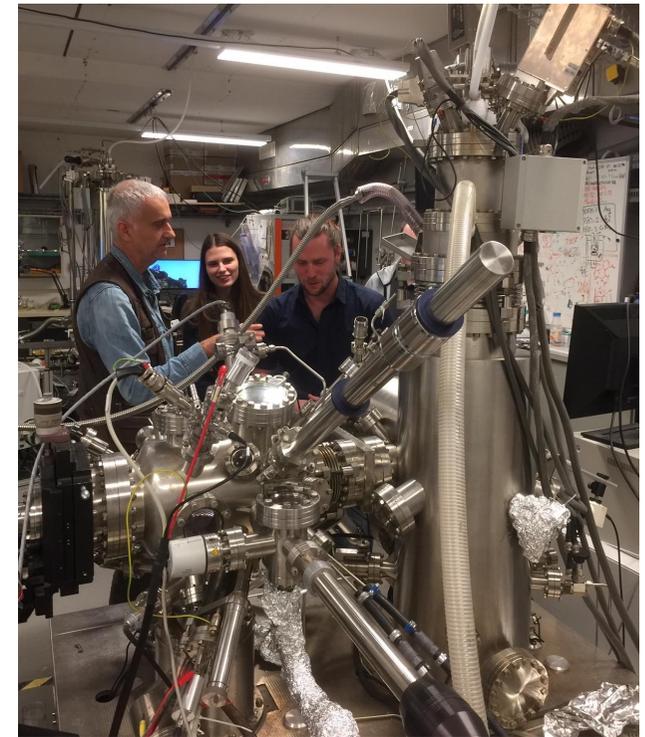
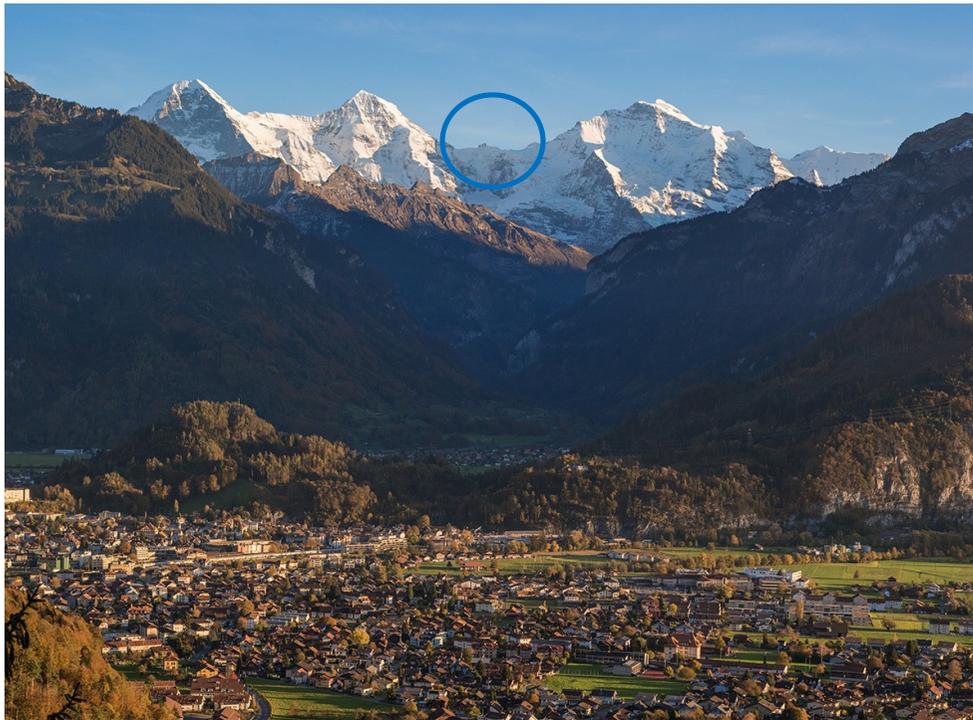


Universität
Basel

How did the connection between Gabor Domokos and Jungfrauoch come about - the path led *via* physics in Basel (Ernst Meyer)

In a nutshell, between Budapest (mathematics) – Basel (physics) – Bern (chemistry) we explore “Polygonal tessellations as predictive models of molecular monolayers “

And so, Gabor also visited in 2021 the High Altitude Research Station on Jungfrauoch



Gabor at the Physics Laboratory, Basel

And so, the story about the Gömböc G 1410 began

We are proud that since 2022 the Gömböc G 1410 is on display in the Library of the Research House, directly under the Sphinx Laboratory.

This Library is an important meeting place for scientists and many political visitors from all over the world.



A small selection of examples:

Visit of the Ambassadors of Finland, Sweden and Norway to the Station, March 2018



Forthcoming soon:
Prof. Sir Peter Gluckman, President of the International Science Council, Paris, will visit the Station on October 15, 2022, together with a numerous delegation.

British Ambassador Jane Owen in the Library, March 2022



Visit of the Chinese Embassy, June 2019



Visit of the US Ambassador Scott Miller to the Station, August 2022



Gömböc G 1410, because on 14. October (1922) the Swiss Government decided to build the high-altitude research station on Jungfrauoch, a station which since its opening on 1. August 1931 is run by an International Foundation.



And there is even a historical scientific connection to Hungary: The first documented international scientific project on the station dates from 10. August 1931 from a researcher from Budapest.

10. August.
Beginn der wissenschaftlichen Arbeit
Herr Dr. A. Jendrassik, aus Budapest über Bestrahlung von Ergosterinlösungen mit direkter und indirekter Höhen-sonnenstrahlung, mit gleichzeitiger Feststellung des Absorptionsspektrums und der biologischen Wirksamkeit der bestrahlten Lösungen im Hygienischen Institut zu Budapest.

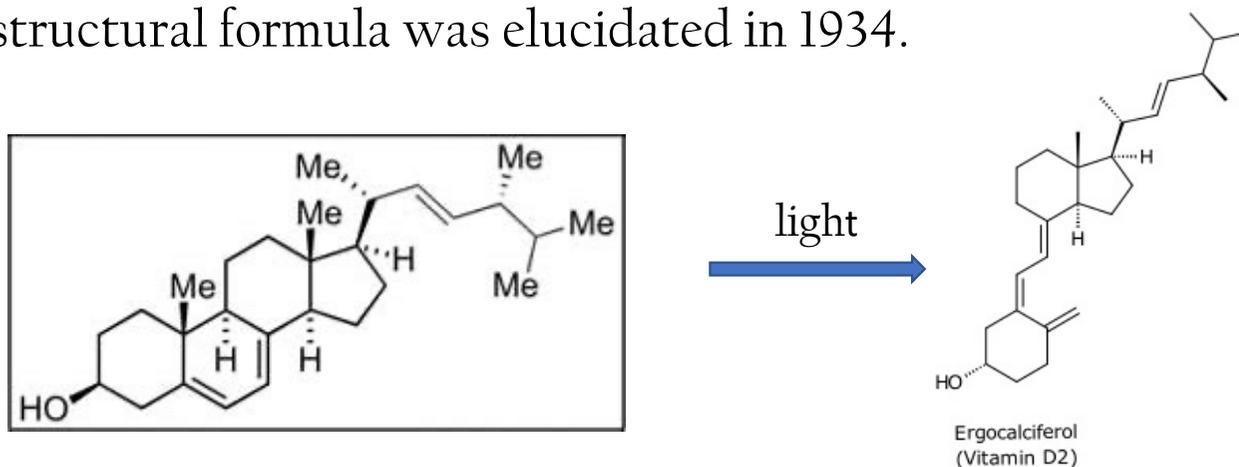
The first entry in the logbook from the year 1931

Dr. Aladar Jendrassik (1896-1945), Ass.-Prof. at the Polytechnic Institute Budapest, studied chemical engineering in Budapest and graduated in 1920.

His experiment at the Jungfrauoch Research Station in 1931 dealt with the influence of high-altitude radiation on ergosterol solutions.

Ergosterol is a precursor (provitamin) of vitamin D2, into which it can be photochemically converted by UV radiation.

This connection was discovered in 1927 by the Göttingen chemist Adolf Windaus (Nobel Prize for Chemistry 1928) and studied in detail in subsequent years; the structural formula was elucidated in 1934.



A. Jendrassik

Biochemische Zeitschrift 252 (1932) 205-211

If we look back in history, of course, we have to start with the construction of the railroad to JJ



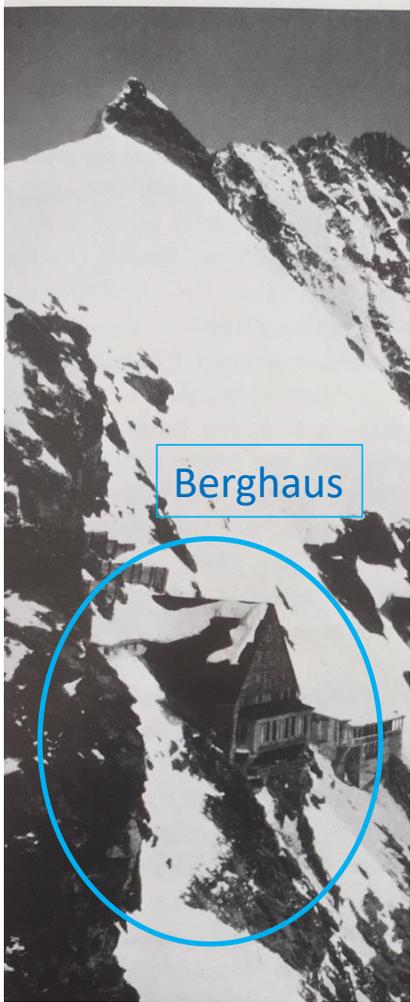
ADOLF GUYER-ZELLER, † 1899
ERBAUER DER JUNGFRAUBAHN



In 1894, the Swiss Government granted the concession to A. Guyer-Zeller for the construction of a railroad to the summit of the Jungfrau;

it contained the liability (Art. 9a) to provide financial and other help to the installation of a scientific observatory for meteorology and telluric-physical measurements.

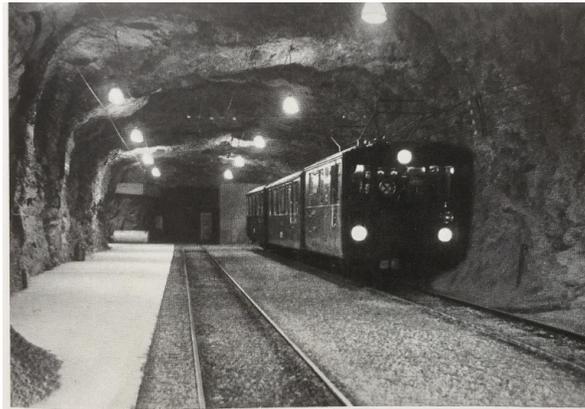
The railroad is built in 1912 and tourism starts



Phot. Gyger, Adelhöden
BLICK VOM BERGHAUS GEGEN SÜDEN AUF DEN GROSSEN
ALETSCHGLETSCHER
Zu Artikel von Dr. Maier und Dr. Linder

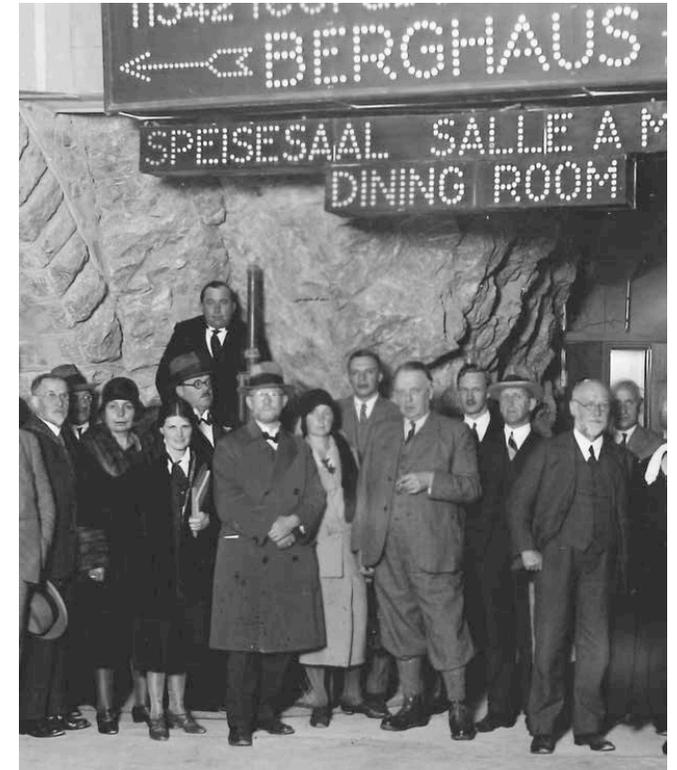


Ausblick vom Speisesaal im Berghaus Jungfrauoch



Phot. de Benoist
FELSGEWÖLBE DER STATION JUNGFRAUJOCH (3457 m)

August 1st, 1912
Opening of the Berghaus



On the terrace of the «Berghaus»



It spreads a charm ...

„The train is here“ - so the researchers are coming too

Meteorological measurements have been carried out on the JJ since 1922



Meteo Pavilion at the JJ, 1925, it was destroyed by strong wind several times.

At first still provisional:
1927/28 The „Mönchsgipfel“ – a site for scientific
research; Gubert von Salis and Werner Kohlhörster



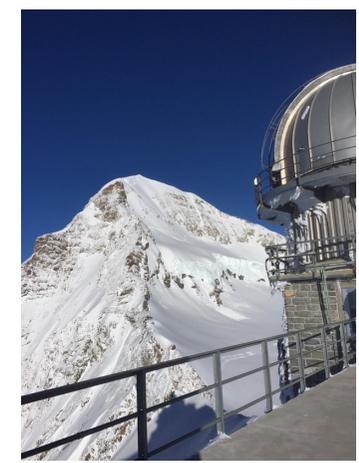
Zelt my Pav. Eingang beim Mönchsgipfel.



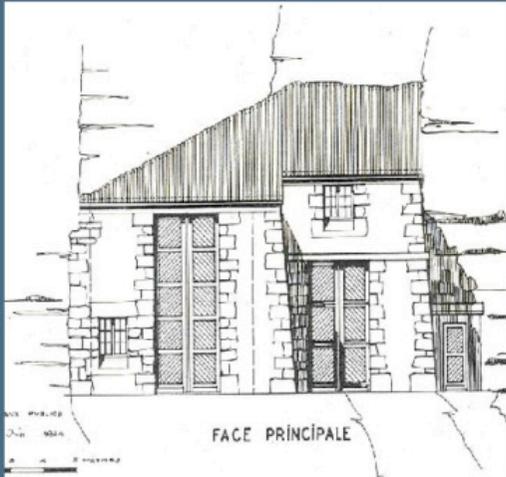
View of the Mönch



*Inneres des Eispalastes of dem Moench.
VII 1927.*



The "ideal" site an hermitage nested in the Sphinx cliff



The main facade with two doors for the way in/out on rails of the telescopes

Structure similar to the Berghaus :

- building excavated in the rock with rooms for the instruments and small room for the observers
- terrace for open air observations



The incredible choice

to abandon the visibility to half of the Northern Sky in favour of the Equatorial and Southern Sky, as seen from the Junfrauoch under poor seeing conditions was aberrant.

Circumpolar stars not visible from the Geneva station !

As we have seen, on 14th October, 1922, on the initiative of A. de Quervain, a decision was taken by the Swiss Government (BR) to build a solid research station on the JJ.

And so the JJ Commission was founded by the „Schweizerische Naturforschende Gesellschaft“ with A. de Quervain as its first President.

Alfred de Quervain studied natural science at the University of Bern; he was Privatdozent (1905) at the University of Zürich and ETHZ (†1927)

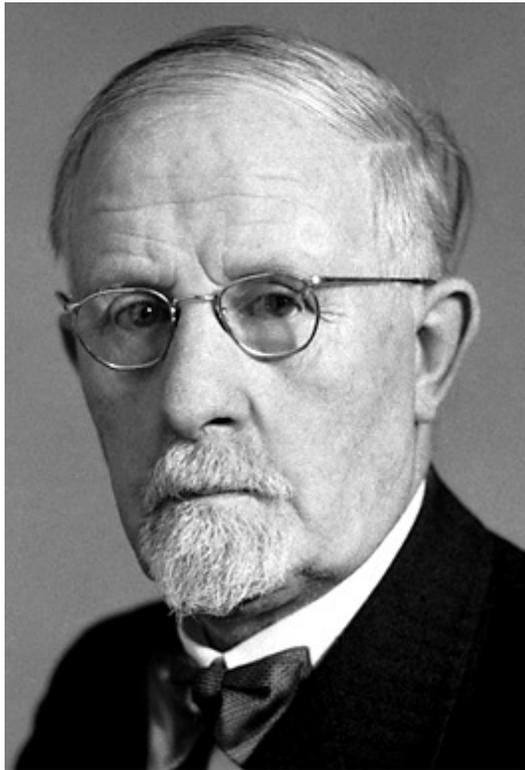


PROF. DR. A. DE QUERVAIN, † 1927
INITIANT UND ERSTER PRÄSIDENT
DER JUNGFRAUJOCH-KOMMISSION



Greenland expedition of 1912

1927, the second President of the
Jungfrauoch Commission



Prof. Walter R. Hess
(1949 Nobel Price in Medicine)

5th September 1930, the
International Foundation is established
W.R. Hess as 1st President of the Foundation

Unter dem Namen:

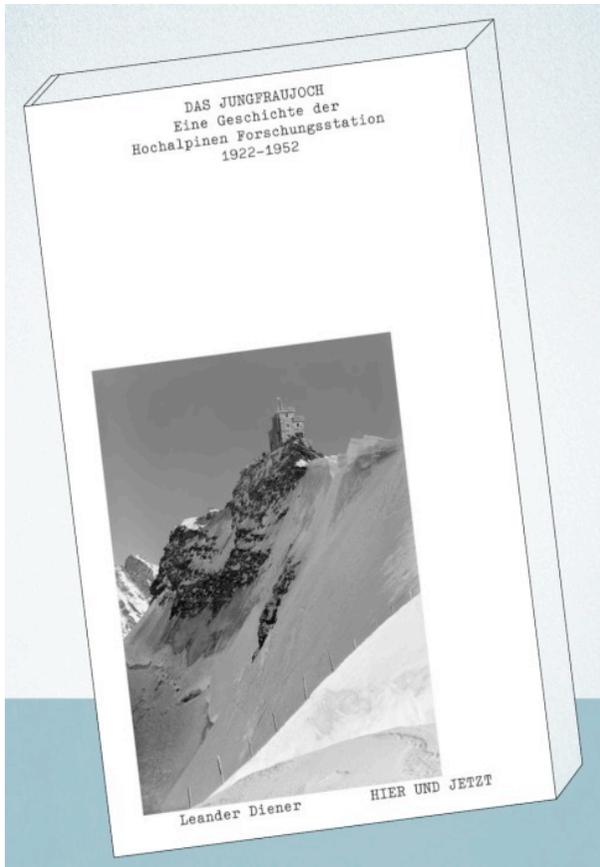
HOCHALPINE FORSCHUNGSSTATION JUNGFRAUJOCH
STATION SCIENTIFIQUE DU JUNGFRAUJOCH
THE JUNGFRAUJOCH SCIENTIFIC STATION

errichtet die

Schweizerische Naturforschende Gesellschaft in Gemeinschaft mit der Kaiser
Wilhelm-Gesellschaft zur Förderung der Wissenschaften in Berlin, der Universität
Paris, der Royal Society London, der Akademie der Wissenschaften in Wien, unter
Mitwirkung der Jungfraubahn-Gesellschaft in Bern

eine der Aufsicht des Schweizerischen Bundesrates unterstellte Stiftung im Sinne von

The International Foundation – a Masterpiece (only one slide for a fascinating Swiss scientific history)



Vortrag: Prix de Quervain 2022
Bern, 24. November 2022

The federal authorities (BR) have "closely" controlled the International Foundation and used for foreign policy purposes; the Minister of the Interior, BR Albert Meyer, for example, personally took over the supervision of the Foundation.



One of the tensions that characterized the founding years was the search for a balance between the preservation of Swiss independence and the pursuit of broad international networking in the environment of this emerging scientific "Leuchtturms" in the middle of the Swiss Alps.

The formation of the International Foundation was a real «Eiertanz», Keywords are: «Germany – France»; Scandinavia, USA (Rockefeller Foundation); Italy and Japan: BR Giuseppe Motta (Political Department) worked emphatically on it: «es sei geradezu eine Pflicht, Italien zum Beitritt aufzufordern» / «it is a duty to ask Italy to join».

From the 1920s to the 1950s, the Swiss Government (BR) was heavily involved in the business of the International Foundation.

The international orientation prevailed over the preservation of national independence
in the new research project in the Swiss Alps

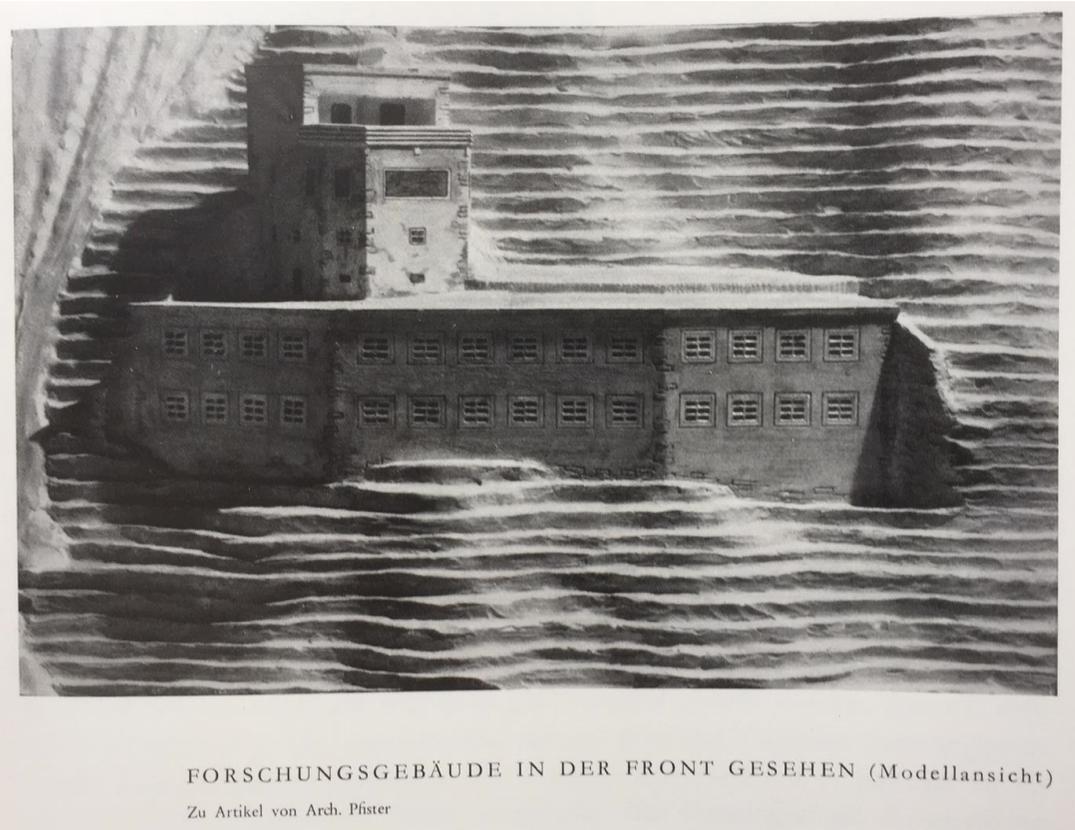
W. Hess convinced BR Albert Meyer
when he referred to Swiss neutrality,
which just will be strengthened by
an international research station.



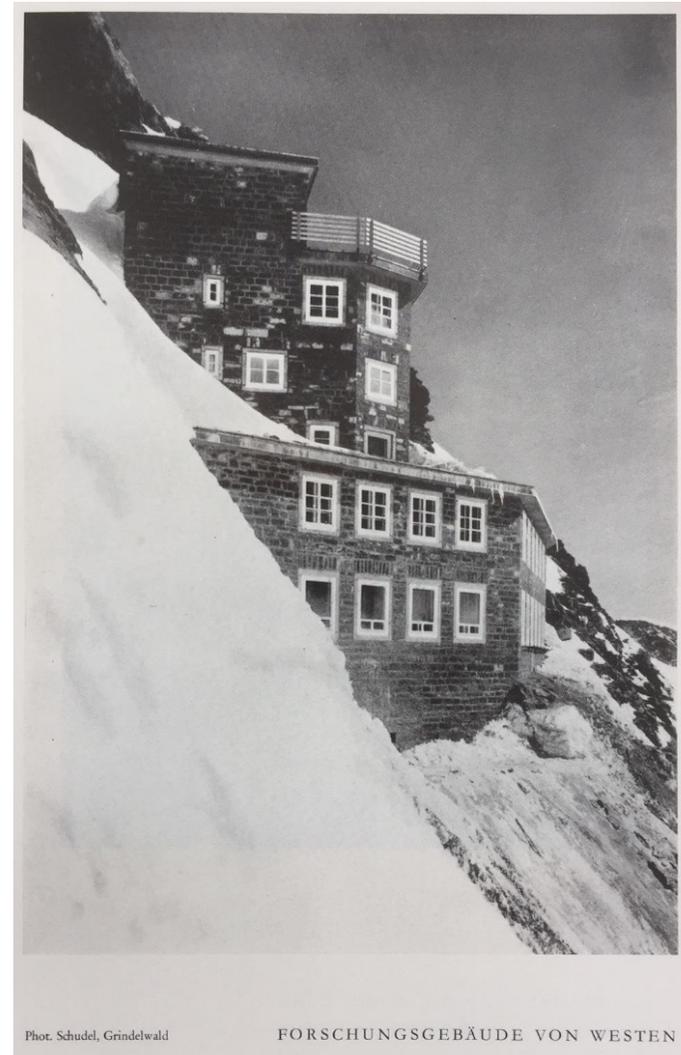
Die Schweiz bietet einen idealen Ort, wo sich die Vertreter der anderen Staaten kennenlernen und sich auch achten und lieben lernen (BR A. Meyer).

Switzerland offers an ideal place where the representatives of the other states can get to know each other and also learn to respect and love each other (BR A. Meyer).

4th July 1931, opening of the „Felsenheim“



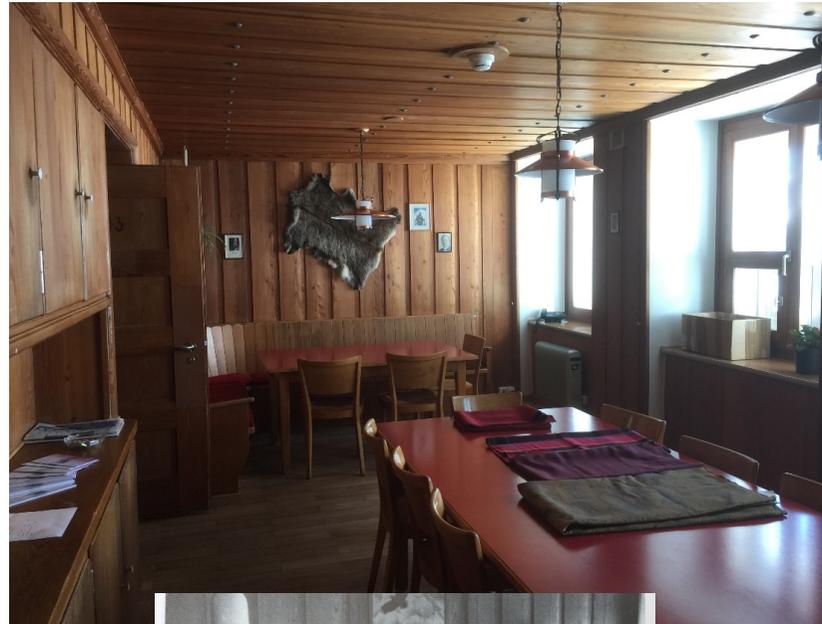
From the planning (22.12.1928) to the realisation



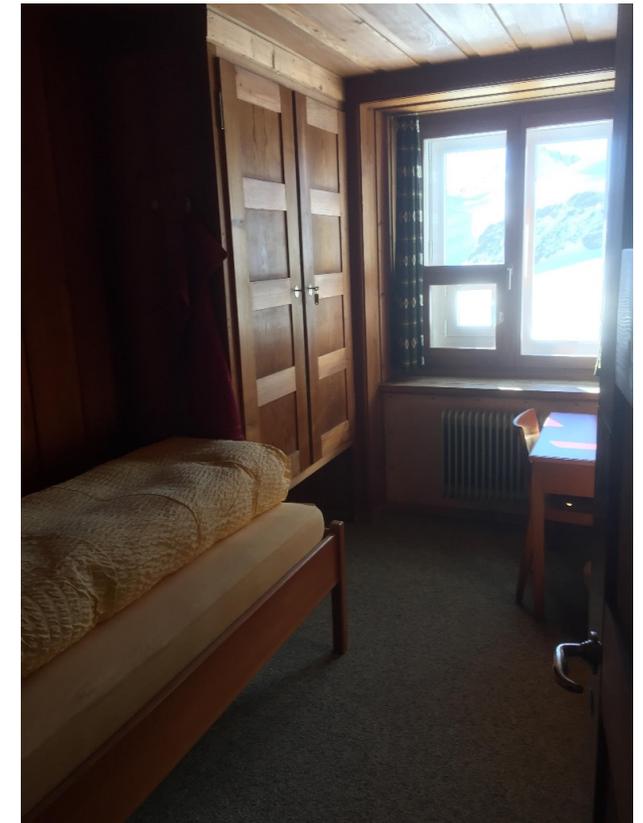
2022, im Forschungshaus (Felsenheim)

Gemeinschaftsraum, original

2018, neue Küche

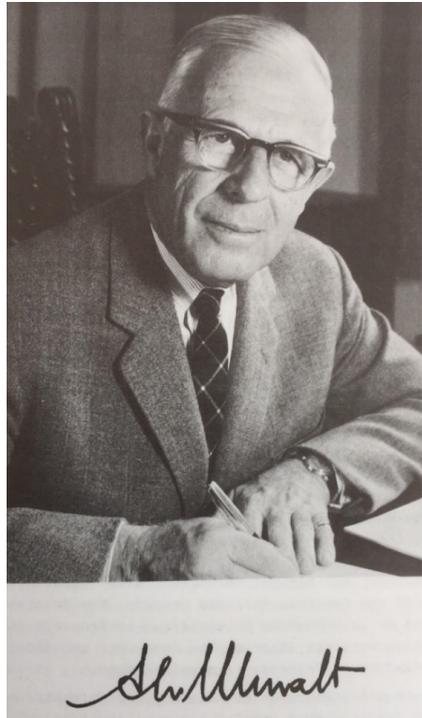


Zimmer, original, 13 Betten



Professor Alexander von Muralt mit Mitarbeitern im Aufenthaltsraum der Forschungsstation; im Hintergrund das Bild von Professor Walter Rudolf Hess. (Aufnahme: Peter Heman, Basel.)

Alexander von Muralt
2nd President of the International Foundation
1937 – 1973



1952, Initiator and Founder of
the Swiss National
Science Foundation



Professor Alexander von Muralt mit Mitarbeitern im Aufenthaltsraum der Forschungsstation; im Hintergrund das Bild von Professor Walter Rudolf Hess. (Aufnahme: Peter Heman, Basel.)



1937
Sphinx Observatory



Richtfest des Sphinxgebäudes

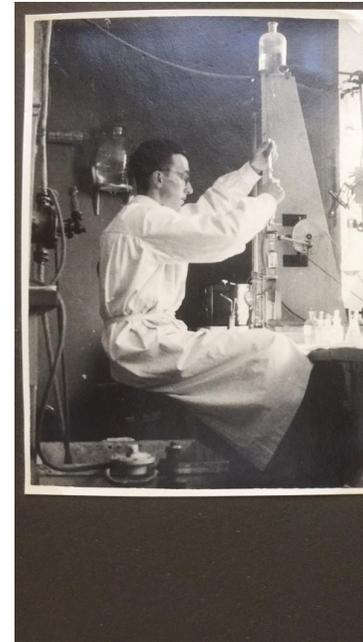


„Sphinx“
originally
housed only a
“Meteorological
Observatory”



Jungfraujoeh
ca. 1939

Mood pictures:
1939, Students of Physiology from
Bern University on the Research Station



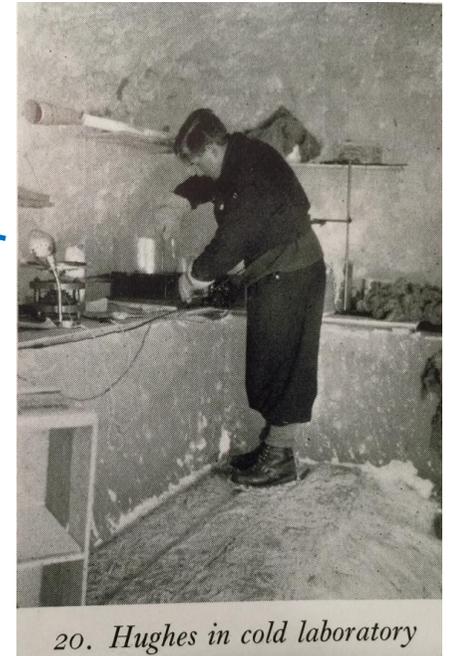
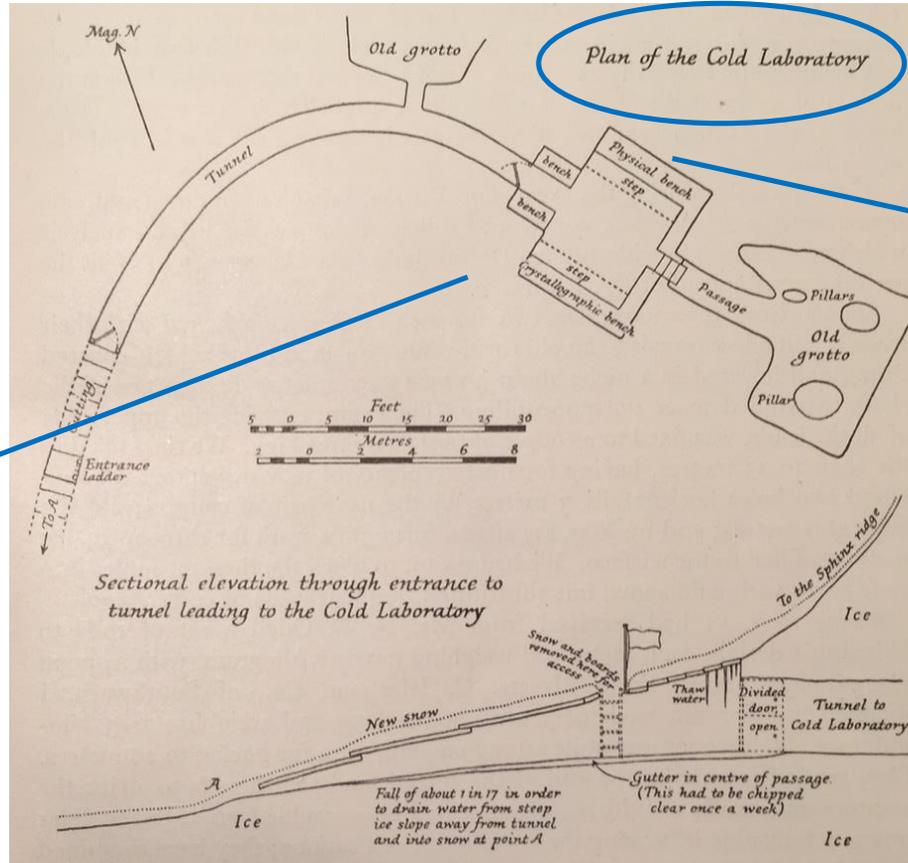
In the research house



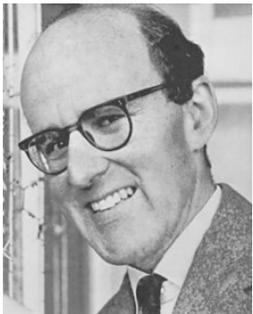
Research in full concentration
with a fantastic view



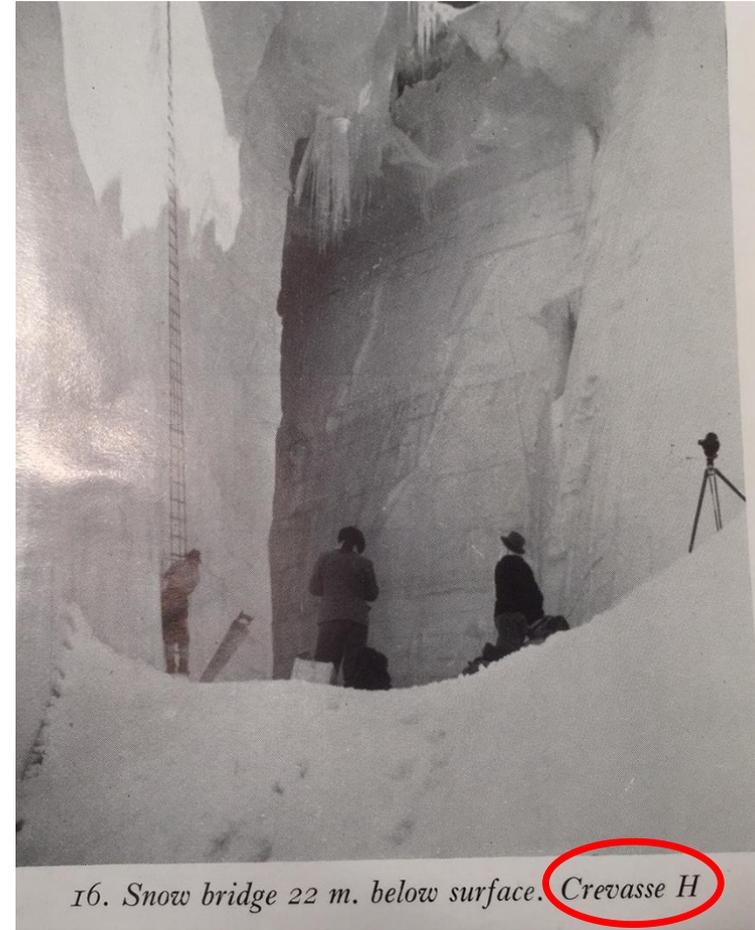
Eis-Forschung / Glaziologie
in den 1930/40er
durch Seligman und Perutz



20. Hughes in cold laboratory



The laboratory benches were simply unhewn ice covered with boards. Light and power were brought by mains from the railway. Work in the cold laboratory was not unpleasant; on a snowy day it was a relief to escape from the wind. Perutz, who worked there longer than others, wore an old airman's suit, and put his feet in sacks stuffed with straw. Hughes seemed to thrive on cold.



1937/38

Glaziology by Seligman and Perutz,

A crystallographic investigation of glacier structure and the mechanism of glacier flow*

BY M. F. PERUTZ, *Cavendish Laboratory, Cambridge*

Nature, 1939



1931 in a mountain hut

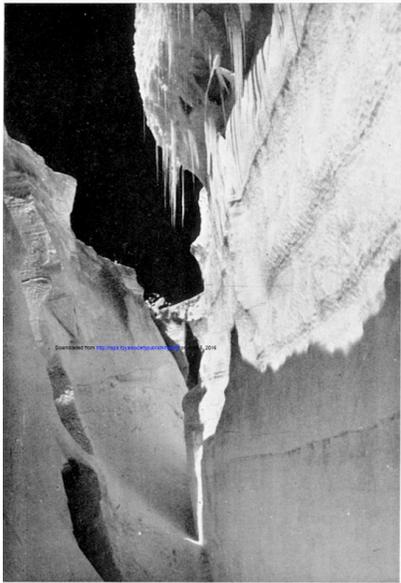


FIG. 1

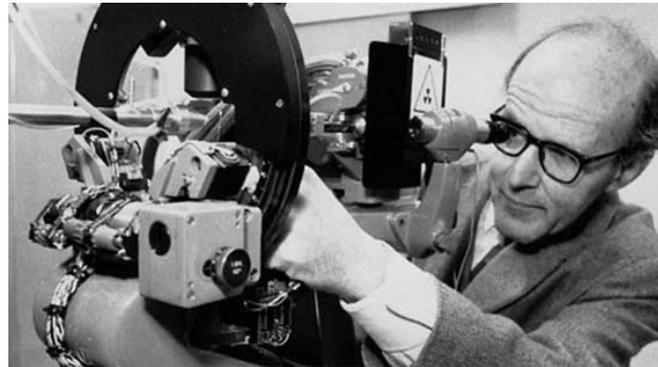


FIG. 2

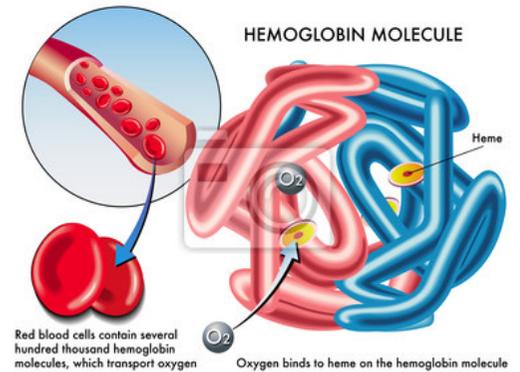
Plate 16

FIG. 1. Annual bands in a crevasse on the Mönchfirn. The distances between successive bands vary between 3 and 4 m. Ice bands are not visible owing to the weathering of the surface by the sun. On the left-hand wall all bands are covered by a thin layer of fresh snow.

FIG. 2. Ice bands in a crevasse on the Mönchfirn. The thickness of the larger bands is about 5 cm.



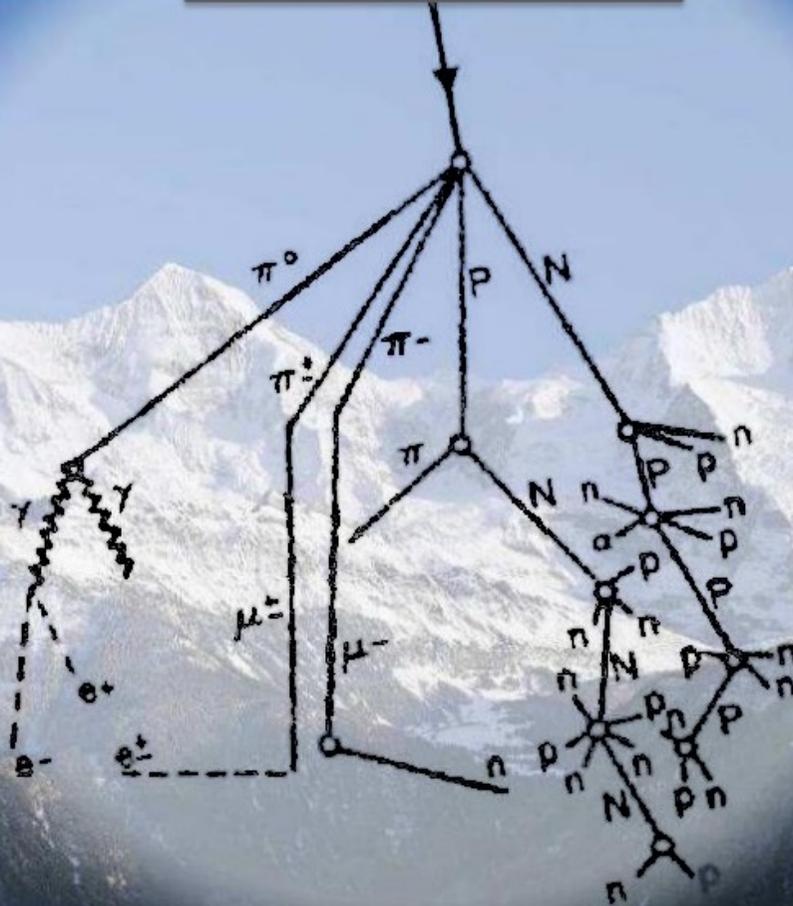
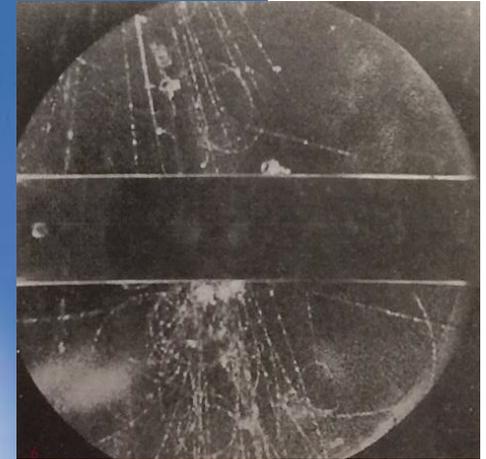
In Cambridge, UK



Nobel Prize in Chemistry, 1962



Incident
Cosmic-ray Particle



1948

PMS Blackett

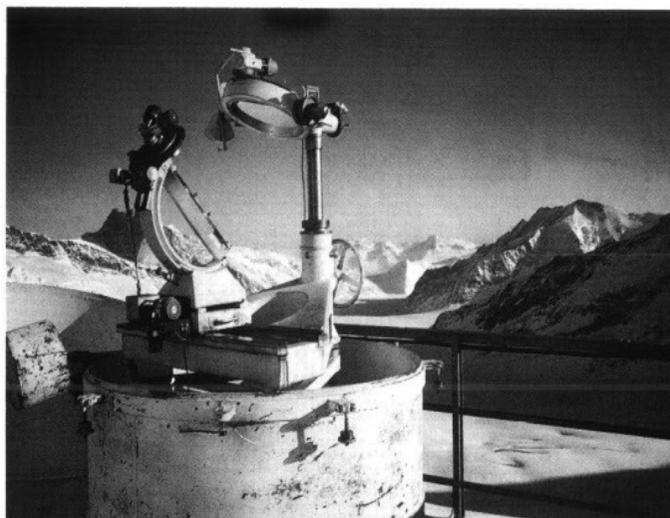


1950

CF Powell

Marcel Migeotte (1912-1992), Professor at the Université de Liège, a pioneer in atmospheric chemistry.

We will celebrate on 16/17th February, 2023, the European Historical Chemistry Landmark Award given to the JJ Research Station based on the pioneering work of the Liège group at JJ from the 1950th on.



The Coelostat; M. Migeotte and D. Jehoulet setting up the heliostat

The spectrometer installed on the Sphinx Site (1958-1989)

Current Members of the International Foundation (2022)

**International Foundation
High Altitude Research Stations
Jungfrauoch and Gornergrat**

Fonds National de la Recherche Scientifique,
Bruxelles

Max-Planck Gesellschaft, München

The Royal Society, London

Österreichische Akademie der Wissenschaften,
Wien

University of Helsinki, Helsinki

Peking University, Peking

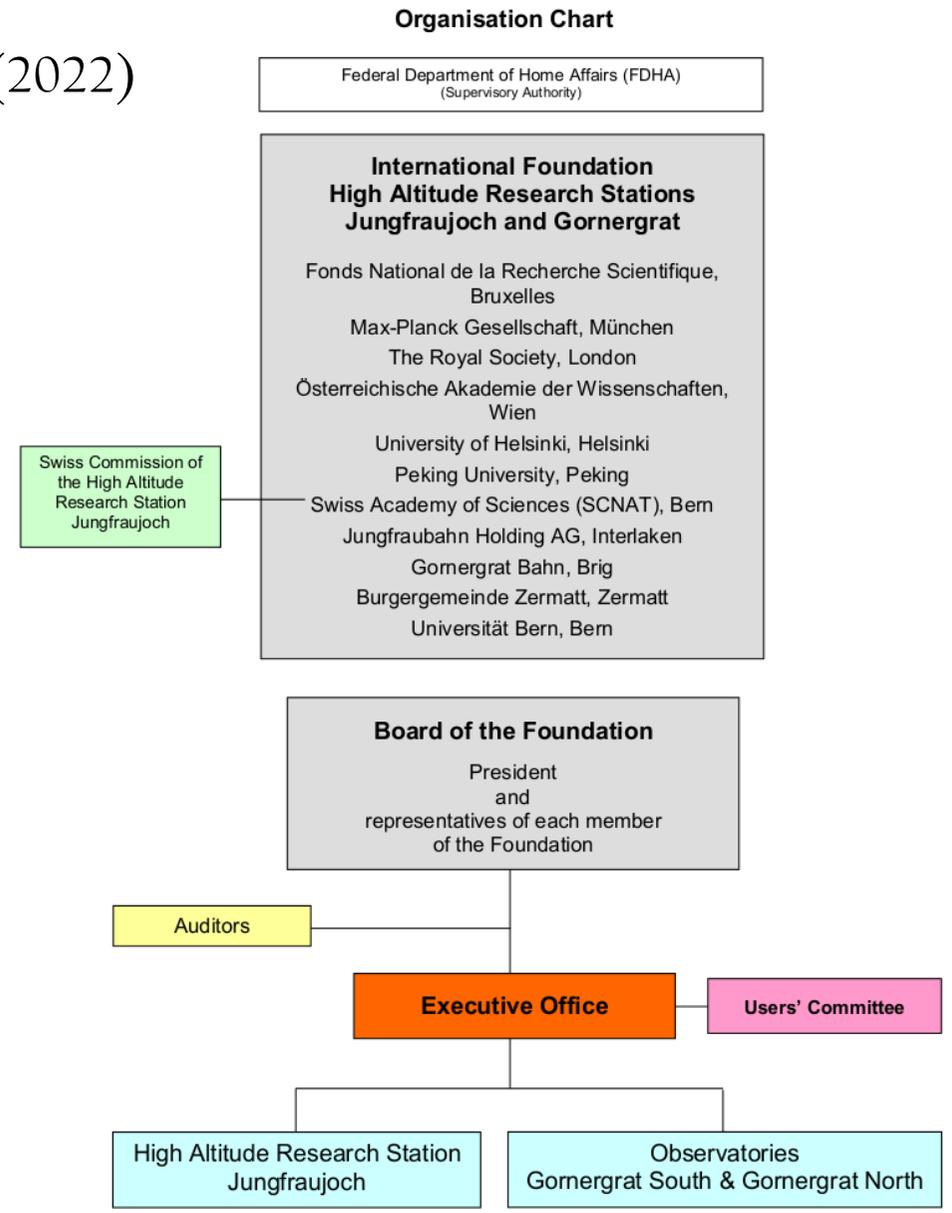
Swiss Academy of Sciences (SCNAT), Bern

Jungfraubahn Holding AG, Interlaken

Gornergrat Bahn, Brig

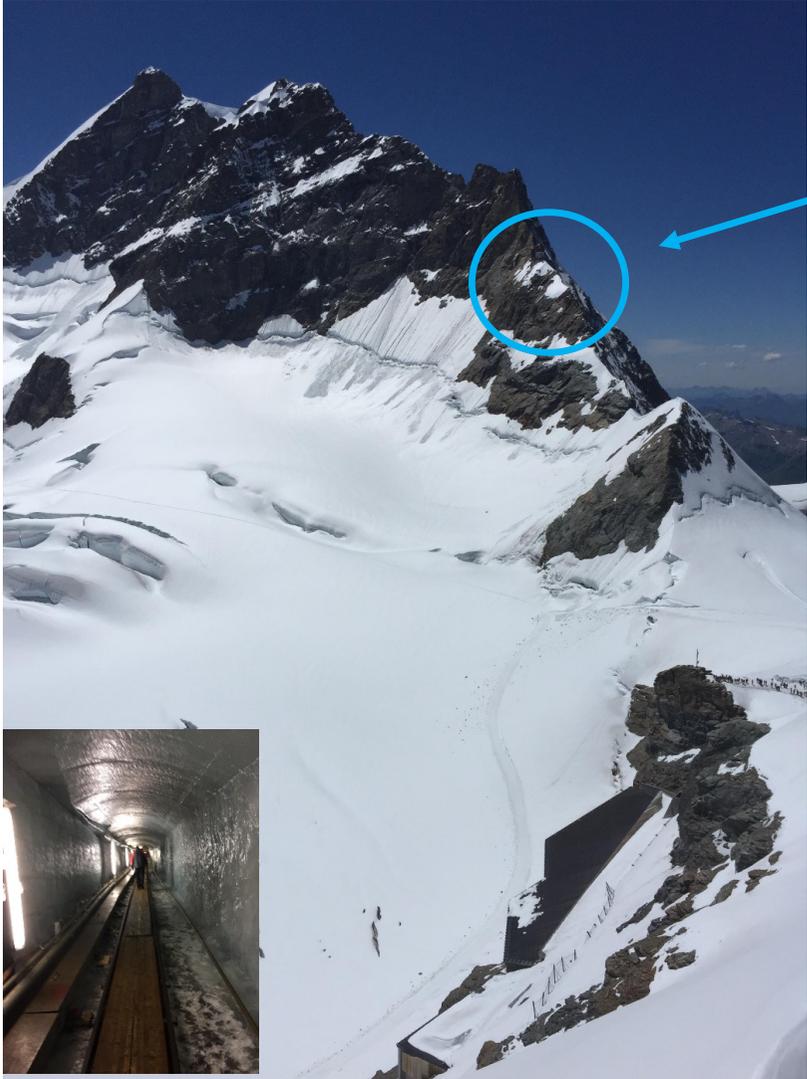
Burgergemeinde Zermatt, Zermatt

Universität Bern, Bern

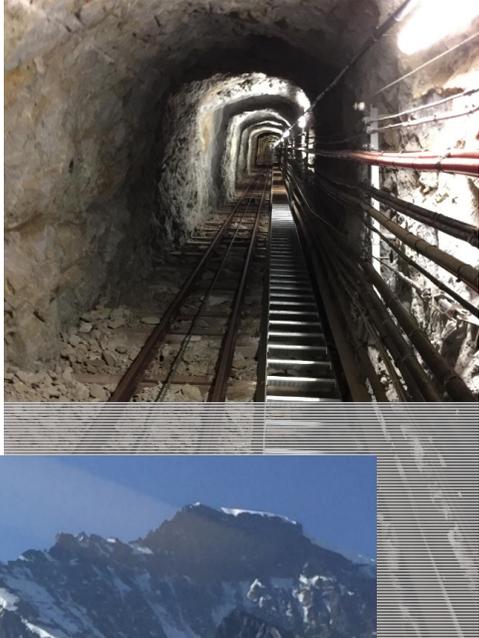




Erweiterung zum Ostgrat (east ridge) / 3700 m ü M



East Ridge Station



Sphinx



Erweiterung Ostgrat / 3700 m ü M



The vision of SCNAT and HFSJG is that the Research Station Jungfrauoch remains, and continues to develop as one of the leading high altitude infrastructures worldwide for investigating alpine surroundings, particularly in environmental and climate research.

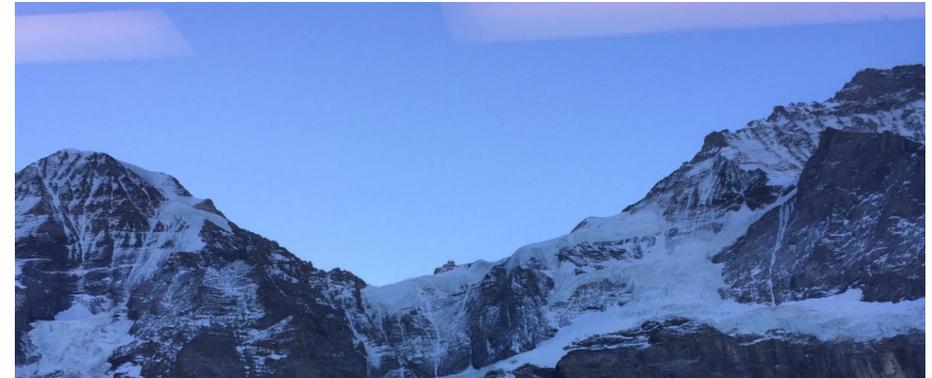


Sphinx Laboratory



Die Höhenlage macht es aus,
die Atmosphäre ist reiner, trockener

Being in the upper part of the atmospheric
boundary layer (ABL)

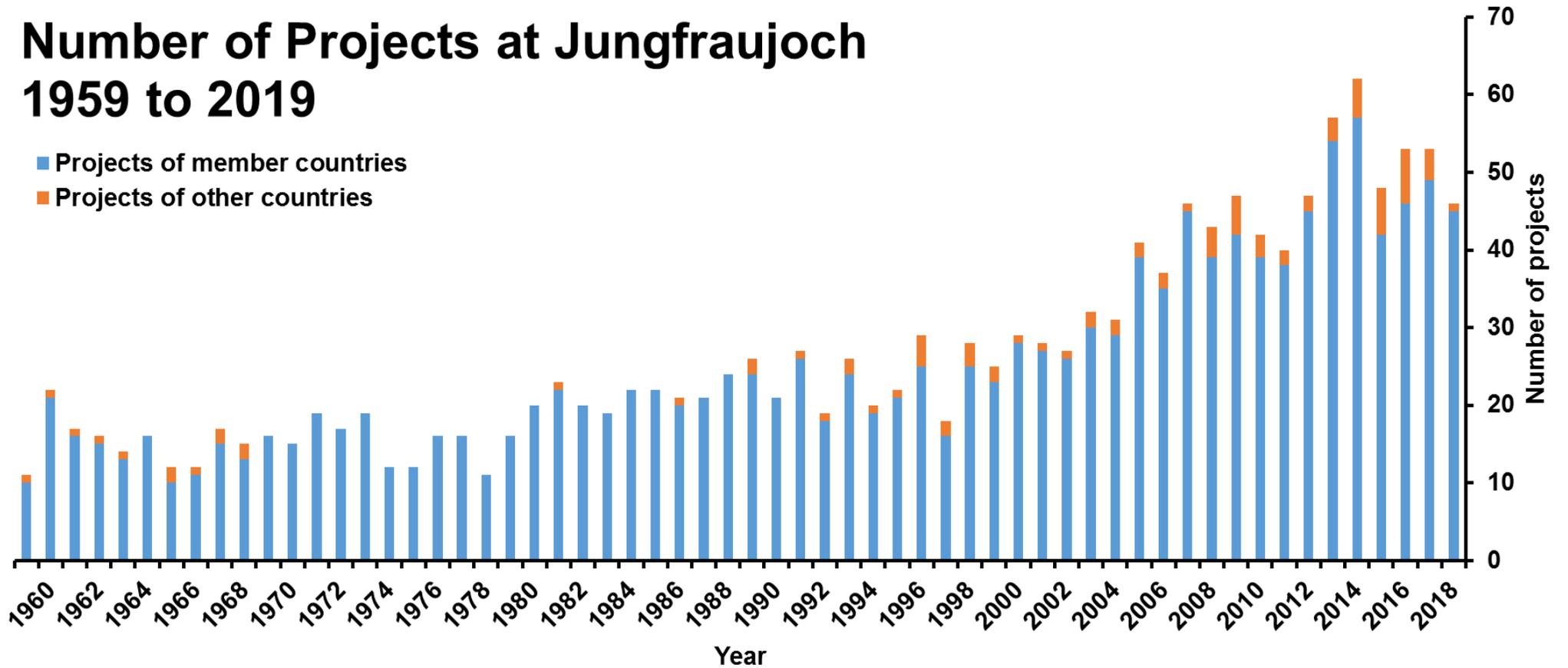


Swiss Federal Laboratories for Materials Testing and Research / Empa
Air Pollution / Environmental Technology
Überlandstrasse 129
CH-8600 Dübendorf
Switzerland

EMPA
Materials Science & Technology

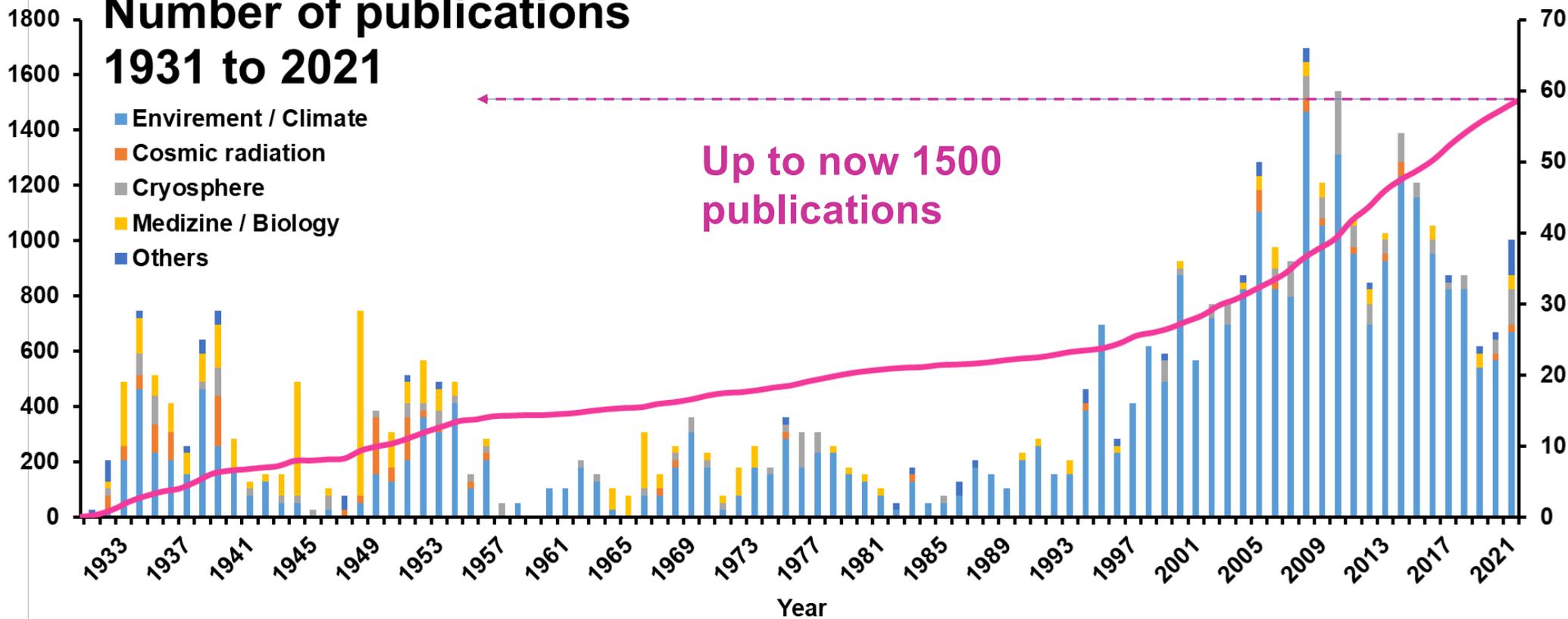
Feinstaubprobe, gesammelt während 24 h, 720 m ³		Ambient particulate matter, collected during 24 h, 720 m ³	
leeres Filter	Jungfraujoch	blank filter	Jungfraujoch
Jungfraujoch während Saharastaub Ereignis	Stadt, verkehrsbelastet	Jungfraujoch during saharan dust event	urban, traffic site

Number of Projects at Jungfraujoch 1959 to 2019



see yearly Activity Reports on www.hfsjg.ch

Number of publications 1931 to 2021





Representative of many excellent works:

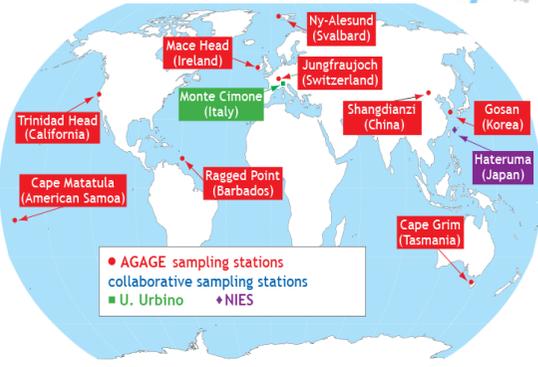
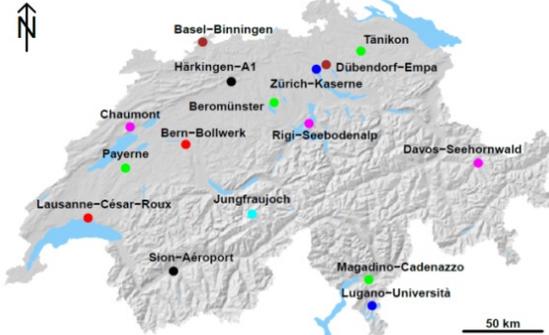
Science, May 2016
Urs Baltensperger *et al.*

On average, based on data from the
research station:

ca. 1 scientific publication / week

ca. 1 BS, MS, PhD thesis / month

Global Stations of GAW



Jungfrauoch – International Monitoring



- GAW:** Global Atmosphere Watch of WMO
- NABEL:** National Air Pollution Monitoring Network
- AGAGE:** Advanced Global Atmospheric Gases Experiment
- EMEP :** European Monitoring and Evaluation Programme
- ICOS:** Integrated Carbon Observation System
- ACTRIS:** European Infrastructure for the observation of Aerosol, Clouds, and Trace gases



Virtual Alpine Observatory - VAO
www.vao.bayern.de

Members:

Austria	France
Germany	Italy
Slovenia	Switzerland

Associated:

Bulgaria	Czech Republic
Georgia	Norway

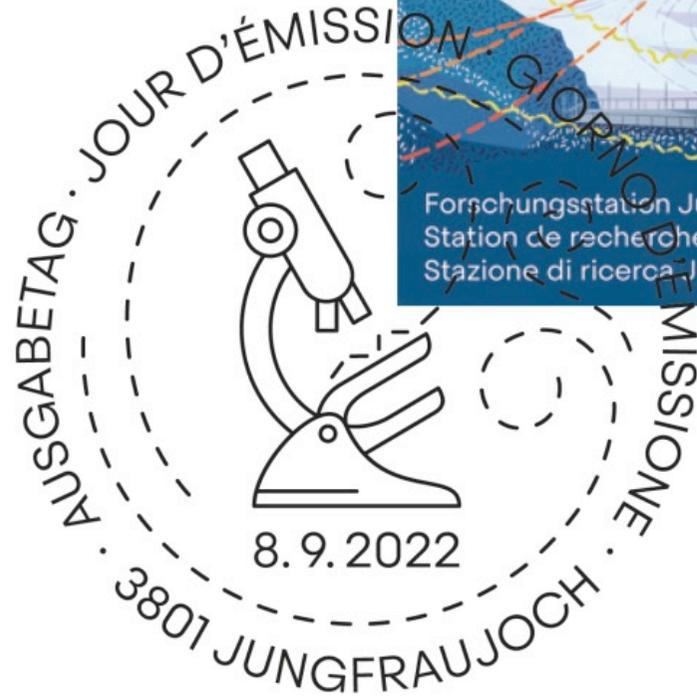
Observers:

Alpine Convention	European Space Agency

VAO ist eine länder- und fachübergreifende Kooperation

VAO is a transnational and multidisciplinary cooperation

Sonderbriefmarke zu 100 Jahre JJ Forschung



1922 - 1952 - 2022



Wissenschaft in freier Sphäre - dies ist unser Privileg, einer internationalen Forschergemeinschaft auf der alpinen Höhenstation freies Gastrecht bieten zu können.

Science in a free sphere - this is our privilege, to be able to offer free hospitality on the alpine station to an international scientific community.

Heute haben wir das Gleichgewicht zwischen der Bewahrung der schweizerischen Eigenständigkeit und dem Streben nach breiter internationaler Vernetzung gefunden.

Today, we have found the balance between preserving Swiss independence and the striving for a broad international networking.