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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 76

ATTENDANCE AT CORRENS COLLOQUIUM, GOTTINGEN VISITS TO SEVERAL INSTITUTES AND MUSEUMS CONCERNED WITH NATURAL SCIENCES GEOLOGICAL FIELD TRIP TO AAR MASSIF AND BINNTAL, SWITZERLAND

June - July, 1963

BY

J. H. Y. RIMSAITE

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CONTENTS

Introduction

The main purpose of the trip to Europe was to attend the Scientific Colloquium in honour of Professor C. W. Correns. The papers presented at this meeting provided a good opportunity to learn about a great variety of research studies and developments in the fields of crystallography, mineralogy and petrology. Titles of all papers with some comments are given in Part I of this report. It was also possible to establish personal contact and to discuss special mineralogical problems with the leading experts, and to arrange visits to their institutes and laboratories.

The problems of special interest arising from the writers' recent studies were:

(1) Dehydration phenomena observed in natural hydrous minerals, and

(2) Occurrences of micro "antiperthitic" plagioclase (An_{20-50}) in some Canadian rocks.

Natural dehydration phenomena of hydrous minerals provide serious structural problems which involve changes in the anionic framework. The genesis of micro "antiperthitic" plagioclase is not known and the possibility of exsolution seems to be very improbable from the results of laboratory experiments on synthetic feldspars. There is practically no published data on these subjects. In this connection, several Institutes were visited and the above problems were brought up during discussion with scientists concerned with crystal structures and with dehydration mechanism in order to learn their opinion about these phenomena. Both problems were found to be of great mineralogical and geological importance and further detailed study was particularly encouraged by Professor F. Laves, Professor C. W. Correns, Professor J. Zemann and Professor O. Glemser (Head of Inorganic Chemistry Institute, Gottingen) who offered their collaboration.

The writer also visited Institutes and Research Laboratories concerned with isotope and geochemical studies, X-ray crystallography, optical mineralogy, emission spectroscopy and clay mineralogy. Some of these Institutes possess impressive mineral and rock collections. Visits were also made to Museums of Natural History containing exhibits of rocks, minerals, gems, jewellery, ornamental stones and porcelain.

A short account of these visits, including names of the Institutions and titles of some publications is given in Part II.

Finally, the writer was fortunate to have the opportunity of joining the guided geological trip to Oberwallis (Swiss Alps) with the Crystallographic Institute, E. T. H., Zürich. The trip was suggested to the writer by Miss Mabel Corlett, who is a graduate student at E. T. H. and kindly made all necessary arrangements. Description of this trip which includes notes on geology of scenic routes: Simplon, St. Gotthard, Rhone Valley and Grimsel Pass is given in Part III.

Numerous personal friends, professors and former colleagues were very helpful in suggesting and arranging visits to various Institutions on short notice. A previous acquaintance (even a casual one at the conference) provided a more informal atmosphere and a possibility for deeper discussion and analysis of scientific problems. Most of the Institutes and scientists visited in Europe are concerned chiefly with highly specialized problems which is evident from publications, e.g. of Mineralogical Institute, Göttingen, or from the interpretation of isotopic ages of the Alps by scientists of Swiss Universities.

The writer did not find any single Institution which could be compared in size, scope of research and a great variety of scientific equipment with the Survey and with National Research Council.

I. SCIENTIFIC CORRENS COLLOQUIUM

Göttingen University, Germany

The scientific colloquium to honour Professor C. W. Correns on his seventieth birthday was organized by Professor H. Winkler, present Director of the Mineralogical Institute of Göttingen University. The Colloquium was held on June 7th from 9 a.m. to 7:30 p.m. in the auditorium of the Mineralogical Institute.

Former students and associates of Professor Correns were invited to present short papers on their recent research studies. Over 200 were present, including Government Officials of the West German Federal Republic, Rectors of two universities, Deans, Professors, representatives of scientific societies, optical firms and oil companies.

During the official part, Professor Correns received two medals: one from the President of the Federal Republic, another "Stille Medal" for his contribution to the Geological Sciences. Professor W. von Engelhard, Rector of Tübingen University, presented Professor Correns with the Honorary Degree of Doctor of Sciences of Tübingen University. Many good wishes from various societies and universities were extended to Professor Correns after which the presentation of papers began. Because of the limited time, only selected papers of outside attendants could be presented. These papers will be published in a Special CORRENS VOLUME. Abstracts were not available. Titles and summaries of the papers are as follows:

1. New Minerals in Lime-rich Inclusions of Basalts of the Eifel by Karl Jasmund, Director of Mineralogical Institute, Cologne University.

Discussion included: separation procedures, results of X-ray and optical studies and PT diagrams of the system $CaO.Al_2O_3$ - $CaO.Fe_2O_3$. The question was brought up whether it is justified to give new names to hydrated minerals. These new minerals are hydrous calcium aluminates.

2. Some Geochemical Observations in Connection with the Askja - Eruption, 1961 by G. E. Sigvaldason, Reykjavik, Iceland.

This paper was illustrated with impressive colour slides taken by the speaker at night during the eruption. Analyses of thermal water from different localities were compared, including pH, SiO_2, Ca, Mg, Na, K, Cl, F, SO_4, HCO_3. It was observed that some ions are leached by meteoric water. Fluorine content showed considerable variation.

3. On the Origin of Colour of Smoky Quartz by Karl Chudoba, Göttingen.

The causes of coloration were discussed: (1) organic origin, (2) colouring ions (Fe/Ti), (3) radioactivity, (4) structural disorder, liberation of Si-atoms, (5) colour centres of electronic nature. Results based on present X-ray studies of crystal structure and X-ray fluorescence analyses of trace elements indicate that the colour of quartz is related to iron impurities and exposure to radiation. Absolutely clear diamond quartz exposed to radiation remains clear.

4. On Micas in Igneous and Metamorphic Rocks by J. Rimsaite, Ottawa, Canada.

5. Electrostrictive Crystals, Their Synthesis and Uses by Martin Mehmel, Professor, Munich University.

Properties of minerals were discussed in relation to vibration state of ions at elevated temperatures, induced pressure and in an electric field.

6. Estudio de Sedimentos Costeros de la Guinea Continental Espanola (Study of Coastal Sediments of Spanish Continental Guinea) by Josefine Pérez Matéos and Juan J. Alonso Pascual, Madrid, Spain.

A comparison was made between mineral components in igneous and metamorphic rocks of the terrain and in sediments. The degree of alteration of detrital minerals was considered. The proportion of altered and fresh mafic constituents and quantitative distribution of zircons in sediments was illustrated in schematic maps.

7. On Experiments Concerned with Identification and Characterization of Ceramic Feldspars by O. E. Radczewski, Aachen.

A mixture of orthoclase (70-76%), plagioclase (16-20%), quartz (5%) and mica (5%) should yield a white melt which is required for production of ceramic materials. In order to obtain a homogeneous mixture, these ingredients are ground to 6μ. A rapid determination of the homogeneity of mixes is made with the aid of optical and electron microscopes. Dark field microscopy in oils with intermediate R.I. permits a rapid distinction of minerals which appear coloured: kaolinite is violet, quartz is blue-green, mica yellow. There is also a difference between plagioclase and orthoclase. The microscope heating stages with Pt - Pt + 15% Rh thermocouples which can be heated to 1600°C are used to study melting and cooling phenomena.

8. Genesis of Zoned Beryl Pegmatites of Venturinha (Viseu, Portugal) from Geochemical Viewpoint by Jose Marques Correia Neves, Professor of Mineralogy, Coimbra, Portugal.

Schematic illustration of minerals present in graphic marginal zone, intermediate and central zone was followed by results on triclinicity measurements of potassium feldspars from these zones. Two maxima were observed, at 60 per cent and 80 per cent triclinicity. The abundance of trace elements in different minerals was expressed as ratios. Rb was found to be relatively high (2,500 p.p.m.) in pegmatitic K-feldspar and relatively low in albite. Concentration of Rb was plotted versus K, Sr vs Ca, Rb vs Ba etc. Such comparison of elements showed a very interesting relationship.

9. On Differentiation of Facies in Boehmite-Diaspore Bauxites of Southern France by Ida Valeton, Docent, Hamburg University.

Vertical section through bauxite deposit was divided into three zones: (1) lower: dolomitic, kaolinite-bearing bauxite, (2) intermediate: plastic, deformed zone, rich in pisolites which were broken and subsequently healed, (3) upper: containing 60 per cent boehmite and diaspore, and about 10 per cent goethite. Zones 1 and 3 are rich in iron. Type and nature of iron-bearing minerals indicates oxidation potential during bauxite formation and gives some idea of the environment.

10. On Genesis of Strontianite of the Münsterland by H. Harder, Head of Mineralogy Department, Münster University.

Two possible hypotheses of strontianite origin were discussed: (1) lateral secretion, and (2) hydrothermal. The latter is favoured by the author. X-ray study and chemical analyses of strontianite and of surrounding calcareous clay were performed. Strontianite contains 4.8 - 7.7% $CaCO_3$ and $<$ 0.01 - 0.05% $BaCO_3$.

11. Spectrographic Analysis of Very Small Meteoritic Globules by E. Preuss, Professor of Mineralogy, Regensburg.

Small, apparently meteoritic globules were found in mesozoic sediments. They are approximately 50 microns in diameter.

Emmission spectrographic analysis was made for Mg, Si, Ge, Mn, Fe and Ni.

12. Determination of Trace Elements in Sea Water by Means of Neutron Activation Analysis by E. Bolter, New Haven, Conn., U.S.A.

(not presented)

13. On Crystal Structure of $(NH_4)_3 GaF_6$ by Sigrid Schwarzmann, Crystallographic Institute, Munich University.

Crystal structure of $(NH_4)_3 GaF_6$ was compared with the structure of cryolite. The unit cell is composed of four molecules. F-atoms occupy corner positions of the Octahedron, NH_4-edges and gallium is present within the octahedron. The distances between F - F and F - NH_4 were discussed.

14. On Studies of Crystal Structures of Alkalizincates by Bruno Brehler, Marburg University.

Structures of $Li_2ZnCl_4 . nH_2O$, $Na_2ZnCl_4 . 3H_2O$ and KZn_2Cl_5 were discussed, including space group, unit cell constants, number of molecules in the unit cell and the distance Zn-Cl. Models showing the positions of various atoms in the crystal lattice were presented.

15. On Calcium Silicate Hydrate and Calcium Germanate Hydrate by F. W. Locher and W. Richartz, Düsseldorf.

Calcium silicates and calcium germanates are important constituents of cements. The latter is used in the production of propellers. Crystallization of these compounds was discussed in relation to temperature, CaO/SiO_2 ratio and CaO concentration of solutions. Depending on physical-chemical conditions, these compounds crystallize in form of small needles (Ca 1 μ to 5 μ in length) which produce stronger cements or are platy. Electron diffraction photographs and X-ray diffraction patterns of the crystals were shown.

16. Some Applications of Sediment Petrography to Oil Geology by Hans Füchtbauer, Hannover.

The transportation directions and origin of sediments in gulfs and basins can be determined from their heavy detrital minerals. These can be compared to glacial boulders which indicate the flow directions of glaciers. This permits construction of palaeogeographic maps. Lithological facies of recent basins are correlated with areas rich in microfauna. Results are applied to ancient gulfs, thus permitting location of oil basins. Migration of oil is controlled by structure, age of a deposit, and particularly by the pressure induced by overlying rocks. Oil forms thin coatings on quartz grains thus preventing further growth of quartz.

17. On Lead Content in Kaoline from Hirschau-Schneittenbach by H. M. Köster, Mineralogical Institute, Regensburg.

Kaolinite with segregations of cerusite forms by process of alteration from arkosic feldspar. This arkose contains biotite, garnet and other heavy minerals which on disintegration yield sufficient lead to account for the presence of cerusite in the kaolinite deposits. This opinion is based on studies of lead and copper content in kaoline and other rocks in this area, and on quantities of altered arkose. Hydrothermal origin of cerusite was also considered.

18. Improvements in Routine Elutriation Analyses of Clay and Soil Specimens by B. Mattiat, Hannover.

Equipment used for preparation of clay and soil samples and efficiency of separation into $< 2\mu$, $2 - 6\mu$, $6 - 20\mu$ and $20 - 60\mu$ size fractions was discussed. The coarse fraction, $20 - 60\mu$, in most cases is composed of aggregates which affect particle size distribution in all fractions. The abundance of the finest fraction ($< 2\mu$) varies depending on the efficiency of disintegration procedures. Two examples were demonstrated. There is a relationship between the mineral composition and particle size of the fraction.

19. Stratigraphic and Palaeographic Problems from the Sediment-Petrographic Viewpoint by D. Heim, Mainz.

The abundance and nature of heavy minerals have been studied in sandstones of lower Triassic "Buntsandstein". Samples were separated into several size fractions: $< 1\mu$, $1 - 5\mu$, $5 - 10\mu$, $10 - 20\mu$, $20 - 50\mu$ and $50 - 100\mu$. Quantities of apatite, tourmaline, zircon, garnet and other heavy minerals were determined in each fraction. Results of distribution studies of heavy minerals aided in reconstruction of accumulation conditions of Triassic sandstones and indicated that they were piling up from Northeast.

After the presentation of the papers, Professor Correns expressed his sincere thanks to all and the colloquium was closed.

After the Scientific Colloquium, attendants had an opportunity to visit various laboratories of Crystallographic, Mineralogical and Sediment Petrographic Institutes. Several receptions provided an opportunity for informal discussion of papers with their Authors.

II. VISITS TO INSTITUTIONS CONCERNED WITH NATURAL SCIENCES

Country, City	Institution and Address	Scientists	Position and Special field
Holland Amsterdam	Geologisch Institut, Vrije Universiteit, de Lairesses-traat 142.	Prof. William Uytenbogaardt	Director, Ore Microscopy
Germany Göttingen	Mineralogy Department, Göttingen University, Lotzestrasse 16-18.	Prof. C. W. Correns Prof. H. Winkler	Director, emeritus Present Director
	Sediment Petrographisches Institut der Universität, Göttingen, Lotzestrasse 13.	Prof. C. W. Correns	Conducts research studies.

Country, City	Institution and Address	Scientsts	Position and Special Field
	Staff: O. Braitsch: Minerals and origin of salt deposits. Petrofabrics. Dr. Paula Schneiderhöhn: Sedimentation, instructs mineralogy students in chemistry. Dr. A. Haydemann: Adsorption of trace elements in clays. Synthesis of quartz at low temperatures. Experiments on alter-nation of clay minerals.		
	Mineralogisch-Petrographisches Institut der Universität, Göttingen, Lotzestrasse 16-18.	Prof. H. Winkler	Director, Experimental metamorphism.
	Staff: Prof. S. Koritnig: curator of mineral collections. Prof. Hans K. Wedepohl: Geochemical studies Supervises X-ray fluorescence and spectrographic (emission) laboratories.		
	Mineralogisch-Kristallographisches Institut der Universität, Göttingen, Lotzestrasse 16-18.	Prof. J. Zemann	Director, Crystal Structures.
	Institut für Geochemie der Universität, Göttingen, Lotzestrasse 16-18.	Prof. L.H. Ahrens	Director.
	Zentrallaboratorium fur die Geochemie der Isotope, in Göttingen (new building behind the main building of Mineralogical Institute, Lotzestrasse 16-18.	Dr. H. Nielsen	Conducts studies on sulphur isotopes.
	Geologisches Institut der Universität, Göttingen Bahnhofstrasse (near railway station).	Prof. E. Bederke	Director.
	Anorganisch-Chemisches Institut der Universität, Göttingen Hospitalstrasse 8-10.	Prof. O. Glemser	Director.
		Dr. E. Schwarzmann	Infrared spectro-scopy (s. [illegible]).

Country, City	Institution and Address	Scientists	Position and Special Field
Munich	Technische Hochschule, München Corner Luisenstr., Theresienstr., Gabelsbergerstr.		(See Regensburg)
	Institut für Kristallographie der Universität, München, Luisenstr. 37.	Prof. G. Menzer	Director.
		Dr. Sigrid Schwarzmann	Crystal structures.
Regensburg	Staatl. Forschungsinstitut fur angewandte Mineralogie, Regensburg (associated with Technische Hochschule, München).	Prof. E. Preuss	Meteorites emission spectroscopy.
		Doc. H.M. Köster	Clay mineralogy applied to ceramics.
Switzerland Bern	Mineralogisch-Petrographisches Institut der Universität, Bern, Sahlistrasse 6.	Prof. E. Niggli	Director, Dean of Faculty of Nat. Sci.
		Doc. E. Jaeger	Geochemistry, Age determinations.
Zürich	Institut fur Kristallographie und Petrographie, Eidg. Technische Hochschule, Zürich 6, Sonneggstrasse 5.	Prof. F. Laves	Director, Crystal structures of feldspars.

Staff: Docent O.W. Flörke: (Structural crystallography).
Docent Marc Grünenfelder: (petrologists, heterogeneity of accessory zircons and their U/Pb ages).
Docent Bambauer: (study of Swiss minerals, colour of quartz, mineral collections).
Dr. W. Hoffman: (high temperature minerals, tridymite).
Dr. Hans Nissen: (X-ray studies of labradorites).
Dr. Don Bloss: (Senior post-doctorate fellow from Illinois: twinning of micas, Structures of heated feldspars).
Miss Mabel Corlett: (Research fellow from Canada, superstructures and twinning of pyrrhotite).

Country, City	Institution and Address	Scientists	Position and Special Field
	E.T.H., Versuchanstalt fur Wasserbau und Erdbau, Zürich, Schmelzbergstr. 9.	Dr. Max Muller-Vonmoos	Chief of experimental laboratory.

The main purpose of the visits to the research institutions was to learn about most recent developments and nature of studies in the field of geological and related sciences.

Amsterdam

Geological Institute of Vrije Universiteit, Amsterdam is still in the old building. There is not much space for scientific equipment. However, Prof. Uytenbogaardt showed the writer plans of the new building, which is near completion and will be equipped with modern instruments. One of the first to be installed will be the electron probe microanalyzer. Prof. Uytenbogaardt considers the Cambridge instrument to be the most useful for application to mineralogical studies. At the present time the Institute is concerned chiefly with teaching. The method of geochemical instruction was found to be particularly interesting; the laboratory contains a chart showing diagramatically the abundance of various metals and the state in which they occur in nature, e.g. as native elements, as oxides, halides, silicates, etc. After completing the chemical analysis of a mineral, students place this mineral into the proper column on the schematic chart. This method aids in learning about the geochemical character of each element and about minerals in a very clear and comprehensive manner. Professor Uytenbogaardt studies the reflectivity of minerals at certain wavelengths with Leitz equipment. Reflectivities measured on minerals are compared with those of synthetic standards. To prevent tarnishing and any alteration in reflectivity due to the effect of humid air, polished sections are stored in small boxes which are kept in sealed plastic bags from which most of the air was removed under vacuum. The application of the electron microanalyzer for the study of heterogeneous thorites and other minerals was discussed. Professor Uytenbogaardt showed his radioactive specimens which he described in a recent paper "A davidite-thorite paragenesis on the Island of Bjorko, Sweden". His mineral collection also contains a few specimens from the Bancroft area, Ontario.

Göttingen

The faculty of Mathematics and Natural Sciences of Göttingen University is chiefly concerned with the preparation of the young generation of scientists for independent highly specialized research studies. Many institutes are concerned chiefly with

Country, City	Institution and Address	Scientists	Position and Special Field

research work, and relatively little with teaching. The Faculty contains the following Institutes concerned with the Geological Sciences: Department of Geology with Institutes of Geology and Palaeontology; Department of Mineralogy with Institutes of Crystallography, Geochemistry, Mineralogy-Petrology and of Sedimentary Petrology; Institute of Geophysics, which is headed by Professor Julius Bartels, the authority on terrestrial magnetism; Institute of Geography concerned with morphology, glacialogy, pleistocene, climatology and anthropology; Institute of Inorganic Chemistry which closely collaborates with Institutes of Crystallography and Sedimentary Petrography.

Institute of Crystallography is concerned mainly with crystal structures and carries out X-ray analyses on single crystals. A large, modern X-ray laboratory is equipped with its own power line and contains Bueger-Precession and Weissenberg cameras. The writer discussed with Professor Zemann, Director, and Professor O. Mellis, a guest from Stockholm University, changes in crystal structures on dehydration and the most effective X-ray procedures for their studies.

Institute of Mineralogy contains several sections: X-ray diffraction laboratory, concerned mainly with X-ray analyses of fine-grained samples, contains an X-ray diffractometer, Guinier-Wolff cameras, original Debye-Scherrer cameras and those modified by Jasmund for clay minerals analysis (114.6 mm. in diameter). Samples are prepared and cameras loaded by persons who require the analyses. Routine operation is performed by technical personnel.

Geochemical laboratories are equipped with Jarrell-Ash emission spectrograph, X-ray fluorescence unit, flame-photometer and colorimeter. Dr. Wedepohl demonstrated sample preparation procedures for X-ray fluorescence analysis: samples are pulverized and pressed into aluminium rings which hold powder firmly thus preventing loss during storage. He pointed out that cellophane sheets, which are commonly used to hold a loose powder sample, absorb certain wave-lengths and thus can effect analytical results. XRF sensitivity for potassium is approximately 0.1 - 0.2%. Analysis of Si, Al and Mg is possible but not too good. Dr. Wedepohl will come to Canada next fall as an exchange professor of geochemistry.

Ore Mineralogy. Professor Koritnig uses Zeiss ore microscope and Zeiss filter slide with colours of the sun spectrum for reflectivity measurements in ore minerals. The filter can be fitted on the petrographic microscope for work in transmitted light at a definite wavelength. Some parts of Zeiss equipment for reflectivity measurements are quite new and are tested by Prof. Koritnig before their mass-production for the market. Professor Koritnig showed the writer a recently completed doctors' thesis on magnetic particles in basaltic rocks of Meissner. This study was carried out under his supervision in part in the Mineralogical Institute and in the Geophysical Institute in connection with magnetic properties of basalts. Chemical composition and homogeneity of magnetite-ilmenite particles were studied by means of the electron probe microanalyzer (Cambridge instrument) in the Mining Academy, Clausthal. Results are only semi-quantitative, because the exact chemical composition of ilmenite and magnetite is not known. Professor Koritnig believes that much development work will be necessary before microanalyses can be fully evaluated. He stressed particularly the need for reliable standards.

The following publications illustrate the results and nature of research studies of the Mineralogical-Petrographic Institute:

(1) Chemical composition of gaseous and liquid inclusions in minerals of some granites and pegmatites by R. Goguel (1963). Geoch. et Cosmoch. Acta, 27, 155-181.

(2) Contributions to geochemistry of copper by K.H. Wedepohl (1962). Geolog. Rundschau 52, 492-504.

(3) Contribution to geochemistry of sulphur by W. Ricke (1960). Geoch. et Cosmoch. Acta, 21, 35-80.

(4) Contribution to geochemistry of chromium by F. Fröhlich (1960). Geoch. et Cosmoch. Acta, 20, 215-240.

(5) Clastic and pyroclastic sediments of the "Rotliegenden" in southern Harz by G. Müller (1962). Beitrage zur Mineral. u. Petrogr. 8, 440-490.

The Institute of Sedimentary Petrography is concerned with mineralogical and petrographic studies of sediments, including clay minerals. Experiments on mineral synthesis at low temperatures and on alteration of minerals under conditions similar to those of diagenesis are also carried out.

(1) Preparation of Samples and Elutriation

Specimens are ground in wooden mortars to prevent destruction of individual mineral particles. Then they are treated with a NH_4OH solution to liberate particles and agitated for 40 hours in the shaking apparatus. Fractionation is carried out by means of settling in glass cylinders, with high frequency centrifuges and with the Öden balance. Minerals are studied by means of the petrographic microscope, differential-thermal apparatus, X-ray diffractometer and chemical analyses. The institute does not have an electron microscope, but arrangements can be made to use those of other institutes. Chemical and X-ray diffraction analyses are performed in the Mineralogical-Petrographic Institute.

(2) Weathering of Clay Minerals

Experiments are presently being carried out on weathering of kaolinite and montmorillonite. Samples are treated with pure water and weak acidic and alkalic solutions in plastic cylinders to prevent SiO_2 contamination. Constant agitation is necessary to prevent coagulation and settling of the particles. Experimental results indicate that aluminium remains in the crystal lattice and silica gradually dissolves. Quantities of dissolved silica are determined by colorimetric method.

(3) Synthesis of Quartz

Synthesis of quartz from a gel at low temperatures is carried out by Dr. Haydemann. Alkalies: Li, Na, K, etc. are used as "mineralizers". Experiments are performed in sealed reagent tubes which are heated in the drying furnace. Quartz crystallizes already at 100°C.

Some more recent publications by Professor C.W. Correns and by other scientists of the Institute are:

(1) Experiments on the decomposition of silicates and discussion of chemical weathering by Carl W. Correns (1963). Clays and Clay Minerals 10, 443-459.

(2) The experimental chemical weathering of silicates by C.W. Correns (1961). Clay Minerals Bull. 4, No. 26, 249-265.

(3) Observations sur la formation et la transformation de mineraux argilieux lors de la decomposition des basaltes by C.W. Correns (1962). Colloques Internationaux du Centre National de la Recherche Scientifique. No. 105. Genese et Synthese des Argilles. Paris 3-6 Juillet, 1961, 109-121.

(4) Minerals in brick clays by C.W. Correns (1958). VI International Ceramics Congress, Wiesbaden, 1958 Transactions, 184-193.

(5) Origin and composition of salt deposits. Mineralogy and Petrography, 3 Volume. by O. Braitsch (1962). Ed. Springer, Berlin-Göttingen-Heidelberg.

(6) On the geochemistry of bromine in saline sediments. Part 1: Experimental determination of Br-distribution in various natural salt systems by O. Braitsch and A.G. Herrmann (1963) Geoch. et Cosmoch. Acta, 27, 361-391.

(7) Studies on the geochemistry of nitrogen by F. Wlotzka (1961), Geoch. et Cosmoch. Acta, 24, 106-154.

(8) The origin of lime-oolitic facies of the lower "Buntsandstein" in northern Germany by H.E. Usdowski (1962) Beitr. zur Min. u. Petrogr. 8, 141-179.

Note: Professor O. Braitsch has recently been appointed Head of the Mineralogy Institute in Freiburg Br. He replaces Professor Tröger. Professor L.H. Ahrens will return shortly to the Union of South Africa to become Chairman of the Geochemistry Department in Cape Town.

Zentrallaboratorium fur die geochemie der Isotope in Göttingen is concerned with geochemical studies of stable isotopes and is available to all scientists in Germany who are interested in such studies. The research work is conducted by Dr. H. Nielsen (mineralogist) under the supervision of Professor C.W. Correns. The Advisory Committee consists of Professor Brinkmann, Bonn (geologist, chairman); Professor Haxel, Heidelberg (physicist); Professor Glemser, Göttingen (chemist); Professor Ernst, Erlangen (mineralogist); Professor Voigt, Hamburg (palaeontologist) and the Curator of the Göttingen University. The Committee determines the research program for one year in advance. The mass spectrographic laboratory was ready for operation in 1961 and since that time has performed more than 2,000 determinations. It is equipped with the mass spectrometer Atlas Ch-4. A second mass spectrometer was recently installed and is almost ready for operation. There is also a laboratory for wet chemical analysis and a sample preparation room. In addition to the permanent staff, there are scientists from other institutions who work on a temporary basis on special problems. Because of increasing interest in the isotope studies, plans are being made for further expansion.

The ratio S^{32}/S^{34} (22:210) of troilite from Cañon Diablo is used as the standard. The ratios determined on sulphide and sulphate minerals are expressed as positive and negative deviations from the standard ratio of troilite. Analytical results are summarized in the chart which is displayed in the mass spectrographic laboratory. This chart presents positive and negative deviations of individual minerals which are shown in corresponding colours in rows representing a deposit or an individual vein. This chart permits a rapid comparison of: (1) the behaviour of the S^{32}/S^{34} ratio in a certain mineral in various deposits; (2) variation of the ratio in a certain mineral of an individual deposit or vein; (3) magnitude of variation in S^{32}/S^{34} ratio in all minerals from diverse deposits, and (4) mineralogical composition of a deposit.

The following publications of the central Isotope Laboratory give in some detail the experimental procedures, results and accuracy of determinations, and petrological interpretation of results:

(1) Ratios of S-isotopes in barite and in sulphides from hydrothermal veins in "Schwarzwald" and in younger barite veins in southern Germany and their genetic significance by K.V. Gehlen, H. Nielsen and W. Ricke (1962) Geoch. et Cosmoch. Acta, 26, 1189-1207.

(2) An example of interpreting the isotope ratios of sulphur by H. Nielsen (1960). Summer course on nuclear geology, Varenna, 191-201, Ed. Comitato Nazionale per l'Energia Nucleare, Laboratoris di Geologia Nucleare Pisa.

Details in general organization of the Central Isotope Laboratory are given in Mitteilungen, Deutsche Forschungsgemeinschaft 1/63, February 1963, pp. 13-16.

The Institute of Inorganic Chemistry, Göttingen University in addition to teaching, is concerned with extensive structural studies of various chemical compounds. The special field of these studies is the determination of the bond types and of the nature of water in inorganic aquoxides. Professor O. Glemser, Director, and his staff studied in great detail the transition of aluminium, iron, silicon and other hydroxides to oxides in part by means of infrared spectroscopy. As a result of these studies, Professor Glemser proposed a new classification of aquoxides ("Results and Problems of the Compounds of the Oxide-water Systems" by O. Glemser (1961). Angewandte Chemie 73, 785-805). The purpose of the visit was to discuss with Professor Glemser and Dr. Schwarzmann (specialist in infrared spectroscopy) the dehydration phenomena of natural micas observed by the writer from the chemical viewpoint. Both Professor Glemser and Dr. Schwarzmann were very interested in this problem. The possibilities of future detail studies by means of infrared spectroscopy, nuclear magnetic resonance, neutron diffraction and X-ray diffraction analysis of single crystals were discussed.

Regensburg

Regensburg is an old, pre-Roman city on the Danube River. It has a great number of interesting buildings, among them the ruins of the Roman city wall, a beautiful Gothic cathedral with towers over 300 feet high, estates of the princess of Thurn-und-Taxis which occupy several blocks and contain displays of Roman ornamental stones, and houses in which the famous astronomer Keppler lived and died.

The State Research Institute of Applied Mineralogy is located in an estate in the city of Regensburg. It is associated with the Technische Hochschule, München which was severely damaged during the last war and is still under construction. Two sections were visited: (i) spectrographic laboratories and (ii) laboratories of clay mineralogy applied to ceramics.

(i) The spectrographic laboratory is under the supervision of Professor Preuss who is particularly interested in the direct analysis of very small quantities of trace elements in minerals, rocks and ashes. He believes that the concentration of any trace element by chemical procedures encounters possible losses and thus leads to incorrect results. He has recently constructed a new spectrograph with very high resolution for the analysis of trace metals in very low concentrations. Because of high resolution, the new spectrograph records only a limited part of spectrum. It can be easily adjusted to cover the desired range of the spectrum. To obtain the entire spectrum in the range of ca 2,200 - 4,600 A°, a second, small Hilger spectrograph is focused on the same sample. The two spectrographs operate simultaneously. Professor Preuss is also interested in meteorites which he studies under the microscope and by means of spectrographic analysis.

(ii) Laboratories of clay mineralogy applied to ceramics are equipped with the elutriation apparatus, centrifuge, X-ray diffractometer, Guinier camera, ion-exchange columns, a microscope with a heating stage which can be heated to 1,600°C. (Leitz instrument) and the apparatus for differential thermal analysis. Docent H.M. Köster conducts the research studies of clay minerals and gives some practical advice to companies and persons concerned with raw materials for the production of ceramics.

Munich

The Institute of Crystallography, Munich University is concerned with teaching and with the detailed study of crystal structures. The X-ray diffraction laboratory is equipped with Weissenberg and Guinier-Jagodzinski cameras which can be heated. A special transformer and a neutron diffractometer have been installed to study the exact hydrogen positions in the crystal lattices of hydrous minerals. Dr. Sigrid Schwarzmann, who kindly showed the Institute to the writer on Saturday when it is officially closed, studies crystal structures of complex fluorides. The Institute displays numerous models showing atomic structures of crystals which were determined by the Institute Director, Professor Menzer, successor of Professors Max von Laue and P.H. von Groth. The Institute has also mineral collections which were damaged during the war. The lost specimens are being gradually replaced by purchased ones and by donations.

Switzerland
Bern

The Mineralogical-Petrographic Institute of Bern University is concerned with teaching and with research studies in the field of mineralogy, petrography and geology. The Institute has several laboratories, including one of clay mineralogy which is equipped with the elutriation apparatus, the apparatus for magnetic separation of clay minerals in suspension and the equipment for differential thermal analysis which was constructed by Dr. Jaeger. Docent Jaeger is teaching geochemistry, including

Switzerland
Bern (cont.)

isotope geochemistry and its application for age determinations. She plans to give a practical course and training in mass spectrometry and in isotopic age determination procedures to interested students. Dr. Jaeger supervises the itotope analysis at the Institute. She is particularly concerned about possible contamination of the samples and of equipment during analyses. They found that cigarette smoke contains strontium and when blown into the mass spectrometer, considerably affects the analytical results, especially of geologically young alpine specimens. Therefore, smoking is not permitted in the laboratory for isotope analysis. Dr. Jaeger analyzes her own specimens and also carries out isotope analyses for other scientists who submit prepared samples and interpret results. The laboratory is concerned mainly with studies of Sr-Rb isotopes and to a lesser extent with U-Pb isotopes. New equipment will be installed for the study of K-Ar isotopes. Strontium is concentrated for the isotope analyses, while rubidium 87 is determined by means of the mass spectrometer without concentration. It is interesting to note that total rubidium and strontium are not determined before the mass spectrometric isotope analysis. Dr. Jaeger has not yet had any samples which would contain insufficient Sr or Rb for isotope analysis. The age determinations are performed on the whole rock specimens and on individual minerals of these rocks. The high Sr/Rb age obtained on albite

Switzerland
Bern (cont.)

is explained by the migration of Sr from potassium-rich minerals to sodium-rich minerals. Petrological evidences of metamorphism and the occurrence of more than one generation of minerals were discussed in connection with the interpretation of isotopic ages. Dr. Jaeger mentioned the difficulty of separating micas of different generations. She was able to separate only the very small quantities required for optical studies. They separate only relatively coarse-grained minerals. Fine-grained minerals (ca 250 mesh) are separated in Basel using clay mineral procedures.

Professor E. Niggli, Director of the Institute and Dean of the Faculty of Natural Sciences, conducts mineralogical research studies. One of his graduate students examines in detail the rare mineral deposit of Langenbach/Binn. Geological studies of the Institute are carried out mainly in the Bern Alps.

Zürich

E.T.H. The Institute of Crystallography is under the chairmanship of Professor F. Laves, the authority on feldspar structures. In addition to teaching, the Institute provides research facilities for scientists who are mainly concerned with the study of crystal structures and with the mineral synthesis. Professor Burri, head of the Petrographic Department, collaborates with Professor Wenk of Basel University in conducting studies on the relationship between the chemical composition and physical properties of minerals.

Zürich (cont.)

The Institute of Crystallography is particularly concerned with the study of Alpine minerals. Synthetic minerals are prepared under different conditions in order to determine the relationship between the crystal habit and the environment of crystallization. An attempt was made to synthesize the Dauphine quartz, Tessiner quartz, smoky and clear quartz. Studies were made on the origin of ghost quartz (Phantom quartz) which consists of several generations of quartz with thin films of chlorite on the surface of each generation. Of special interest is a platy quartz, elongated parallel to one of the prismatic faces perpendicular to the c-axis. Several scientists are studying feldspars and their intergrowths. Dr. H.U. Nissen showed the writer results of his studies on labradorites. He studies labradorites, in connection with their colour and shimmer. The colour is measured by means of a photometer (modified Perkins-Elmer model) which records the wave length and the intensity of light. Oriented crystals, at least 1 sq. cm. in size are used. Two types of labradorites can be distinguished by this method: 1. which gives one maximum and 2. with two maxima. Another distinction is made on the basis of K_2O content which varies between 0.1 and 0.3 per cent. The latter are considered high potassium labradorites. Dr. Nissen showed electron photomicrographs of labradorites magnified to 800,000 times and X-ray precession

Zürich (cont.)

photographs with the precession axes a and c. The c-axis patterns permit the identification of small amounts of K-feldspar in plagioclase. Precession patterns showed the presence of oriented cryptocrystalline particles either of monoalbite, microcline or of monoclinic K-feldspar in labradorites. Dr. Nissen presented to the writer 5 analyzed labradorites, four of them from Canada and one from Finland. Professor Laves and Dr. Nissen were interested in the "microantiperthitic" plagioclases (An_{20-45}) which the writer observed in some Precambrian rocks of Quebec. The origin of K-feldspar particles in plagioclases was discussed. The X-ray laboratory of the Institute has several Precession cameras a Guinier-Jagodzinski camera, Weissenberg cameras and an X-ray diffractometer. Heating equipment can be fitted on the most of these cameras. The Institute also has a Leitz microscope heating stage which can be heated to 1600°C.

Age determination of Alpine rocks and minerals is carried out in collaboration with Bern University which makes the isotope analysis. Dr. Grünenfelder recently completed his studies on heterogeneity of accessory zircons and has published a paper on petrogenetic significance of their U/Pb ages ("Heterogenitat akzessorischer Zirkone und die petrogenetische Deutung ihrer Uran/Blei-Zerfallsalter" by Marc Grünenfelder (1963) Schweiz. Min. Petr. Mitt. 43, 235-257). The discussion and interpretation of results is made on the basis of the detailed mineralogical and petrographic studies. Dr. Grunenfelder distinguished two types of zircons: clear and cloudy-milky types. Clear zircons were homogeneous and well crystallized while milky zircons gave broad reflection spots on precession photographs, thus indicating some structural disorder or a composite nature of the crystal, and showed heterogeneous distribution of U, Hf and Zr which were determined with the electron probe microanalyzer (A.R.L. instrument, Lausanne). Some zircons contained inclusions of radioactive minerals. The cloudy appearance of zircons is attributed to minute fractures which are partly filled with water. Both types are considered to be cogenetic; however, the cloudy zircons gave younger age (210 m.y.) than the clear ones (305 m.y.). The cloudy zircons contained three times as much uranium as the clear zircons. The possibility of the diffusion of lead and the presence of dissolved uranium and lead in aqueous solutions present in the cracks of milky zircons is discussed.

Further discussion of isotopic ages of the Alpine minerals and rocks will be given in the section on the Field Trip to the Aar Massif.

E.T.H. Experimental Research Institution Applied to Hydrology and Construction Engineering is concerned with studies of soil and rock specimens from areas selected for major construction projects. Studies consist of the determination of mineral composition and of the amount and nature of organic matter present in sediments. Textures, petrofabrics and porosities of fine-grained sediments is determined in thin sections. Dr. Max Muller-Vonmoos mentioned the difficulty of preparing thin sections of fine-grained sediments which contain clay minerals without destroying their textures. The Institution has a chemical section for the determination of organic compounds and a mineralogical section which is equipped with the instruments commonly used in clay mineralogy. Consultation is given to companies and institutions concerned with the construction of dams, bridges, roads and buildings.

MUSEUMS

Geological and other museums containing collections of minerals, rocks, ornamental stones and pottery were visited in order to learn about the natural history of the country and about its culture. It was also interesting to get some ideas for possible uses of Canadian minerals and rocks for the practical and decorative purposes, and for the encouragement of handicrafts.

Holland,
Amsterdam. The Royal Tropical Institute, The Tropical Museum (Linneusstraat) contains scientific collections from the tropics and a handsome collection of minerals from South Africa (on the second floor). It also displays beautiful wood carvings from different parts of Africa.

Delft. "Blue Delft" pottery manufacturers display a great variety of ornamental items, including vases, lamps, decorative plates of various sizes and ornaments for interior and exterior decoration. Tools and manufacturing techniques are shown to the visitor. Delft pottery is made from imported clay. Cobalt oxide is used for decoration of blue pottery. New Delft pottery is decorated with multicoloured patterns.

The Hague. Peace Palace contains numerous oriental vases carved from natural stones. The most impressive one is a green jasper

The Hague (cont.)

vase from Russia presented by the Tsar Nicolas II. It is about 10 feet high, oornamented with gilded garlands.

Germany, Göttingen.

The Mineralogical Institute, Lotzestr. 16-18, displays a small collection of precious and semi-precious stones in the entrance hall. A systematic mineral collection is not available to the public.

The Geological Institute, Bahnhofstrasse, displays a large systematic collection of rocks in the hall to the left of the entrance. The Palaeontological Institute contains a large collection of fossils which are displayed in the hall to the right of the entrance.

Munich.

Munich has over 30 museums and many more interesting private collections. The city was severly damaged during the war and some museums, including the Bavarian State Collection of General and Applied Geology, are not available to the public. This collection is stored in the Institute of Geology, Luisenstr. 37. Access to this collection was possible through personal acquaintance with a member of the University Staff.

Deutsches Museum, Museuminsel 1, is the museum of natural sciences and of technical inventions. It contains the following sections: mining, physics, chemistry, meteorology, transportation, textile and electrical engineering.

Residenz-Museum and Schatzkammer (Treasury), Max-Joseph Platz 3, is located in the former royal residence of Bavarian

Munich (cont.)

kings. It contains magnificent collections of royal jewellery adorned with emeralds, diamonds, rubies, sapphires and pearls. It also displays fine specimens of jasper vases, amber and other semi-precious stones and possesses one of the finest porcelain collections from various countries which were collected through several centuries.

Regensburg

The Research Institute of Applied Mineralogy contains a systematic mineral collection which was started by Professor Hugo Strunz.

Switzerland, Bern.

The Mineralogical-Petrographic Institute, Sahlistrasse 6, contains very good specimens of Swiss minerals, including the best examples of phantom quartz, large crystals of pink fluorite, large twinned crystals of feldspars and systematic mineral collections.

The Museum of Natural History, Bernastr. 15. The section of geology is located on the third floor. In one of the halls are displayed Swiss minerals and geological maps and sections showing their occurrences. Particularly impressive are the dioramas with huge crystals of morion, clear and smoky quartz which reach over three feet in height. In contrast to large crystals of fluorite, adularia, amethyst and other types of quartz, are small rare minerals from Lengenbach/Binn which are kept under magnifying glasses, because it is difficult to see them

Switzerland, Bern. (cont.)

with the naked eye. Systematic mineral collections are arranged according to crystal structures, physical properties and chemical composition. In another hall are displayed Swiss petrographic, palaeontological and stratigraphic collections, and geological maps. Geological sections of the long tunnels are particularly interesting. There is also a display of Swiss ore minerals. The Museum was founded in 1694. The architecture of Bern is unique. The houses are built of pale-green Tertiary glauconitic sandstone.

Zürich.

The Institutes of Crystallography and Petrography, Sonneggstr. 5, have displays of plastic geological models of the Alps and systematic collections of minerals and rocks. There are also collections of Alpine minerals, one case of meteorite collections and collections of tectites. Models of crystal structures are displayed along the walls.

England, London.

The Geological Museum, South Kensington, Exhibition Road (opposite the Victoria and Albert Museum). The decorative entrance arch is made of polished slabs of British marbles. The coloured terrestrial globe in the main hall shows the geology of the Earth. In the main Hall are displayed collections of precious and semi-precious stones, and ornamental stones, including vases of fluorspar ("Blue John"), of pink gypsum, of Sibirian aventurine quartz and of serpentine. Handsome

England, London. (cont.)

specimens are displayed from all parts of the world, including Alpine quartzes, Canadian labradorites and sodalite, jade from Burma, Australian opal, synthetic and natural gemstones of South Africa, etc. The geological events are illustrated in dioramas. In the second floor are located specimens of ores and ore minerals, building stones, ores of previous metals, collections of British minerals and dioramas showing mineral deposits and mining operations in Great Britain and in the Commonwealth countries. More detailed information may be found in "A short guide to the Exhibits". The Geological Museum. Museum of practical Geology, Department of Scientific and Industrial Research, London, Her Majesty's Stationery Office, 1958.

The Natural History Museum, Cromwell Road. The section of mineralogy is located on the second floor to the left of the stairway. In addition to systematic mineral collections, there is an exhibit of meteorite specimens and of "pseudo meteorites" which are not meteorites but resemble them in appearance. Photographs of some minerals and of precious stones can be purchased at the entrance.

The British Museum, Russel Pl. contains rich collections of ancient pottery, ornamental stones and sculptures from Greece, Rome and the Orient. There are also exhibits of porcelain specimens and of Wedgwood pottery.

Norway,
Oslo.

The Mineralogical-Geological and the Palaeontological Museum, Sarsgate 1, is located in the Botanical Gardens which can be reached by trams No. 1 and 7 from the city centre. In the entrance hall and along the stairway are huge mineral specimens from Norwegian pegmatites. Some feldspars reach over five feet in height. On the main floor are exhibits of rocks and illustrations of Norway's geological history. There is a complete collection of alkalic rocks from the Oslo region and a large relief model on which is shown the distribution of different rocks and the relationship of the present-day relief to these rocks. There are also exhibits of gemstones, of fluorescent minerals and of radioactive minerals with their autoradiographs. Methods used in age determination are explained in a comprehensive manner. In the Palaeontological Museum is a section of anthropology with an exhibit illustrating the evolution of man. There are reproductions of Ca 30,000-year-old animal paintings of pre-historic man.

Italy.

The finest examples of ornamental stones and of precious and semi-precious stones can be seen in their natural environment in the Italian cities. The beautiful mosaics of marble and of precious stones are in the St. Mark's Basilica and in Doge's Palace, Venice. The Cathedral of Milan is an architectural masterpiece of white marble.

III - 1. The Field Trip to Oberwallis with the E.T.H. Institute of Crystallography, Zürich.

The purpose of the trip was to study the geology and petrology of the Aar Massif, to collect the Alpine minerals and to visit the Lengenbach/Binn deposit of rare sulphosalts. The trip was conducted by Dr. H.U. Bambauer and Dr. M. Grünenfelder. Most members of the Institute, including Professor Laves, participated in the field trip and travelled by cars from Zürich via Lucerne, Meiringen, Grimsel Pass, Gletsch and Rhone Valley to Binn (Fig. 1). The route passed through the Helvetic Nappes, Permian and post-Permian sedimentary mantle (Meiringen); Innertkirchen granite and gneiss zone; the northern envelope of crystalline schists (Guttannen); the Central Aare granites, Mittagfluh and Grimsel granites; the southern envelope of the crystalline schists (Gletsch), along the Rhone Valley between the Aar and Gotthard Massifs (Fiesch) and Penninic Nappes (Binn-Lengenbach), Figs. 2-5. The following twelve localities were examined: (marked 1-12, Figs. 2, 3 and 5).

(1) The Aare George, 1 km north of Innertkinchen.

Structure and geology of the Aar Massif was discussed by Dr. Grünenfelder: The envelope of crystalline schists of the Aare granites consists of pre-Hercynian sediments (clays, sands, limestones and dolomites) which were metamorphosed during pre-Hercynian orogenies into biotite augen gneisses, muscovite-chlorite-sericite schists, biotite hornfelses, amphibolite and marbles. They contain magmatic inlayers of aplite, muscovite-tourmaline pegmatites and lenses of serpentinite. Regional metamorphism and the emplacement of granites in the core of the massif took place during the Hercynian orogeny which was followed by the deposition of plant-bearing argillites (Westphalian D) and of clastic sediments of the Lower Permian. Quartz porphyries and tuffs of the Lower Permian were overlain by autochtonous and para-autochtonous Triassic and Jurassic sediments. Finally, the uplift of the massif to its present position, faulting and folding took place during the Tertiary Alpine orogeny. Following the uplift, large tearcracks and fractures formed in the granitic rocks as a result of decreased pressure. These fractures and cracks were penetrated by circulating solutions which supplied various elements necessary for the growth of the following crystals in the fractures: rock crystal, smoky quartz, adularia, chlorite, calcite, ankerite, apatite, titanite,rutile brookite, anatase, fluorite, galena, hematite (iron roses) sphalerite, molybdenite, beryl, milarite, bazzite and kainosite.

(2) Innertkirchen Granite, 2.5 km. S.E. of Innertkichen

The granite is heterogeneous and is composed of variable amounts of quartz, microperthite (Or. plag.), plagioclase (Ab.-01), altered biotite, sericite, pinite, garnet, apatite, zircon, sagenite, accessory pyrite, hematite, tourmaline and graphite. The granite is medium- to coarse-grained, grey with black and white patches.

(3) Biotite gneiss of the Northern Gneissic Envelope, 0.7 km. S.E. of Guttannen.

Brownish-grey biotite gneisses with irregular feldspar porphyroblasts are composed of quartz, altered plagioclase (And.-Labr.), brown biotite, sphene, apatite, garnet and graphite. Foliation is almost vertical.

(4) Mittagfluh Granite, Tschingelbrucke (Road cut).

The granite is medium-grained, dark grey with white specks. It is composed of quartz, plagioclase, perthitic K-feldspar, brown and green biotite, chlorite, stilpnomelane, zircon and other accessory minerals. This granite is described in detail by Dr. Jaeger et al, who determined K/Ar ages on the biotites: "Biotite-Varieties and Stilpnomelane in Mittagfluch Granite which was affected by the Alpine Metamorphism (Aar Massif)" by E. Jaeger, E. Kempter, E. Niggli and H.M. Wüthrich (1961). Schweiz. Min. Pet. Mitt. 4, 117-126.

Dr. Grünenfelder discussed the isotopic ages of minerals and rocks of the Aar Massif. Twenty age determinations are available. Most of the age determinations were carried out by Dr. Jaeger applying Rb/Sr, K/Ar and lead isotope methods.

The results are as follows:

Rock	Mineral	Method	Age (mmy)
Pegmatite in the Northern Gneissic Envelope	Muscovite	Rb/Sr	317±30
N. Gneisses of Erstfeld	Biotite	Rb/Sr	298±12
N. Gneisses of Erstfeld	Biotite	Rb/Sr	305±12
N. Gneisses of Erstfeld	Bleached biotite	Rb/Sr	170±27
Grimsel Granite	Zircon	Pb^{207}/Pb^{206}	300±25

Rock	Mineral	Method	Age (mmy)
Mittagfluh Granite, Tschingelbrucke	Whole rock	Rb/Sr	256±22
	Whole rock	Rb/Sr	193±21
	Biotite	Rb/Sr	54±3
	Biotite (gr. & br.)	Rb/Sr	72
	Biotite (gr. & br.)	K/Ar	77
	Microcline	Rb/Sr	102±8
	Albite	Rb/Sr	2200±250
Central Aare Granite	Biotite (green)	K/Ar	23
	Biotite (green)	Rb/Sr	18.5±2
Central Aare Granite	Zircon	Pb^{207}/Pb^{206}	300±70
(aplitic facies)	Whole rock	Rb/Sr	249±40

Pegmatitic muscovite from the northern envelope of gneisses, the biotite from northern gneiss and zircons from Grimsel and central Aare granite gave the oldest ages: 317 m.y. and ca 300 m.y. of the Hercynian orogeny. The age obtained on bleached biotite is much younger (170 m.y.). Rb/Sr ages of the whole rock vary, thus indicating "an open system". The ages of biotite from the Mittagfluh granite are much younger, hybrid ages, intermediate between the Hercynian and Alpine orogenies. Rb/Sr and K/Ar ages of the green biotite of the central Aare granite gave an age of the Alpine orogeny (23 and 18.5 m.y.). Microcline age, 102 m.y., is also a hybrid age, and the surprisingly high age obtained on albite is explained by the loss of Sr from K-bearing minerals and its concentration in sodium-bearing minerals in rocks affected by metamorphism (in this case by the Alpine orogeny). It is interesting to note that: (1) the relationship in behaviour of Rb-Sr and K-Ar isotopes is similar, because of similar ages (23 and 18.5 m.y., and 72 and 76 m.y.); (2) biotites of the Mittagfluh granite gave approximately the same hybrid age (72 and 76 m.y.) thus indicating that the radiogenic strontium and argon are not completely lost during orogeny, or that the Mittagfluh granite was uplifted earlier than the central Aare granite, and (3) Rb/Sr age of the green biotite (from Central Aare granite) is slightly lower than its K/Ar age. Professor Laves and Dr. Grünenfelder discussed the geochemistry of strontium and rubidium.

(5) Alpine Tear-Fractures in Grimsel Granite, Sommerloch.

A large, almost horizontal cavern in the granite was examined. This cavern was overgrown with crystals of clear and smoky quartz. Most of the crystals found were singly terminated and right-handed. Some were doubly terminated. The origin of silica-bearing solutions was discussed.

(6) Grimsel Granite with Inclusions of Biotite Gneisses with Tear-Fractures, cliffs near Grimselholspitz (Nollen).

Grimsel granite is unconformably overlain by gneisses and contains large inclusions (1 foot in diameter) of biotite gneisses. Fractures in the Grimsel granite are filled with chlorite, epidote and massive molybdenite. Dr. Grünenfelder discussed the nature of zircons which occur in granites and gneisses.

(7) <u>Augengneisses with Granodioritic Relic Textures</u>, Cliffs near Hotel Gletsch.

Grey augengneisses contain two generations of porphyroblastic feldspar; one elongated parallel to schistosity and the other which does not show any apparent relationship to the schistosity.

(8) <u>Main Zone of Migmatites</u>, Cliffs along the Highway Gletsch-Brig.

The zone of migmatites is composed of diorites, amphibolites, gabbro and aplites.

(9) <u>Tear-Fractures in Biotite Quartz Diorite and in Migmatites</u>, St. Niklaus.

In the caverns were found large crystals of hornblende, calcite and quartz; overgrown with dark brown films.

(10) <u>The Deposit of Sulfosalts, Lenenbach</u> (Fig. 5)

The deposit can be reached from Binn on foot (about 45 minutes walk). The sulphides and sulphosalts occur in a band of Triassic dolomite between Penninic schists and the Monte Leone nappe. The dolomite was in part covered by the lavine of snow. The white sugary dolomite contains abundant fine-grained tarnished crystals of pyrite, relatively rare red specks of realgar, yellow oripiment, green malachite, pale yellow sphalerite, phlogopite and "grey ore", minerals of sulphosalts. The sulphosalts are fine-grained and their positive identification and study is possible only by means of the X-ray diffractometer and chemical analysis. Over thirty following minerals have been found in the Lengenbach deposit since mining started in 1731:

i <u>Oxides</u>: quartz and rutile

ii <u>Carbonates</u>: dolomite, calcite, malachite, parisite

iii <u>Phosphate</u>: hamlinite

iv <u>Sulphate</u>: barite

v <u>Silicates</u>: hyalophane, tourmaline, muscovite, phlogopite, fuchsite, prehnite.

vi <u>Sulphides and Arsenides</u>: pyrite, sphalerite, galena, realgar, oripiment, arsenopyrite, MoS_2 (differs in structure from the hexagonal molybdenite).

vii <u>Sulphosalts</u>: (mainly lead and copper sulphoarsenides): baumhauerite, binnite, dufrenoysite, hatchite, hutchinsonite, jordanite, lengenbachite, liveingite, marrite, proustite, rathite, seligmannite, scleroclase, smithite, trechmannite.

The chemical composition and illustrations of these minerals are given by W. Nowacki: "The Re-opening of the Mineral Occurrence Lengenbach (Binnatal, Canton Wallis)" by W. Nowacki (1960). The Museum of Natural History, Bern.

The occurrence is under the protection of the Museum of Natural History and of Bern University which continue the research studies.

The origin of the deposit and its mining history were discussed by Dr. Bambauer and Mr. Imhof. The original dolomitic sediments were penetrated by hydrothermal solutions. Pyrite, sphalerite, arsenopyrite, galena and molybdenite crystallized at this stage. During subsequent metamorphism, these sulphides were attacked by As- and Sb- bearing solutions and locally altered to complex sulphosalts. The replacement textures and relics of former sulphides can be observed under the microscope. Mr. Imhof is the "Strahler", a local mineral collector and prospector who claims the deposit and has the mining rights. The mineral occurrence is "claimed" by the first discoverer by leaving there his hammer with his initials. The local ethics respects the rights of the original discoverer and does not permit anyone else reclaim such occurrence without his permission. Mr. Imhof inherited "Strahler's" rights from his ancestor. In 1945 he found a giant crystal of realgar (6 x 4 x 2 cm., 95 grams in weight) which is now in the Bern Museum of Natural History. The most beautiful Alpine minerals present in various museums were obtained from these local collectors, "Strahler". Mr. Imhof has also his own mineral collections and exhibits in the Binn settlement. He sells and exchanges the minerals.

(11) Tear Fractures in Altbachtobel, 1 km. north of Lax. about 1 hour's climb from Fiesch along the mountain stream.

Euhedral minerals occur in rock fractures and cavities. Desmine crusts, pink fluorite coatings, hematite, quartz, adularia, albite and quartz crystals were collected.

(12) Tear Fractures SW of Belvedere (Rhone glacier)

These are about one hour on foot from Belvedere, along the gorges and streams towards the Rhone glacier. The fractures and caverns are torn and opened up by the glaciers. The areas of glacial erosion are the best collecting localities of the Alpine minerals. The gorges and streams break off the minerals and concentrate them in the debris. Quartz crystals, crystal clear adularia, twinned feldspars up to several inches in diameter and crystals coated with thin films of chlorite were found.

The best examples of the Alpine minerals of the Grimsel Pass area were seen in the private mineral collections of the "Strahler" (local prospectors) in Guttannen. Professor Laves purchased there a great number of minerals for research study and for the Museum of the Institute. Minerals present in these private collections include: smoky quartz, rock crystals (different habit), morion, amethyst, clear adularia, feldspar (different habit and twins), epidote, titanite, amianthus, zeolites, prehnite, calcite (conical, pyramidal, crystals), fluorite (large pink cubes), anatase, rutile, axinite, scheelite, milarite, kainosite, monazite, synchisite, bastnaesite, xenotime, hematite (iron roses), goethite, chlorite, and many others.

OTHER TRIPS

Trip 2. <u>Grindelwald</u>

Bern-Thun, 20 minutes by train. Thun-Interlaken West (1.5 hrs. by boat). Interlaken West-Interlaken East (10 min. by train). Interlaken East-Grindewald (1 hr. by train). The route passes through the Helvetic nappes. From Grindelwald and Interlaken there is a magnificent view of numerous snow-capped mountain peaks, including Eiger, Jungfrau, Finsterhorn and Mönch. The highest peaks occur in the zone of the northern gneisses (Fig. 2).

Trip 3. <u>The Rift Valley of Rhine from Mainz to Cologne</u>. (8.30 a.m. to 5.30 p.m. by boat).

The Rhine Valley is a unique example of the relationships between Nature, industry, art and legend. The Rift Valley was formed during Oligocene. It cuts a block of Devonian slates and quartzites, metamorphosed deposits of the Palaeozoic geosyncline. On the both sides of the valley are numerous cliffs with mediaeval castles and fortresses. They were built by knights in order to control the traffic along the river and to collect taxes from wealthy merchants who transported their goods from the North Sea to the Mediterranean countries and vice versa. The Rhine passes through the district of Mosel with terraced cliffs which are used for the cultivation of wine. Of geological interest are: the Hunsrück District (the uplifted block of Devonian slates), legendary Lorelei with protruding cliffs of Taunus quartzites which are responsible for countless ship-wrecks, the district of Eifel basalts and "Siebengebirge" (Tertiary volcanics on the eastern banks of the Rhine River almost facing the city of Bonn). The Eifel and "Siebengebirge" are composed of volcanic alkalic rocks with occurrences of leucite. Trachite contains large phenocrysts of white-grey feldspar. One of the peaks is crowned with the ruins of the castle "Drachenfels" (named after a legendary knight who fought dragons. The relationship between still occasionally fuming fumaroles and hot springs and the dragons who spit fire is obvious). Already in the eleventh century the volcanic rocks were used in the construction of the Cathedral in Cologne. Some of the castles collapsed into the nearby quarries and restrictions on further removal of rocks had been made for the protection of the remaining ruins.

ROUTE SKETCH-MAP of TRIPS 1 and 2 - SWITZERLAND

Road Map 1:850,000
taken from
Grieben Guide Book 257

Figure 1

<u>Trip 1</u>
Route: Zürich, Luzerne, Meiringen, Gletsch, Fiesch, Binn

<u>Trip 2</u>
Route: Bern, Thun, Interlaken, Grindewald.

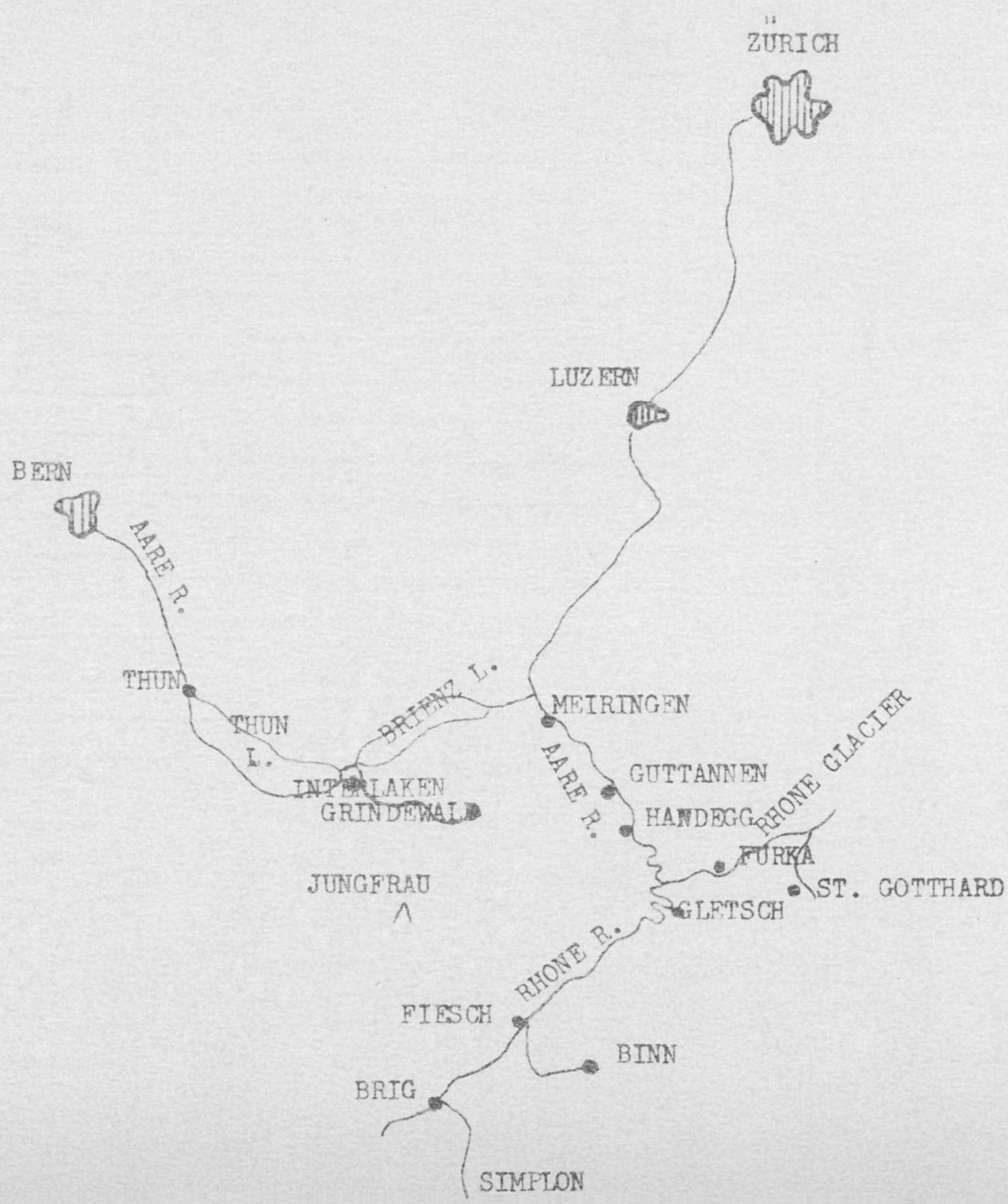


FIGURE 2

GEOLOGICAL - PETROGRAPHIC SKETCH
MAP of the AAR MASSIF 1:250,000
(after Th. Hügi)

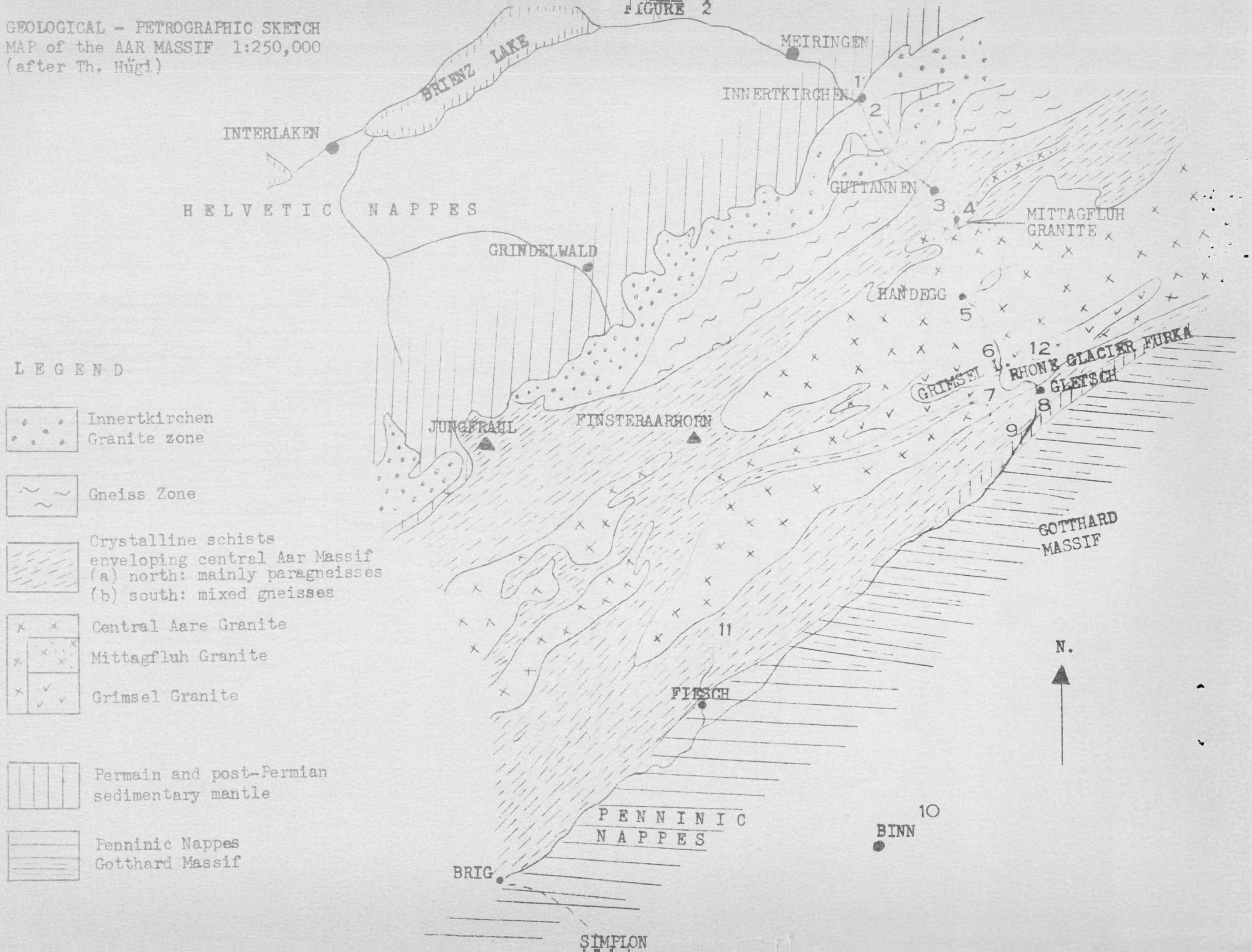


FIGURE 3

Geological Section of Central Aar Massif: Meiringen - Gletsch

(based on studies of the Mineralogical-Petrographic and Geological Institutes of Bern University. Taken from Geol. Map "Grimsel Pass" 1:75,000)

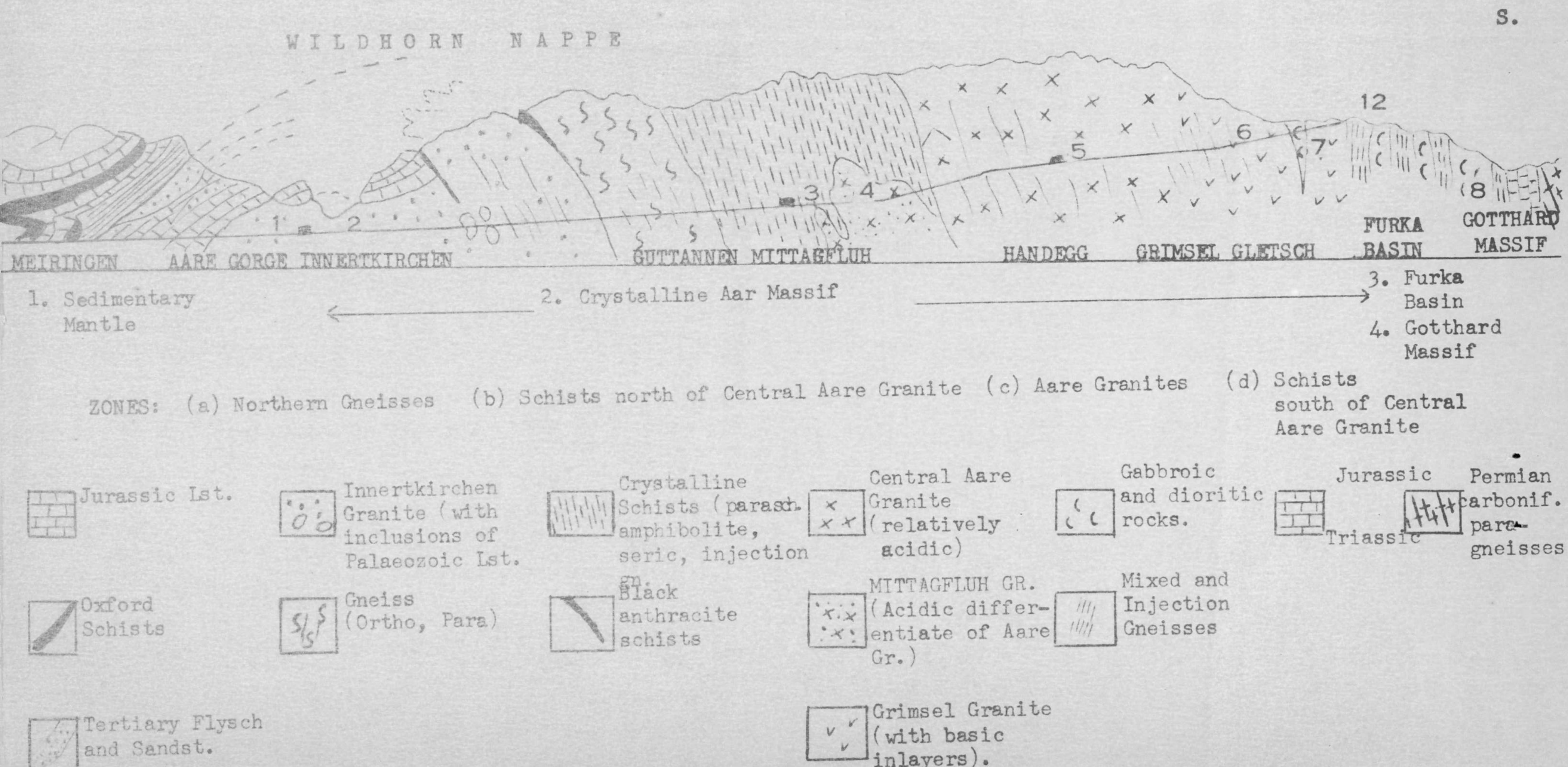
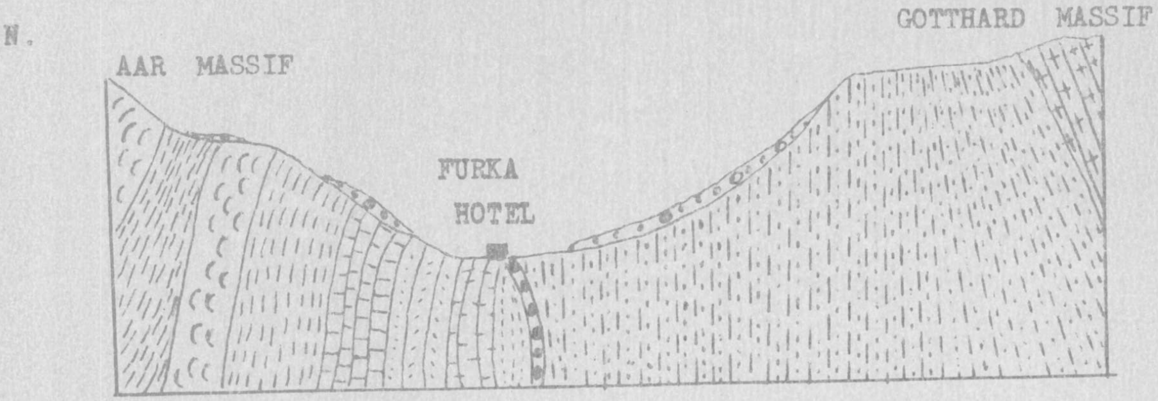


FIGURE 4

Geological Section of Furka Basin (between Aar and Gotthard Massifs) 1:14,000 (according to E. Ambühl).



L E G E N D:

MORAIN

AAR MASSIF
- Metamorphic injection + mixed Gneisses
- Diverse Magmatic Rocks

LIAS
- Lst.
- Lst. Marble
- Black Phyllites

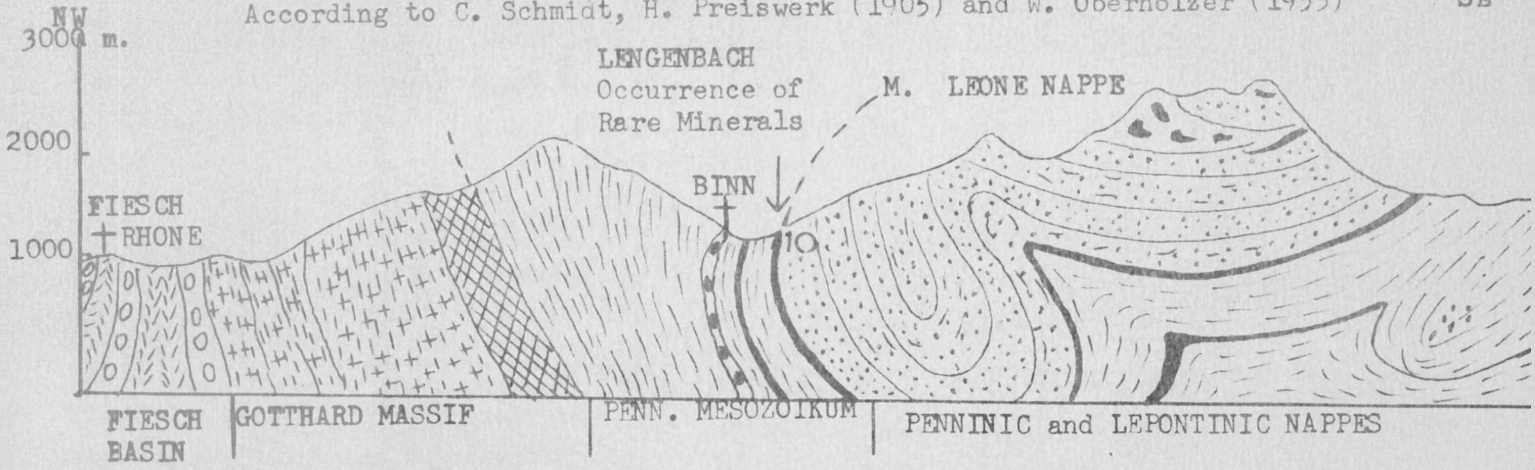
TRIASSIC
- Argillitic sandstone

PERMO-CARBONIFEROUS
- Sericite-chlorite gneisses } Sch. and

GOTTHARD MASSIF
- Quartzitic paragneisses

FIGURE 5

Section: Fiesch-Binn-Lengenbach (1:75,000)
According to C. Schmidt, H. Preiswerk (1905) and W. Oberholzer (1955)



- FOLIATED SERICITE and BIOTITE GNEISSES
- Two MICA GNEISSES
- PENNINIC SLATES (garnetiferous)
- TRIASSIC SUGARY DOLOMI' GYPSUM
- PERMO-CARBONIFEROUS CONGLOMERATE GNEISSES
- SLATES OF THE GOTTHARD MASSIF
- OPHIOLITE (Greenschist)
- PERIDOTITE SERPENTINE